Roadway Design Manual

Nebraska Department of Roads

NDOR
Nebraska
Department of Roads

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Introduction

1. PURPOSE OF MANUAL

This manual has been developed to provide guidance and assistance to the roadway designer and other **Nebraska Department of Roads (NDOR)** personnel in the practices and procedures for the detailed design of roadways and the preparation of contract plans. The manual has been developed to meet the following principal objectives:

- Document **NDOR** guidelines with regard to design criteria and practices for the development of plans;
- Define design criteria to guide judgments and decisions made by **Roadway Design Division** personnel;
- Describe the coordination necessary to develop plans in a timely and cost effective manner;
- Describe the most current and effective design techniques and practices and to present charts, tables and other information useful to designers.

2. HOW TO USE THE MANUAL

This manual has been written to provide information for both the new designer and for the more experienced designer. General guidelines and design practices are described. For more detailed explanation of the topics, references are provided for the reader.

It should be noted that the **NDOR** design criteria presented in this book generally conforms to the guidelines of the **American Association of State Highway and Transportation Officials (AASHTO)** in publications such as **AASHTO's** <u>A Policy on Geometric Design of Highways and Streets</u>. In some instances, where nationwide guidelines do not fit Nebraska conditions, **NDOR** design practice differs from **AASHTO** guidelines. For those situations **NDOR** guidelines take precedence over **AASHTO's** less stringent guidelines. However, if the **NDOR** design criteria cannot be attained the designer should follow **AASHTO's** less stringent guidelines.

NDOR and the **Board of Public Roads Classifications and Standards** have developed the <u>Nebraska Minimum Design Standards</u>. These standards represent minimum design values. Higher values should be used if it is environmentally friendly and economically feasible. The designer should contact his/her supervisor if **NDOR** standards cannot be met because a design exception approval may be required (See Chapter One: <u>Design Standards</u>, Section 6).

Throughout the manual, the words "shall", "should", and "may" are used to describe the appropriate application of various design techniques. The following definitions describe the proper application of these terms:

- "Shall" is a mandatory condition; the designer will make every practical effort to follow the criteria. If it is impractical to follow the "shall" criteria, the designer needs to obtain **Assistant Design Engineer** approval and document the decision made, or obtain authorization for a design exception (See Chapter One: <u>Design Standards</u>, Section 6).

- "Should" is an advisory condition; the designer is recommended, not mandated, to follow the criteria. For situations where it is impractical to follow the "should" criteria, the designer needs to obtain **Assistant Design Engineer** approval and document the decision made (See Chapter One: Design Standards, Section 6.D).
- "May" is a permissive condition; the designer should make reasonable efforts to follow the design criteria. For situations where it is impractical to follow the "may" criteria, the designer does not need authorization for design variances.

Several formatting conventions have been used in the manual to aid the designer in locating information. When Exhibits are discussed in the text, the titles are highlighted, e.g., **EXHIBIT 2.1**. Individuals, sections, divisions, and other organizations with which interaction may be required appear in bold lettering, e.g., **Roadway Design Division Engineer.** References to material in other chapters of this manual are shown as: Chapter Two: Roadway Design Process, for example, with pertinent sections noted as appropriate.

3. MANUAL UPDATES

This manual may be found on the internet at:
http://www.nebraskatransportation.org/roadway-design/pdfs/rwydesign.pdf.

This site should be accessed periodically for changes in design guidance and for errata. Any changes and error corrections will be incorporated into the manual every July 1.

4. SOURCES OF INFORMATION

This manual is a principal source of information providing general guidance on design guidelines and practices. Other sources of information are listed in the REFERENCES section found at the back of each Chapter. Suppliers of construction materials also may be used as sources of information for special design problems such as special culverts, retaining walls, impact attenuators, etc.

Where possible, Internet connections have been given for reference materials cited in this manual. This connection will follow the first citation of a document in a chapter and will also appear in the REFERENCES section found at the back of the Chapter.

CHAPTER ONE
DESIGN STANDARDS

LIST OF EXHIBITS

CHAPTER ONE
DESIGN STANDARDS

Chapter One
Design Standards

1. DESIGN STANDARDS

Design standards have been developed to provide a systematic means of achieving quality roadway design in a uniform manner. They incorporate basic design considerations and design controls, described in later sections, for the various functional classes of roadway and types of improvements to be made.

This manual and the Nebraska Minimum Design Standards, (Reference 1.1), are the primary sources of roadway design standards for **NDOR.** These state standards are based on guidelines from **AASHTO,** the **Federal Highway Administration (FHWA),** the **Occupational Safety and Health Administration (OSHA)**, the **Access Board**, and others. **NDOR** has also developed additional guidelines for 3R projects called the Needs Study Criteria. On projects in municipal areas, designers may also need to comply with local codes and street standards. For additional information, the following sources may be consulted:

NDOR Publications

The following is a partial listing of pertinent **NDOR** publications:

- Nebraska Department of Roads Bridge Office Policies and Procedures, (BOPP Manual) (http://www.nebraskatransportation.org/design/bridge/bopp.htm)
- Access Control Policy to the State Highway System (http://www.nebraskatransportation.org/roway/pdfs/accesscontrol.pdf)
- Standard/Special Plans Book
- State of Nebraska Department of Roads Standard Specifications for Highway Construction (http://www.nebraskatransportation.org/ref-man/spece.htm)
- State of Nebraska Department of Roads Supplemental Specifications to Standard Specifications for Highway Construction (http://www.nebraskatransportation.org/ref-man/supspecem.htm)
- Nebraska Department of Roads Standard Item Listing (http://www.nebraskatransportation.org/letting/bid-item-history-info.htm)
- Nebraska Department of Roads Construction Manual (http://www.nebraskatransportation.org/ref-man/cman-toc.htm)

AASHTO Publications

The following is a partial listing of applicable **AASHTO** publications:

- A Policy on Geometric Design of Highways and Streets (latest edition)
- Roadside Design Guide
- A Policy on the Accommodation of Utilities Within Highway Right-of-Way
- A Policy on the Accommodation of Utilities Within Freeway Right-of-Way
- Guide for the Development of Bicycle Facilities
- Guide for Erecting Mailboxes on Highway

Federal Highway Administration (FHWA) Publications
(http://www.fhwa.dot.gov/index.html)

The **Federal Highway Administration (FHWA)** sets forth specific policies and procedures for projects on the National Highway System (NHS), (See Section 7.A). **FHWA** manuals, bulletins, notices and technical advisories are available for guidance. Examples of some of their publications are:

- A User's Guide to Positive Guidance, FHWA-TO-81-1
- Federal Aid Policy Guide (http://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0470a.htm)
- New Methods for Determining Requirements for Truck Climbing Lanes, FHWA-IP-89-022
- Manual on Uniform Traffic Control Devices (http://mutcd.fhwa.dot.gov/kno-millennium.htm)
- Traffic Control Devices Handbook

The Access Board
(http://www.access-board.gov)

The **Access Board** is an independent Federal agency devoted to accessibility for people with disabilities. Guidelines developed under the Americans with Disabilities Act (ADA), which covers access to a wide range of facilities in the public and private sectors and under the Architectural Barriers Act (ABA), which requires access to certain federally funded facilities may be found at: (http://www.access-board.gov/adaag/html/adaag.htm)

2. NEBRASKA MINIMUM DESIGN STANDARDS

(http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

The Nebraska Minimum Design Standards, (Reference 1.1) are developed by the **Board of Public Roads Classifications and Standards**. Included are design standards for rural and municipal state highways, municipal streets and rural roads. Also included are typical cross-sections for new and reconstructed rural state highways and rural roads. These standards generally represent minimum values; higher values should be used within reasonable economic and environmental limits. To ensure uniform practice on a statewide basis, designs not meeting the minimum design standards may not be used without a design relaxation (See Section 6.). Deviations from minimum design standards to save established slopes, trees, wetlands or right-of-way items (e.g., wells, windmills, towers, cemeteries, etc.) will require design relaxation approval.

In addition, it is **NDOR** policy to use **EXHIBITS 1.1, 1.2 AND 1.3** for typical urban cross-sections. These exhibits are not in the Nebraska Minimum Design Standards (Reference 1.1); therefore deviation from these typical sections only requires **Division Head** and **Traffic Engineering Division** approval.

The designer should follow these steps to use the Nebraska Minimum Design Standards (Reference 1.1):

1. Review the engineering review statement and recommendations from the **Planning and Project Development Division**.
2. Request projected traffic data from the **Traffic Analysis Section** in the **Planning and Project Development Division**.
3. Determine the roadway segment's national functional classification, (See Section 7.B).
4. Determine if the project roadway is on the priority commercial system, (See Section 7.D).
5. Determine whether the terrain is level or rolling, (See Section 8.D).
6. Enter the Nebraska Minimum Design Standards (Reference 1.1) to determine the design number and other design information.
7. Compare the minimum design standards requirements with the recommendations from the engineering review statement. If there is a discrepancy, the designer should discuss it with his/her **Roadway Design Project Manager** to determine if changes can be made. If changes cannot be made, follow the design relaxation procedures (See Section 6).

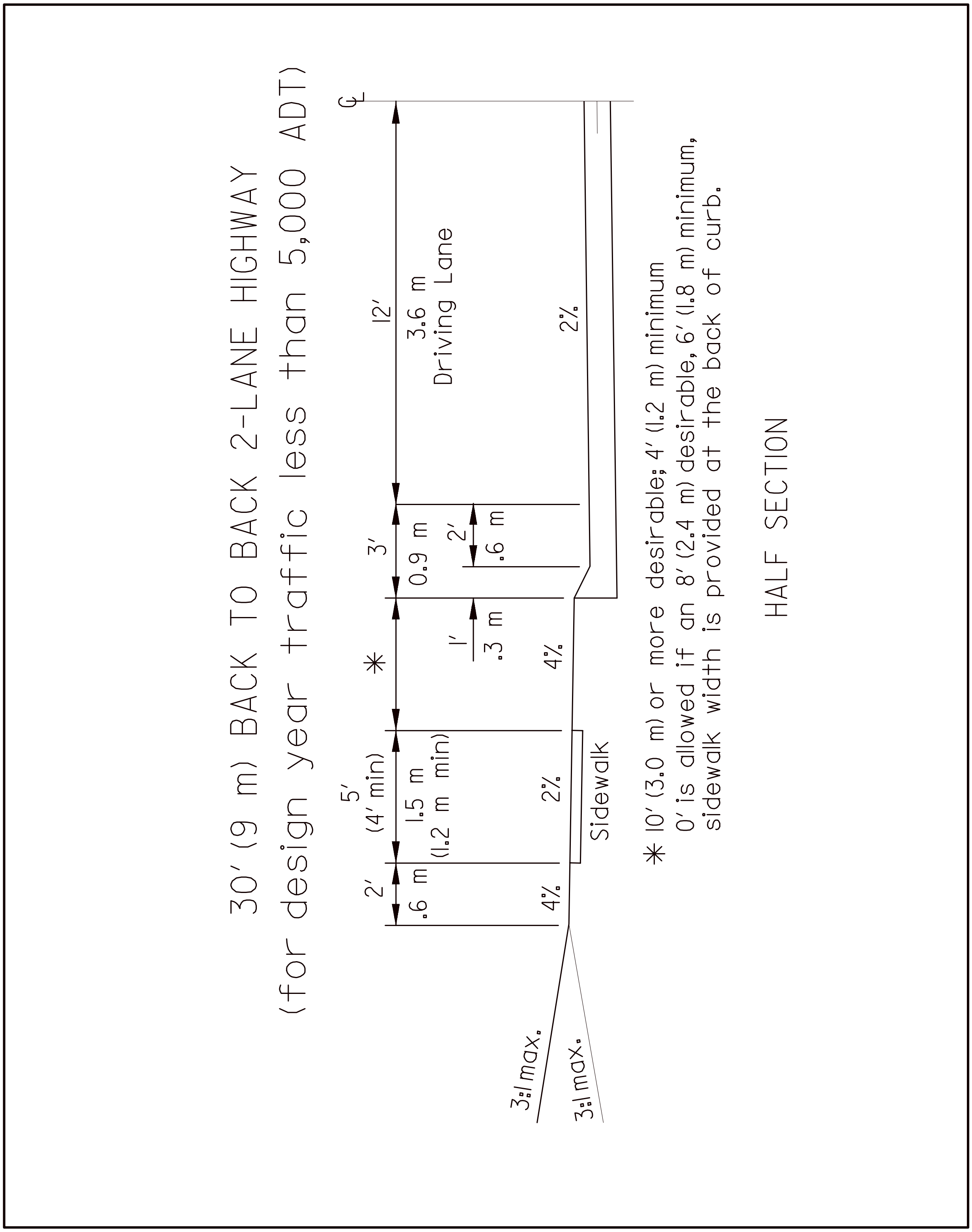


Exhibit 1.1 Urban Typical Cross-Sections: 2-Lane Undivided

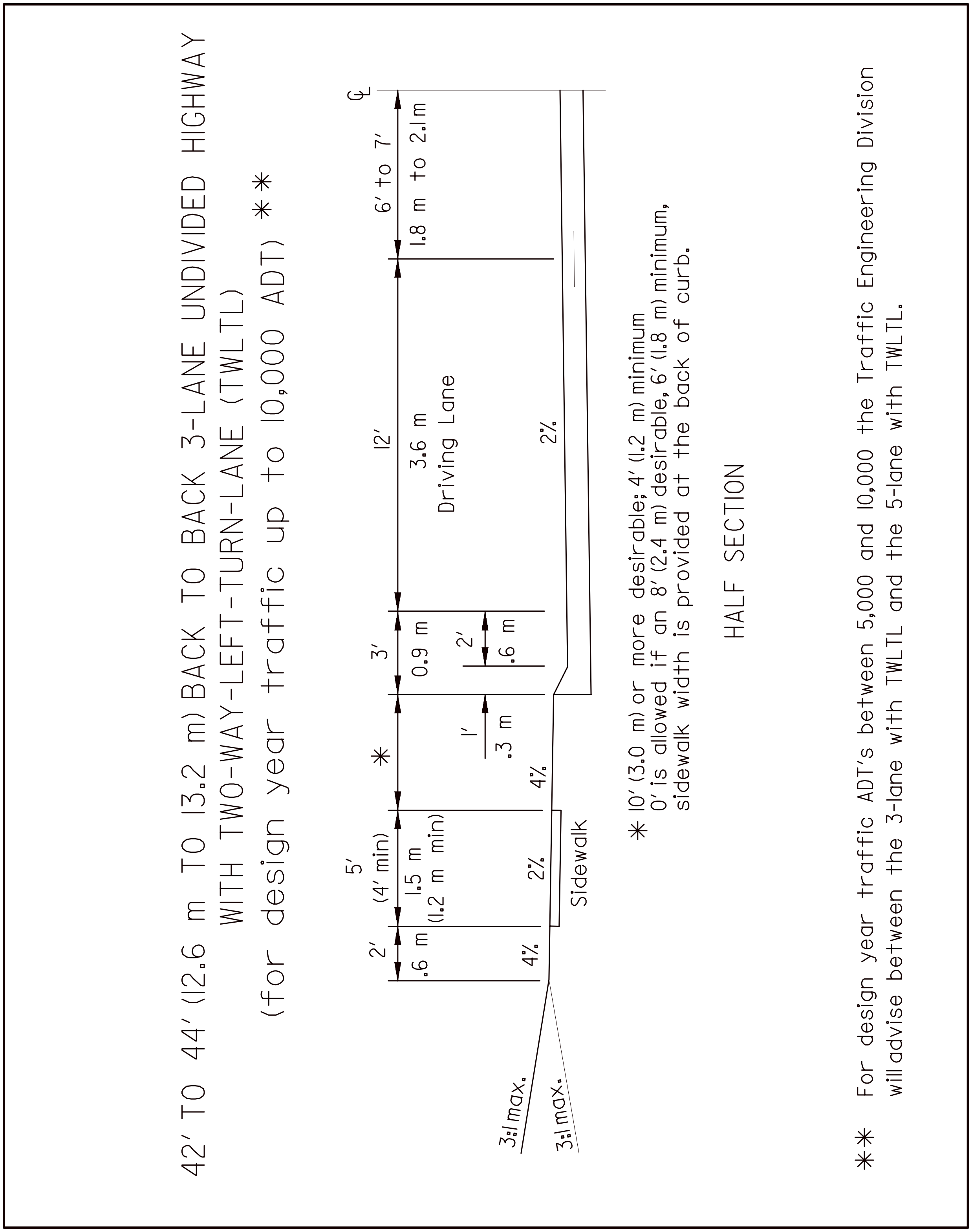


Exhibit 1.2 Urban Typical Cross-Sections: 3-Lane Undivided

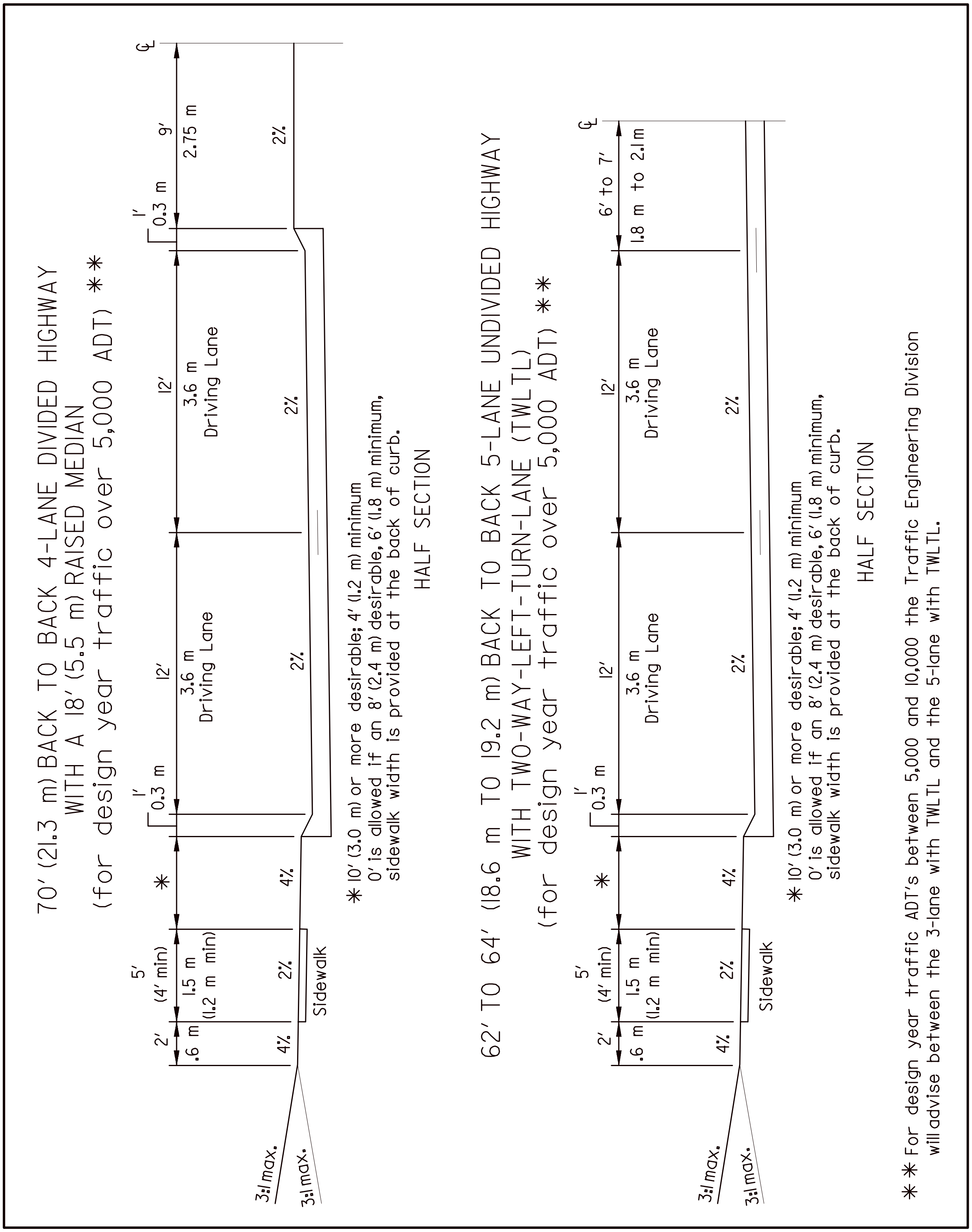


Exhibit 1.3 Urban Typical Cross-Sections: 4-Lane Divided And 5-Lane Undivided Highways

2.A New and Reconstructed Projects

New and reconstructed projects generally consist of: construction of a new road, relocating an existing route on new alignment, major widening (adding lanes) on an existing road, or reconstruction of an existing route on old alignment. New and reconstructed projects also include projects in which the principal activity is building a new bridge or rehabilitation consisting of bridge widening. New and reconstructed projects shall be considered when:

- Significant existing geometric deficiencies are to be corrected.
- Significant grading is to be done that requires major right-of-way to be acquired and/or major utility relocations.

2.B Resurfacing, Restoration and Rehabilitation (3R) Projects

In general, 3R projects consist of surfacing the existing roadway, for which very little grading is required. It may include the improvement of shoulders, bridges, the roadside, and appurtenances such as guardrail.

3R projects, undertaken to extend the life of an existing highway and to enhance highway safety, may also include upgrading of geometric features such as minor roadway widening at intersections, improving sight distance, and other incidental improvements related to safety or traffic operations. 3R bridge work would include minor construction improvements such as installing new bridge railings, deck replacement, or major bridge repairs for structural soundness. 3R projects are generally constructed within the existing right-of-way. When major acquisition of additional right-of-way is required for a 3R project, the segment should be designed to new and reconstructed standards and consideration should be given to changing it to a new and reconstructed project.

Supplemental improvements on 3R projects (i.e., rehabilitation exceeding the minimum standards) are subject to the following limitations:

- The scope and cost of proposed supplemental improvements shall be detailed in the preliminary engineering review report and/or the plan-in-hand report.
- Supplemental improvements must show a favorable benefit/cost ratio or be incidental in cost. An incidental cost is defined as less than a 10% increase in the base cost of the 3R project. The base cost of a 3R project shall be that cost necessary to construct the project to the minimum 3R standards.
- All supplemental improvements require **Deputy Director-Engineering** approval.

3. NEEDS STUDY CRITERIA PROJECTS

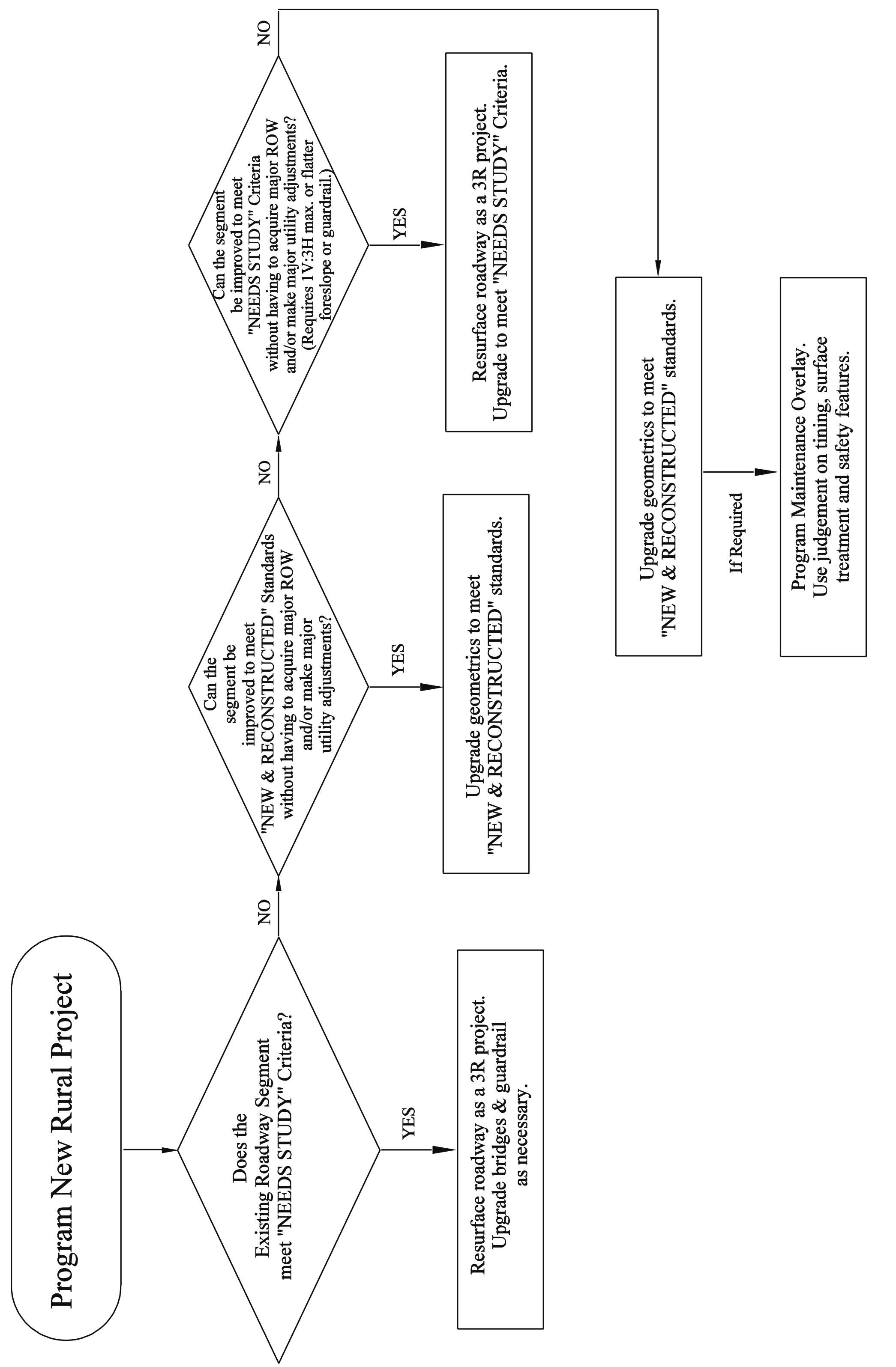
In addition to the minimum 3R design standards developed by the **Board of Public Roads Classifications and Standards**, there is also a needs study design criteria which provides a higher level of rehabilitation than the minimum 3R standards for rural projects.

Each year the **Materials and Research Division: Classification, Needs and Pavement Management Unit,** conducts a needs study that evaluates every segment of roadway in the state highway system according to average daily traffic (ADT), percent trucks, surface condition, shoulder width, and roadway deficiencies. This study compares each roadway segment with the needs study criteria. Any segment that does not meet the criteria is noted and the cost to upgrade that segment is calculated. District needs are then calculated as a percentage of statewide needs. The allocations to Districts are based on the needs study. The highway program is based on many factors such as pavement management data, high accident locations, economic and socio-political considerations, etc. The needs study is published in the State Highway Inventory Report as segment evaluation listings. (See Reference 1.2).

EXHIBIT 1.4 is a flow chart of the needs study project definition process. As can be seen in the flow chart, a proposed rural project first is evaluated based on its existing condition relative to the needs study criteria. Design should meet or exceed needs study design criteria whenever possible so that project deficiencies can be removed from the needs study listing.

If the existing roadway meets the needs study criteria, then the project will be programmed as a 3R project with resurfacing, bridge upgrades, and guardrail improvements as necessary. If the roadway segment does not meet the needs study criteria but can be improved to meet new and reconstructed standards without major right-of-way acquisition and/or without major utility adjustments, the project will be programmed for geometric upgrade to meet the new and reconstructed standards. If the roadway segment does not meet the needs study criteria and cannot be improved to meet new and reconstructed standards without major right-of-way acquisition and/or utility adjustment, additional evaluation is made to determine if the segment can be improved to the needs study criteria without acquiring major right-of-way and/or utility adjustments. If this evaluation indicates needs study criteria can be met, then the project is programmed as a 3R project to meet those criteria. If the segment cannot meet needs study criteria under those conditions, the roadway segment project will be programmed for geometric upgrade to new and reconstructed standards.

RURAL PROJECT DEFINITION FLOW CHART



* Special Study Areas will allow segments within 2 feet of "NEEDS STUDY" Top Width to be considered as meeting the "NEEDS STUDY" Criteria. An Exception may be needed.

** Use existing fill slope in place and guardrail fill slopes as required to meet minimum 3R standards. May grade 1V:3H or flatter fill slopes instead of guardrail if no ROW is required and there are no hazards at the toe of slope. However, small slivers of fill should be avoided.

Exhibit 1.4 Needs Study Decision Process

3.A Needs Study Criteria

The Needs Study criteria are grouped into six categories: Interstate, Expressway, and the four 20-year future traffic groups, which consist of the following average daily traffic (ADT) groups: 3000 and greater; 1700 – 2999; 400 – 1699; and under 400. The approved criteria are applied to the statewide system to determine the geometric needs. For design purposes design year traffic shall be used instead of future ADT when using these criteria. The design year shall be the year of initial construction plus 20 years.

FUTURE ADT

3000 and greater
- 12 ft. (3.6 m) Surfaced Lane Width.
- 10 ft. (3.0 m) Shoulder Width.
- Paved Shoulder – 8 ft. (2.4 m) of the 10 ft. (3.0 m) will be paved.
- Stopping Sight Distance – not more than one crest vertical curve per 1 mile allowed below 55 mph (90 km/h), no crest vertical curves below 45 mph (70 km/h).
- Lanes – Four lanes required at a future traffic of 6000 ADT or greater.

1700 – 2900
- 12 ft. (3.6 m) Surfaced Lane Width.
- 8 ft. (2.4 m) Shoulder Width.
- Paved Shoulder – if on Priority Commercial System, 10 ft. (3.0 m) shoulder required, 8 ft. (2.4 m) of which shall be surfaced.
- Stopping Sight Distance – not more than two crest vertical curves per 1 mile allowed below 55 mph (90 km/h); no crest vertical curves below 45 mph (70 km/h).

400 – 1699
- 12 ft. (3.6 m) Surfaced Lane Width.
- 6 ft. (1.8 m) Shoulder Width.
- Paved Shoulder – if on Priority Commercial System, 10 ft. (3.0 m) shoulder required, 8 ft. (2.4 m) of which shall be surfaced.
- Stopping Sight Distance – no crest vertical curves below 45 mph (70 km/h).

Under 400
- 12 ft. (3.6 m) Surfaced Lane Width.
- 4 ft. (1.2 m) Shoulder Width.
- Stopping Sight Distance – no crest vertical curves below 40 mph (60 km/h).

STRUCTURES

Future ADT	Roadway Width
3000 and greater	44 ft. (13.4 m) wide; 39 ft. (11.9 m) wide if on 4-lane divided highway.
1700 – 2999	40 ft. (12.2 m) wide; 44 ft. (13.4 m) wide if on Priority Commercial System.
400 – 1699	36 ft. (11.0 m) wide; 44 ft. (13.4 m) wide if on Priority Commercial System.
Under 400	32 ft. (9.6 m) wide; 44 ft. (13.4 m) wide if on Priority Commercial System.

3.B <u>Needs Study Criteria Design Policy Guidelines</u>

The following "Needs Study Criteria" design policy guidelines have been developed for use on Resurfacing, Restoration, and Rehabilitation (3R) Projects on Non-Interstate Rural State Highways; it is not intended that they be used on New and Reconstructed Rural State Highways.

For those projects not on the expressway system having design year traffic less than 6,000 ADT:

1. **Top Width:**

A. If the existing roadway top width (shoulder break to shoulder break) is within 2 ft (0.6 m) of the needs study criteria width, it shall be considered as meeting needs study criteria and the shoulder width deficiency shall be removed from the "Needs Study". For example, an existing 24 ft (7.2 m) pavement with 9 ft (2.7 m) shoulders would not be widened to provide a 10 ft (3 m) shoulder. An exception letter, including the removal of the shoulder width deficiency from the Needs Study, would be written for the approval of the appropriate **Division Head**.

B. If the existing roadway top width (shoulder break to shoulder break) is within 4 ft (1.2 m) of the needs study criteria width and the existing roadway has 6:1 foreslopes, it shall be considered as meeting needs study criteria and the shoulder width deficiency shall be removed from the "Needs Study". For example, a highway, not on the Priority Commercial System, with design year traffic of 1200 ADT, an existing 24 ft (7.2 m) pavement width, 4 ft (1.2 m) wide shoulders, and 6:1 foreslopes would not be widened to provide 6 ft (1.8 m) wide shoulders. An exception letter, including the removal of the shoulder width deficiency from the Needs Study, would be written for the approval of the appropriate **Division Head.**

2. **Slopes:** For those projects where the existing roadway top is equal to or exceeds, or is within 2 ft (0.6 m) of the needs study criteria width, slopes that are 3:1 or flatter should remain, unless:
   a. A horizontal or vertical alignment change is required.
   b. Accident history and a cost effective analysis indicate a flatter slope is required.
   c. Culvert extensions require slope adjustment.

3. **Culverts:** Culvert extensions should be evaluated to determine if guardrail is an acceptable alternative to the extension. Factors to consider are cost, maintenance, right-of-way required, number of culverts needing treatment, etc.

4. **Bridges:** Bridges that are structurally sound, within 4 ft. (1.2 m) of the needs study criteria width, and that will not need deck replacement within five years of the roadway improvement may stay in place. Bridge Rail should meet **AASHTO** requirements from the <u>Roadside Design Guide</u> (Reference 1.3) or be retrofitted if the bridge is to remain. When bridges need to be replaced, and structural conditions indicate that an existing bridge can be widened to within 2 ft (0.6 m) of needs study criteria width in lieu of requiring a replacement bridge, this will be considered as meeting needs study criteria if this width does not restrict the movement of farm machinery and products.

All projects in the above category will have a scoping review by the **Planning and Project Development** and/or **Roadway Design Divisions** and the **District Engineer**, prior to the initiation of the development of plans, to determine the scope of work necessary to comply with needs study criteria as modified above. **FHWA** shall be invited to all scoping reviews when the project cost is estimated to exceed $1,000,000 and the project is on the Interstate System, (See

Section 6.A). Both the applicable division representative and the **Roadway Design Engineer** shall sign a scoping report describing the results of that review. This will not replace the plan-in-hand field review normally held.

The needs study criteria and design policy guidelines should not replace the judgment of the designer. When exceptions to these or other aspects of the needs study criteria appear appropriate, a recommendation of such, with the reasons for the exception, should be submitted to the **Deputy Director-Engineering** or the affected **Division Head** (See Section 6).

4. MAINTENANCE AND PEP PROJECTS

The **Board of Public Roads Classifications and Standards** has also established minimum maintenance standards for each functional classification roadway (“Procedures for Classifications and Standards”, Reference 1.4). Maintenance projects are programmed for bringing the roadway surfacing back to its’ original condition.

4.A <u>Maintenance Project Policy Guidelines</u>

Design guidelines for projects to be designed under “Maintenance Projects” are as follows:

1. “Maintenance Projects” shall consist of resurfacing work and shoulder work only. If there are deficiencies, other than surfacing, a future project should be programmed to correct them.
2. Maintenance projects are for 24 ft. (7.3 m) or less in width only, except:
   A. For roadways with existing surfaced shoulders, resurfacing of the existing surfaced shoulders will be allowed if the **Materials and Research Division** determines that a grade raise of more than ½ in. (13 mm) is needed.
   B. 28 ft. (8.5 m) widths will be allowed on roadways with an existing 28 ft. (8.5 m) top.
3. No surface widening work will be allowed, except:

   When the **Materials and Research Division** has determined that the surfacing strategy will be an in-place recycle of the existing asphalt surface to a certain depth, then a lowering of the grade to a lesser depth will be accomplished by trench widening up to 2-ft. (600 mm) in width on each side. A resurfacing of the entire surfaced roadway width will then be made with up to a 2½ in. (64 mm) overlay. The total existing roadway width, outside edge of shoulder to outside edge of shoulder, does not change. This surface widening is a direct result of this type of maintenance strategy rather than the result of a planned surface widening to meet 3R Minimum Design Standards, thus the **NDOR**, in its sole discretion, has determined that any maintenance project with this type of strategy may remain classified as a maintenance project.

4. A grade raise of up to 2 in. (50 mm) is acceptable; a grade raise of more than 2 in. (50 mm) will be the exception and will require justification by the **Materials and Research Division** documented to the project file. Up to a ½ in. (13 mm) grade raise will require no shoulder or guardrail work. A grade raise of more than ½ inch will require an investigation for the need of guardrail work (See Chapter Nine: <u>Guardrail and Roadside Barriers</u>, Section 1.L).

5. Surfacing will be feathered out at intersections and driveways.
6. Surfacing will be milled out at bridge approaches so that there is no grade raise at bridges.
7. A city agreement will not be required unless requested by the **District Engineer**.
8. If the grade is raised and the contractor does the shoulder work, the **District Engineer** will determine if suitable earthwork material is available within the right-of-way.
9. The “10-ft. straightedge, 1/8 in. variation limit, in the longitudinal direction, and at the discretion of the Engineer” version of a smoothness specification will be used on all maintenance projects.
10. No ADA, guardrail, new mailbox turnout, or superelevation correction work will be allowed.
    A. If guardrail work is required the project will be reclassified to a 3R project.
    B. If ADA work is required, the urban portion of the project will be reclassified to a 3R project.

4.B Pavement Extension Plan (PEP) Policy

PEP (Pavement Extension Plan) projects are maintenance projects, the primary difference being the funding source. These funds are set aside for use on the mainline only, usually removing and replacing 2 in. (50 mm) of the surfacing.

All Maintenance project guidelines will apply to PEP projects. Additional guidelines, which apply to PEP projects only, are as follows:

1. A segment of highway is PEP eligible if either or both the historic and current Nebraska Surfacing Index (NSI) is from 62 to 73 and surfacing doesn’t require extensive patching or base work. The **District Engineer** should review the sections adjacent to the candidate location to see if the adjacent section is in worse shape. If the adjacent section is in worse shape it must be programmed before a PEP can be approved for the candidate section.
2. Existing surface must be asphalt or composite. The **District Engineer** shall analyze the composite sections and not pick candidates that will require joint repair.
3. Current truck ADT must be less than 500 for asphalt sections and 750 for composite sections.
4. A PEP candidate location cannot already be in the five-year program.

5. OTHER TYPES OF PROJECTS

5.A Safety Improvement Projects

Safety improvement projects are projects that are usually located at specific high accident sites. The **Highway Safety Section** identifies the high accident locations and the **Safety Committee** then evaluates individual projects on a case-by-case basis. **District Engineers** may also request study of individual locations. Usually safety improvement projects are designed with 10-year traffic forecasts. These projects may include intersection projects, adding left turn lanes, minor radii improvements, sight distance improvements, etc.

5.B Enhancement Projects

The Federal-Aid Highway Program specifies that 10% of the STP funds will be available for transportation enhancement projects. The Nebraska Transportation Enhancement Program provides funding to local, regional and state governmental entities to construct and restore transportation infrastructure that is not eligible to be funded through other programs. Examples of transportation infrastructure projects that would be eligible under this program include trails, development of scenic byways, restoration of historic transportation facilities, and other projects directly related to the historic, current or future transportation infrastructure.

Interested governmental entities may submit proposals to **NDOR** for enhancement projects. Three categories have been established for project eligibility:

- Historic preservation: easement or property acquisition, historic highways, historic transportation facilities, archaeological planning.
- Trails: facilities for bicycles and pedestrians, easement or property acquisition, railway corridors.
- Scenic byways: easement acquisition, scenic highways, landscaping, runoff mitigation.

5.C Off-System Urban Projects

The federal STP provides funds on an annual basis for all cities of the first class in Nebraska. The funding split is 80% federal and 20% city. Eligible projects under this program include:

- Construction, reconstruction, resurfacing, restoration and rehabilitation and operational improvements for highways and bridges on any public road rated higher than a minor collector, including work to accommodate other transportation modes.
- Capital costs for transit projects and publicly owned bus terminals and facilities.
- Carpool projects, parking facilities and non-recreational bicycle and pedestrian facilities.
- Highway and transit safety improvement programs, rail-highway grade crossings and projects to mitigate hazards due to wildlife.
- Capital and operating costs for traffic monitoring, management and control facilities.
- Transportation control measures listed in Section 108 of the Clean Air Act, (Reference 1.5) (http://www.ehso.com/ehshome/caa2.php)
- Wetlands mitigation efforts.

5.D Secondary Roads - Off-System Rural Projects

The **Government Affairs Division** deals with all off-system rural roads for which local road standards have been developed. For further information see Part Two of the Nebraska Minimum Design Standards (Reference 1.1).

5.E Accessibility Requirements for Handicapped Individuals

The Americans with Disabilities Act (ADA) of 1990 (http://www.usdoj.gov/crt/ada/adahom1.htm) provides comprehensive civil rights protection to individuals with disabilities in the areas of employment, transportation, public accommodations, state and local government services and telecommunications. The **Architectural and Transportation Barriers Compliance Board (Access Board)** issued the "Americans with Disabilities Act Accessibility Guidelines" (ADAAG) (Reference 1.6) (http://www.access-board.gov/adaag/html/adaag.htm) in July 1991. The "Uniform Federal Accessibility Standards" (UFAS) (Reference 1.7) (http://www.access-board.gov/ufas/ufas-html/ufas.htm) were issued in August 1984. State and local governments (public entities) have the option of using either UFAS or ADAAG standards. Both references apply to the design, construction, and alteration of public facilities. The following are some specific areas that these standards shall be specifically adhered to during design:

- All new or 3R rest area facility design must comply with References 1.6 or 1.7.
- All new or altered parking facility design must comply with References 1.6 or 1.7.
- All urban 3R projects must comply with References 1.6 or 1.7.
- The design of all facilities such as sidewalks and curb cuts located on a site (new construction, reconstruction or 3R projects) will comply with UFAS or ADAAG.
- Design of pedestrian overpasses and underpasses may use ramps with maximum 12:1 grade with a maximum rise of 30 inches (750 mm) between landings. For grades less than 20:1, platforms are not required. Other features should comply with UFAS or ADAAG.

Any exception to the ADAAG or UFAS requirements shall be documented and approved by the **Deputy Director-Engineering**. This documentation shall then be placed in the project's correspondence file. Exception requests must clearly show why it is impractical to comply with the ADA requirements. Documentation shall be sufficient enough that if an ADA non-attainment claim is brought against the **NDOR**, the **General Service Administration (GSA)** can readily make a decision without needing any additional information. For further information see Section 6 and Appendix C, "Design Exceptions for NHS Projects".

6. DEPARTURE FROM STANDARDS

Design policies and standards generally represent minimum values. Higher standards should be used within reasonable economic limits. If minimum design standards, needs study criteria and Americans with Disabilities Act (ADA) standards are not met, a design relaxation must be requested unless the project is classified as a minimum maintenance project. The request for design relaxation approval must be documented and must include accident rate analysis, collision diagrams, accident spot location maps, plans showing the area of the relaxation and cost comparisons.

6.A Oversight Authority for Departure from Standards

NDOR has approval authority for the departure from standards for State-funded projects and for the following types of Federal-aid projects:

a. All projects not on the Interstate System.
b. All 3R projects on the Interstate System.
c. All new/reconstructed projects on the Interstate System with a total project cost of less than $1 million.
d. Bridge or roadway projects crossing over or under the Interstate Highway system which do not change existing access conditions to the Interstate nor affect the permanent operating characteristics of the Interstate facility.

FHWA has approval authority on all new/reconstructed projects on the Interstate System with a cost of $1 million or more including the following:

a. Road on new location.
b. Remove and replace existing pavement (pavement layers down to the foundation course or entire pavement structure including fracture slab construction).
c. Widening to provide continuous lanes (mainline, weaving, accel/decel c-d lanes).
d. Reconstructed interchanges.
e. New bridges.
f. Bridge replacement or rehabilitation incorporating unusual designs or unique features.
g. ITS projects or projects integrating ITS components.

Regardless of funding source, **FHWA** retains approval authority for all changes or modifications to the Interstate System including new interchanges or modifications to existing interchanges and changes in access control. The **FHWA** is also responsible for ensuring that federal requirements outside the scope of Title 23 (Federal-aid Highway Laws and Regulations, Reference 1.8) (http://www.access.gpo.gov/nara/cfr/waisidx_02/23cfrv1_02.html) are met. For example, right-of-way actions, environmental processing, and disadvantaged business enterprise support still require federal oversight and design relaxation approval.

6.B Procedure for the Relaxation of Minimum Design Standards

Requests for design relaxation of the Nebraska Minimum Design Standards (Reference 1.1) shall go through the appropriate **Division Head** and **District Engineer** and requires the approval of the **Deputy Director-Engineering.** After this is obtained, it shall be sent to the **Secretary of the Board of Public Roads Classifications and Standards** at least ten working days prior to the board meeting where it shall be presented to the **Board of Public Roads**

Classifications and Standards for their approval. **EXHIBIT 1.5** is an example design relaxation letter.

Appendix C, "Design Exceptions for NHS Projects", explains the process for securing design relaxations on projects involving **FHWA** or the **Board of Public Roads Classifications and Standards**.

A design relaxation request letter should contain the following items:

- Project design: basic design parameters for the project (e.g., design number, current and design traffic volumes, design speed, posted speed, percent trucks, etc.).
- Degree of reduction in the standard: both the required standard value and the proposed reduced value of the design feature should be clearly stated.
- Design exception effect on other standards: there should be clear discussion of the design exception's anticipated effect on the safety and operation of the facility, and its compatibility with adjacent sections of the roadway. Since safety enhancement is an essential element of any project design, exceptions should not degrade the overall relative safety of the highway.
- Accident history analysis: a statement comparing the project's accident history to the statewide average for comparable routes is not sufficient analysis of the design exception's effect on project safety. "Sufficient analysis" should include more than the accident rate and/or history of the project. The discussion should include locating or identifying hazardous locations, accident clusters or accident trends within the project limits.
- Cost of attaining full standards: the cost of obtaining the full project standards must be quantified, rather than relying upon statements that the work required to meet the full standards would be "too costly" or beyond the project's scope. The costs should be realistically based on detailed cost analysis.
- Mitigating features: when features are added to the project to mitigate the effects of a design exception, they should be documented in the files.
- Future improvements: future work that will correct the substandard design feature should be documented in the files. This information should include the project numbers and their anticipated construction dates.
- Resultant environmental impacts: although avoidance or minimization of environmental impacts has not typically been used to justify or approve design exceptions, there have been cases where full standards were not achieved due to their environmental implications. For these situations, the environmental effects of the design exception should be noted, even when the design exception justification will actually be based upon some other factor.
- Other factors that could affect the decision: for example, proposed development in the project area or local concerns may be issues to be addressed.

A design relaxation request letter shall have the following attachments:

- The existing typical section.
- The proposed typical section.
- The typical section required by the Nebraska Minimum Design Standards, (Ref. 1.1).

Oct. 13, 2000

(Secretary's name)
Secretary of Public Roads
Classifications and Standards
P.O. Box 94759
Lincoln, NE 685019-4759

Dear (Secretary's name):

Re: Project No. _________________
Control No. _________________
Project Name:________________

The Department is seeking a relaxation of Board of Public Roads and Classification Standards for a 7.9 mile segment of Highway US-83 in Cherry County. This project is located midway between Thedford and Valentine. It begins at R.P. 179+11 and ends at R.P. 186+91. The majority of this project is on the Valentine National Wildlife Refuge.

Traffic Count:	1999	2024
ADT	1075	1935
DHV	125	205
Heavy Trucks	20%	20%

Twenty-year forecast map 401-1700 ADT

The design standard is DR-4, new and reconstruction, major arterial, rolling terrain with a 60 mph design speed. It is on the priority commercial system. The project design includes the following:

-A 66 foot alignment shift to the west for the first 3.3 miles of the project, from R.P. 179+11 to R.P. 182+41. The roadway width will be 24 feet, asphalt construction, with 10 foot shoulders, 8 feet of which will be surfaced. This portion of the project is not on the Valentine National Wildlife Refuge.

-The next 2.5 miles of the project, from R.P. 182+41 to R.P. 184+91, will consist of an overlay of the existing 24 foot roadway with the addition of 10 foot shoulders, 8 feet of which will be surfaced. This portion of the project is within the wildlife refuge.

-The final 2.0 miles of the project, from R.P. 184+91 to R.P. 186+91, will consist of regrading the vertical alignment on the existing horizontal alignment by constructing a temporary roadway parallel to the existing lanes. The roadway width will be 24 feet with 10 foot shoulders, 8 feet of which will be surfaced. This portion of the project is also on the wildlife refuge.

Exhibit 1.5a Example Design Relaxation Letter

The design standard calls for 6:1 side slopes to lateral obstacle clearance and a maximum grade of 4%. Our design includes 2.9 miles in which the side slope is 3:1 directly from the turf shoulder and two grades of greater than 4%, one at –5.65% and one at -5.52%. The location of these requested exceptions is within the Valentine National Wildlife Refuge. These measures have been taken, after extensive negotiations with the United States Fish and Wildlife Service, to minimize the impacts of the project on the refuge, particularly in areas containing the Western Prairie Fringed Orchid, which is an endangered species, and to minimize or avoid impacting wetlands. The USFWS would not have signed the required Final Environmental Assessment/Programmatic Section 4(f)/Biological Opinion for this project had we not taken these measures.

The accident rate for this section of US-83 is 0.550 acc/mvm, which compares to the statewide average of 1.059 acc/mvm for a two-lane rural section.

If this exception is approved, vertical alignment as a deficiency should be removed from the needs study.

Please arrange to have the Department of Roads on the agenda of the regularly scheduled Nov. 17, 2000 meeting at the Ramada Limited, in Lincoln, NE.

If you require further assistance, please advise.

Sincerely,

(Name)
Deputy Director-Engineering

Attachments: Location Map
½ Size Plan and Profile
½ Size Aerials

Exhibit 1.5b Example Design Relaxation Letter (Continued)

6.C Procedure for Exceptions of the Needs Study Criteria

Exceptions to the "Needs Study Criteria" should be sent through the appropriate **Division Head** and will require approval of the **Deputy Director-Engineering**. Exceptions to the "Needs Study Criteria" that meet the Design Policy Guidelines (See Section 3.B) require the approval of the appropriate **Division Head** and **District Engineer**.

Each exception must be documented in letter form. Each exception letter must state if the deficiency shall or shall not be removed from the Needs Study. Copies of all exception letters shall be sent to the **Materials and Research Division: Classification, Needs, and Pavement Management Unit** and to the **Traffic Engineering Division.**

6.D Procedure for When Desirable Conditions Cannot be Attained

The designer should submit a letter to the project file in those instances where it is not possible to meet the desirable design condition, (the designer may use the Design Decision Documentation Sheet, DR Form 335, for this purpose). This letter should be reviewed and signed by any affected Divisions (i.e. Wetlands, Traffic, etc.) as well as by the appropriate level of supervision (such as the **Roadway Design Project Manager** or the **Assistant Design Engineer**). For example: where it is not possible to design a temporary roadway to a design speed 10 mph less than the existing posted speed limit the designer should set forth the reasons why a lower design speed is necessary and have the **Traffic Division** review and sign the letter, as well as having the **Roadway Design Project Manager** sign-off on the reduced design speed. This would not necessarily need to be a routed letter; an e-mail from Traffic stating that the design has been reviewed and approved could suffice.

7. HIGHWAY SYSTEM CLASSIFICATION

The roadway system has been classified for identification, prioritization and funding purposes for planning, design, traffic operations, and administration of the highway program. Classification relates to network, function, roadway location, access, traffic volume, trip purposes and length. In turn, classification designation dictates the standards that should be used for roadway design.

7.A Federal Classification

The National Highway System (NHS) is an interconnected system of principal arterial routes that serves major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities and other major travel destinations. NHS highways also meet national defense requirements and serve interstate and interregional travel (Reference 1.9).

The Surface Transportation Program (STP) is a funding program that includes public roads not functionally classified as minor rural collectors, local roads, or streets. It includes some collector routes that were not previously on the federal-aid system. In addition to being a funding source for these routes, the STP specifies some set aside funds for obstacle elimination projects and for transportation enhancement activities (See Section 5.C).

7.B Nebraska National Functional Classification

(http://www.nebraskatransportation.org/maps/highway/nat-func.pdf)

Functional classification is the grouping of highways by the character of service they provide. It basically considers the level of access and mobility the roadway is to provide. The Nebraska National Highway Functional Classification (NNFC) Map identifies four roadway classes:

1. Interstates and freeways.
2. Principal arterials.
3. Minor arterials.
4. Major collectors.

These classes are based on **American Association of State Highway and Transportation Officials' (AASHTO)** functional classes found in A Policy on Geometric Design of Highways and Streets (Reference 1.9).

The intended purpose of a roadway determines its design. Functional classification is a means of identifying the travel purposes to be served. The Nebraska National Highway Functional Roadway Classes on the map are:

- Interstate: a national defense highway system established to connect most cities of 50,000 or more population in the U.S., with complete access control and a minimum of two 12 ft. (3.6 m) lanes in each direction, divided in most instances by wide medians.
- Principal Arterials: corridor movement with trip length and density compatible with significant statewide or interstate travel. There is usually a high operating speed and level of service with some degree of access control through limiting intersection spacing and direct property access.
- Minor Arterials: routes to provide linkage of cities, towns and other traffic generators, integrating interstate and intercounty service, usually at relatively high speed and minimum interference to through movement.
- Major Collectors: serve a dual function of property access and feeding arterials, generally for shorter trip lengths. They will have lower speeds and levels of service than arterials. In urban areas, collectors are usually designed to discourage through traffic in residential areas by following indirect and discontinuous alignment.

All other roadways are local roads and streets.

7.C Nebraska State Functional Classification

(http://www.nebraskatransportation.org/maps/highway/state-func.pdf)

By act of the **Nebraska Legislature,** the **Board of Public Roads Classifications and Standards** has established a state functional classification. The state functional classification is defined for rural and municipal areas. **EXHIBITS 1.6 AND 1.7** identify characteristics of roadway types in rural and municipal settings, respectively. Rural highways consist of all public highways and roads outside the limits of any incorporated municipality. Municipal streets are all public streets within the limits of any incorporated municipality. Municipal areas are further subdivided by population size: over 50,000 (urban areas), 5,001-49,999 (small urban areas), and 1-5,000 (villages and cities of the second class) (See “Procedures for Classifications and Standards”, Reference 1.4). Municipalities of 5,001 and over population are cities of the first class.

Functional Classification	General Characteristics
Interstate	- The Federally designated National System of Interstate and Defense Highways.
Expressway	- A group of highways following major traffic desires in Nebraska which rank next in importance to the National System of Interstate and Defense Highways. The expressway system is one that ultimately should be developed to multilane divided highway standards.
Major Arterial	- The balance of routes that serve major statewide interests for highway transportation. This system is characterized by high-speed, relatively long-distance travel patterns.
Scenic-Recreation	- Highways or roads located within or which provide access to or through state parks, recreation or wilderness areas, other areas of geographical, historical, geological, recreational, biological, or archaeological significance, or areas of scenic beauty.
Other Arterial	- Highways of less importance as through-travel routes that serve places of smaller population and smaller recreation areas not served by higher systems.
Collector	- Highways that pick up traffic from many local or land-service roads and carry it to community centers or to the arterial systems. They are the main school bus routes, mail routes, and farm-to-market routes.
Local	- All remaining rural roads except minimum maintenance roads.
Minimum Maintenance	- (a) Roads used occasionally by a limited number of people as alternative access roads for areas served primarily by local, collector, or arterial roads, or (b) roads which are the principal access roads to agricultural lands for farm machinery and which are not primarily used by passenger or commercial vehicles.

Exhibit 1.6 Nebraska State Rural Highway Functional Classifications
(Source: Reference 1.10)

Functional Classification	General Characteristics
Interstate	- The Federally designated National System of Interstate and Defense Highways.
Expressway	- (a) Extensions of rural expressways within some urban areas and (b) some additional routes serving very high volumes of local traffic within urban areas.
Major Arterial	- Extensions of rural major arterials that provide continuous service through municipalities for long-distance rural travel. They are the arterial streets used to transport products into and out of municipalities.
Other Arterial	- (a) Municipal extensions of rural other arterials and (b) arterial movements peculiar to a municipality's own complex, that is streets which interconnect major areas of activity within a municipality, such as shopping centers, the central business district, manufacturing centers, and industrial parks.
Collector	- A group of streets which collect traffic from residential streets and move it to smaller commercial centers or to higher arterial systems.
Local	- The balance of streets in each municipality, principally residential access service streets and local business streets. They are characterized by very short trip lengths, almost exclusively limited to vehicles desiring to go to or from adjacent property.

Exhibit 1.7 Nebraska State Municipal Streets Functional Classification
(Source: Reference 1.10)

7.D Priority Commercial and Expressway Systems

7.D.1 Priority Commercial System

The Priority Commercial System, initiated in 1988, provides a continuous network of routes that are designed to carry higher traffic volumes, especially larger volumes of commercial vehicles.

This system, which includes the rural expressway system, was established at 3,303 miles. As with all state systems, there may be variances in exact mileage from year-to-year as highway alignments change and as municipal boundaries are altered. It directly serves all of the first class (5,001 – 100,000 population) and larger cities, directly serves 80 of the 115 second class cities (800 – 5,000 population), and comes within 10 miles of another 18 second class cities.

The non-expressway portion of this system is being constructed with two 12 ft. (3.6 m) driving lanes and 10 ft. (3 m) shoulders, 8 ft. (2.4 m) of which is to be paved. In addition to the system as established, any route which has a design year traffic volume (the volume at year construction begins, plus 20 years) of 3,000 ADT or greater will be developed with 8 ft. (2.4 m) paved shoulders. Bridges are to be widened to shoulder width.

7.D.2 Expressway System

As part of the 1988 Needs Study, Department of Roads' engineers reviewed Nebraska socioeconomic data. This data included population and demographic trends, general economic activity as reflected in sales tax revenue, agricultural production, employment data, and other information relative to economic trends. The initial review precipitated the development of an expanded Expressway System of approximately 600 miles.

Factors included in the development of the system were: 1) to connect urban centers of 15,000 population or greater to the Interstate System, 2) to add those routes which have an average daily traffic of 500 or more heavy commercial vehicles, and 3) to add additional segments for continuity.

The Expressway System is being constructed as multi-lane divided highways. Interchanges may be built where an Expressway intersects with high volume highways. Access other than at public roads will be limited. Whether the system will directly serve developed areas, or whether bypass routes will be constructed, will be decided on a case-by-case basis. The Expressway System currently consists of some two-lane highways that will ultimately be constructed to multilane divided highway standards.

7.E 28' (8.4 m) Surfaced Top System

Due to erosion problems, Sandhills area highways not on the Priority Commercial System will have a 28' (8.4 m) pavement width, striped at 24' (7.2 m), and shoulders appropriate for design year traffic.

In 1998, the 28' (8.4 m) top system was expanded to include some highways not in the Sandhills. It was determined that most highways in the 850 – 3,000 future ADT group should have 2' (0.6 m) paved shoulders. The additional surfacing is intended to reduce the number of accidents resulting from the loss of control of vehicles that stray off of the pavement edge.

8. DESIGN CONTROLS

Once the type of roadway improvement is determined and the functional classification of the roadway known, several basic factors serve as design controls. They are determinants for other geometric design standards. See the Nebraska Minimum Design Standards (Reference 1.1) and A Policy on Geometric Design of Highways and Streets, (Reference 1.11).

8.A Design Year Forecast Traffic

The ADT for the design year, the year twenty years after the completion of the project, is used as a target in design for rural major arterials (DR4 through DR7- See Nebraska Minimum Design Standards, Reference 1.1) and rural roads. The DHV is the targeted value for design year traffic for rural expressways and major arterials (DR1 through DR3), and municipal streets.

Twenty-year traffic projections on individual project segments must be compared to the priority commercial system map for design standard compliance.

8.B Design Speed

See the Nebraska Minimum Design Standards, (Reference 1.1). Design the project to the anticipated posted speed or greater.

8.C Sight Distance

Sight distance is the length of roadway that is visible to the driver in various situations including stopping sight distance, passing sight distance, and intersection sight distance. For further discussion of sight distance see Chapter Three: Roadway Alignment, Section 1.

8.D Terrain

Terrain is a design control affecting alignment. Two basic types of terrain are found in Nebraska:

- Level: the condition where highway sight distances, as governed by both horizontal and vertical restrictions, are generally long or could be made to be so without construction difficulty or major expense.
- Rolling: the condition where the natural slopes rise above and fall below the road or street grade and where occasional steep slopes offer some restriction to normal horizontal and vertical roadway alignment.

8.E Access Control

Access control effectively increases roadway capacity by restricting the number and location of access points along the highway. This provides a safer environment for the roadway user, increases the efficient movement of through traffic, and reduces roadway accidents by minimizing the number of conflict points located along the highway (See Chapter Fifteen: Right-of-Way, Section 3).

8.F Lateral Obstacle Clearance

Lateral obstacle clearance is the roadside area starting at the edge of the travel lane available for the safe use of errant vehicles. It may consist of the shoulder, a recoverable slope, a non-recoverable slope and/or a clear runout area. The required lateral obstacle clearance will vary depending upon the design roadway standard (DR) (See Nebraska Minimum Design Standards, Reference 1.1). Chapter Six: The Typical Roadway Cross-Section, Section 2, discusses this further.

8.G Urban/Rural

Separate design standards have been developed for rural areas and urban (municipal) areas. In addition, typical cross-sections differ depending upon rural/urban location. In general, urban design standards reflect lower design speeds and restricted rights-of-way for the higher traffic volumes more common in urban areas while rural design standards reflect higher design speeds and the more flexible right-of-way opportunities possible in rural areas.

9. DESIGN ANALYSIS AND EVALUATION

9.A Capacity Analysis

NDOR's goal is to provide a transportation system to meet the needs of the forecast design year traffic. Providing unlimited capacity to handle any amount of traffic is not fiscally responsible. Good design must provide sufficient roadway capacity, providing acceptable levels of service to motorists without undue burden on the resources of the state. The principal objective of capacity analysis is to estimate the maximum amount of traffic that can be accommodated by a given facility while maintaining predetermined operational quality, or level of service.

Capacity analysis provides the necessary information to evaluate improvement alternatives. The designer should work with the **Traffic Engineering Division** to ensure that the design typical section and alignment contained in the project file would provide the intended capacity and level of service for the project roadway.

9.B Economic Analysis

In general, the designer should follow the design standards unless the estimated cost of doing so is exorbitant. When a design relaxation is to be requested, the designer needs to substantiate the specific estimated costs associated with following versus deviating from the minimum design standards The **Construction Division Cost Estimating Unit** provides assistance as requested by the designer for determining cost estimates of different design alternatives (See Chapter Twelve: Cost Estimating).

9.C Accident Analysis

Project improvements typically are evaluated on the basis of accident analyses. High accident location analyses are performed to prioritize projects and also to evaluate project alternatives. The **Traffic Engineering Division** performs accident analyses.

10. REFERENCES

1.1 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

1.2 Nebraska Department of Roads, State Highway Inventory Report.

1.3 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 1996.

1.4 The Board of Public Roads Classifications and Standards, "Procedures for Classifications and Standards," Current Edition.

1.5 The Clean Air Act: 23 U.S.C. 109(1) as amended, 42 U.S.C. 7401-7428 (http://www.ehso.com/ehshome/caa2.php)

1.6 Architectural and Transportation Barriers Compliance Board (Access Board), "Americans with Disabilities Act Accessibility Guidelines," U.S. Government, Washington, D.C., 1991 and current updates. (http://www.access-board.gov/adaag/html/adaag.htm)

1.7 "Uniform Federal Accessibility Standards," U.S. Government, Washington, D.C., 1984. (http://www.access-board.gov/ufas/ufas-html/ufas.htm)

1.8 23 Congressional Federal Register 625 (http://www.access.gpo.gov/nara/cfr/waisidx_02/23cfrv1_02.html)

1.9 "Intermodal Surface Transportation Efficiency Act: The National Highway System, The Backbone of America's Intermodal Transportation Network," U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., December, 1993. (http://ntl.bts.gov/DOCS/ste.html)

1.10 Nebraska. Laws, Statutes, Etc., Nebraska Highway and Bridge Law; Consisting Of Chapter 39, Highways and Bridges; Sections 49-801 And 49-802, Definitions And Rules Of Construction; Article 6 Of Chapter 60, Nebraska Rules Of The Road. Revised Reissued Statutes Of Nebraska, Current Edition

1.11a American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 1990. (English units)

1.11b American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 1994. (Metric units)

1.11c American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2001.

CHAPTER TWO
ROADWAY DESIGN PROCESS

LIST OF EXHIBITS

CHAPTER TWO
ROADWAY DESIGN PROCESS

Chapter Two
Roadway Design Process

1. DESIGN PROCESS OUTLINE
(http://www.nebraskatransportation.org/roadway-design/#designprocess)

The Design Process Outline (DPO), (Reference 2.1), summarizes the major activities to be completed during the course of project design. A copy of the current DPO, (Reference 2.1), shall be used to track activities performed for each project. Activities in the DPO, (Reference 2.1), are major work categories. Activities consist of groups of tasks. Tasks are steps to take to accomplish an activity. Upon completion of the tasks associated with a given activity, a major project benchmark is reached.

Not all activities will be required for all projects. All applicable tasks within each activity should be completed. Some tasks may occur simultaneously. The order in which tasks are completed does not necessarily have to follow the order in which they appear in the outline; however some critical path tasks will need to be completed before proceeding on to the next activity. The designer should look at the activities and tasks before starting a project (or an activity) and decide which tasks are appropriate for the project and the priority they have for completion.

These design process activities are included in the Project Scheduling System (PSS). Each activity number corresponds to an activity on the PSS. The PSS includes average times for completion of each activity associated with a project for project scheduling. The **Project Scheduling and Program Management Section** tracks the progress of all projects on the PSS, maintains this information and then updates the actual project schedule as activity completion dates are supplied. Estimated letting dates, based on the activity completion dates, are provided to other decision makers for prioritization and funding.

Completion dates should be recorded on the DPO, (Reference 2.1), beside each applicable activity as activities are completed. The last task listed under each activity signifies the official completion of that activity. The dates of completion for each activity should be entered on the PSS.

Many of the activities in the DPO, (Reference 2.1), seem to duplicate earlier tasks. This reflects the need to check and recheck information. This is especially true for projects that may extend over lengthy time periods. It is important to carefully check to be sure all items are included and nothing has been overlooked.

On the DPO, (Reference 2.1), some activities have more than one activity number. The second number should be used when consultants are used to perform the activity and when a designer reviews consultants' work related to that activity for time sheet purposes. For example, preliminary roadway design is activity 5307/5309. If a consultant is hired to complete this work on a project, the activity number is 5309.

While not part of the PSS system, the same activity numbers are also used on time sheets for employee timekeeping and payroll purposes. Time sheets should reflect the activity worked on in two-hour increments. Work on an activity in shorter time increments should be lumped together at the end of the week.

2. ENGINEERING REVIEW (ACTIVITY 5202)

The **Planning and Project Development Division** or the **Roadway Design Division** prepares an engineering review and scope determination for New and Reconstructed projects and for major 3R projects, (See **EXHIBIT 'O'** of the DPO, Reference 2.1). For smaller safety projects and other projects of smaller scope, the **Roadway Design Division** may do the initial project review and setup under Activity 5308. See Chapter Thirteen: Planning and Project Development, Section 3, for additional discussion of the engineering review.

3. INITIAL PROJECT REVIEW AND SETUP (ACTIVITY 5308)
(For projects without an Engineering Review)

On safety projects, the **District** usually will request safety improvements for a specific location. The **Roadway Design Division** will obtain the as-built plans, scope the project, develop a cost estimate and forward this information to the **Highway Safety Office** for a benefit/cost analysis. The **Safety Committee** will review the project to see if it meets the criteria for a safety project. If the appropriate criteria for a safety project are met, the **Safety Committee** reviews the request, may suggest recommendations, and approves the request. The **District Engineer** and others (e.g., **City**, **County**, etc.) must then approve the request. After approval, the **District Engineer** prepares the Highway Improvement Planning Request (DR Form 73) and forwards it to the **Deputy Director-Engineering** for approval.

On rural projects that require an initial project review and setup, the rural project definition flowchart (See **EXHIBIT 1.4**) should be used to determine the proper course of action for a project, (See also Chapter One: Design Standards, Section 2). **EXHIBIT 2.1** should be used to record the initial project scoping data. Consult the **Corridor Studies Engineer** in the **Planning and Project Development Division** for additional information

The last action in Activity 5308 occurs when the designer submits the initial project review to the **Project Scheduling and Program Management Section** for incorporation into PSS.

Roadway Design Division

Initial Project Scoping Data Sheet

Date: ....
By: ....

1. Highway ____________________ Control No. ____________________
   Ref. Post ____________________ Project No. ____________________
   Length ____________________ Project Name ____________________

2. 20-Year Forecast Traffic Range ______________ Trucks _____ Dr. Std. _____
   Expressway ________ Priority Commercial __________ Sandhills Area ________

3. Typical Section | Existing | Proposed | Standards
   Driving lanes
   Shoulders
   Bridges

4. R.P. | L x W | S.R. | Proposed Work | sq ft Cost (m^2 Cost)

5. Needs Study Deficiencies
   Pavement Width ________ Shoulder Width ________ Sight Distance __________
   Vertical Curves ______

6. Photolog Notes:

7. District Engineer Comments:

8. Proposed Work:

9. Estimated Cost
   ______ Miles (Kilometers) X $______ / mile (km) = __________
   Bridges ______________________X 1.18 (estimate increase) = __________
   Miscellaneous ______________________________ = __________
   Add P.E. ________% Utilities ________ E & C ________% = __________
   ROW______________________________ = __________
   Total Estimated Cost = __________

Exhibit 2.1 Initial Project Scoping Data Sheet

4. PRELIMINARY ALIGNMENT DESIGN FOR BRIDGE HYDRAULICS (ACTIVITY 5306/5312)

Activity 5306/5312 consists of the preliminary design of the horizontal and vertical alignments, through any bridge areas on a project, for submittal to the **Bridge Division** for use in hydraulic analysis. This activity only applies to projects with 5 or more bridge structures.

5. PRELIMINARY ROADWAY DESIGN (ACTIVITY 5307/5309)

Activity 5307/5309 consists of data collection, data analysis and preliminary design tasks. For some projects, the first four tasks of this activity may be completed prior to a designer being assigned to the projects.

5.A Obtain Preliminary Data

During Activity 5307/5309, survey information is processed by the **CADD Applications Unit** and sent to the appropriate **Roadway Design Project Manager**. A designer will be assigned to review the survey and the project data sheet and to identify missing topographic items by viewing the photolog.

If additional survey work is required, request a survey through the **Highway Geodetic and Preliminary Survey Supervisor.** If the survey information is sufficient, the survey is returned to the **CADD Applications Unit** for loading existing centerline(s) and cross-sections on the computer. If there is no surveyed alignment, the **Roadway Design Project Manager** sends as-built plans to the **CADD Applications Unit**. Terrain is only loaded on the workstation during the preliminary process if the project requires plan and profile sheets. The project is sent to **Drafting** and the **Roadway Design Project Manager** so **Drafting** can create the base plans. Once the base plans are complete, the designer will then receive and review the plotted plans and/or electronic files from **Drafting**.

The **Roadway Design Project Manager** will conduct a start-up meeting with **Drafting, Right-of-Way**, and the designer to assign responsibilities for the development of preliminary plans. The designer or **Drafting** may be responsible for drafting. The designer or the **Drafter** places the initial design in the file. Preliminary files are also made available, in electronic form, to the **Right-of-Way Division** so that they can begin Ownership right-of-way plans.

The roadway designer will create a project file, including information obtained from the **Planning and Project Development Division**. The designer will maintain the file until the project is constructed.

The designer should review the correspondence, the as-built plans and the engineering review or Highway Improvement Planning Request, (DR Form 73). Read the engineering review and/or the Initial Project Data Form (DR Form 333), and check to see if any environmental documentation will be required (See Chapter Thirteen: Planning and Project Development, Section 4).

The most current photolog should be examined looking for safety hazards, utility discrepancies, posted speeds, school or pedestrian crossings, differences from the preliminary plans, etc.

5.B Confirm Scope of Project

The designer should review the project scope with the **Roadway Design Project Manager, Assistant Design Engineer**, and, if necessary, the **Roadway Design Division Engineer** and the **District Engineer** and confirm the proposed alignment. If extended time has passed since the alignment was originally proposed, policies may have changed that may impact the alignment.

The need for right-of-way surveys and utility surveys should be confirmed and ordered. If, for example, the project scope has changed, e.g., from an overlay to a reconstructed section, a right-of-way survey may be needed. If the survey is old, it may need updating to be sure all utilities are included. The designer should also determine the appropriate design standard and typical section for the project (See Chapter One: Design Standards, Section 2). He/she should also call the **District Engineer** to obtain the balance factor.

5.C Begin Preliminary Design

The preliminary vertical and horizontal alignment is developed during Activity 5307/5309 including preliminary intersection and frontage road design, if applicable. The designer should discuss the alignment with the **Traffic Engineering Division** to coordinate lane configuration, signing, etc. Earthwork computations should be made after the horizontal and vertical alignment has been developed and surveys and balance factors have been obtained. If the **Planning and Project Development Division** has not prepared a location map, a one should be drawn for public hearings and agreements.

5.D Request Information from Other Divisions

An accident records report for the project for the previous three years should be requested from the **Highway Safety Section**. This will include such information as an accident rate analysis, collision diagram, spot map, etc., as appropriate.

Obtain the H and HS ratings for all bridges that are to remain in place from the **Bridge Division**. The **Bridge Division** will also provide structural analyses of bridge-size culverts (i.e., 20 ft (6 m) in width measured along the roadway centerline) and a bridge data sheet. On reconstruction projects where the fill over an existing culvert (pipe or box) is to increase, the **Bridge Division** will provide, upon request, an analysis of structural capacity. Also, receive and review preliminary type, size and location (TS&L) sheets from the **Bridge Division**.

Wetland delineation plans (2-W sheets) should be obtained from the **Environmental Permits Unit** (See Chapter Thirteen: Planning and Project Development, Section 4.B). The **Planning and Project Development Division** will provide the design year traffic data, e.g., ADT, DHV, percent trucks, etc., upon request. Once traffic data have been obtained, the information should be forwarded to the **Materials and Research Division** on a Pavement Determination Request Form (See Chapter Eight: Surfacing, Section 1 and **EXHIBIT 8.1**). The **Materials and Research Division** will provide a preliminary pavement determination.

Activity 5307/5309 also includes the task to request additional survey(s) as needed. This is a reminder to check for missing or incorrect information such as pivots, water lines, sewers, utilities, right-of-way, new drives, culvert size, shelter belts, etc., and for extending cross-sections, pavement shots, wetlands, etc. Check construction books for culvert sizes.

Depending upon the type of project, the **Traffic Engineering Division** will provide special studies and recommendations for traffic engineering items. See Chapter Fourteen: Traffic Engineering, Section 1, for additional information.

Ordinarily, the **Utilities Section** of the **Planning and Project Development Division** keeps track of utility locations and will check surveys they receive from the **Roadway Design Division**. Occasionally, a designer may want to do this independently. For example, a utility may be noted during the plan-in-hand inspection that was not on the preliminary survey and the designer can then check on it.

To check the permits for utilities that are in the right-of-way, query the CICS1 program on IBM as follows:

1. Enter CICS1 by entering C1 and your DR# and password (the same process as accessing your time sheets.
2. Enter 8 to select Integrated Highway Inventory System.
3. Enter 21 to select Use and Occupancy Permits.
4. Enter 2 to Select Query.
5. Enter 3 to select Use and Occupancy Permit by Hwy/Cnty/Type/Status Query.
6. Enter the highway # and a reference post range – county, type and status may be left blank.

This shows a list of permits in the area selected.

Check for any recently issued utility permits and also check to see that all of the utilities are accounted for on the utility survey. Note that the desired utility location shown on the permit may not be the actual location of the utility. The **Utilities Section** makes a final check of the locations of all utilities. Contact the **Permit Section** of the **Right-of-Way Division** and the **Utilities Section** for assistance with details about permits.

5.E Drainage

The Drainage Design and Erosion Control Manual, Chapter One, (Reference 2.2), describes drainage design procedures. This activity will begin with determining if the project is in the floodplain and what types of control and what the allowable headwater is. Draw a drainage map and compute the drainage areas. Determine the Q values and size drainage structures. Contact the **Bridge Hydraulics Section** or the **Roadway Design Hydraulics Engineer** to discuss bridge sizes and other structure issues. Begin the following designs:

- Culverts and storm sewers.
- Special ditches.
- Median drains.
- Erosion and sedimentation control measures (preliminary).

5.F Initiate Special Investigations

Some projects may require special investigations. Special investigations should be initiated during Activity 5307/5309. The following topics may require special investigation:

- Drainage structures and box culverts requiring special design or special plans from the **Bridge Division.**
- Railroad agreement information from **Railroad Liaison Engineer.**
- Detours/temporary roads (e.g., road shifts, temporary road construction, phasing, etc.).
- Retaining walls.
- Soils investigation by the **Materials and Research Division** for compaction requirements, etc.
- Traffic signals and signing from the **Traffic Engineering Division.**
- Lighting from the **Roadway Design Lighting Unit.**
- Erosion control from the **Agronomist**.
- Hazardous materials, electric substations, underground storage tanks, etc. from the **Planning and Project Development Division.**

Assemble the special provisions related to the above topics as they apply to the project.

5.F.1 Additional Survey

At any time throughout the design activities, additional survey work may be needed. For example, a special drainage structure may require additional survey information because right-of-way is affected. Request additional survey work through the **Highway Geodetic and Preliminary Survey Supervisor.**

5.F.2 Traffic Engineering Review

Coordinate roadway design with the **Traffic Engineering Division**. They will review the plans for compatibility of geometrics with traffic requirements.

5.G Aerial Photo (2-A) Sheet Preparation

Consider the time since the previous aerial photo (2-A) sheets were developed prior to public hearings. If the aerial photos, from which the public hearing displays are made, are less than 18 months old, they may be used for the public hearing. If project stations run the same, 2-W sheets from the **Environmental Permits Unit** may be used.

The following information should be shown on the 2-A sheets:

- Alignment.
- Stationing.
- Shifted alignment, if any.

As a general rule, existing wetlands need to be shown on air photo plans, (2W Sheets). See Chapter Thirteen: Planning and Project Development, Section 4.B, for information regarding wetlands.

5.H Utilities on Urban Projects

Cities are not required to have permits to occupy the right-of-way. Thus, it is important to determine any city-owned utility locations and possible conflicts by meeting with utility owners and the **Utility Coordinators**.

5.I Preliminary Access Control Determination

Determine preliminary access control during Activity 5307/5309 by:

- Obtaining relevant information from the **District Engineer** and others.
- Reviewing the zoning, existing and future land use.
- Conducting a field examination.
- Considering intersection sight distance, natural barriers, property lines, and the development of future frontage roads.

See Chapter Fifteen: Right-of-Way, Section 3, and the Access Control Policy to the State Highway System, (Reference 2.3), (http://www.nebraskatransportation.org/roway/pdfs/accesscontrol.pdf)

5.J Review Design Checklist

The last step in Activity 5307/5309 is to review the design checklist (See **EXHIBIT 'B'** of the DPO, Reference 2.1). Go through the checklist and mark off the completed or required tasks, note of the tasks that will continue into the next activity, and be certain that all applicable tasks have been completed. Once the checklist has been reviewed, Activity 5307 ends. Note the completion date on the DPO, (Reference 2.1), for the project and enter the date in the PSS. When the design checklist has been reviewed for this activity, stop charging time to Activity 5307/5309.

6. COST UPDATE 1 - STATUS 30 (ACTIVITY 5403)

The cost estimate checklist (**EXHIBIT 'C'** of the DPO, Reference 2.1) should be checked to be certain that all applicable items for the project are incorporated into the cost estimate. Funding splits should be verified with the **Roadway Design Project Managers** for projects within city limits and/or within railroad rights-of-way. The Project Information Sheet, (DR Form 342) should be updated and quantities should be submitted to the **Cost Estimating Unit** on Project Quantity Sheets, (DR Form 343). Submit the completed project information sheet and cost estimate forms to the **Roadway Design Project Manager** for his/her review. See Chapter Twelve: Cost Estimating, Section _, for further details. Activity 5403 ends with the completion of the **Roadway Design Project Manager** review. Enter the date of completion on the PSS. Please note that Activity 5403 should not be used for annual cost updates on PSS. PSS does not schedule annual cost updates.

7. DESIGN PLAN-IN-HAND (PIH) (ACTIVITY 5315)

Activity 5315 is always an **NDOR** activity. If a **consultant** is responsible for design, this activity is a joint **Consultant**/**NDOR** activity. During Activity 5315, obtain right-of-way Ownership Plans from the **Right-of-Way Division.** See Chapter Fifteen: Right-of-Way, Section 2.B, for further information.

7.A Plan-in-Hand Plans

The plan-in-hand plans are prepared consisting of the:

- Location map.
- Typical section.
- Traffic data (on the typical section sheet).
- Wetland delineation plans (2-W) sheets from the **Environmental Permits Unit**.
- 2-A sheets (if the project does not include wetlands).
- Plan and profile sheets.
- 2-L sheets.

See Chapter Eleven: Plan Preparation for an explanation of the various plan sheets

The plans should include the following preliminary details:

- Earthwork balance points, quantities and balance factor.
- Line shifts (new geometrics).
- Limits of construction.
- Detailed limits of construction for urban areas.
- New grade line with vertical curve data and grades.
- Intersection designs, frontage roads, county road alignments, major commercial driveways.
- Begin and end project stations.
- Proposed culvert sizes (include Drainage Area, Design Q, and Headwater).
- Channel changes, if any.
- Preliminary storm sewer design in urban areas.
- Edge of pavement, drives and walks in urban areas.
- Project centerline and surveyed baseline on a 2-A sheet.
- Areas of impacted wetlands.
- All available aerial and underground utility facility locations (electrical, telephone, pipelines, gas, cable TV, etc.).

Plans submitted to the **Utilities Coordinator** will require the most up-to-date details on the items listed in **EXHIBIT 'G'** of the DPO, (Reference 2.1).

Contact the **Utilities Section** to coordinate activities related to any utility conflicts.

7.B Plan-in-Hand Plan Distribution

The plan-in-hand plans including location map and typical section, stamped preliminary and dated, should be distributed to the entities shown in **EXHIBIT 'F'** of the DPO, (Reference 2.1), at least two weeks prior to the inspection date. Use the Design Plans Transmittal form, (DR Form 135), and the Letter of Transmittal form, (DR Form 480), for submittal and notification of plan availability. DR Form 135 should be used for transmittals within **NDOR**, and DR Form 480 should be used for other agency transmittals, e.g., cities, counties, consultants, other state agencies, etc.

7.C Conduct the Plan-in-Hand Inspection

The plan-in-hand inspection is a field inspection of the proposed project by the **District Engineer, FHWA** (if they have oversight, see Chapter One: Design Standards, Section 6.A), **City/County Representatives, Utilities Coordinator, Roadway Design Project Manager, Assistant Design Engineer** and the designer. Use the checklist shown in **EXHIBIT 'H'** of the DPO, (Reference 2.1), as a reference to note any items that need to be addressed during the plan-in-hand inspection or may be noted during the inspection. The following items should be taken to the plan-in-hand inspection:

- Camera, 100 ft (100 m) tape, hand level.
- Safety vest, cap/hard hat, strobe light.
- One set of half-size cross-sections.
- One set Stage II right-of-way plans.
- Four sets of half-size plans.
- Plan-in-hand checklist.
- Correspondence file(s).
- Contact aerial photos.
- Drainage maps/worksheets.
- Erosion control checklist.

Following the plan-in-hand inspection, consolidate all sets of comments into one set of plans, label the set as official plan-in-hand plans and place them on file. These plans are then a milestone document for the project. This activity is the end of Activity 5315. Enter the completion date on the PSS.

8. PIH REPORT (ACTIVITY 5318/5338)

This activity consists of the preparation and review of the plan-in-hand report. An optional meeting may be held with the **Assistant Design Engineer** and **Division Head** to discuss the plan-in-hand prior to the completion of the plan-in-hand report. The plan-in-hand report, location map, accident report, engineering review statement and other miscellaneous attachments, as appropriate, are routed to the appropriate individuals for review and approval as listed in **EXHIBIT 'I'** of the DPO, (Reference 2.1).

Please note the plan-in-hand report may go back and forth several times before the final report is approved. The **Roadway Design Office Manager** incorporates all the approved changes and then submits them for signatures.

The plan-in-hand report outline should be followed (See **EXHIBIT 'I'** of the DPO, Reference 2.1). An abbreviated report format may be used for off-system projects. Note that starred topics must have comments attached for all projects. A list of possible safety enhancements is shown in **EXHIBIT 'I'** of the DPO, (Reference 2.1).

On resurfacing projects, or projects not requiring additional right-of-way, add the following statement to the plan-in-hand report:

> A special provision will be written to remove those trees that are inside the lateral obstacle clearance zone, but not beyond the limits of existing right-of-way.

Once the appropriate parties approve the plan-in-hand report, copies are released for additional distribution. Copies of the plan-in-hand report with location maps and any miscellaneous attachments are distributed to the individuals or agencies listed in EXHIBIT 'I' of the DPO, (Reference 2.1). This marks the end of Activity 5318/5338. Enter the completion date on the PSS.

9. ROADWAY FUNCTIONAL DESIGN (ACTIVITY 5316/5326)

Roadway functional design (Activity 5316/5326), incorporating comments from the plan-in-hand field inspection and the Public Information Meeting, (if held), may begin while the plan-in-hand report is being circulated for approval. The designer may need to revise the plans based on comments from the Public Information Meeting and from the final plan-in-hand report. One of **NDOR's** goals is to have as much of the final design accomplished as possible at the functional design stage (Activity 5316). The only changes to the project design after the functional design stage should be as a result of the design public hearing, unanticipated utility problems or changes as a result of right-of-way negotiations.

The designer should conduct a post-plan-in-hand meeting (Meeting "B") with **Drafting** and **Roadway Design Project Manager** to coordinate making the necessary changes (See EXHIBIT 'A' of the DPO, Reference 2.1). Design details to be considered may also include locations of borrow and/or waste pit sites, guardrail locations, etc. Erosion control design should also be coordinated with the **Roadside Design Section.**

The functional design plans should then be sent to the **Environmental Permits Unit** with the preliminary design showing impacted wetlands, possible mitigation sites, any proposed channel change locations including typicals and justification for both impacted wetland and channel changes, i.e., why avoidance was not possible. Plans for public hearing meetings should show existing wetland sites. The decision will be made at the dry run whether to show potential mitigation sites. The designer should search potential mitigation sites for the most appropriate site and make a recommendation at the dry run. Coordination with the **Environmental Permits Unit** is essential in determining the number of acres (hectares) impacted and the most appropriate mitigation site. See Chapter Thirteen: Planning and Project Development, Section 4.B, for further discussion of wetlands procedures.

Special investigations may also be updated as needed during Activity 5316/5326 for such items as drainage structures, railroad agreement information, detour/shoofly, retaining walls, stairs (from the **Bridge Division**), soils investigation, phasing, traffic, lighting, signing, erosion control. Again, additional surveys may be required for mitigation sites, borrow/waste pits, etc. The **Traffic Engineering Division** may also need to review the updated plans.

9.A Special Provisions

Activity 5316/5326 also includes the initial writing of any special provisions that may be needed for the project. This information accompanies the computations for the Plans, Specifications and Estimates (PS&E) package.

9.B Initiate Agreements

The **Roadway Design Division** initiates agreements by completing the Request for Agreement form (DR Form 65). The request form is forwarded to the appropriate division for processing. The designer should keep track of the agreement progress and provide any necessary display information. Agreements go to the **District Engineer** to obtain signatures from other parties to the agreements. See DOR-OI 45-5, "Agreements" (Appendix F, "Selected NDOR Operating Instructions") for further information regarding agreements.

9.B.1 City Agreements

All projects within city/municipal limits that are designed to 3R standards or higher will require a city agreement. The **Planning and Project Development Division** prepares city agreements based on information obtained from the **Roadway Design Division.** City agreements may be developed for such things as maintenance and operation of roadway lighting including poles beyond city limits. See Chapter Thirteen: Planning and Project Development, Section 5.A, for further information.

On all city agreements city limits should be described by stationing or reference post, either prior to Section 1 of the agreement or on the cost estimate sheet. Also note if the city limits encompass the entire highway right-of-way or one side only. The transmittal letter for the agreement should be sent from the **Roadway Design Project Manager** through the **Assistant Design Engineer** to the **District Engineer.**

City agreements will not be required, with the **District Engineer's** approval, on Pavement Extension Projects (PEP) and on Maintenance Resurfacing Projects.

9.B.2 Irrigation Agreements

The **Planning and Project Development Division** works with the appropriate **Water Districts** regarding irrigation agreements.

9.B.3 Railroad Agreements

The **Railroad Liaison Engineer** in the **Rail and Public Transportation Division** is responsible for all agreements, easement documents, and railroad special provisions. The designer should realize that some agreement and easement documents take considerable time to be executed. Early coordination is essential.

When there is railroad involvement but an agreement and/or easement are not needed, the **Railroad Liaison** group will draft railroad special provisions to add to the letting package. See Chapter Thirteen: Planning and Project Development, Section 5.G, for further information.

9.C Design Access Control

Once the roadway designer is prepared to make recommendations regarding access control, he/she should contact the **Highway Right-of-Way Associate** in the **Property Management Section** of the **Right-of-Way Division** and request to be on the agenda for the next access control meeting. The designer presents his/her recommendations to the **Control Access and Permit Review Committee** with the necessary supporting documentation. Access control is required on all interstate, expressway and four-lane divided highways. The department will consider acquiring access rights on all other highways when:

1. The 20 year forecast traffic (ADT) is 3001 or greater, as shown on the department's current 20 Year Forecast Traffic Map; or
2. The route is within the present or projected two mile zoning limits of first class cities (population 5,000 to 99,999) and within the present or projected three mile zoning limits of primary (population 100,000 to 299,999) and metropolitan class cities (population more than 300,000); or
3. There are three miles or less between the interstate and the connecting or parallel highway; or
4. At other locations deemed appropriate.

The designer should provide an aerial photo with property lines and locations of access sites that meet the policy for the committee's review and approval. The designer may need to take the project to several access control meetings throughout the design process.

EXHIBIT 'K' of the DPO, (Reference 2.1), lists the necessary documentation needed for access control meetings at various project stages. See Chapter Fifteen: Right-of-Way, Section 3, for additional discussion of access control. Document the results of the access control meetings in the project file and route the information through the **Roadway Design Engineer, Planning and Project Development Engineer, Right-of-Way Manager** and the **Highway Right-of-Way Associate.**

9.D Receive Additional Documentation

If the project has a Class I or Class III environmental classification, a draft environmental impact statement (DEIS) or draft environmental assessment (DEA), as appropriate, will be submitted to the **Roadway Design Division** from the **Planning and Project Development Division.** See Chapter Thirteen: Planning and Project Development, Section 4.A, for additional discussion.

The **Materials and Research Division** will also submit an approved pavement determination to the designer, see Chapter Eight: Surfacing, Section 1.B, for additional information. This is an indicator that a cost update will be due.

9.E Notifications

Notify the **Public Hearings Officer** of the availability of plans for projects that will not have public hearings. Plans will be available to the public in the **District Engineer's** office. See Section 12 for further information regarding public notification and public hearings.

9.F Design Relaxations

If a design relaxation is necessary, the request for relaxation should be submitted to the **Director-State Engineer,** the **Nebraska Board of Public Roads Classifications and Standards,** and/or the **Federal Highway Administration,** as appropriate. Chapter One: Design Standards, Section 6, discusses the design relaxation process in further detail.

9.G Submit Functional Plans

Functional plans, also known as hearing plans, should be submitted to the individuals and agencies shown in EXHIBIT 'F' of the DPO, (Reference 2.1). If a public hearing is to be held, these plans shall be submitted to the appropriate entities five weeks prior to the public hearing. Functional plans should be stamped preliminary plans and dated. This is the end of Activity 5316/5326. Enter the completion date on the PSS.

10. COVENANT RELINQUISHMENT AGREEMENT

A covenant relinquishment agreement (CRA) is a signed agreement between **NDOR** and a **City/County** in which **NDOR** maintains ownership of the right-of-way for utility easement purposes but relinquishes responsibility for the maintenance and operation of the roadway facility to the **City/County**. In a CRA, **NDOR** agrees to bring the roadway surfacing up to an acceptable serviceability value. The designer will need to get a determination from the **District Engineer** and/or the **Project Scheduling and Program Management Section** on whether the surfacing of the relinquishment should be added to the project or if a separate project should be programmed, unless the relinquishment is part or an expressway project, in which case the cost to improve the relinquishment will be a project cost. The scope of work on the segment to be relinquished must be justified and be approved on a scoping document, such as the plan-in-hand report or a revised DR-73 form ("Highway Improvement Programming Request").

The designer should review any CRAs that may have been developed to determine if new or revised CRAs are needed. If a new CRA is required or revisions are needed, the designer shall provide the necessary information for the documents. The approximate location should be identified and a location map exhibit should be prepared by **Drafting**. Submit the information for the CRA to the **Materials and Research Division**. Review the draft CRA and exchange comments. A signed agreement must be received prior to scheduling a dry run for a public hearing, (See Section 12, for further information regarding public hearings). For further information on relinquishments see Section 21; Chapter Fifteen: Right-of-Way, Section 7.E; and the Department of Roads' Operating Instruction 60-13, "Relinquishment of Roads from the Highway System" (Appendix F, "Selected NDOR Operating Instructions").

11. COST UPDATE 2 -STATUS 40 (ACTIVITY 5406)

Review the cost estimate checklist (EXHIBIT 'C' of the DPO, Reference 2.1) for the project. Check for funding splits on the Initial Project Data form, (DR Form 333), or the Project Data Revision form, (DR Form 334) and/or on CICS1/CICS3. Quantities should be submitted to the **Cost Estimating Unit** on Project Quantity Sheets, (DR Form 343), and the Project Information Sheet, (DR Form 342), should be updated. Submit the completed project information sheet and cost estimate forms to the **Roadway Design Project Manager** for his/her review. The last task in Activity 5406 is the completion of the **Roadway Design Project Manager's** review. Enter the completion date on the PSS. Do not sign off on Activity 5406 on PSS when completing an annual cost update. See Chapter Twelve: Cost Estimating, Section _, for further details.

12. DESIGN PREPARATION FOR PUBLIC HEARINGS (ACTIVITY 5323/5324)

12.A Public Hearings

A public hearing is an advertised formal meeting, presided over by a **Highway Commissioner**, to present the proposed project to the public and to obtain public input. Design functional plans (Activity 5316) and R.O.W. ownership plans are needed for this meeting. Before scheduling the public hearing, the designer will need to obtain a signed city covenant agreement (if applicable), a signed covenant relinquishment agreement (if needed) and a signed draft environmental document and noise study, if a noise study was conducted. These documents are required *before* a public hearing may be scheduled. Hearing guidelines must be followed for proper public notice of the hearing, for information that must be presented, and for the hearing procedures. A transcript is made of the verbal and written testimony. Location public hearings and design public hearings may be held separately or they may be combined into one hearing. See "Guidelines for Public Hearing", **EXHIBIT 'M'** of the Design Process Outline, (Reference 2.1), for further information.

The following items should be collected and/or prepared for the public hearing:

- Comments from Public Information Meeting, if applicable.
- Design year traffic information (i.e., design year is 20 years after the year of construction completion).
- Typical section display.
- Aerial photo display (less than 18 months old).
- Hearing plans (See **EXHIBIT 'F'** of the DPO, Reference 2.1).
- Engineering statement (take 5-10 extra copies to the hearing for the **Highway Commissioner** to give to the media).

A dry run should be held six weeks prior to a proposed public hearing. **EXHIBIT 'L'** of the DPO, (Reference 2.1) lists people who should be invited to a dry run. Contact the **Design Standards Engineer** for a current list of people who should be invited. Be sure that the **Director**, the **Deputy-Director Engineering** and the **Roadway Design Division Engineer** are available to attend. Others may be invited when appropriate. The **District Engineer** should also be contacted and asked if he/she would like to attend the dry run. The dry run should simulate an actual public hearing. It provides the opportunity to practice and refine the presentations prior to an actual public hearing. The public hearing checklist (**EXHIBIT 'M'** of the DPO, Reference 2.1) should be used to gather information and tools for the dry run and the public hearing.

A "Public Hearing Notice Worksheet", (**EXHIBIT 2.2**), a "Fact Sheet" (**EXHIBIT 'S'** of the Design Process Outline, Reference 2.1), a detour map (if applicable) and a current location map is to be submitted to the **Public Information Office** in the **Communication Division** prior to the dry run. After the dry run is completed, the designer provides the **Secretary of the Highway Commission** and the **Public Hearings Officer** with a copy of the engineering statement. The **Public Hearings Officer** will provide the designer with a copy of the presentation including exhibits that will be used during the hearing. The **Public Hearings Officer** advertises the hearing in the official county newspaper and in general circulation newspapers in the project area at five and at two weeks prior to the hearing date.

The designer is responsible for providing the **District** and **City** (if applicable) with a set of design functional plans at the same time as the advertising information is submitted to the **Public Hearings Officer**. After the hearing, the designer will submit a copy of the engineering statement to the **Secretary of the Highway Commission**.

Public hearings will be held for all environmental Class I projects, (those requiring an environmental impact statement), and environmental Class III projects, (those having an environmental assessment) (See Chapter Thirteen: <u>Planning and Project Development</u>, Section 4). All environmental Class II projects, (categorical exclusions), are reviewed on an individual basis to determine if a hearing will be held. The plan-in-hand report will note the decision made. All environmental Class I and III projects will require **State Highway Commission** recommendation and the **Governor's** approval, as will any Class II project for which a public hearing is held. Public Hearing Statements should include some environmental statements, such as:

- Thoughtful design and construction techniques are used to minimize the impacts to the environment, wetland areas will be avoided when possible and replaced when eliminated.
- Temporary water pollution control measures will be used to reduce soil erosion.
- Trees will be saved where consistent with good design.
- On this project some trees are located within the proposed construction limits and will be removed.
- After construction, disturbed areas will be seeded with grasses and wildflowers chosen based upon the soil type and compatibility with the surrounding vegetation.

After the hearing is over, the designer reviews and consolidates comments that were made, and compiles the plans, displays and hearing statement for the permanent file as hearing plans. Comments from the afternoon informal session are put in one set of plans and stamped as public hearing documents.

The completion date for Activity 5323 occurs at this point for solely roadway design tasks. Enter the completion date on the PSS at this time. Other divisions share responsibility for the rest of the tasks in Activity 5323. Designer time associated with public hearing tasks should be charged to Activity 5323 even after the completion date has been entered on PSS.

12.B <u>Highway Commission Statement</u>

After the public hearing has been held, the designer or **Roadway Design Project Manager** shall prepare a Highway Commission statement, (forms may be obtained from the Roadway Design vault). The statement will be presented to the **Highway Commission**. The **Assistant Design Engineer** reads the statement into the **Highway Commission** proceedings, summarizes the comments received at the public hearing, and answers questions. A copy of the statement goes to the **Highway Commission Secretary**. Upon receipt of approval from the **Highway Commission** and the **Governor**, the project proceeds. Receipt of approval marks the end of Activity 5323 for time sheets.

12.C Public Meetings

Communication between **NDOR** and the public is an important ongoing activity coordinated by the **Public Hearings Officer** in the **Communication Division**. Depending on the nature of the project, several types of contact may be made during the course of a project. The **Public Hearings Officer** publishes notices for hearings in general circulation newspapers in project areas to provide information about the proposed projects to the public. Types of public meetings that are held are:

- Public Information Meetings.
- City and/or County Officials Meetings.
- Property Owners Pre-Hearing Meetings.
- Pre-hearing Information Meetings.
- Location Public Hearings.
- Design Public Hearings.

For guidance on which type(s) of public meeting(s) should be held for a project see the "Public Meeting Checklist", **EXHIBIT 'R'** of the Design Process Outline (Reference 2.1). Plan and agreement requirements for the various types of public meetings may be found in **EXHIBIT 2.2**.

Meeting Type	Design Plans (Activity #)	Environmental Permits Unit Plans	R.O.W. Plans	Signed Agreements (As Necessitated by the Project)
"Preliminary/Input From Public" Information Open House	Preliminary Plans (#5315)	Wetlands Impacts and Potential Mitigation Sites	Ownership	
"In Lieu Of A Hearing" Information Open House	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
"Pre-Design Hearing" Information Open House	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
Property Owners Pre-Hearing Meeting	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
Corridor Hearing	Functional Plans (#5316)	Wetlands Impacts and Potential Mitigation Sites	Ownership	Covenant Relinquishment Agreement
Public Hearing	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
City and/or County Officials Meeting	Functional Plans (#5316)	Wetlands Impacts and Preferred Mitigation Site(s	Ownership	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
"Project Update" Information Open House	Functional Plans (#5316) or Better (if available)***	Wetlands Impacts and Preferred Mitigation Site(s)	Ownership or Better (if available)***	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
"L.O.C./Phasing" Information Open House	L.O.C. Plans (#5335)	Wetlands Impacts and Preferred Mitigation Site(s)	Appraisal***	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **
Information Meeting Prior to Appraisal and Acquisition	L.O.C. Plans (#5335)	Wetlands Impacts and Preferred Mitigation Site(s)	Appraisal***	City Covenant Agreement Covenant Relinquishment Agreement Draft Environmental Document(s) * or a FONSI **

* Includes a Noise Study, if one was conducted.
** An Environmental Assessment with a **F**inding **O**f **N**o **S**ignificant **I**mpact
*** All required final environmental documents must be signed before R.O.W. Appraisal and Final Design Activities (#5355) can begin.

For further information see Sections 9 and 16, Chapter Thirteen: Planning and Project Development, (Section 4), and Chapter Fifteen: Right-of-Way, Sections 3.F & 4.

Exhibit 2.2 Plan and Agreement Requirements for Public Meetings

12.C.1 Public Information Meetings

Public information meetings are advertised meetings held to inform the public of the proposed project location and/or design, to obtain public input and to answer questions through one-on-one conversations with the public. These are not recorded meetings but citizen Comment Sheets are made available. The required plans and agreements for these meetings may be found in **EXHIBIT 2.2**. Items that should be taken to a public information meeting may be found on the "Public Meeting Checklist" in **EXHIBIT 'M'** of the Design Process Outline (Reference 2.1).

Items 5 through 9 and 11 through 26 are usually sufficient for a public information meeting, but items 2 through 4 may be added if a mosaic is available. The designer should create a "Project Fact Sheet", **EXHIBIT 'M'** of the Design Process Outline (Reference 2.1), for distribution at the public information meeting.

Public information meetings are scheduled in coordination with the **District Engineer** and/or the **Planning and Project Development Division**. Meetings usually are held for major relocations and location studies, right-of-way appraisal, design and scope changes, wetlands impacts, projects in villages and cities, and sometimes for an engineering review. There are various types of public information meetings:

- A **"Preliminary/Input from the Public" Information Meeting"** is often scheduled to solicit public input prior to putting proposed design features on a map. This meeting may be held in concert with the plan-in-hand.
- An **"In Lieu of a Hearing" Information Meeting"** is held when the public has indicated there is significant interest in the project but no public hearing is planned. This may also be used in the case of a Class II environmental classification project (See Chapter Thirteen: Planning and Project Development, Section 4).
- An **"Information Open House"** meeting is always held in the afternoon of a design hearing.
- A **"Project Update" Information Meeting** is held when 18 months or more have elapsed since a design hearing was held or when there has been a change in the scope of the project.
- A **"Limits of Construction/Phasing of Construction" Information Meeting** is held to inform adjacent property owners of the possible impacts to their property. In metropolitan areas, these meetings are often held only with homeowner groups that are affected by the project. If there are fewer than four affected properties, and no public information meeting is held, LOC Design Plans (Activity 5335) will be sent to the **District Engineer** who will be asked to contact the property owners, showing them our proposed design and explaining its impact to their property.
- An **Information Meeting Prior to Appraisal and Acquisition** is held to answer questions regarding the project and the **Department of Roads** property acquisition process. Landowners impacted by the project are particularly encouraged to attend. The preliminary R.O.W. plans must have been completed before this meeting. This is a meeting held by the **Roadway Design Division**, which may be attended by appraisers from the **R.O.W. Division**. Factors considered in selecting a Pre-Appraisal Information Open House include: a decision by the **Assistant Design Engineer**, a request from the **District Engineer** or **D.O.R. Administration**, elapsed time since a previous meeting with the public, etc.

The designer should submit a "Public Hearing Notice Worksheet", (**EXHIBIT 2.3**), a "Fact Sheet" (**EXHIBIT 'S'** of the Design Process Outline, Reference 2.1), a detour map (if applicable) and a current location map to the **Public Hearings Officer** five weeks prior to a proposed information open house so that the required meeting advertising and official notifications may be produced. The first publication occurs three weeks prior to the meeting and the final publication will be one week prior to the meeting. The designer is responsible for providing the **District** and (if applicable) the **City/Village** office with a set of plans at the same time that the advertising information is sent to the **Public Hearings Officer**. See Section 12.A for additional information.

After each meeting all notes from the various plans and note pads shall be consolidated onto one set of plans and/or one set of minutes. The minutes will become part of the project file and the plans shall be properly tagged as "Information Meeting" or "Public Hearing" plans and will be kept until the project has been built. It is the responsibility of the designer to insure that all promises for studies, phasing, and/or plan changes are honored and that any information received that affects other divisions is shared.

12.C.2 City and/or County Officials Meeting

The **Assistant Design Engineer** will determine when a **City and/or County** officials meeting is to be held. While it is not necessary that the **Roadway Design Division** conduct all of the meetings and coordination, such as in utilities conflicts, they are responsible for seeing that it is accomplished. The plan and agreement requirements for this meeting may be found in **EXHIBIT 2.2**.

12.C.3 Property Owners Pre-Hearing

Pre-hearing meetings may be held with impacted property owners on projects entailing major changes in access, parking, drop off lanes, right-of-way, driveways, relocation (especially of occupied residences), etc. The **Assistant Design Engineer** will determine when a property owner pre-hearing will be held. See **EXHIBIT 2.2** for the required plans and agreements for this meeting.

Public Hearing Notice Worksheet

Please return to the Public Information Office in the Communication Division prior to your hearing dry run or scheduling of your open house.

Your Name:		Division, Section, Unit:
Phone No.:	Fax No.:	Type of Hearing: *(Check one)* ☐ Notice of highway corridor hearing ☐ Notice of highway design hearing ☐ Notice of information open house ☐ Pre-appraisal meeting ☐ Other *(please specify)*
Date of Hearing:		
Time of Hearing or Information Meeting: Starting:____________ Ending:__________ *(if appropriate)*		
Hearing Location: *(Building, Address, and City)*		Time of Preceding Information Discussions, if any: Starting -- Ending ---.
		Division(s) and/or District(s) Providing Personnel for Informal Discussions: ☐ Roadway Design ☐ Planning & Project Development ☐ Right-of-Way ☐ District
Project No(s). and "Known As" Descriptions:		Control No.: *(For internal referencing only)*
Briefly Describe Location and Type of Proposed Improvement: *(Major Elements)*		
Total Lanes in the Completed Project:		Project to be Constructed Under Traffic? ☐ Yes ☐ No
Highway Access Control Information:		

DR Form 356, May 05/

(Continued)

Exhibit 2.3 Public Hearing Notice Worksheet

<table>
<tr><td colspan="3">Detour Information:</td></tr>
<tr><td colspan="3">Shoo-fly Information:</td></tr>
<tr><td colspan="3">Right of Way Information:</td></tr>
<tr><td colspan="3">Roadway Removal, Relinquishment:</td></tr>
<tr><td colspan="3">Acquisition of Business, Residence or Other Structures:</td></tr>
<tr><td colspan="3">Environmental Areas, including Wetlands to be Affected by the Project:</td></tr>
<tr><td rowspan="3">Location and Address Where Preliminary Plans may be Inspected:</td><td colspan="2">Contact Person for News Release:</td></tr>
<tr><td colspan="2">Phone No.: (Include Area Code)</td></tr>
<tr><td>Have you attached the most current map detailing the location of the proposed improvement?</td><td>☐ Yes
☐ No</td></tr>
<tr><td colspan="3">Is the project politically sensitive? (Explain – for background purposes only)</td></tr>
<tr><td>Section/Unit Manager Reviewing & Approving Hearing Notice Materials:</td><td>Phone No.:</td><td>Fax No.:</td></tr>
</table>

Exhibit 2.3 Public Hearing Notice Worksheet (Continued)

13. ROADWAY DESIGN (ACTIVITY 5325/5327)

Activity 5325/5327 begins with a review of the hearing plans and the public hearing transcript. Typical cross-sections should be updated as necessary. The **Materials and Research Division** will provide the final typical pavement cross-sections.

Design of geometrics and grades for driveways, intersections, frontage roads and cross-sections should be completed during this activity. Compute impacted wetlands and submit them to the **Environmental Permits Unit** for recommendations regarding elevations and mitigation.

Finalize any special investigations such as drainage structures, box culverts, railroad agreement information, detours/temporary roads, construction phasing, retaining walls, soils investigations, traffic signals, lighting, signing, marking, wetlands mitigation plans, erosion and sedimentation control measures (both temporary and permanent). Review the design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1). Order additional surveys, if necessary. Have the **Traffic Engineering Division** review any pertinent changes.

Submit plans to **Drafting** for final plan preparation upon completion of the special investigations. The end of Activity 5325 coincides with the scheduling of the **Roadway Design Division** review meeting (See Activity 5335). Enter the completion date on the PSS.

14. ROADWAY DESIGN REVIEW/ LIMITS OF CONSTRUCTION PLANS ACTIVITY 5335/5336)

The **Roadway Design Division** review meeting with the **Roadway Design Project Manager** is the first task in Activity 5335/5336 and is held to check the plans using the design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1), the plan-in-hand plans, and the hearing plans.

14.A Limits of Construction Plans

The limits of construction plans should show the final limits of construction including all culverts, driveways, intersections, dikes, etc. and taking into account the needs of **Lighting**, **Utilities**, **Roadside Development**, **Wetlands**, and **Traffic**. Distribute the limits of construction plans with location maps and typical sections to the entities shown in **EXHIBIT 'F'** of the DPO, (Reference 2.1). The plans should be stamped preliminary and dated.

After L.O.C. plans have distributed, notice should be given when changes are made to the L.O.C. plans that may affect **R.O.W. Design**, **Utilities**, **Bridge**, **Traffic,** the **Wetlands Unit** or other divisions. Some examples of changes:

- Construction Limits.
- Special Ditches (even if within the planned R.O.W., it may affect utilities).
- Vertical Profile.
- Intersection/ Drive Locations.
- Temporary Roadways, etc.
- Impacts to Wetlands areas.

R.O.W. Design, **Utilities** and any other affected sections shall be notified when work is beginning on a change. Send an e-mail to:

- **R.O.W. Design Engineer.**
- **ROW Designer.**
- **Utilities Engineer.**
- **Utility Coordinator.**
- **Wetlands Unit.**
- Other affected sections.

The notification shall include the following information:

- Project Name & Number.
- Control Number.
- Tract Numbers affected.
- A brief description of the changes.
- An approximate completion date.

14.B Other Tasks in Activity 5335

A meeting with the **Traffic Engineering Division** may be held to review any unusual situations related to traffic concerns, e.g., intersection, pavement marking plans, etc. Typically, the **Traffic Engineering Division** is simply notified that the limits of construction plans are available (See **EXHIBIT 'F'** of the DPO, Reference 2.1). In addition, the **Lighting Unit** should be given a set of base plans if there is lighting involved.

Any covenant city agreements should be completed and sent to the **District Engineer** to obtain signatures. The final task in Activity 5335 is a meeting of **Right-of-Way, Drafting, Roadway Design Project Managers, Assistant Design Engineers** and the **Utilities Coordinator.** Enter the completion date on the PSS.

15. COST UPDATE 3 – STATUS 45 (ACTIVITY 5408)

Review the cost estimate checklist (**EXHIBIT 'C'** of the DPO, Reference 2.1) for the project to be certain all items are included. Recheck the funding splits on the Initial Project Data form, (DR Form 333), the Project Data Revision form, (DR Form 334), and/or on CICS1/CICS3. The Project Information Sheet, (DR Form 342) should be updated and updated quantities should be submitted to the **Cost Estimating Unit** on Project Quantity Sheets, (DR Form 343). Submit the completed project information sheet and cost estimate forms to the **Roadway Design Project Manager** for his/her review. See Chapter Twelve: Cost Estimating, Section _, for further details. The last task in Activity 5408 is completion of the **Roadway Design Project Manager** review. Do not use Activity 5408 to record annual cost updates on PSS.

16. DESIGN REVIEW SUPPORT PROCESSES (ACTIVITY 5340)

The designer should review the scheduled letting date, the anticipated time to construct the project, etc. on the PSS to be certain the schedule is still on track. Review the schedule, keeping the following (and other similar) activities and concerns in mind:

- **Agreements:** city, county, irrigation, and railroad. Recognize that some city/county councils may only meet once a month. Also be aware that irrigation modifications can only be done during that part of the year when there is no water in the systems. Railroad owners may be out of state, and agreements require extended lead-time.
- **Final Relinquishment Agreement:** agreements must be executed prior to submittal of the plans package to **PS&E** (See Section 21).
- **Wetlands:** permitting requires input from multiple agencies; mitigation should be done in winter months, if possible.
- **Utilities:** seasons are also critical for utility relocation.
- **Right-of-way:** acquisition is a lengthy process (See Chapter Fifteen: Right-of-Way, Section 5).
- **Soils:** surcharge and settlement may need to be programmed into the construction schedule.
- **Phasing:** coordinate bridge and roadway construction phasing, etc.
- **Promises:** be aware of promises made, e.g., construction completed before football season.
- **Logo signs:** tourist-oriented directional (TOD) signs should be moved during the off-peak tourist season, if possible.
- **Miscellaneous:** nesting seasons of birds that nest on bridges, trout migration, etc.

The estimated working days for construction should also be reviewed and the letting date should be confirmed. Lettings usually occur once a month. This is the end of Activity 5340. Enter the completion date on the PSS.

17. PRELIMINARY RIGHT-OF-WAY PLAN REVIEW (ACTIVITY 5345)

At this stage, right-of-way design is on the critical path. In Activity 5345, the designer should review the Preliminary Right-of-Way plans (See Chapter Fifteen: Right-of-Way, Section 2.C). Once the roadway designer has received and reviewed the plans, the roadway designer holds a Preliminary R.O.W. plan review meeting and invites those shown in **EXHIBIT 'Q'** of the DPO, (Reference 2.1) to discuss design of the preliminary right-of-way. **Right-of-Way Design** provides a copy of the Preliminary Right-of-Way plans to the **Roadway Design Division.** Receipt of these plans marks the end of Activity 5345. Enter the completion date on the PSS.

18. DESIGN PLANS TO UTILITIES SECTION (ACTIVITY 5350)

At this stage of the project, the design is complete except for any changes from right-of-way negotiations and any unforeseen utility changes. **Right-of-Way Design** will send Appraisal Right-of-Way plans to the **Roadway Design Division** for review. The designer should transmit a set of the most recent reproducible plans to the **Utilities Section** for them to distribute the plans to affected utilities. Contact the **Utilities Coordinator** to discuss the project further and to check for any other utility conflicts. Enter the completion date on the PSS.

19. INFORMATION MEETING PRIOR TO APPRAISAL AND ACQUISITION (ACTIVITY 5314)

If information meetings prior to appraisal and acquisition are held, the designer should attend along with the **Roadway Design Project Manager,** the **District Engineer,** and sometimes the **Construction Project Manager** and **Appraisers** from the **R.O.W. Division.** These meetings will use Appraisal Right-of-Way plans, (See Chapter Fifteen: Right-of-Way, Section 2.D). The **Roadway Design Division** handles the arrangements for these information meetings, (See Section 12.C, for further information).

Make any required changes as a result of the appraisal and negotiations. Be sure that all parties, such as the **Utility Coordinator,** are notified of changes.

20. CHANGES TO FINAL DESIGN (ACTIVITY 5355/5357)

The final design (Activity 5355/5357) begins with a review of the design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1) for any uncompleted tasks. This is the beginning of the final compilation of all of the information for the PS&E package. It also includes pre-appraisal meetings, if the **Chief Appraiser**, with input from the roadway designer, deems them necessary.

20.A Check on Other Agreements

The designer must also check on the status of all required permits and agreements so that all necessary documentation will be completed. Waterway permits, railroad agreements, status of utilities forms (that document all utilities negotiations have been settled and plans for relocation prior to construction are complete), county agreements, **Natural Resource District (NRD)** agreements, Irrigation District negotiations, etc. should all be obtained.

The city utility conflicts cost estimates and plans (if required) should be obtained. The cost estimates are required for the financial portion of the covenant agreement and should include the percentage of betterment/non-betterment work. As long as the work is non-betterment, **NDOR** pays the cost of relocation.

Ordinarily, the city will provide its own plans for utility relocation, especially for sanitary sewers. The city utility rehabilitation plans may or may not be included in the **NDOR** project. In some cases, the city work is completed prior to **NDOR** construction. In other cases, particularly in smaller cities, the utility rehabilitation may be incorporated into **NDOR** plans. A meeting should be held during this stage between the designer and city-owned utilities to discuss relocation/rehabilitation. Items to be discussed include such things as scheduling so the city can phase its work, betterment/non-betterment, etc. Enter the completion date on the PSS.

21. FINAL RELINQUISHMENT AGREEMENT (FRA)

The **Materials and Research Division** provides the covenant relinquishment agreements (CRA) for the final relinquishment agreement (FRA). The designer should review the CRA prior to preparing information for the FRA. The exact limits of the relinquished segment are included in the FRA along with a location map exhibit from **Drafting**, and a resolution and petition form (See **EXHIBIT 2.4**).

The designer should review the completed FRA location map exhibit with his/her supervisor, and then send all the information to the **Materials and Research Division**. The designer should review the draft FRA and then return it to the **Materials and Research Division** for processing. For further information on relinquishments see Section 10; Chapter Fifteen: Right-of-Way, Section 7.E; and the Department of Roads; Operating Instruction 60-13, “Relinquishment of Roads from the Highway System” (Appendix F, “Selected NDOR Operating Instructions).

Resolution and Petition

WHEREAS, the Nebraska Department of Roads of the State of Nebraska, has notified the City of ______________________, Nebraska, of its intention to relinquish a portion of State Highway No. _______.

NOW THEREFORE, BE IT RESOLVED by the City of ___________________________, Nebraska that said City herewith petitions for relinquishment of said portion of said State Highway No. ______________ located within the Corporate Limits of said City, and which the Department of Roads intends to relinquish pursuant to Statute Nos. 39-1314-15 of Revised Statutes of Nebraska (1988).

AND BE IT FURTHER RESOLVED, that the Department of Roads be notified of the desire of said City of _________________ to maintain said portions of State Highway No. _________, by transmitting a copy of this Resolution to said Department.

Passed and approved this _________ day of ___________________, 20___.

By _________________________________

Title ________________________________

ATTEST:

____
City Clerk

Exhibit 2.4 Resolution and Petition Form

22. PREPARATION OF FINAL PLANS PACKAGE/FINAL PLAN REVIEW FOR PS&E (ACTIVITY 5369/5368)

This activity essentially is the assembly of the final plans package. Plans submitted to **PS&E** shall have all plan corrections completed by **Drafting** prior to submission. The designer should complete any outstanding miscellaneous design plans, (i.e., guardrail). The design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1) should once again be checked.

Computations should be received from the **Materials and Research Division** and typical sections should be finalized. The computation sheets for each pay item should be completed, checked and rechecked, preferably by someone other than the one who did the original computations. Design details should be completed.

For further information, see Chapter Eleven: Highway Plan Preparation, Section _.

22.A Assemble Project Data

The designer should accumulate all project data including but not limited to the following:

- Right-of-way certificate, (See Chapter Fifteen: Right-of-Way, Section 6).
- Status of utilities, (See Appendix I, "Projects Not Usually Requiring a Status of Utilities").
- Seeding and erosion control special provisions and special plans.
- Agreements with city, county, Irrigation District, utilities, railroads, NRD, sanitary improvement districts (in urban areas), (See Section 10 and Chapter Thirteen: Planning and Project Development, Section 5.A).
- Final Relinquishment Agreement, (See Section 21).
- Waterway permits, e.g., 404 permit, nationwide permit (NWP), channel relocation, floodplain certification, etc., (See Chapter Thirteen: Planning and Project Development, Section 4).

The total design package including graphical presentation of plans, complete notes and details should be reviewed so that nothing has been forgotten. Again, use the design checklist (**EXHIBIT 'B'** of the DPO, Reference 2.1). Any special provisions that have been compiled should be elaborated on and/or finalized. The soils report should be reviewed and checked for the need for special provisions such as a compaction requirement (2K) sheet.

Receive plans from:

- **Bridge Division.**
- **Traffic Engineering Division.**
- **Lighting Unit.**
- **Materials and Research Division**.
- **Right-of-Way Design** (Ownership plans).
- Others , e.g., **City, County, Utilities, NRD**, etc.

Computer books for the **District Engineer** should be prepared including slope stake book, blue top book and paving grades, (See Appendix D, "Earthwork Books").

22.B Percentage of Work Near Railroad

The **Construction Division** needs to provide the contractor with information about the percentage of work, by cost, within 50 ft. (15 m) of the centerline of the nearest railroad track on railroad right-of-way and the percentage of work within the railroad right-of-way that is further than 50' (15 m) from the centerline of the nearest railroad track. The contractor needs this information to obtain railroad protective liability insurance, which depends upon the location of work with respect to the location of the railroad. The designer should calculate these figures for the PS&E package. The following equations are to be used to calculate the percentages of work:

% of work on RR ROW within 50' (15 m) of the centerline of the nearest track (Group _) = [(The cost of Group _ on RR ROW within 50' (15 m) of the centerline of the nearest track) ÷ (The cost of Group _ total)] x 100%.

% of work on RR ROW outside of 50' (15 m) of the centerline of the nearest track (Group_) = [(The cost of Group_ on RR ROW outside of 50' (15 m) of the centerline of the nearest track) ÷ (The cost of Group_ total)] x 100%.

The **Construction Division Cost Estimating Unit** can assist the designer in calculating costs. See Chapter Twelve: Cost Estimating, Section _, for further information.

22.C Check Earthwork and Notes

Use the earthwork checklist (**EXHIBIT 'N'** of the DPO, Reference 2.1) to review earthwork information. Verify that a utility note is included that shows the contractor is responsible for notifying utilities prior to digging.

Note that in some cases shoulder construction notes specify separate pay items by station. Check for:

- Earthwork balance points and quantities.
- Covercrop seeding note: on expressway projects where traffic remains on the existing roadway and then switches to new travel lanes, some areas may need seeding more than once.
- Shoulder construction notes.
- Superelevation notes.
- Scale stamp on cross-sections: horizontal and vertical scales will differ.
- Grade alignment at project ends and crossings for detours and temporary roads.
- Special provisions, e.g., surcharge over winter.
- Sketches for construction items, e.g., typicals for dikes, guardrail, driveways on 2-S sheets, etc.

Be sure that project stationing is shown on plans, typical sheets and project length sheet.

The final task of activity 5369 is the completion of a PS&E Required Sheet (DR Form 280). This form is a legal size sheet that should be completed to accompany the PS&E package. Enter the completion date on the PSS.

22.D <u>Checking Plans for Conflicts</u>

The designer is responsible for checking plans generated by other divisions for conflicts with the Roadway Design plans. For example: Have light poles or overhead traffic signs been installed in front of the guardrail? Are there conflicts with existing or proposed utilities and the storm sewer design?

22.E <u>Final Plan Review For PS&E</u>

Activity 5369/5368 includes the final check of all construction notes with the computation sheets and includes a review of the PS&E plans with the **Roadway Design Project Manager**. The design checklist (<u>**EXHIBIT 'B'**</u> of the DPO, Reference 2.1) should be used.

The city financial agreement should be prepared and sent to the **District Engineer** to obtain signatures. See DOR-OI 45-5, "Agreements", (Appendix F, "Selected NDOR Operating Instructions") for further information regarding agreements.

The final task for this activity is the submittal of PS&E plans to the **PS&E Section** in the **Construction Division.** Enter the completion date on the PSS when the project is given to **PS&E**.

During the period after a project has been advertised for letting until it has been let to contract, all questions from outside the **Nebraska Department of Roads** (i.e. contractors or suppliers) regarding the project and plans shall be referred to the **Highway Construction Scheduling Manager** in the **Construction Division**.

23. POST LETTING SUPPORT AND PLAN REVISION (ACTIVITY 5375/5376)

The project is not complete until construction is finished and **NDOR** has accepted the finished product. The **Roadway Design Division** may be involved in revisions at any time during construction of a project. If a project plan is to be revised after it has been sent to **PS&E** but before it is advertised for bid, **PS&E** will send it back to **Drafting** for changes to be made. The changes are not numbered at this stage. If, however, the project has been advertised and changes are necessary, plan revision procedures should be used: changes should be numbered, deletions crossed out, additions noted, etc. See Chapter Eleven: <u>Plan Preparation</u>, Section _, for plan revision procedures.

24. ARCHIVING THE PROJECT FILE

After the project is completed, the designer is responsible for archiving the project file in the vault. Archive instructions (transmitted by the vault to the designer) should be used to properly prepare the file for archives. This usually occurs two years after final computations are completed.

25. REFERENCES

2.1 Nebraska Department of Roads, Design Process Outline, Current Edition (http://www.nebraskatransportation.org/roadway-design/#designprocess)

2.2 Nebraska Department of Roads, Drainage Design and Erosion Control Manual, Current Edition

2.3 Nebraska Department of Roads, Access Control Policy to the State Highway System, Current Edition. (http://www.nebraskatransportation.org/roway/pdfs/accesscontrol.pdf)

CHAPTER THREE
ROADWAY ALIGNMENT

LIST OF EXHIBITS

CHAPTER THREE
ROADWAY ALIGNMENT

Chapter Three
Roadway Alignment

This chapter presents **NDOR** policies and criteria for the design of roadway horizontal and vertical alignments. **AASHTO's** A Policy on Geometric Design of Highways and Streets (Reference 3.1) fully describes the alignment considerations presented in this chapter and should be referred to for further details. **NDOR** policies take precedence over Reference 3.1, however, if **NDOR** policies cannot be attained, **AASHTO** policies should be followed.

1. SIGHT DISTANCE

Sight distance is the length of roadway ahead that is visible to the driver. The minimum sight distance available on a roadway should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. Although greater length is desirable, sight distance at every point along the roadway should be at least that required for a below average operator or vehicle to stop in this distance. Sight distance will affect design of:

1. Vertical and horizontal alignment.
2. At-grade intersections, including railroad/highway grade crossings.
3. Interchanges.

There are four types of sight distance values: stopping, decision, passing and intersection sight distance.

1.A Stopping Sight Distance

Stopping sight distance is the sum of:

- The distance traversed by a vehicle from the instant the driver sees an object necessitating a stop to the instant the brakes are applied (brake reaction distance); and
- The distance required to stop the vehicle from the instant brake application begins (braking distance).

Stopping sight distance is important for designing crest and sag vertical curves and for determining horizontal clearance on horizontal curves. See Sections 4.C.1 and 4.D.1 for further discussion.

1.B Decision Sight Distance

Decision sight distance is the distance required for a driver to see a decision point or obstacle in the roadway environment, recognize that an action is required, choose the appropriate action (stop, accelerate, change lanes, etc.), and complete the chosen action. In visually cluttered environments such as interchanges, urban intersections, lane drops and detours, the required sight distance may be longer than the required stopping sight distance. See A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Chapter 3 for further information.

1.C Passing Sight Distance

The driver on a two-lane, two-way roadway needs sufficient sight distance to complete a passing maneuver safely without cutting off the passed vehicle and before meeting oncoming vehicles that may have appeared during the passing maneuver. Sufficient passing sight distance should be provided at frequent intervals to allow a single vehicle to pass a single vehicle. See Section 4.C.2 and A Policy on Geometric Design of Highways and Streets (Reference 3.1c) Chapter 3 for further discussion.

1.D Intersection Sight Distance

Intersection sight distance consists of the provision of sight triangles along each leg of an intersection, which are free of visual obstacles, giving a driver sufficient time and distance to avoid conflicts at the intersection. See Chapter Four: Intersections, Driveways and Channelization, Section 1.C.2, and A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Chapter 9, for further discussion.

2. COMBINATION OF HORIZONTAL AND VERTICAL ALIGNMENT

Roadway alignment and drainage design must be coordinated to ensure compatibility between roadway geometrics and drainage design, (drainage design is discussed in Chapter One of the Drainage Design and Erosion Control Manual, Reference 3.2). The designer should check the horizontal alignment against the vertical alignment to insure that the flat section of a vertical curve does not align with the flat section of a superelevation runout. This combination of horizontal and vertical alignment will result in a pavement section with insufficient longitudinal gradient and roadway cross slope for adequate drainage of the roadway surface, (See Section 4.A.2).

The design of horizontal and vertical roadway alignments must be carefully coordinated with any intersections, interchanges, railroad crossings, airfields, bridges and/or any other structures located within the project limits. Proper coordination may eliminate undesirable roadway characteristics. See Chapter Four: Intersections, Driveways and Channelization, Chapter Five: Interchanges, and Chapter Ten: Miscellaneous Design Issues, Sections 1, 2, and 3 for further information.

A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Chapter 3, “Combinations of Horizontal and Vertical Alignment”, should be consulted for additional information on horizontal and vertical alignment coordination in design.

3. HORIZONTAL ALIGNMENT DESIGN

Major considerations in horizontal alignment are safety, design speed, topography, the environment and economics. Motorist safety is important in all elements of roadway design. Design speed is the maximum safe speed that can be maintained when conditions are so favorable that the design features of the facility govern the speed a motorist is likely to use to traverse the roadway. An alignment that follows the natural topography of the area generally provides the most aesthetically pleasing and most environmentally and economically constructed roadway. Other factors, such as maintenance considerations, may also influence selection of the final alignment. In urban areas, right-of-way and development considerations may have a greater impact on alignment.

The functional classification of the roadway to be designed and the design year average daily traffic (ADT) establishes the minimum design standards to be used, (See Chapter One: Design Standards, Section 2). The **Board of Public Roads Classifications and Standards** establishes these standards and typical sections (See the Nebraska Minimum Design Standards, Reference 3.3) (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf). Curvature, sight distance, roadway width, clearance and maximum gradient are all functions of the design speed, which is dictated by the functional classification of the roadway.

Usually, the **Planning and Project Development Division** will recommend an approximate horizontal alignment during the engineering review. It is the responsibility of the designer to check the alignment, especially on curves, and to verify compliance with standards.

3.A Horizontal Curvature

NDOR designs and designates horizontal curves based on the radius of the curve, (for conversion from/to degree of curvature see Appendix L, "Degree of Curvature"). The use of a minimum horizontal curve radius should be avoided, unless economically or environmentally necessary due to topographical conditions. Any change in direction with a deflection angle of 1° or greater will require a horizontal curve. For small deflection angles, curves should be long enough to avoid the appearances of kinks, at least 500 ft. (150 m) long.

Computer programs will generally perform curve calculations. The guidelines that follow give the designer a working knowledge of the methods of curve computation and serve as a reference for the occasions when manual computation is required.

3.A.1 Simple Curves

Computations of simple curves involve the relationships expressed in the formulas shown in **EXHIBIT 3.1.** **NDOR** uses arc definition for curve computation. Usually the PI station, the intersection angle (Δ) and the circular curve radius are established. The remaining curve data must be computed.

3.A.2 Reverse Curves

A reverse curve consists of two curves on opposite sides of a common tangent with a relatively short tangent length between curves. The length of tangent between the curves is usually dictated by superelevation requirements for each curve (See Section 3.B). Reverse curves are generally undesirable for high-speed highways due to the special considerations required for development of superelevation.

3.A.3 Compound Curves

A compound curve consists of two consecutive curves that join on the same side of a common tangent with no tangent length between the curves. Compound curves should be avoided whenever possible on mainline design. When field conditions dictate that a compound curve be utilized (e.g., for locations where an obstruction cannot be mitigated otherwise), the ratio of the flatter radius to the sharper radius should not exceed 1.5:1.

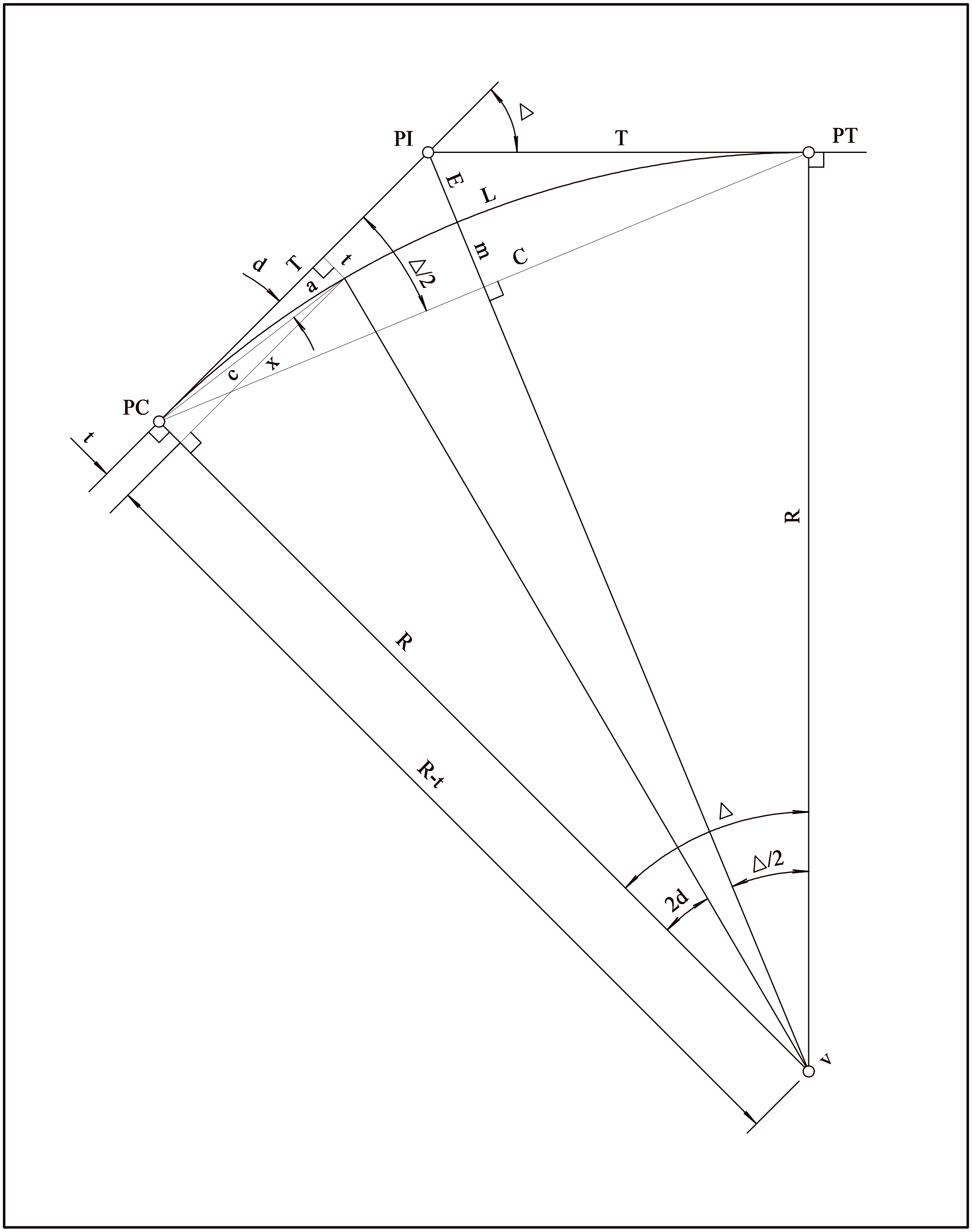


Exhibit 3.1a Elements of a Simple Curve

Curve Symbols and Abbreviations	Curve Formulas
Δ Intersection angle a Length of arc in ft. (meters) c Length of any chord from PC to any point on curve, or chord for any given arc in ft. (meters) C Length of long chord in ft. (meters), PC to PT d Deflection angle from tangent to any point on curve D Degree of curve based on 100 ft arc (E only) E External distance (PI to midpoint of curve) L Length of curve in ft. (meters), distance from PC to PT along curve m Middle ordinate (midpoint of arc to midpoint of long chord) PC Point of curvature (beginning of curve) PI Point of intersection of tangents PT Point of tangency (end of curve) R Radius of curve in ft. (given in Metric, m) t Tangent offset to any point on curve T Tangent distance, distance from PC to PI, distance from PI to PT V Intersection of radii at center of circular arc x Distance along tangent from PC to any point on curve (perpendicular to radius)	$\Delta = LD/100$ ***(English)*** $a = 200\,d/D$ ***(English)*** $c = 2R(\sin aD/200)$ ***(English)*** $C = 2R(\sin(\Delta/2))$ ***(English & Metric)*** $d = aD/200$ ***(English)*** $\cos d = (R - t)/2R$ ***(English & Metric)*** $D = 5729.57795/R$ ***for 100 ft arc (English)*** $D = 100\,\Delta/L$ ***(English)*** $L = 100\,\Delta/D$ ***(English)*** $m = R(1 - \cos(\Delta/2))$ ***(English & Metric)*** $R = 5729.57795/D$ ***for 100 ft arc*** $t = (c)\sin d$ ***(English & Metric)*** $t = R - (R\cos 2d)$ ***(English & Metric)*** $t = R(1 - \cos 2d)$ ***(English & Metric)*** $x = R\sin 2d = (c)\cos d$ ***(English & Metric)*** $E = R/(\cos(\Delta/2)) - R$ ***(English & Metric)*** $T = R(\tan(\Delta/2)) = \sin(\Delta/2)/\cos(\Delta/2)$ ***(English & Metric)*** $t = R - \sqrt{R^2 - X^2}$ ***(English & Metric)*** $\pi = 3.141592653$ $L = 2\pi R(\Delta^{\circ})/360$ ***PC Sta. = PI Sta. – T*** ***PT Sta. = PC Sta. + L***

Exhibit 3.1b Elements of a Simple Curve

3.A.4 Broken Back Curves

A broken back curve consists of two consecutive curves deflecting in the same direction joined by a short tangent. Broken back curves normally are undesirable. They should be used only at major three-legged intersections where, for example, a county road intersects with a highway or where there are two intersecting highways that have significant truck traffic carrying live loads (e.g., livestock trucks) or having high centers of gravity.

3.A.5 Spiral Transitions

NDOR sees only marginal benefits in the design of spiraled transition circular curves for new roadway alignments, in most cases. Spiral transition circular curves are preferred on interstate ramps, due to the higher percentage of truck traffic, and may be used on other roadway designs with **Assistant Design Engineer** approval, (See Chapter Five: Interchanges and Grade Separations, Section _).

3.B Superelevation

The minimum horizontal curve radius is limited by the design speed (V) of the facility and by the maximum superelevation rate (e_{max}) permitted. Selection of a maximum superelevation rate depends on several factors. These factors include design speed, location, climatic conditions, roadside conditions, future or ultimate development, roadway characteristics, facility type and driver expectations. **EXHIBIT 3.3** summarizes the preferred superelevation rates in Nebraska.

For rural highways a desirable superelevation rate of 6%, (**EXHIBIT 3.7**), should be used unless design constraints dictate the use of the maximum superelevation rate. Due to prevailing snow and ice conditions, the maximum superelevation rate shall not exceed 8%, (**EXHIBIT 3.8**). The use of the maximum superelevation rate of 8% requires **Assistant Design Engineer** approval.

High-speed urban roadways [V > 45 mph (70 km/h)] are preferably designed using a maximum superelevation rate of 4%, (**EXHIBIT 3.9**). If there are no traffic stops or signals present or anticipated in the future, a maximum superelevation rate of 6% may be acceptable if compatible with roadside conditions.

Low-speed urban roadways [V $\leq$ 45 mph (70 km/h)] are preferably designed using a maximum superelevation rate of 4%, (**EXHIBITS 3.10 & 3.11**). Low-speed urban roadways should not be designed with a superelevation rate of less than 2%.

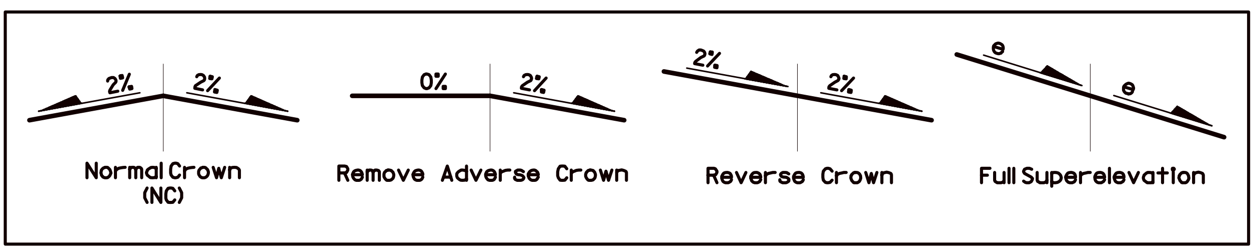


Exhibit 3.2 Crowns

Location	Max. Allowable Superelevation	Desirable Superelevation
Rural Roadways	8%* (**EXHIBIT 3.8**)	6% (**EXHIBIT 3.7**)
High-Speed Urban Roadways V > 45 mph (V > 70 km/h)	6% (**EXHIBIT 3.7**)	4% (**EXHIBIT 3.9**)
Desirable Design, Low-Speed Urban Roadways V ≤ 45 mph (V ≤ 70 km/h)	4% (**EXHIBIT 3.10**)	4% (**EXHIBIT 3.10**)
Minimum Design, Low-Speed Urban Roadways V ≤ 45 mph (V ≤ 70 km/h)	4%** (**EXHIBIT 3.11**)	4%** (**EXHIBIT 3.11**)

* Requires **Assistant Design Engineer** approval.
** Requires **Design Project Manager** approval.

Exhibit 3.3 Superelevation Rates

3.B.1 Transition Lengths

The superelevation transition length is the distance required to transition the roadway from a normal crown section to a fully superelevated section. Superelevation transition length is the sum of the superelevation runoff (L_r) and the tangent runout. Superelevation runoff length is the distance required to transition the roadway from a section with the adverse crown removed to a fully superelevated section, or vice versa, (See A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 3). Tangent runout is the distance required to transition the roadway from a normal crown section to a section with the adverse crown removed, or vice versa. The Standard/Special Plans Book, (Reference 3.4), illustrates the relationship between superelevation transition and runoff length for dual lane highways with crowned surface, dual lane highways with tangent surface and for two-lane roadways. For simple curves, 1/5 to 2/5, preferably 1/3, of the superelevation runoff length (L_r) should be placed on the curve. A minimum profile grade of 0.5% will be maintained through the area where the adverse crown has been removed to facilitate pavement drainage. The desirable profile grade through this area is 1.5%.

The minimum superelevation runoff lengths shown in **EXHIBITS 3.7 THROUGH 3.11** were calculated for two-lane and four-lane undivided roadways and for four-lane divided roadways with narrow medians [16 ft. (4.9 m) or less in width]. On this basis, runoff lengths for six-lane roadways would triple the derived values for two-lane roadways. While these lengths may be desirable, they are frequently not feasible. The following empirical guidelines from A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Exhibit 3-28, should be utilized to determine the minimum superelevation runoff lengths for multilane roadways:

- Three-lane roadways: 1.25 times the corresponding length for two-lane roadways.
- Four-lane undivided roadways: 1.5 times the corresponding length for two-lane roadways.
- Six-lane undivided roadways: 2.0 times the corresponding length for two-lane roadways.

3.B.2 Axis of Rotation

The axis of rotation is the point on the roadway cross-section about which the roadway is rotated to attain the desired superelevation through the horizontal curve. The Standard/Special Plans Book, (Reference 3.4), illustrates **NDOR** standard procedures for the application of the axes of rotation in superelevation development for four-lane divided highway sections and for two-lane highway sections. See A Policy on Geometric Design of Highways and Streets, (Reference

3.1c), Chapter 3, for methods of attaining superelevation where **NDOR** standard procedures do not apply.

Superelevation will be rotated about the profile grade line, which on two-lane highways is the highway centerline. This method minimizes the elevation differential between the pavement edges and their normal profiles. Rotation about the inside or outside axis of the roadway is acceptable when required to satisfy field conditions such as surface drainage on a curbed facility.

For multi-lane facilities with crowned surfaces and depressed medians of 40 ft. (12.2 m) or less in width, the axis of rotation and the profile grade point is about the inside edge of the inside (median) shoulder. This method results in the maintenance of a 2 ft. (600 mm) depth median ditch. See **EXHIBIT 3.4** and the Standard/Special Plans Book, (Reference 3.4). When the median width is greater than 40 ft. (12.2 m), the axis of rotation and the profile grade point may be the centerline of the individual lanes.

For multi-lane facilities with tangent surfaces and depressed medians of 40 ft. (12.2 m) or less in width, the axis of rotation is about the profile grade line, which is the inside (median) lane edge of each roadway. This method maintains the median in a horizontal plane throughout the curve. See **EXHIBIT 3.5** and the Standard/Special Plans Book, (Reference 3.4). When the median width is greater than 40 ft. (12.2 m), the axis of rotation and the profile grade point may be the centerline of the individual lanes.

For multi-lane facilities with raised medians, the axis of rotation and the profile grade point are the projected lane at the back of the median curb (See **EXHIBIT 3.6**).

3.B.3 Smoothing of Pavement Edge Profile

Angular breaks in the vertical profile of the pavement edge through the superelevation transition length should be rounded in the final design. For general appearance and safety, **NDOR** softens these sharp angular breaks by the insertion of short vertical curves along the pavement edge. As an approximate guide, the minimum vertical curve length in ft. (meters) can be set as numerically equal to the design speed in miles (kilometers) per hour. Greater lengths should be used where possible and consideration should be given to using a standard distance of 100 ft. (30 m) where practical.

3.B.4 Superelevation for 3R Projects

The superelevation for 3R projects shall be designed in accordance with Section 3.B except as follows:

- The rural design speed shall be the posted speed limit, the original design speed from the as-built plans, or 60 mph (100 km/h), whichever is greater.
- Use the e_{max} = 6% table and correct the existing superelevation to match the table. If the existing superelevation rate is over 6%, use the existing e (check against the e_{max} = 8% table, which should not be exceeded).
- List e on the plans for all curves; do not put "Use existing Superelevation" on the plans.

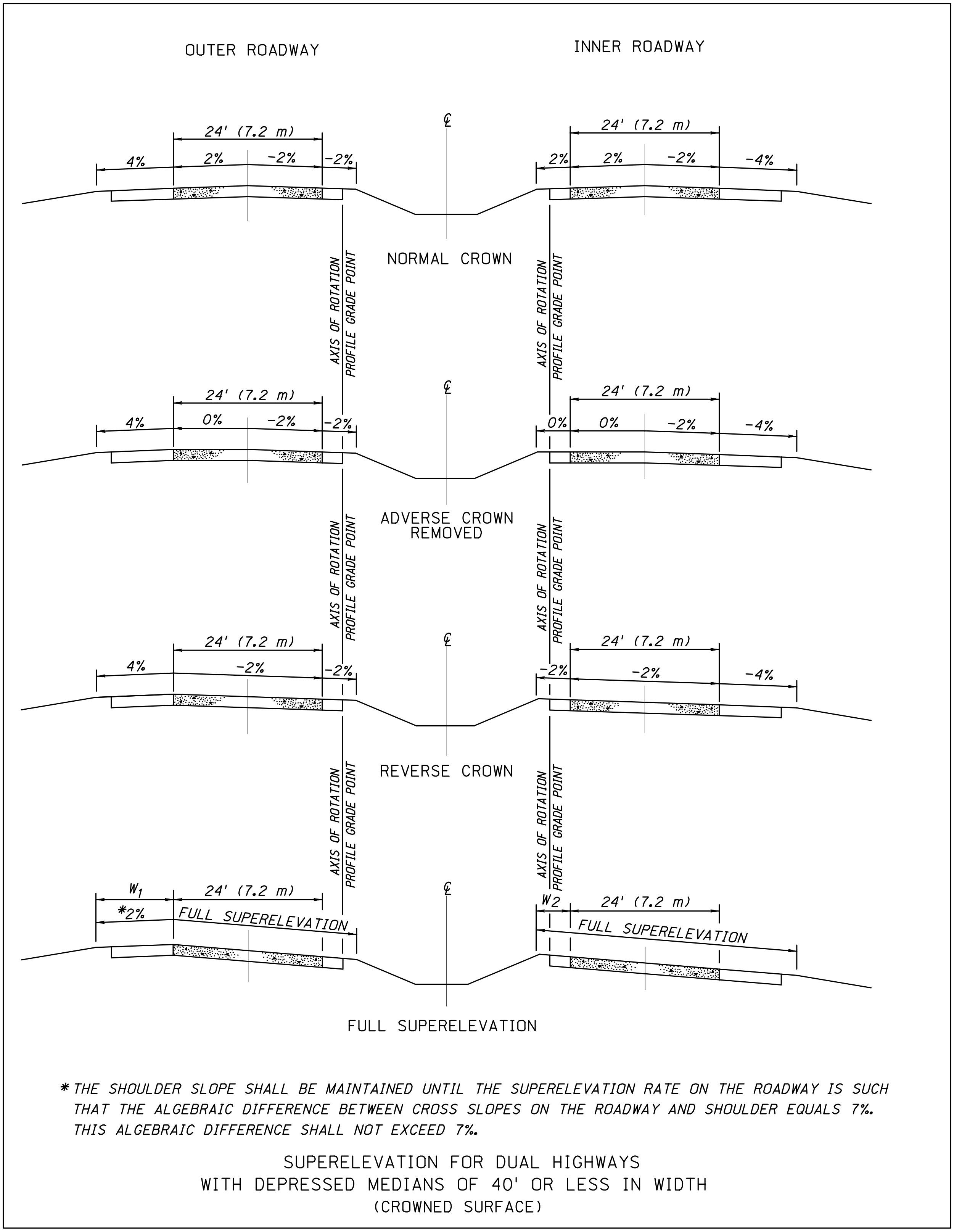


Exhibit 3.4 Superelevation for Dual Highways (Crowned Surface)

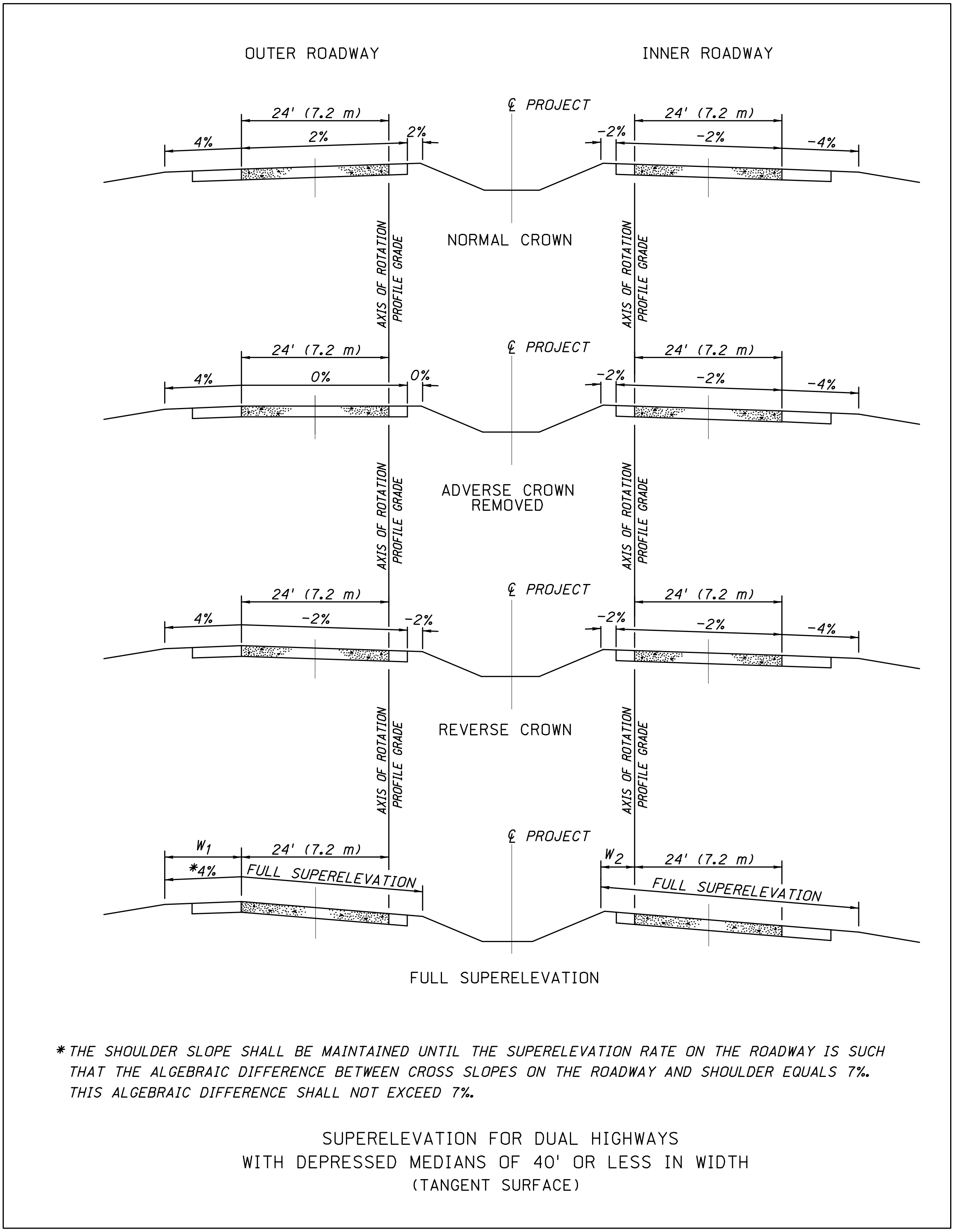


Exhibit 3.5 Superelevation for Dual Highways (Tangent Surface)

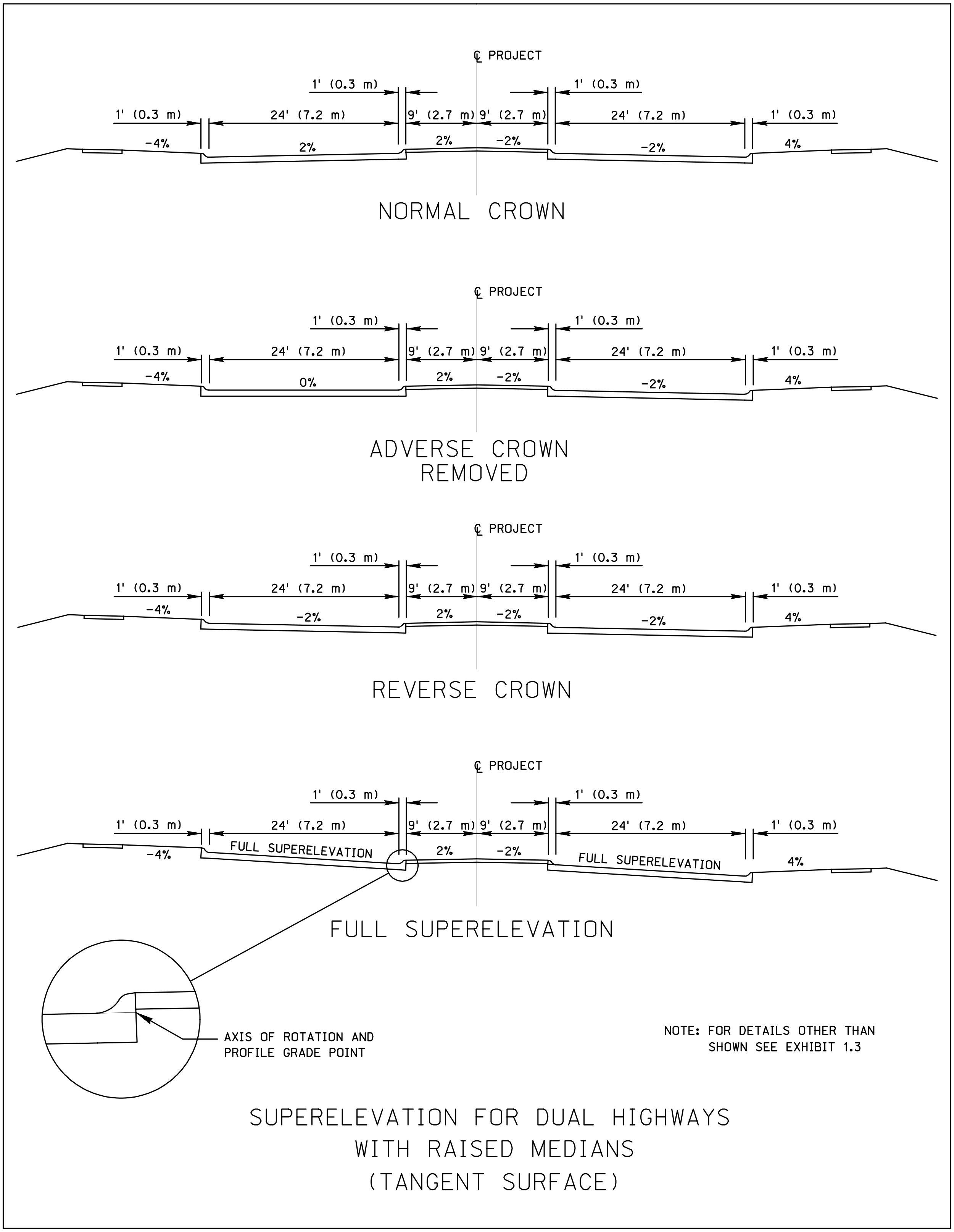


Exhibit 3.6 Superelevation for Dual Highways w/Raised Median

Radius of Curve (ft.)	V=45 mph			V=50 mph			V=55 mph			V=60 mph			V=65 mph			V=70 mph			V=75 mph			V=80 mph		
	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane	e (%)	Relative Gradient 263:1 2 Lane	Relative Gradient 197.2:1 4 Lane	e (%)	Relative Gradient 286:1 2 Lane	Relative Gradient 214.5:1 4 Lane
		L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)	
23000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
20000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
17000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
14000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	63	95	2.0	69	103
12000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	60	90	2.0	60	90	2.0	63	95	2.1	72	108
10000	NC	0	0	NC	0	0	NC	0	0	2.0	60	90	2.0	60	90	2.1	63	95	2.3	73	109	2.5	86	129
8000	NC	0	0	NC	0	0	2.0	60	90	2.0	60	90	2.3	69	104	2.5	75	113	2.8	88	133	3.1	106	159
6000	2.0	60	90	2.0	60	90	2.2	66	99	2.6	78	117	2.9	87	131	3.2	96	144	3.6	114	171	4.0	137	206
5000	2.0	60	90	2.2	66	99	2.6	78	117	3.0	90	135	3.4	102	153	3.7	111	167	4.2	133	199	4.7	161	242
4000	2.3	69	104	2.7	81	122	3.1	93	140	3.6	108	162	4.0	120	180	4.4	132	198	4.9	155	232	5.5	189	283
3500	2.6	78	117	3.0	90	135	3.5	105	158	3.9	117	176	4.4	132	198	4.9	147	221	5.4	171	256	5.9	202	303
3000	2.9	87	131	3.4	102	153	3.9	117	176	4.3	129	194	4.8	144	216	5.3	159	239	5.8	183	275		Rmin = 3060	
2500	3.3	99	149	3.8	114	171	4.3	129	194	4.8	144	216	5.3	159	239	5.8	174	261		Rmin = 2510				
2000	3.8	114	171	4.3	129	194	4.9	147	221	5.4	162	243	5.8	174	261		Rmin = 2050							
1800	4.1	123	185	4.6	138	207	5.1	153	230	5.6	168	252	6.0	180	270									
1600	4.4	132	198	4.9	147	221	5.4	162	243	5.9	177	266		Rmin = 1660										
1400	4.7	141	212	5.2	156	234	5.7	171	257	6.0	180	270												
1200	5.0	150	225	5.6	168	252	5.9	177	266		Rmin = 1340													
1000	5.5	165	248	5.9	177	266		Rmin = 1065																
900	5.7	171	257	6.0	180	270																		
800	5.9	177	266		Rmin = 835																			
700	6.0	180	270																					
		Rmin = 660																						

e_{max} = 6%

KEY:

V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 12 ft. lane
(does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divided roadways with median widths of 40 ft. or greater, use the relative gradient given for the 2 lane roadway. The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Exhibit 3-22.

Exhibit 3.7a (English)
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max}= 6%)

Radius of Curve (m)	V=60 km/h			V=70 km/h			V=80 km/h			V=90 km/h		
	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)
7000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
5000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
3000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
2500	NC	0	0	NC	0	0	NC	0	0	2.0	18	27
2000	NC	0	0	NC	0	0	2.0	18	27	2.1	19	29
1500	NC	0	0	2.0	18	27	2.2	20	30	2.7	25	37
1400	NC	0	0	2.0	18	27	2.4	22	33	2.8	26	38
1300	2.0	18	27	2.1	19	29	2.5	23	34	3.0	27	41
1200	2.0	18	27	2.2	20	30	2.7	25	37	3.2	29	44
1000	2.1	19	29	2.6	24	36	3.1	28	43	3.6	33	49
900	2.3	21	32	2.8	26	38	3.4	31	47	3.9	36	53
800	2.5	23	34	3.1	28	43	3.6	33	49	4.2	38	58
700	2.8	26	38	3.4	31	47	4.0	37	55	4.6	42	63
600	3.1	28	43	3.8	35	52	4.3	39	59	5.0	46	69
500	3.5	32	48	4.2	38	58	4.8	44	66	5.4	49	74
400	4.0	37	55	4.7	43	64	5.3	48	73	5.9	54	81
300	4.6	42	63	5.4	49	74	5.9	54	81	Rmin = 335		
250	5.0	46	69	5.8	53	80	6.0	55	82			
200	5.5	50	75	6.0	55	82	Rmin = 250					
175	5.8	53	80	Rmin = 195								
150	6.0	55	82									
140	6.0	55	82									
	Rmin = 135											

Radius of Curve (m)	V=100 km/h			V=110 km/h			V=120 km/h			V=130 km/h		
	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 263:1 2 Lane L_r(m)	Relative Gradient 197.2:1 4 Lane L_r(m)	e (%)	Relative Gradient 286:1 2 Lane L_r(m)	Relative Gradient 214.5:1 4 Lane L_r(m)
7000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
5000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
3000	2.0	18	27	2.0	18	27	2.3	22	33	2.5	26	39
2500	2.0	18	27	2.3	21	32	2.7	26	38	3.0	31	46
2000	2.5	23	34	2.8	26	38	3.3	31	47	3.7	38	57
1500	3.1	28	43	3.6	33	49	4.2	40	60	4.7	48	73
1400	3.3	30	45	3.8	35	52	4.4	42	63	5.0	51	77
1300	3.5	32	48	4.0	37	55	4.7	45	67	5.3	55	82
1200	3.7	34	51	4.2	38	58	5.0	47	71	5.6	56	85
1000	4.2	38	58	4.8	44	66	5.6	53	80	6.0	62	93
900	4.5	41	62	5.1	47	70	5.8	55	82	Rmin = 950		
800	4.9	45	67	5.4	49	74	6.0	57	85			
700	5.2	48	71	5.8	53	80	Rmin = 755					
600	5.6	51	77	6.1	55	82						
500	5.9	54	81	Rmin = 560								
400	Rmin = 435											

$e_{max} = 6\%$

KEY:
V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 3.7 m lane (does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divided roadways with median widths of 12 m or greater, use the relative gradient given for the 2 lane roadway.
The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Exhibit 3-22.

Exhibit 3.7b (Metric)
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max}= 6%)

Radius of Curve (ft.)	V=45 mph			V=50 mph			V=55 mph			V=60 mph		
	e	Relative Gradient		e	Relative Gradient		e	Relative Gradient		e	Relative Gradient	
	(%)	250:1 2 Lane	187.5:1 4 Lane	(%)	250:1 2 Lane	187.5:1 4 Lane	(%)	250:1 2 Lane	187.5:1 4 Lane	(%)	250:1 2 Lane	187.5:1 4 Lane
		L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)	
23000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
20000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
17000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
14000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
12000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
10000	NC	0	0	NC	0	0	NC	0	0	2.0	60	90
8000	NC	0	0	NC	0	0	2.0	60	90	2.1	63	95
6000	2.0	60	90	2.0	60	90	2.4	72	108	2.7	81	122
5000	2.0	60	90	2.4	72	108	2.8	84	126	3.2	96	144
4000	2.4	72	108	2.9	87	131	3.4	102	153	3.9	117	176
3500	2.7	81	122	3.2	96	144	3.8	114	171	4.4	132	198
3000	3.1	93	140	3.7	111	167	4.3	129	194	5.0	150	225
2500	3.7	111	167	4.3	129	194	5.0	150	225	5.7	171	257
2000	4.4	132	198	5.1	153	230	5.9	177	266	6.6	198	297
1800	4.7	141	212	5.5	165	248	6.3	189	284	7.1	213	320
1600	5.2	156	234	5.9	177	266	6.7	201	302	7.5	225	338
1400	5.6	168	252	6.4	192	288	7.2	216	324	7.8	234	351
1200	6.2	186	279	7.0	210	315	7.7	231	347		Rmin = 1205	
1000	6.8	204	306	7.6	228	342	8.0	240	360			
900	7.2	216	324	7.8	234	351		Rmin = 965				
800	7.6	228	342	8.0	240	360						
700	7.9	237	356		Rmin = 760							
600	8.0	240	360									
		Rmin = 600										

Radius of Curve (ft.)	V=65 mph			V=70 mph			V=75 mph			V=80 mph		
	e	Relative Gradient		e	Relative Gradient		e	Relative Gradient		e	Relative Gradient	
	(%)	250:1 2 Lane	187.5:1 4 Lane	(%)	250:1 2 Lane	187.5:1 4 Lane	(%)	263:1 2 Lane	197.2:1 4 Lane	(%)	286:1 2 Lane	214.5:1 4 Lane
		L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)	
23000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
20000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
17000	NC	0	0	NC	0	0	NC	0	0	2.0	69	103
14000	NC	0	0	2.0	60	90	2.0	63	95	2.0	69	103
12000	2.0	60	90	2.0	60	90	2.0	63	95	2.2	75	113
10000	2.0	60	90	2.1	63	95	2.4	76	114	2.6	89	134
8000	2.4	72	108	2.6	78	117	2.9	92	137	3.3	113	170
6000	3.1	93	140	3.4	102	153	3.8	120	180	4.3	147	221
5000	3.6	108	162	4.1	123	185	4.5	142	213	5.1	175	262
4000	4.4	132	198	4.9	147	221	5.5	174	261	6.2	213	319
3500	4.9	147	221	5.5	165	248	6.2	196	294	7.0	240	360
3000	5.6	168	252	6.3	189	284	7.0	221	332	7.8	267	401
2500	6.4	192	288	7.2	216	324	7.8	246	369		Rmin = 2675	
2000	7.4	222	333	7.9	237	356		Rmin = 2215				
1800	7.7	231	347		Rmin = 1820							
1600	8.0	240	360									
1400		Rmin = 1485										

$e_{max} = 8\%$

(Use of this table requires Assistant Design Engineer approval)

KEY:

V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 12 ft. lane
(does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divided roadways with median widths or 40 ft. or greater, use therelative gradient given for the 2 lane roadway.
The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Exhibit 3-23.

Exhibit 3.8a (English)
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max} = 8%)

Radius of Curve (m)	V=60 km/h			V=70 km/h			V=80 km/h			V=90 km/h			V=100 km/h			V=110 km/h			V=120 km/h			V=130 km/h		
	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 250:1 2 Lane L_r(m)	Relative Gradient 187.5:1 4 Lane L_r(m)	e (%)	Relative Gradient 263:1 2 Lane L_r(m)	Relative Gradient 197.2:1 4 Lane L_r(m)	e (%)	Relative Gradient 286:1 2 Lane L_r(m)	Relative Gradient 214.5:1 4 Lane L_r(m)
7000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
5000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	21	31
3000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	18	27	2.1	19	29	2.4	23	34	2.6	27	40
2500	NC	0	0	NC	0	0	NC	0	0	2.0	18	27	2.1	19	29	2.4	22	33	2.9	27	41	3.1	32	48
2000	NC	0	0	NC	0	0	2.0	18	27	2.2	20	30	2.6	24	36	3.0	27	41	3.5	33	50	3.9	40	60
1500	NC	0	0	2.0	18	27	2.4	22	33	2.8	26	38	3.4	31	47	3.9	36	53	4.6	44	66	5.1	52	79
1400	2.0	18	27	2.1	19	29	2.5	23	34	3.0	27	41	3.6	33	49	4.1	37	56	4.9	46	70	5.4	55	83
1300	2.0	18	27	2.2	20	30	2.7	25	37	3.2	29	44	3.8	35	52	4.4	40	60	5.2	49	74	5.8	60	89
1200	2.0	18	27	2.4	22	33	2.9	27	40	3.4	31	47	4.1	37	56	4.7	43	64	5.6	52	80	6.3	65	97
1000	2.2	20	30	2.8	26	38	3.4	31	47	4.0	37	55	4.8	44	66	5.5	50	75	6.5	62	92	7.4	76	114
900	2.4	22	33	3.1	28	43	3.7	34	51	4.4	40	60	5.2	48	71	6.0	55	82	7.1	67	101	7.9	81	122
800	2.7	25	37	3.4	31	47	4.1	37	56	4.8	44	66	5.7	52	78	6.6	60	90	7.6	72	108		Rmin = 830	
700	3.0	27	41	3.8	35	52	4.5	41	62	5.3	48	73	6.3	58	86	7.2	66	99	8.0	76	114			
600	3.4	31	47	4.3	39	59	5.1	47	70	6.0	55	82	6.9	63	95	7.7	70	106		Rmin = 665				
500	3.9	36	53	4.9	45	67	5.8	53	79	6.7	61	92	7.5	69	103	8.0	73	110						
400	4.7	43	64	5.7	52	78	6.6	60	90	7.5	69	103	8.0	73	110		Rmin = 500							
300	5.6	51	77	6.7	61	92	7.6	69	104		Rmin = 305			Rmin = 395										
250	6.2	57	85	7.4	68	101	7.9	72	108															
200	7.0	64	96	7.9	72	108		Rmin = 230																
175	7.4	68	101	8.0	73	110																		
150	7.8	71	107		Rmin = 175																			
140	7.9	72	108																					
130	8.0	73	110																					
		Rmin = 125																						

e_{max} = 8%

(Use of this table requires Assistant Design Engineer approval.)

KEY:

V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 3.7 m lane
(does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divided roadways with median widths of 12 m or greater, use the relative gradient given for the 2 lane roadway. The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Exhibit 3-23.

Exhibit 3.8b (Metric)
Values for Design Elements Related to Design Speed and Horizontal Curvature
(e_{max} = 8%)

Radius of Curve (ft.)	V=50 mph			V=55 mph			V=60 mph		
	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane	e (%)	Relative Gradient 250:1 2 Lane	Relative Gradient 187.5:1 4 Lane
		L_r (ft.)	L_r (ft.)		L_r (ft.)	L_r (ft.)		L_r (ft.)	L_r (ft.)
12000	NC	0	0	NC	0	0	NC	0	0
10000	NC	0	0	NC	0	0	NC	0	0
8000	NC	0	0	2.0	60	90	2.0	60	90
6000	2.0	60	90	2.0	60	90	2.0	60	90
5000	2.0	60	90	2.3	69	104	2.5	75	113
4000	2.3	69	104	2.6	78	117	2.8	84	126
3500	2.5	75	113	2.7	81	122	3.0	90	135
3000	2.7	81	122	2.9	87	131	3.3	99	149
2500	2.9	87	131	3.2	96	144	3.5	105	158
2000	3.2	96	144	3.5	105	158	3.8	114	171
1800	3.3	99	149	3.7	111	167	3.9	117	176
1600	3.5	105	158	3.8	114	171	4.0	120	180
1400	3.7	111	167	3.9	117	176	Rmin = 1505		
1200	3.9	117	176	4.0	120	180			
1000	4.0	120	180	Rmin = 1190					
	Rmin = 930								

$e_{max} = 4\%$

KEY:

V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 12 ft. lane (does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divided roadways with median widths of 40 ft. or greater, use the relative gradient given for the 2 lane roadway.
The use of a relative gradient other than given in the table requires Roadway Design Project manager approval

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Exhibit 3-21.

Exhibit 3.9a (English)
Values for Design Elements Related to Design Speed and Horizontal Curvature
High Speed Roadways (e_{max} = 4%)

Radius of Curve (m)	V=80 km/h			V=90 km/h			V=100 km/h		
	e (%)	Relative Gradient 250:1 2 Lane L_r (m)	Relative Gradient 187.5:1 4 Lane L_r (m)	e (%)	Relative Gradient 250:1 2 Lane L_r (m)	Relative Gradient 187.5:1 4 Lane L_r (m)	e (%)	Relative Gradient 250:1 2 Lane L_r (m)	Relative Gradient 187.5:1 4 Lane L_r (m)
7000	NC	0	0	NC	0	0	NC	0	0
5000	NC	0	0	NC	0	0	NC	0	0
3000	NC	0	0	NC	0	0	2.0	18	27
2500	NC	0	0	2.0	18	27	2.0	18	27
2000	2.0	18	27	2.0	18	27	2.2	20	30
1500	2.0	18	27	2.3	21	32	2.6	24	36
1400	2.1	19	29	2.4	22	33	2.7	25	37
1300	2.2	20	30	2.5	23	34	2.8	26	38
1200	2.3	21	32	2.6	24	36	2.9	27	40
1000	2.5	23	34	2.7	25	37	3.2	29	44
900	2.7	25	37	3.0	27	41	3.4	31	47
800	2.8	26	38	3.2	29	44	3.5	32	48
700	3.0	27	41	3.4	31	47	3.7	34	51
600	3.2	29	44	3.6	33	49	3.9	36	53
500	3.5	32	48	3.8	35	52	4.0	37	55
400	3.7	34	51	4.0	37	55	Rmin = 490		
300	4.0	37	55	Rmin = 375					
	Rmin = 280								

$e_{max} = 4\%$

KEY:

V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 3.7 m lane (does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divided roadways with median widths of 12 m or greater, use the relative gradient given for the 2 lane roadway.
The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Exhibit 3-21.

Exhibit 3.9b (Metric)
Values for Design Elements Related to Design Speed and Horizontal Curvature
High Speed Roadways (e_{max} = 4%)

Radius of Curve (ft.)	V=25 mph			V=30 mph			V=35 mph			V=40 mph			V=45 mph		
	e (%)	Relative Gradient 185:1 2 Lane	Relative Gradient 138.75:1 4 Lane	e (%)	Relative Gradient 185:1 2 Lane	Relative Gradient 138.75:1 4 Lane	e (%)	Relative Gradient 185:1 2 Lane	Relative Gradient 138.75:1 4 Lane	e (%)	Relative Gradient 185:1 2 Lane	Relative Gradient 138.75:1 4 Lane	e (%)	Relative Gradient 185:1 2 Lane	Relative Gradient 138.75:1 4 Lane
		L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)			L_r (ft.)	
8000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
6000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	NC	0	0
5000	NC	0	0	NC	0	0	NC	0	0	NC	0	0	2.0	44	67
4000	NC	0	0	NC	0	0	NC	0	0	2.0	44	67	2.0	44	67
3500	NC	0	0	NC	0	0	2.0	44	67	2.0	44	67	2.2	49	73
3000	NC	0	0	NC	0	0	2.0	44	67	2.1	47	70	2.4	53	80
2500	NC	0	0	2.0	44	67	2.0	44	67	2.4	53	80	2.6	58	87
2000	2.0	44	67	2.0	44	67	2.3	51	77	2.6	58	87	2.9	64	97
1800	2.0	44	67	2.1	47	70	2.4	53	80	2.7	60	90	3.0	67	100
1600	2.0	44	67	2.2	49	73	2.6	58	87	2.9	64	97	3.2	71	107
1400	2.0	44	67	2.4	53	80	2.7	60	90	3.0	67	100	3.4	75	113
1200	2.2	49	73	2.5	56	83	2.9	64	97	3.2	71	107	3.6	80	120
1000	2.4	53	80	2.7	60	90	3.1	69	103	3.5	78	117	3.8	84	127
900	2.5	56	83	2.9	64	97	3.2	71	107	3.6	80	120	3.9	87	130
800	2.6	58	87	3.0	67	100	3.4	75	113	3.8	84	127	4.0	89	133
700	2.7	60	90	3.2	71	107	3.6	80	120	3.9	87	130		Rmin = 730	
600	2.9	64	97	3.4	75	113	3.8	84	127	4.0	89	133			
500	3.1	69	103	3.6	80	120	3.9	87	130		Rmin = 565				
450	3.2	71	107	3.7	82	123	4.0	89	133						
400	3.4	75	113	3.8	84	127		Rmin = 420							
350	3.6	80	120	3.9	87	130									
300	3.7	82	123	4.0	89	133									
250	3.9	87	130		Rmin = 300										
		Rmin = 205													

$e_{max} = 4\%$

KEY:

V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 12 ft. lane (does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divided roadways with median widths of 40 ft. or greater, use the relative gradient given for the 2 lane roadway.
The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Exhibit 3-21.

Exhibit 3.10a (English)
Values for Design Elements Related to Design Speed and Horizontal Curvature
Desirable Design for Low Speed Roadways (e_{max} = 4%)

Radius of Curve (m)	V=40 km/h e (%)	V=40 km/h Lr(m) 185:1 2 Lane	V=40 km/h Lr(m) 138.75:1 4 Lane	V=50 km/h e (%)	V=50 km/h Lr(m) 185:1 2 Lane	V=50 km/h Lr(m) 138.75:1 4 Lane	V=60 km/h e (%)	V=60 km/h Lr(m) 185:1 2 Lane	V=60 km/h Lr(m) 138.75:1 4 Lane	V=70 km/h e (%)	V=70 km/h Lr(m) 185:1 2 Lane	V=70 km/h Lr(m) 138.75:1 4 Lane
2500	NC	0	0	NC	0	0	NC	0	0	NC	0	0
2000	NC	0	0	NC	0	0	NC	0	0	NC	0	0
1500	NC	0	0	NC	0	0	NC	0	0	2.0	14	20
1400	NC	0	0	NC	0	0	NC	0	0	2.0	14	20
1300	NC	0	0	NC	0	0	NC	0	0	2.0	14	20
1200	NC	0	0	NC	0	0	2.0	14	20	2.0	14	20
1000	NC	0	0	NC	0	0	2.0	14	20	2.2	15	22
900	NC	0	0	2.0	14	20	2.0	14	20	2.4	16	24
800	NC	0	0	2.0	14	20	2.1	14	21	2.5	17	25
700	NC	0	0	2.0	14	20	2.3	16	23	2.7	18	27
600	2.0	14	20	2.1	14	21	2.5	17	25	2.9	20	29
500	2.0	14	20	2.3	16	23	2.7	18	27	3.1	21	31
400	2.1	14	21	2.5	17	25	3.0	20	30	3.4	23	35
300	2.4	16	24	2.8	19	28	3.3	22	34	3.8	26	39
250	2.6	18	26	3.0	20	30	3.6	24	37	3.9	26	40
200	2.8	19	28	3.3	22	34	3.8	26	39	Rmin = 215		
175	2.9	20	29	3.5	24	36	3.9	26	40			
150	3.1	21	31	3.7	25	38	4.0	27	41			
140	3.2	22	33	3.8	26	39	Rmin = 150					
130	3.3	22	34	3.8	26	39						
120	3.4	23	35	3.9	26	40						
110	3.5	24	36	4.0	27	41						
100	3.6	24	37	4.0	27	41						
90	3.7	25	38	Rmin = 100								
80	3.8	26	39									
70	3.9	26	40									
60	4.0	27	41									
	Rmin = 60											

$e_{max} = 4\%$

KEY:
V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 3.7 m lane (does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divide roadways with median widths of 12 m or greater, use the relative gradient given for the 2 lane roadway. The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Adapted from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Exhibit 3-21.

Exhibit 3.10b (Metric)
Values for Design Elements Related to Design Speed and Horizontal Curvature
Desirable Design for Low Speed Roadways (e_{max} = 4%)

Radius of Curve (ft.)	V=30 mph			V=35 mph			V=40 mph			V=45 mph		
	e (%)	Relative Gradient 185:1 2 Lane L_r (ft.)	Relative Gradient 138.75:1 4 Lane L_r (ft.)	e (%)	Relative Gradient 185:1 2 Lane L_r (ft.)	Relative Gradient 138.75:1 4 Lane L_r (ft.)	e (%)	Relative Gradient 185:1 2 Lane L_r (ft.)	Relative Gradient 138.75:1 4 Lane L_r (ft.)	e (%)	Relative Gradient 185:1 2 Lane L_r (ft.)	Relative Gradient 138.75:1 4 Lane L_r (ft.)
740	NC	0	0	NC	0	0	NC	0	0	2.0	44	67
730	NC	0	0	NC	0	0	NC	0	0	2.2	49	73
720	NC	0	0	NC	0	0	NC	0	0	2.4	53	80
710	NC	0	0	NC	0	0	NC	0	0	2.7	60	90
700	NC	0	0	NC	0	0	NC	0	0	3.0	67	100
690	NC	0	0	NC	0	0	NC	0	0	3.3	73	110
680	NC	0	0	NC	0	0	NC	0	0	3.6	80	120
670	NC	0	0	NC	0	0	NC	0	0	3.8	84	127
540	NC	0	0	NC	0	0	2.0	44	67		Rmin = 665	
530	NC	0	0	NC	0	0	2.3	51	77			
520	NC	0	0	NC	0	0	2.7	60	90			
510	NC	0	0	NC	0	0	3.1	69	103			
500	NC	0	0	NC	0	0	3.5	78	117			
490	NC	0	0	NC	0	0	4.0	89	133			
375	NC	0	0	2.0	44	67		Rmin = 489				
370	NC	0	0	2.4	53	80						
365	NC	0	0	2.7	60	90						
360	NC	0	0	3.0	67	100						
355	NC	0	0	3.3	73	110						
350	NC	0	0	3.6	80	120						
345	NC	0	0	4.0	89	133						
250	2.0	44	67		Rmin = 345							
245	2.4	53	80									
240	2.9	64	97									
235	3.4	75	113									
230	4.0	89	133									
		Rmin = 230										

KEY:
V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 12' lane (does not include tangent runout, see Section 3.B.1).
NC = Normal crown section

Notes: For 4 lane divided roadways with median widths of 40 ft. or greater, use the relative gradient given for the 2 lane roadway. The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Derived from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Equation 3-33:

$$e/100 + f_{max} = V^2/15R$$

$$e_{max} = 4\%$$

(Use of this table requires Design Project Manager approval.)

Exhibit 3.11a (English)
Values for Design Elements Related to Design Speed and Horizontal Curvature
Minimum Design for Low Speed Urban Roadways (e_{max} = 4%)
(Radius and e Derived Using f_{max})

Radius of Curve (m)	V=50 km/h			V=60 km/h			V=70 km/h		
	e (%)	Relative Gradient 185:1 2 Lane L_r(m)	Relative Gradient 138.75:1 4 Lane L_r(m)	e (%)	Relative Gradient 185:1 2 Lane L_r(m)	Relative Gradient 138.75:1 4 Lane L_r(m)	e (%)	Relative Gradient 185:1 2 Lane L_r(m)	Relative Gradient 138.75:1 4 Lane L_r(m)
211	NC	0	0	NC	0	0	2.0	14	20
208	NC	0	0	NC	0	0	2.2	15	22
205	NC	0	0	NC	0	0	2.5	17	25
202	NC	0	0	NC	0	0	2.8	19	28
199	NC	0	0	NC	0	0	3.1	21	31
196	NC	0	0	NC	0	0	3.4	23	35
193	NC	0	0	NC	0	0	3.7	25	38
190	NC	0	0	NC	0	0	4.0	27	41
138	NC	0	0	2.0	14	20	Rmin = 190		
136.5	NC	0	0	2.2	15	22			
135	NC	0	0	2.4	16	24			
133.5	NC	0	0	2.6	18	26			
132	NC	0	0	2.9	20	29			
130.5	NC	0	0	3.1	21	31			
129	NC	0	0	3.4	23	35			
127.5	NC	0	0	3.6	24	37			
126	NC	0	0	3.9	26	40			
84	2.0	14	20	Rmin = 125					
82.5	2.5	17	25						
81	2.9	20	29						
79.5	3.4	23	35						
78	3.8	26	39						
	Rmin = 77.5								

KEY:
V = Assumed design speed
e = Rate of superelevation
Lr = Minimum length of superelevation runoff based on a 3.7 m lane (does not include tangent runout, see Section 3.B.1)
NC = Normal crown section

Notes: For 4 lane divide roadways with median widths of 12 m or greater, use the relative gradient given for the 2 lane roadway. The use of a relative gradient other than given in the table requires Roadway Design Project Manager approval.

Source: Derived from "A Policy on Geometric Design of Highways and Streets", (Reference 3.1c), Equation 3-33:

$$e/100 + f_{max} = V^2/127R$$

$$e_{max} = 4\%$$

(Use of this table requires Design Project Manager approval.)

Exhibit 3.11b (Metric)
Values for Design Elements Related to Design Speed and Horizontal Curvature
Minimum Design for Low Speed Urban Roadways (e_{max} = 4%)
(Radius and e Derived Using f_{max})

3.C Horizontal Clearances

The two primary considerations associated with horizontal clearances in alignment design are horizontal sight distance and the clear zone concept (See Chapter Four: Intersections, Driveways and Channelization, Section 1.C.2, Chapter Six: The Typical Roadway Cross-Section, Section 2, and the Roadside Design Guide, Reference 3.5, Chapter 3). Horizontal sight distance is the provision of an area on the inside of a curve, free of sight obstructions, providing the driver with sufficient line of sight for stopping sight distance. The clear zone designates the unobstructed, relatively flat area provided beyond the edge of the travel way for the recovery of errant vehicles.

Adjustments to the horizontal alignment or the normal roadway cross-section may be required where an object, which cannot be removed, is located off of the pavement area and restricts sight distance across the inside of a horizontal curve. Potential sight obstructions include cut slopes, bridge piers, buildings, walls, longitudinal barriers (guardrail, median barriers, bridge rails), cultivated and natural vegetation, wooded areas or other topographic features. Generally, utility poles, traffic signs and other single point elements are not considered sight obstructions on the inside of horizontal curves but should be evaluated on a case-by-case basis.

Because of the many variables associated with alignment, cross-sections, and the number and type of potential obstructions the designer should examine and evaluate each individual horizontal curve to determine the adequacy of the horizontal sight distance.

For general use in the design of a horizontal curve, the sight line is a chord of the curve and the applicable sight distance is measured along the centerline of the inside lane around the curve. A Policy on Geometric Design of Highways and Streets (Reference 3.1c), Exhibit 3-58, illustrates the geometric relationships among the different variables.

3.D Pavement Widening on Curves

For some conditions of speed, curvature, width and traffic composition (percentage of truck traffic), pavement widening may be warranted if a vehicle or truck occupies a greater width due to the rear wheels tracking inside of the front wheels in rounding curves.

Current **NDOR** policy for widening recommends a 14 ft. (4.2 m) surfacing width (2 ft. (600 mm) pavement widening) for the inside lane of horizontal curves if **all** of the following conditions occur:

1. The curve radius is less than 1910 ft. (582 m).
2. The operating speed is 45 mph (70 km/h) or greater.
3. The roadway does not have surfaced shoulders.
4. Projected average daily truck traffic is more than 50 per day.

The width of the outside lane is not adjusted.

The following guidelines are provided for the attainment of pavement widening on a horizontal curve:

1. The full 14 ft. (4.2 m) pavement width begins at reverse crown before the PC and continues to reverse crown after the PT.

2. Taper rates from the 12 ft. (3.6 m) to the 14 ft. (4.2 m) pavement width vary from 1:10 to 1:20. Flatter tapers are not encouraged since truck drivers may use this to drive closer to the surfacing edge.
3. Pavement marking will be a continuation of the 12 ft. (3.6 m) lane conditions.

3.E Station Equations

Station equations can be utilized to avoid revising the stationing throughout the length of a project when changes are made from the original surveyed line in the field. The station equation equates two station numbers, one that is correct when measuring on the line back of the equation and one that is correct when measuring on the line ahead of the equation. Most equations result from office relocation of the surveyed line.

3.F 3R Horizontal Alignment Design

The following elements of horizontal alignment design are subject to improvement within the scope of a 3R project:

1. Radius of Curve/Superelevation. It is often impractical and unnecessary to correct curves on 3R projects. However, where accident data indicate a problem or where the design speed of the existing curve is more than 10 mph (15 km/h) below the design speed of the 3R project (assuming improved superelevation cannot reduce this difference), consideration should be given to reconstructing the curve. If the decision is made to reconstruct the curve, the criteria presented for new construction/reconstruction should be used if practical.
2. Broken Back Curves. Where practical, broken back curves should be combined into a single, horizontal curve, especially where an evaluation of the accident history indicates a problem.
3. Horizontal Sight Distance. Horizontal sight distance criteria presented in this chapter applies to horizontal curves within the limits of a 3R project with the exception that for 3R projects, 1.5 ft. (450 mm) is used for height of object instead of 0.5 ft. (150 mm). Combined with a height of eye of 3.5 ft. (1070 mm), the line-of-sight intercept with the obstruction will then be 2.5 ft. (760 mm) above the center of the inside travel lane. A longitudinal barrier may constitute a horizontal sight obstruction.
4. Pavement Widening on Curves. The policy presented in Section 3.D for pavement widening on curves also applies for 3R projects. Pavement widening may often be the only alignment improvement justified on a particular 3R project.

Chapter One: Design Standards, Section 2.B, discusses design criteria for 3R projects established by the **Board of Public Roads Classifications and Standards**. If these criteria cannot be met, the criteria presented in the 2001 edition of **AASHTO's** A Policy on Geometric Design of Highways and Streets (Reference 3.1c), may be used as a minimum standard for 3R projects.

4. VERTICAL ALIGNMENT DESIGN

The vertical alignment, (profile grade line), is a reference line that establishes the elevation of the pavement and other features of the highway. Vertical alignment is controlled by safety, topography, horizontal alignment, functional classification of the roadway, geology, drainage control, construction costs and appearance considerations. The performance of heavy vehicles on grades is also significant. A practical vertical alignment design will be economically sound, keeping earthwork quantities to a minimum while meeting sight distance and other design requirements. All of these factors must be balanced to produce an alignment that is safe, economical, in harmony with the natural contour of the land and at the same time adequate for the design classification of the highway.

There should be a smooth transition between the proposed profile grade line and the existing grade line of an adjacent highway section. Existing grade lines should be considered for a distance of 2000 ft. (600 m) or more, if practical, to ensure adequate sight distance beyond the proposed project limits. Connections with previously constructed projects should be compatible with the design speed of the proposed project. A connecting profile grade line should be established which satisfactorily joins to the existing alignment and that can also be utilized when the adjoining roadway section is reconstructed.

4.A <u>Grades</u>

The slope or grade of each tangent is expressed in percent rise (+) or fall (-) to the fourth decimal place.

4.A.1 Maximum Grades

The **Board of Public Roads Classifications and Standards** establishes maximum grades based on functional classification, type of improvement, design year traffic volumes, type of terrain and design speed. Grades steeper than those shown in the <u>Nebraska Minimum Design Standards</u> (Reference 3.3) can only be used with an approved design relaxation from the **Board of Public Roads Classifications and Standards** (See Chapter One: <u>Design Standards</u>, Section 6.B). Flatter than maximum grades should be utilized whenever possible.

4.A.2 Minimum Grades

1. <u>Rural Curbed Roadways and Bridges</u>. A minimum grade of 0.50% is desirable. Flatter grades may cause stormwater to spread across the travel way.
2. <u>Urban Curbed Roadways</u>. For urban roadways, the desirable minimum grade is 0.35% but a minimum grade of 0.20% may be utilized. Grades flatter than 0.35% should only be used when absolutely necessary due to the difficulty in maintaining positive drainage runoff. As an alternative to a 0.20% grade, warping the curb line and rolling the centerline grade line at a minimum slope of 0.35% may be considered.
3. <u>Non-curbed Roadways</u>. A minimum grade of 0.35% may be used where the pavement is crowned and supported on firm subgrade. Level longitudinal gradients are acceptable under the same conditions provided consideration is given to the need for special ditches.
4. <u>Superelevation Runout.</u> A minimum allowable profile grade of 0.5% is allowed in the flat area in the transition from normal crown to full superelevation, or in the area where the adverse crown has been removed. The desirable profile grade in this area is 1.5%.

4.A.3 Critical Length of Grade

Critical length of grade is the maximum length of a designated upgrade on which a loaded truck can operate without an unreasonable reduction in speed. A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Exhibit 3-63, gives the critical lengths of grade, related to the percent of upgrade and the speed reduction in miles per hour (km/h), for a typical heavy truck of 200 lb/hp (120 kg/kw)) with an entering speed of 70 mph (110 km/h). For normal design purposes, a speed reduction of 10 mph (15 km/h) is acceptable. See Section 4.F and Reference 3.1c, Chapter 3, for further information.

4.B Vertical Curves

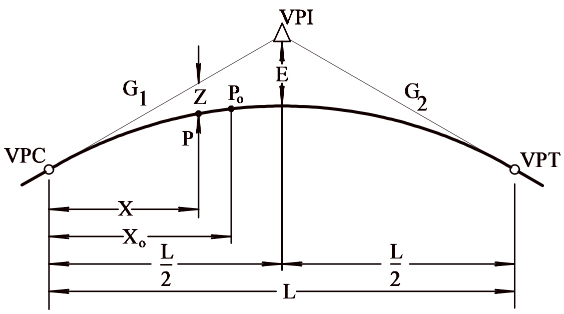
Vertical curves join two intersecting tangents to provide a smooth transition between changes in grade. Vertical curves should be simple in application and should result in a design that is safe, comfortable, pleasing in appearance and adequate for drainage.

The elevation of each vertical PI is identified to the 0.01 ft. (1 mm). A curve length, L, identifies each vertical curve, which is usually defined to the nearest 100 ft. (20 m), (it is desirable to design vertical curves so that the vertical PC and vertical PT fall on even stationing). The relationship of the curve length (L) and the algebraic difference in percent of grades (A) or L/A, is termed the K value, the horizontal distance in feet (meters) required to effect a 1% change in grade. It is a measure of curvature.

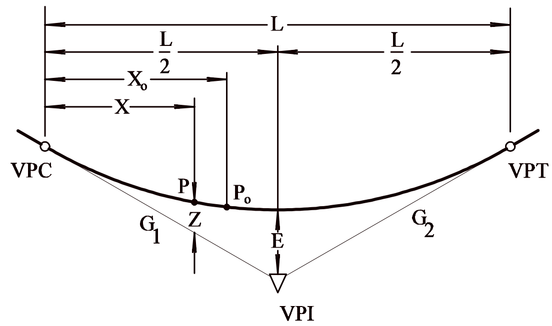
4.B.1 Vertical Curve Computations

The symmetrical parabolic curve is most commonly used in vertical curve design. Symmetrical curves are those with equal tangents at the point where the curve is divided equally by the vertical point of intersection (VPI) of the two tangents.

Dimensions and equations for use in symmetrical vertical curve computations are shown in **EXHIBIT 3.12**. The symbols, abbreviations and formulas apply to both crest and sag vertical curves.



CREST VERTICAL CURVE



SAG VERTICAL CURVE

Terminology:

L = horizontal length of curve, 100' stations (meter)
G_1, G_2 = rates of grade, expressed algebraically, percent
E = external, ft. (meters)
P = any point on the curve
Z = tangent offset to point P, ft. (meters)
X = horizontal distance from the PC or PT to P, stations
S = slope of a line tangent to the curve at P, percent
P_0 = high or low point of the curve
X_0 = horizontal distance from the PC to P_0 in 100' stations (meters)

FORMULAS: (In any vertical curve)

ENGLISH	METRIC
Elev. of VPI = Elev. of VPC + G_1 (L/2)	Elev. of VPI = Elev. of VPC + G_1 (L/2)
Elev. of VPT = Elev. of VPC + (G_1+G_2) (L/2)	Elev. of VPT = Elev. of VPC + (G_1+G_2) (L/2)
$E = L\ (G_2-G_1) / 8$	$E = L\ (G_2-G_1) / 800$
E = ((VPC Elev. + VPT Elev.) / 2 - VPI Elev.) / 2	E = ((VPC Elev. + VPT Elev.) / 2 - VPI Elev.) /2
$Z = 4EX^2 / L^2$	$Z = 4EX^2 / L^2$
$Z = X^2 (G_2-G_1) / 2L$	$Z = X^2 (G_2-G_1) / 200L$
$S = G_1 - (X (G_1-G_2) / L)$	$S = G_1 - (X (G_1-G_2) / L)$
$X_0 = LG_1 / (G_1-G_2)$	$X_0 = LG_1 / (G_1-G_2)$
Elev. of P_0 = Elev. of VPC - $LG_1^2 / 2\ (G_2 - G_1)$	Elev. of P_0 = Elev. of VPC - $LG_1^2 / 2\ (G_2 - G_1)$
Elev of P = Elev. of VPC + $G_1 X$ + $(X^2 (G_2 - G_1)) / 2L$	Elev. of P = Elev. of VPC + $G_1 X$ + $(X^2 (G_2 - G_1)) / 2L$

Exhibit 3.12 Elements and Formulas for Vertical Curves

4.B.2 Evaluation

For New and Reconstructed projects and for 3R projects the K values from A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Exhibits 3-76 and 3-79 shall be used for the evaluation of existing alignments to be left in place and as a basis for a design exception or a relaxation of the Minimum Design Standards.

4.B.3 Design

The primary design control for minimum lengths of vertical curves is stopping sight distance. Minimum lengths of vertical curves as determined by stopping sight distance requirements are generally satisfactory from the standpoint of safety, comfort and appearance.

K values for roadways on new alignment, with minimum and desirable stopping sight distance for crest and sag vertical curves, are shown in **EXHIBITS 3.13 & 3.19** for a range of design speeds and intersection configurations. **NDOR** policy is to provide a vertical curve length of at least 600 ft. (200 m), where practical, for rural and non-curbed highways, even when the desirable stopping sight distance is considerably less. The desirable K values should be used for all new and reconstructed projects. Minimum K values may be used, with **Roadway Design Project Manager** approval, to minimize the length of the vertical curve. The use of K values below those given in A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Exhibits 3-76 and 3-79 for a new and reconstructed project will require either a design exception or a relaxation of the Minimum Design Standards (See Chapter One: Design Standards, Section 6.B).

The given desirable K values in **EXHIBITS 3.13 & 3.19** provide intersection stopping sight distance for passenger cars for various intersection conditions. If the desirable K values cannot be met, the designer should provide the longest vertical curve possible given the various R.O.W. and design constraints. For intersection conditions other than listed, all intersections and driveways, except for field entrances, shall be evaluated for intersection sight distance. See Chapter Four: Intersections, Driveways and Channelization, Section 1.C.2, and Chapter 9 of A Policy on Geometric Design of Highways and Streets, (Reference 3.1c) for further information.

The minimum K values given for stopping sight distance do not meet intersection sight distance requirements. When the minimum K values are used all intersections and driveways, except for field entrances, shall be evaluated for intersection sight distance according to the procedures presented in Chapter 9 of A Policy on Geometric Design of Highways and Streets, (Reference 3.1c). The use of an intersection sight distance less than that given in Reference 3.1c will require **Assistant Design Engineer** approval and either a design exception or a relaxation of the Minimum Design Standards (See Chapter One: Design Standards, Section 6.B).

Special attention to drainage must be exercised where a K value in excess of 143, U.S. Customary (43, Metric) is used. Flat spots may create potential drainage problems necessitating special ditch grades, median inlets or other considerations. A minimum longitudinal grade of 0.2% at a point 50 ft. (15 m) on either side of the curve apex is desirable. This corresponds to a K value of 250, U.S. Customary (75, Metric).

U.S. Customary								
Crest Vertical Curve								
Design Speed (mph)	Minimum Stopping Sight Distance ①		Desirable Stopping Sight Distance (2-Lane, Left-Turn Condition and 2-Lane w/TWTL**, Left-Turn Condition) ②		Desirable Stopping Sight Distance (5-Lane and 4-Lane Divided w/16' Median, Left-Turn Condition) ③		Desirable Stopping Sight Distance (4-Lane Divided w/40' Median, Left-Turn Condition) (Crowned Lanes @) ④	
	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*
35	250	29	453	93	494	121	540	125
40	305	44	517	121	564	158	617	163
45	360	61	582	153	635	200	695	207
50	425	84	647	189	706	247	772	255
55	495	114	711	228	776	299	849	308
60	570	151	776	272	847	356	926	367
65	645	193	841	319	917	417	1003	430
70	730	247	906	370	988	484	1080	499

* K is the length of curve per percent algebraic difference in grades (A). K=L/A.

** TWTL = Two -Way Left-Turn Lane, See Chapter Four: Intersections, Driveways and Channelization, Section 5.C.

@ Check Intersection Sight Distance if Building Tangent Lanes.

① Based on a 3.5' eye height and an object height of 2.0', (See A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 3). These values do not meet intersection sight distance requirements. All intersections and driveways, except for field entrances, shall be evaluated for intersection sight distance according to the proceedures outlined in Chapter 9 of Reference 3.1c. Minimum K values may be used on New and Reconstructed projects with Design Project Manager approval

② Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on an 8.8 second gap in traffic , a 2.33' eye height and an object height of 3.25'. See Exhibit 3.14a for the derivation of the eye and object heights. The use of K values for less than the desirable stopping sight distance requires Design Project Manager approval.

③ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on a 9.6 second gap in traffic , a 2.08' eye height and an object height of 3.0'. See Exhibit 3.14b for the derivation of the eye and object heights. The use of K values for less than the desirable stopping sight distance requires Design Project Manager approval.

④ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on a 10.5 second gap in traffic , a 2.50' eye height and an object height of 3.38'. See Exhibit 3.14c for the derivation of the eye and object heights. The use of K values for less than the desirable stopping sight distance requires Design Project Manager approval.

Note: The NDOR time gap is arrived at by adding an initial time gap of 7.5 sec. (left turn from A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9) plus 0.8 sec. (0.2 sec x 4 for a driveway/intersection approach at a 4% grade) plus 0.5 sec. for each additional 12 ft. lane (or for each 12 ft width of median).

Exhibit 3.13a Design Controls for Crest Vertical Curves (English Units)

Metric								
Crest Vertical Curve								
Design Speed (km/h)	Minimum Stopping Sight Distance ①		Desirable Stopping Sight Distance (2-Lane, Left-Turn Condition and 2-Lane w/TWTL**, Left-Turn Condition) ②		Desirable Stopping Sight Distance (5-Lane and 4-Lane Divided w/4.9 m Median, Left-Turn Condition) ③		Desirable Stopping Sight Distance (4-Lane Divided w/12.2 m Median, Left-Turn Condition) (Crowned Lanes @) ④	
	Length (m)	Rate of Vertical Curvature K*	Length (m)	Rate of Vertical Curvature K*	Length (m)	Rate of Vertical Curvature K*	Length (m)	Rate of Vertical Curvature K*
60	85	11	147	31	160	41	175	43
70	105	17	171	43	187	56	204	58
80	130	26	196	56	214	74	233	75
90	160	39	220	70	240	93	263	96
100	185	52	245	87	267	115	292	118
110	220	74	269	105	294	140	321	143

* K is the length of curve per percent algebraic difference in grades (A). K=L/A.

** TWTL = Two -Way Left-Turn Lane, See Chapter Four: Intersections, Driveways and Channelization, Section 5.C.

@ Check Intersection Sight Distance if Building Tangent Lanes.

① Based on a 1080 mm eye height and an object height of 600 mm, (See A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 3). These values do not meet intersection sight distance requirements. All intersections and driveways, except for field entrances, shall be evaluated for intersection sight distance according to the proceedures outlined in Chapter 9 of Reference 3.1c. Minimum K values may be used on New and Reconstructed projects with Design Project Manager approval.

② Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on an 8.8 second gap in traffic , a 730 mm eye height and an object height of 1000 mm. See Exhibit 3.14a for the derivation of the eye and object heights. The use of K values for less than desirable stopping sight distance requires Design Project Manager approval.

③ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on a 9.6 second gap in traffic , a 640 mm eye height and an object height of 920 mm. See Exhibit 3.14b for the derivation of the eye and object heights. The use of K values for less than desirable stopping sight distance requires Design Project Manager approval.

④ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on a 10.5 second gap in traffic , a 770 mm eye height and an object height of 1040 mm. See Exhibit 3.14c for the derivation of the eye and object heights. The use of K values for less than desirable stopping sight distance requires Design Project Manager approval.

Note: The NDOR time gap is arrived at by adding an initial time gap of 7.5 sec. (left turn from A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9) plus 0.8 sec. (0.2 sec x 4 for a driveway/intersection approach at a 4% grade) plus 0.5 sec. for each additional 3.6 m lane (or for each 3.6 m width of median).

Exhibit 3.13b Design Controls for Crest Vertical Curves (Metric Units)

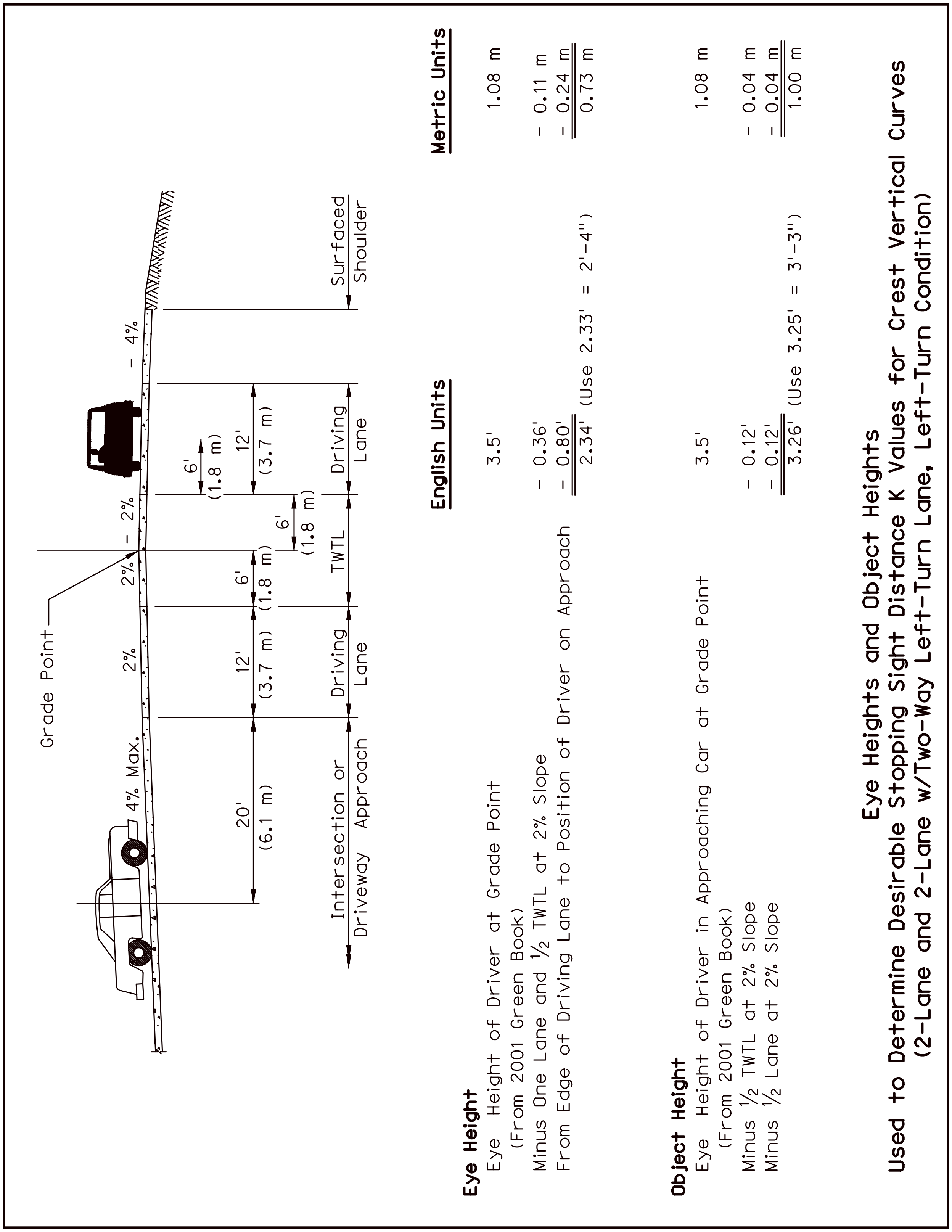
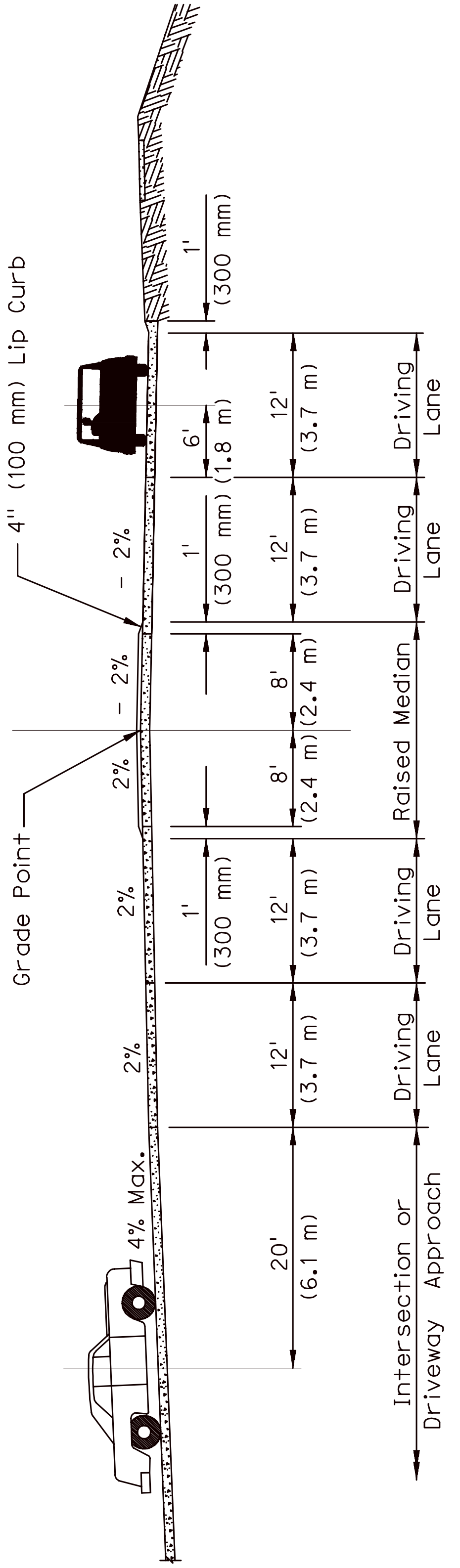


Exhibit 3.14a Eye and Object Heights used to Determine K Values (Crest Vertical Curves)



	English Units	Metric Units
Eye Height		
Eye Height of Driver at Grade Point (From 2001 Green Book)	3.5'	1.08 m
Minus Two Lanes and ½ Median at 2% Slope	- 0.66'	- 0.20 m
From Edge of Driving Lane to Position of Driver on Approach	- 0.80'	- 0.24 m
	2.04' (Use 2.08' = 2'-1")	0.64 m
Object Height		
Eye Height of Driver in Approaching Car at Grade Point (From 2001 Green Book)	3.5'	1.08 m
Minus ½ Median at 2% Slope	- 0.18'	- 0.05 m
Minus 1½ Lanes at 2% Slope	- 0.36'	- 0.11 m
	2.96' (Use 3.0')	0.92 m

Eye Heights and Object Heights
Used to Determine Desirable Stopping Sight Distance K Values for Crest Vertical Curves
(5-Lane and 4-Lane Divided w/16' (4.9 m) Median, Left-Turn Condition)

Exhibit 3.14b Eye and Object Heights used to Determine K Values (Crest Vertical Curves)

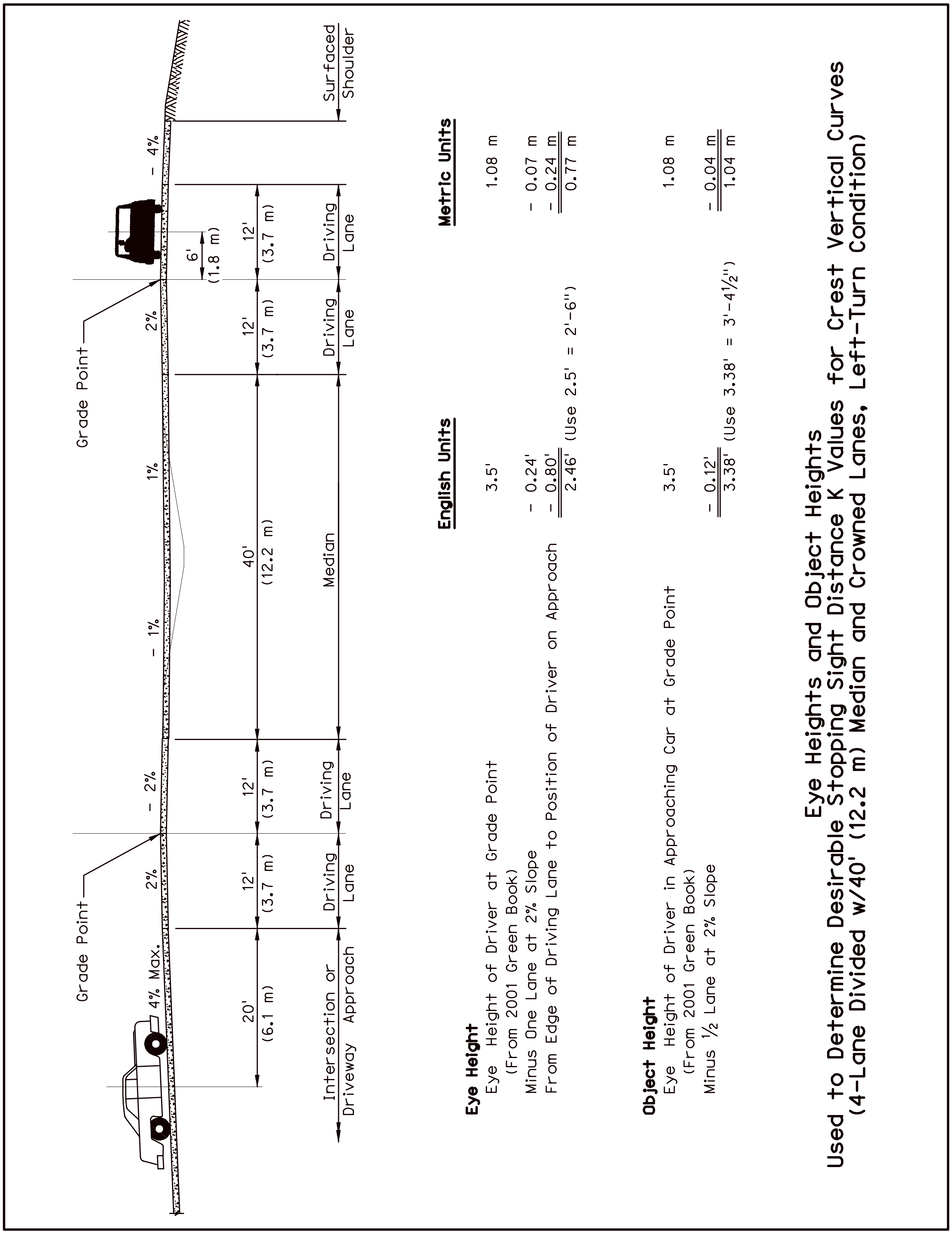


Exhibit 3.14c Eye and Object Heights used to Determine K Values (Crest Vertical Curves)

4.C Crest Vertical Curves

4.C.1 Stopping Sight Distance

EXHIBIT 3.15 depicts the stopping sight distance height of eye and height of object assumptions for crest vertical curves. The equations below may be used to determine the length of crest vertical curves to provide **desirable** stopping sight distance at each design speed, (desirable stopping sight distance includes intersection sight distance). The equations are:

In English — or in Metric — Eq. 3.1

S_d = 1.47 x speed (mph) x time (sec) — S_d = 0.278 x speed (km/h) x time (sec)

Where:
S_d = stopping sight distance = intersection sight distance in ft. (meter).
Time = acceptable time gap in traffic (in seconds) based on intersection conditions (See Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 3). **NDOR** uses a time gap of 8.8 sec. for the two-lane, left-turn condition.

When designing a new crest vertical curve refer to **EXHIBIT 3.13** in choosing an appropriate K value. Multiply K by A (algebraic difference in grade) to obtain the desirable length of vertical curve, L.

Equations 3.2 and 3.3 are used when analyzing an existing crest vertical curve for adequacy. Equation 3.2 is used when the existing vertical curve length L is longer than the stopping sight distance. If the existing vertical length L is less than the stopping sight distance then Equation 3.3 is used to determine the required L.

for $S < L$,

in English, — or in Metric

$$L = \frac{AS^2}{2158} \qquad L = \frac{AS^2}{658} \qquad \text{Eq. 3.2}$$

for $S > L$,

in English, — or in Metric

$$L = 2S - \frac{2158}{A} \qquad L = 2S - \frac{658}{A} \qquad \text{Eq. 3.3}$$

and $L = KA$ — Eq. 3.4

Where:
S = stopping sight distance, ft. (meter);
L = length of vertical curve, ft. (meter);
A = algebraic difference in grades, %; and
K = rate of vertical curvature.

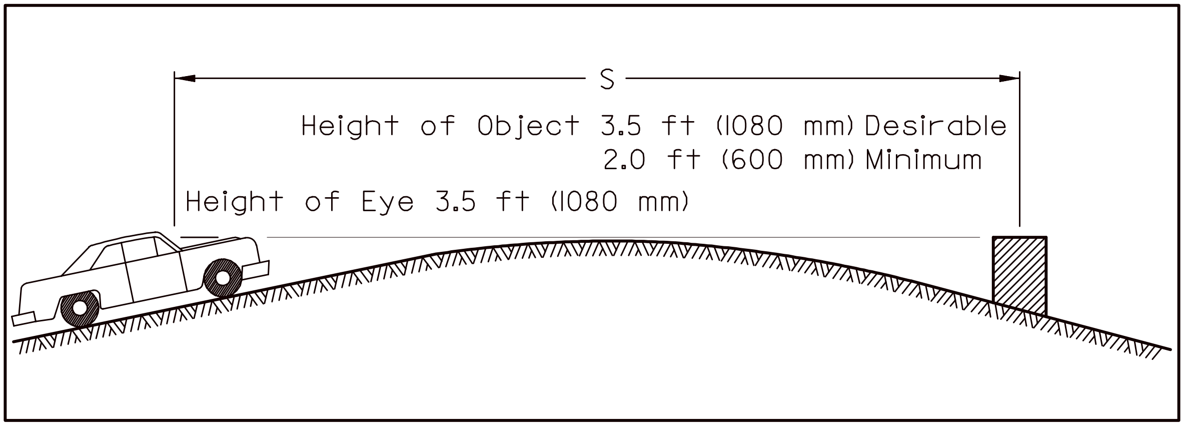


Exhibit 3.15 Crest Vertical Curve Design Elements

4.C.2 Two-Lane, Two-Way Roadways - Passing Sight Distance

When computing minimum passing sight distances, certain assumptions regarding traffic behavior are made:

1. The overtaken vehicle is traveling at a uniform speed.
2. The passing vehicle has reduced speed and trails the overtaken vehicle as it enters a passing section.
3. When the passing section is reached, the driver requires a short period of time to perceive the clear passing section and to react to start the passing maneuver.
4. Passing is accomplished with a delayed start and hurried return in the face of opposing traffic. The passing vehicle accelerates with an average speed 10 mph (15 km/h) higher than that of the overtaken vehicle.
5. When the passing vehicle returns to its lane, there is sufficient clearance between it and an oncoming vehicle in the other lane.

The minimum passing sight distance is the sum of four distances:

d_1 = The distance traveled during perception/reaction time and the initial acceleration to the point of encroachment in the left lane.
d_2 = The distance traveled while the passing vehicle is in the left lane.
d_3 = The distance between the passing vehicle at the end of its maneuver and the opposing vehicle.
d_4 = the distance traveled by an opposing vehicle for 2/3 the time the passing vehicle occupies the left lane, i.e., 2/3 d_2.

The geometrics concerning passing sight distances for crest vertical curves on two-lane highways are similar to those for stopping sight distance. The differences are (a) the height of object is considered as 3.5 ft. (1080 mm) and (b) the minimum passing distances are 7 to 10 times greater than the stopping sight distances for the same design speeds. The equations for minimum length of vertical curve are as follows:

for P < L,

in English

$$L = \frac{AP^2}{2800}$$

or in Metric,

$$L = \frac{AP^2}{864} \qquad \text{Eq. 3.5}$$

for P > L,

in English

$$L = 2P - \frac{2800}{A}$$

or in Metric,

$$L = 2P - \frac{864}{A} \qquad \text{Eq. 3.6}$$

Where:

P = passing sight distance, ft. (meters);
L = length of vertical curve, ft. (meter);
A = algebraic difference in grades, %.

EXHIBIT 3.16 depicts the design considerations related to passing sight distance.

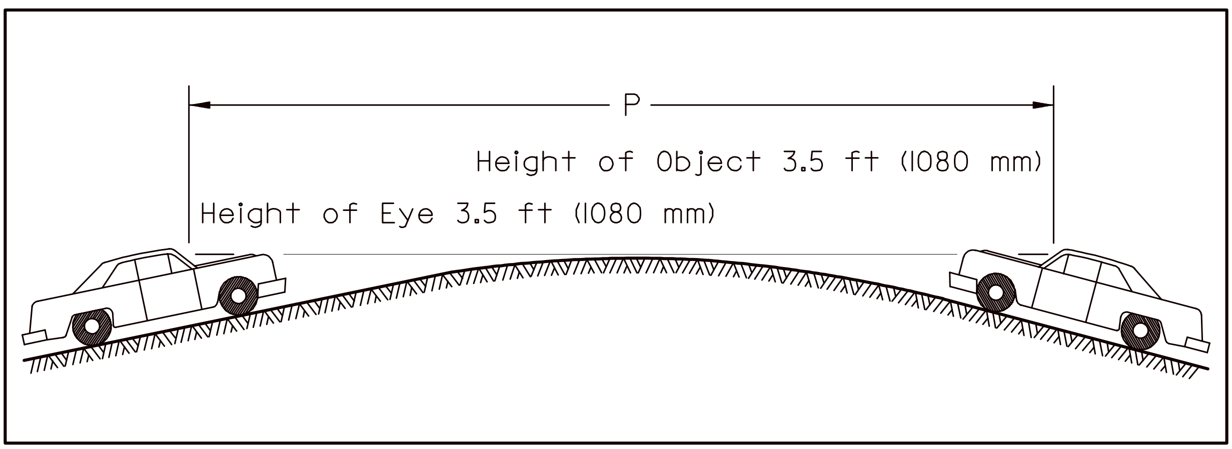


Exhibit 3.16 Passing Sight Distance Design Considerations

EXHIBIT 3.17 shows minimum passing sight distances and related K values for various design speeds. In two-lane highway design, these distances should be exceeded as much as practical.

Design Speed, mph	35	40	45	50	55	60	65	70
Minimum Passing Sight Distance, ft	1280	1470	1625	1835	1985	2135	2285	2480
K Values with Minimum Passing Sight Distance	585	772	943	1203	1407	1628	1865	2197

Exhibit 3.17a Passing Sight Distance for Crest Vertical Curves (English)

Design Speed, km/h	60	70	80	90	100	110	120
Minimum Passing Sight Distance, m	410	485	540	615	670	730	775
K Values with Minimum Passing Sight Distance	195	272	338	438	520	617	695

Exhibit 3.17b Passing Sight Distance for Crest Vertical Curves (Metric)

It is not always practical to design crest vertical curves to provide passing sight distance. Some conditions (e.g., terrain, cost) make it impractical to provide even minimum passing distance at every vertical curve. In some instances it will be necessary to stripe two-lane roadways for "no passing." When this happens, the no passing zone should be as short as practical to assure that passing can be permitted on a greater portion of the total project length.

The “roller-coaster” or “hidden-dip” type of profile should be avoided, (See EXHIBIT 3.18). Such profiles generally occur on relatively straight horizontal alignments where the roadway profile closely follows a rolling natural ground line. These profiles are unpleasant aesthetically and can be hazardous, increasing the possibility of passing maneuver accidents due to an oncoming vehicle being hidden beyond the rise. This type of profile can be avoided by use of horizontal curves or more gradual grades.

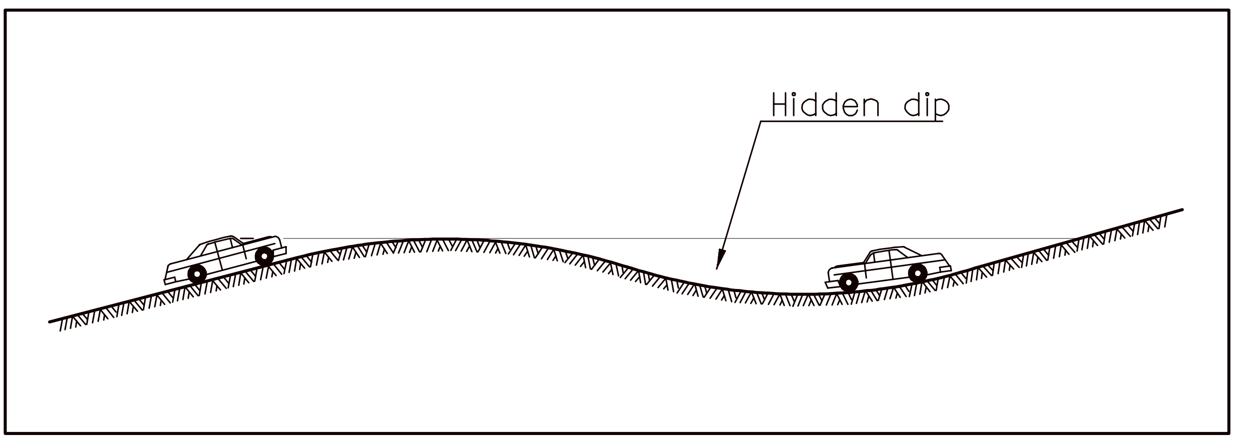


Exhibit 3.18 Roller Coaster Profile

U.S. Customary								
Sag Vertical Curve								
Design Speed (mph)	Minimum Stopping Sight Distance ①		Desirable Stopping Sight Distance (2-Lane, Left-Turn Condition and 2-Lane w/TWTL**, Left-Turn Condition) ②		Desirable Stopping Sight Distance (5-Lane and 4-Lane Divided w/16' Median, Left-Turn Condition) ③		Desirable Stopping Sight Distance (4-Lane Divided w/40' Median, Left-Turn Condition) ④	
	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*	Length (ft)	Rate of Vertical Curvature K*
35	250	49	453	103	494	115	540	127
40	305	64	517	121	564	134	617	149
45	360	79	582	139	635	154	695	170
50	425	96	647	157	706	174	772	192
55	495	115	711	175	776	193	849	214
60	570	136	776	193	847	213	926	236
65	645	157	841	212	917	233	1003	257
70	730	181	906	230	988	253	1080	279

* K is the length of curve per percent algebraic difference in grades (A). K=L/A.

** TWTL = Two -Way Left-Turn Lane, See Chapter Four: Intersections, Driveways and Channelization, Section 5.C.

① Based on a 3.5' eye height, a 2.0' headlight height and a 1^0 upward divergence of the light beam, (See A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 3). These values do not meet intersection sight distance requirements. All intersections and driveways, except for field entrances, shall be evaluated for intersection sight distance according to the proceedures outlined in Chapter 9 of Reference 3.1c. Minimum K values may be used on New and Reconstructed projects with Design Project Manager approval.

② Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on an 8.8 second gap in traffic, a 3.5' eye height, a headlight height of 2.0' and a 1^0 upward divergence of the light beam, (See Reference 3.1c, Chapter 3). The light beam distance has been set to the Intersection sight distance. The use of K values for less than desirable stopping sight distance requires Design Project Manager approval.

③ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on a 9.6 second gap in traffic, a 3.5' eye height, a headlight height of 2.0' and a 1^0 upward divergence of the light beam, (See Reference 3.1c, Chapter 3). The light beam distance has been set to the Intersection sight distance. The use of K values for less than desirable stopping sight distance requires Design Project Manager approval.

④ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on a 10.5 second gap in traffic, a 3.5' eye height, a headlight height of 2.0' and a 1^0 upward divergence of the light beam, (See Reference 3.1c, Chapter 3). The light beam distance has been set to the Intersection sight distance. The use of K values for less than desirable stopping sight distance requires Design Project Manager approval.

Note: The NDOR time gap is arrived at by adding an initial time gap of 7.5 sec. (left turn from A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9) plus 0.8 sec. (0.2 sec. x 4 for a driveway/intersection approach at a 4% grade) plus 0.5 sec. for each additional 12 ft. lane (or for each 12 ft. width of median).

Exhibit 3.19a Design Controls for Sag Vertical Curves (English Units)

Metric								
Sag Vertical Curve								
Design Speed (km/h)	Minimum Stopping Sight Distance ①		Desirable Stopping Sight Distance (2-Lane, Left-Turn Condition and 2-Lane w/TWTL**, Left-Turn Condition) ②		Desirable Stopping Sight Distance (5-Lane and 4-Lane Divided w/4.9 m Median, Left-Turn Condition) ③		Desirable Stopping Sight Distance (4-Lane Divided w/12.2 m Median, Left-Turn Condition) ④	
	Length (m)	Rate of Vertical Curvature K*	Length (m)	Rate of Vertical Curvature K*	Length (m)	Rate of Vertical Curvature K*	Length (m)	Rate of Vertical Curvature K*
60	85	18	147	34	160	38	175	42
70	105	23	171	41	187	45	204	50
80	130	30	196	48	214	53	233	58
90	160	38	220	54	240	60	263	66
100	185	45	245	61	267	68	292	75
110	220	55	269	68	294	75	321	83

* K is the length of curve per percent algebraic difference in grades (A). K=L/A.

** TWTL = Two -Way Left-Turn Lane, See Chapter Four: Intersections, Driveways and Channelization, Section 5.C.

① Based on a 1080 mm eye height, a 600 mm headlight height and a 1^0 upward divergence of the light beam, (See A Policy on Geometric Design of Highways and Streets, Reference 3.1c,Chapter 3). These values do not meet intersection sight distance requirements. All intersections and driveways, except for field entrances, shall be evaluated for intersection sight distance according to the proceedures outlined in Chapter 9 of Reference 3.1c. Minimum K values may be used on New and Reconstructed projects with Design Project Manager approval.

② Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on an 8.8 second gap in traffic, a 1080 mm eye height, a headlight height of 600 mm and a 1^0 upward divergence of the light beam, (See Reference 3.1c, Chapter 3). The light beam distance has been set to the Intersection sight distance. The use of K values for less than desirable stopping sight distance requires Proj. Mgr. approval.

③ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on a 9.6 second gap in traffic, a 1080 mm eye height, a headlight height of 600 mm and a 1^0 upward divergence of the light beam, (See Reference 3.1c, Chapter 3). The light beam distance has been set to the Intersection sight distance. The use of K values for less than desirable stopping sight distance requires Proj. Mgr. approval.

④ Includes Intersection Sight Distance for the given Conditions, (for other intersection conditions see Chapter Four: Intersections, Driveways and Channelization and A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9). Based on a 10.5 second gap in traffic, a 1080 mm eye height, a headlight height of 600 mm and a 1^0 upward divergence of the light beam, (See Reference 3.1c, Chapter 3). The light beam distance has been set to the Intersection sight distance. The use of K values for less than desirable stopping sight distance requires Proj. Mgr. approval.

Note: The NDOR time gap is arrived at by adding an initial time gap of 7.5 sec. (left turn from A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 9) plus 0.8 sec. (0.2 sec x 4 for a driveway/intersection approach at a 4% grade) plus 0.5 sec. for each additional 3.6 m lane (or for each 3.6 m width of median).

Exhibit 3.19b Design Controls for Sag Vertical Curves (Metric Units)

4.D Sag Vertical Curves

4.D.1 Stopping Sight Distance

The minimum length of a sag vertical curve depends mainly on headlight distance at night except in urban areas where roadway lighting is present (See EXHIBIT 3.20). For overall safety on highways it is desirable that the headlight beam distance be nearly the same as the stopping sight distance. EXHIBIT 3.19 gives the desirable and the minimum stopping sight distances for various design speeds. The use of minimum stopping sight distance lengths may be justified on a new and reconstructed project, with **Roadway Design Project Manager** approval, for economic reasons such as in a case where an existing element, such as a structure not qualified for replacement, controls the vertical profile. A design exception or a relaxation of the Nebraska Minimum Design Standards, (Reference 3.3) will be necessary if the sag vertical curve stopping sight distance used for a new and reconstructed project is shorter than that given in A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Exhibit 3-79 (See Chapter One: Design Standards, Section 6.B).

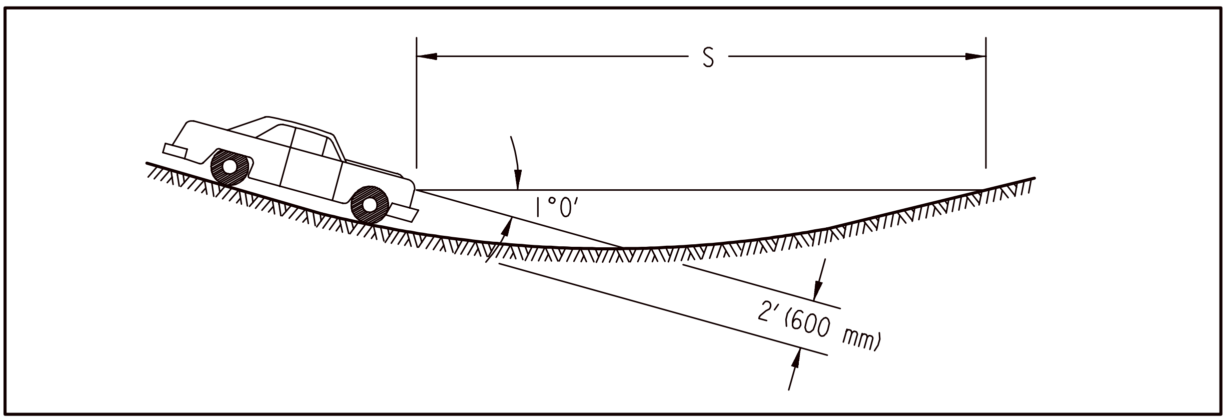


Exhibit 3.20 Sag Vertical Curve Design Elements

The equations below may be used to determine the length of sag vertical curves to provide **desirable** stopping sight distance at each design speed, (desirable stopping sight distance includes intersection sight distance). The equations are:

In English,	or in Metric	Eq .3.1
S = 1.47 x speed (mph) x time (sec)	S = 0.278 x speed (km/h) x time (sec)	

Where:

S = headlight beam distance = stopping sight distance in ft. (meter)

Time = acceptable time gap in traffic (in seconds) based on intersection conditions (See A Policy on Geometric Design of Highways and Streets, Reference 3.1c, Chapter 3). **NDOR** uses a time gap of 8.8 sec. for the two-lane, left-turn condition.

The equations for **minimum** stopping sight distance for sag vertical curves are:

for S < L,

in English, or in Metric,

$$L = \frac{AS^2}{400 + 3.5S} \qquad L = \frac{AS^2}{120 + 3.5S} \qquad \text{Eq. 3.7}$$

for S > L,

in English, or in Metric,

$$L = 2S - \frac{400 + 3.5S}{A} \qquad L = 2S - \frac{120 + 3.5S}{A} \qquad \text{Eq. 3.8}$$

Where:
S = headlight beam distance = stopping sight distance, ft. (meter);
L = length of vertical curve, ft. (meter);
A = algebraic difference in grades, %.

4.D.2 Comfort Criteria

Changing vertical direction on sag vertical curves affects comfort more than on crest vertical curves because gravitational and centrifugal forces are combining rather than opposing. Comfort levels are affected by vehicle body suspension, tire flexibility, weight carried and other factors. Based on the assumption that riding on a sag vertical curve is comfortable when centrifugal acceleration does not exceed 1 ft/sec^2 (0.3 m/s^2), the minimum length of sag vertical curve for comfort criteria is:

in English, or in Metric,

$$L = \frac{AV^2}{46.5} \qquad L = \frac{AV^2}{395} \qquad \text{Eq. 3.9}$$

Where: V = design speed, mph (km/h); and the rest as defined previously.

The length of sag vertical curve required to meet the comfort criteria is only about 50% of that required to satisfy the stopping sight distance requirement (headlight distance). Therefore, comfort criteria may only be a design control on roadways with adequate street lighting and where providing headlight distance is attainable only with significant modifications and/or expenditures.

4.D.3 Underpass Sight Distance

Design of sag vertical curves through underpasses should assure that the underpass structure does not obstruct driver visibility. The following equations apply:

for $S < L$,

in English

$$L = 2S - \frac{800\,(C-5.0)}{A}$$

or in Metric,

$$L = 2S - \frac{800\,(C-1.5)}{A} \qquad \text{Eq. 3.10}$$

for $S > L$,

In English,

$$L = \frac{AS^2}{800\,(C-5.0)}$$

or in Metric,

$$L = \frac{AS^2}{800\,(C-1.5)} \qquad \text{Eq. 3.11}$$

Where:

C = vertical clearance of underpass (excluding allowance for future resurfacing), ft;
S = headlight beam distance = stopping sight distance, ft. (meter);
L = length of vertical curve, ft. (meter);
A = algebraic difference in grades, %.

Underpasses become a design control when the minimum length of sag vertical curve required for unobstructed sight distance at undercrossings exceeds the minimum length of curve required for stopping sight distance (headlight sight distance). The longer of the two lengths will control design.

4.E Low-Speed Municipal Streets

Vertical curves are not required on municipal streets where the algebraic difference in grades is less than 0.2%. Curves must be long enough to ensure desirable stopping sight distance but should not be flattened beyond this distance to such an extent as to make drainage a problem. A series of angular breaks in lieu of a vertical curve is not an acceptable design. Angular breaks are often modified to short vertical curves during construction.

4.F Climbing Lanes

The addition of a climbing lane as an auxiliary lane on the upgrade side of a vertical curve may be desirable where the grade, traffic volume and percent heavy trucks combine to degrade the traffic operations from those on the approach to the grade. The designer should keep climbing lane warrants in mind during design. The **Traffic Engineering Division** analyzes the need for climbing lanes based on capacity and operations characteristics.

The type of roadway facility is usually taken into consideration in the climbing lane analysis. Climbing lanes may be provided on primary two-lane highways based on speed reduction only. For secondary class highways, speed differential and capacity analysis may be used. Climbing lanes should be used to provide uniformity of operation rather than to avoid extreme congestion and disruption. Climbing lanes are applicable on multilane highways where extreme grade conditions reduce the level of service below that provided in adjacent roadway sections. Climbing lanes on multilane facilities may not be warranted until several years after construction even though they are deemed necessary for peak hours of the design year traffic. For this condition, there may be an economic advantage in designing for, but deferring construction of, climbing lanes on multilane facilities. **EXHIBIT 3.21** summarizes **NDOR** standards for design of climbing lanes. See A Policy on Geometric Design of Highways and Streets (Reference 3.1c), Chapter 3, for additional information.

Design Element	**Desirable**	**Minimum**
Lane Width	Same as approach roadway.	Same as approach roadway.
Shoulder Width	Same as approach roadway. For turf shoulders, same as minimum requirement.	Expressway: Same as approach roadway. Other: 4 ft. (1.2 m) paved and 2 ft. (0.6 m) turf.
Cross Slope on Tangent	Same as adjacent travel lane.	Same as adjacent travel lane.
Superelevation	(1)	(1)
Beginning of Full-Width Lane	Near the VPT of the grade.	Where the truck speed is 10 mph (16 km/h) below highway design speed or is at 45 mph (70 km/h), whichever is less. (2)
End of Full-Width Lane (3)	Where the truck has reached highway design speed.	Where the truck has reached 10 mph (16 km/h) below highway design speed. (2)
Entering Taper	1:25	150 ft. (45 m)
Exiting Taper	1:50	200 ft. (60 m)
Minimum Full-Width Length	N/A	1000 ft. (300 m)

1. For horizontal curves on climbing lanes, determine the proper superelevation of the climbing lane on the high side by reading the applicable superelevation table for V = 40 mph (65 km/h) or the design speed, whichever is less (See Section 3.B). This reflects the slower operating speeds of the climbing lane. The maximum allowable difference in cross slope between the travel lane and the climbing lane is 4%.
2. See A Policy on Geometric Design of Highways and Streets, (Reference 3.1c), Chapter 3, to determine truck deceleration and acceleration rates.
3. The designer shall provide sufficient decision sight distance and length of auxiliary lane past the crest of a vertical curve to allow for the safe completion of the merger maneuver. The designer should coordinate the design of the auxiliary lane with the **Traffic Engineering Division**.
4. If there is a mailbox located within the climbing lane, the surfaced mailbox turnout width shall be 10 ft. (3.0 m), of which 8 ft. (2.4 m) will be surfaced, see the Standard/Special Plans Book, (Reference 3.4).

Exhibit 3.21 Standards for Climbing Lanes

4.G Vertical Clearances

4.G.1 Vertical Curve with Obstructions

Required minimum vertical clearance over or under an existing or future obstruction of known elevation often dictates that the vertical profile must pass through a particular point to satisfy minimum clearance criteria. If the point on the profile is located on a vertical curve, the curve length will be dependent upon the required elevation of the given point.

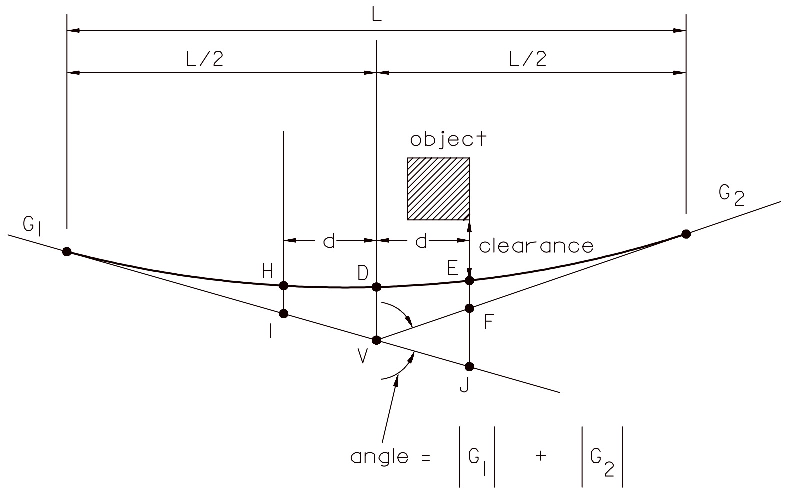
EXHIBIT 3.22 provides a procedure for calculating the length of vertical curve required to pass the curve through a given point. The procedure applies to points located above or below the vertical curve. The calculated length of vertical curve should also be checked against the design criteria presented in Section 4.D.1 to ensure that adequate sight distance is provided on the vertical curve.

4.G.2 Minimum Vertical Clearances for Overhead Facilities

1. Utilities: Vertical clearances for overhead utility facilities shall comply with all applicable state and national electrical codes. Utilities over the roadway shall never be less than 18 ft. (5.5 m) above the roadway, including the shoulders. For additional discussion see Chapter Thirteen: Planning and Project Development, Section 6.
2. Signs or Signal Structures: Vertical clearances for overhead signs or signal structure structures shall comply with the Manual on Uniform Traffic Control Devices for Streets and Highways, (Reference 3.6) (http://mutcd.fhwa.dot.gov/kno-millennium.htm). The minimum allowable overhead clearance shall be 17.5 ft. (5.30 m) above the roadway. This vertical clearance also applies to the roadway shoulders.
3. Bridges: For information on allowable vertical clearances for bridge structures, see Chapter Ten: Miscellaneous Design Issues, Section 2.
4. Airfields: For information on allowable airspace at airfields see Chapter Ten: Miscellaneous Design Issues, Section 3.

4.H Earthwork Balances

Projects should be designed to produce balanced earthwork unless particular features (e.g., geological constraints, floodplains, drainage structures, etc.) dictate otherwise. To attain balanced earthwork, grade adjustments are generally preferable to ditch widening. For further discussion, see Chapter Seven: Earthwork, Section 1.



Step 1: Calculate the curve elevation of point E directly below the object.

$$Elevation_E = Elevation_{Object} - Clearance$$

Step 2: Calculate distance EJ. (G_1 is negative as shown above. d is in stations.)

$$EJ = Elevation_E - Elevation_V - (d)(G_1)$$

Step 3: Calculate the distance EF.

$$EF = Elevation_E - Elevation_V - (d)(G_2)$$

Step 4: Solve simultaneously for L. Both d and L are in stations.

$$EJ/(L/2 + d)^2 = EF/(L/2 – d)^2$$

Exhibit 3.22 Procedure for Vertical Curves with Obstruction

4.I <u>3R Vertical Alignment Design</u>

The following elements of vertical alignment design are subject to improvement within the scope of a 3R project:

1. <u>Grades</u>. Improvements to existing grades should be considered if specific problems exist such as high rates of rear-end collisions, head-on accidents due to improper passing maneuvers, or evidence of pushed/rolled pavement distress at the bottom of steep downgrades.
2. <u>Crest Vertical Curves</u>. Generally, improvements to crest vertical curves on 3R projects are limited unless there is a high rate of accidents attributed to the curve, or the crest hides from view major obstacles such as intersections, narrow bridges or sharp horizontal curvature in combination with excessive speed reductions and high ADT. If the decision is made to flatten a vertical curve, the criteria presented in Section 4.C should preferably be used.

3. Sag Vertical Curves. The minimum acceptable length of sag vertical curve on a 3R project is determined by the comfort criteria presented in Section 4.D.2. If the existing curve does not satisfy this criterion, then consideration should be given to flattening the sag vertical curve. The flattened curve should be designed using the criteria presented in Section 4.D.
4. Climbing Lanes. The addition of climbing lanes should be considered on 3R projects where existing alignment geometrics are deficient and other alignment improvements are determined to be impractical. The climbing lane should be designed using the criteria presented in Section 4.F.

Chapter One: Design Standards, Section 2.B, discusses design criteria for 3R projects established by the **Board of Public Roads Classifications and Standards**. If these criteria cannot be met, the criteria presented in the 2001 edition of **AASHTO's** A Policy on Geometric Design of Highways and Streets (Reference 3.1c), may be used as a minimum standard for 3R projects.

5. ALIGNMENT DESIGN VALUES

A summary of basic alignment design values is presented below. Chapter Eleven: Final Plan Preparation discusses the format and content of the sheets that make up a typical set of roadway design plans. The designer must ensure that the plans are consistent with established practices.

Common horizontal alignment design values and the degree of accuracy to be shown on the plans include:

- Stationing - to the nearest 0.01 ft. (1 mm).
- Radius of curvature - to the nearest foot (0.1 meter).
- Superelevation runoff lengths - rounded to the next appropriate 5 ft. (1.5 m).
- All other curve data - to the nearest 0.01 ft. (1 mm), or to the nearest 0.01 second, whichever is applicable.

Computations for the design of horizontal alignment assume a horizontal plane.

Common vertical profile design values and the degree of accuracy to be shown on the plans include:

- Grades - expressed in percent rise (+) or fall (-) to the fourth decimal place.
- Profile elevations - to the nearest 0.01 ft. (1 mm).
- Vertical curve lengths - usually defined to even 100 ft. (25 m).

6. REFERENCES

3.1a American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, DC, 1990. (English units)

3.1b American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, DC, 1994. (Metric units)

3.1c American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, DC, 2001.

3.2 Nebraska Department of Roads, Drainage Design and Erosion Control Manual, Current Edition

3.3 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

3.4 Nebraska Department of Roads, Standard/Special Plan Book, Current Edition.

3.5 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, DC, 2002.

3.6 United States Department of Transportation Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, Washington, D.C., 2000. (http://mutcd.fhwa.dot.gov/kno-millennium.htm)

CHAPTER FOUR
INTERSECTIONS, DRIVEWAYS AND CHANNELIZATION

LIST OF EXHIBITS

CHAPTER FOUR
INTERSECTIONS, DRIVEWAYS AND CHANNELIZATION

Chapter Four
Intersections, Driveways and Channelization

1. INTERSECTIONS

Intersections are locations where two or more roadways or entrances cross and/or meet each other at the same elevation. Through and turning traffic movements from each approach must be guided within designated areas at controlled speeds. Areas for potential conflict between movements must be limited and separated. The design of the intersection will affect the operation, capacity and safety of the approach roadways. The intersection facility must serve both single vehicles and groups or "platoons" of vehicles.

Intersection design should consider driver expectancy, vehicle operating characteristics and the intersection environment. The intersection design elements should be standardized as much as possible to avoid presenting unexpected or confusing situations to roadway users.

Roadways are designed to accommodate a specific classification of vehicle. The designated classification of a route must be carried through each of the intersections along that route. The maximum length vehicle to be carried by the route, together with all lesser lengths and types of vehicles using an intersection, provide the parameters that the design criteria must meet.

The environment of an intersection includes the surrounding land use, traffic flows, pedestrian and bicycle usage, traffic control, provisions for parking, public transit or taxi service, signing, utilities, guardrail, lighting and road surface conditions. The intent of intersection design should be the safe and efficient movement of vehicles through intersections via the proper use and placement of design elements.

AASHTO's A Policy on Geometric Design of Highways and Streets (Reference 4.1), **FHWA's** Manual on Uniform Traffic Control Devices (MUTCD) (Reference 4.2) (http://mutcd.fhwa.dot.gov/kno-millennium.htm) and the **National Cooperative Highway Research Program** (NCHRP) Report 279 Intersection Channelization Design Guide (Reference 4.3) and NCHRP Report 420, Impacts of Access Management Techniques (Reference 4.4) should be consulted for detailed discussion of intersection design.

1.A Types Of Intersections

Intersections are usually either three-leg or four-leg design (See A Policy on Geometric Design of Highways and Streets, Reference 4.1c, Exhibits 9-3 to 9-12). Three-leg intersections are the basic "T" intersections, with several possible variations depending on the angle of approach. Both three-leg and four-leg intersections may vary in size, shape and channelization.

Multi-leg intersections, (those having five or more legs), should be avoided wherever possible. Measures to improve safety and efficiency of multi-leg intersections include:

- Realignment of one or more of the intersecting legs.
- Combining some of the traffic movements at adjacent intersections.
- Making some legs one-way with the traffic direction away from the intersection.

Many factors enter into the selection of intersection type but the principal controls are design hour traffic volume, composition of traffic, design speed, type of traffic control and design vehicle (See Chapter One: Design Standards, Section 8). Turning and through movement traffic volumes and the traffic control devices to be used are of particular importance.

There are four types of traffic control:

1. No control, where motorists must be able to see and evaluate the intersection and traffic situation in sufficient time to stop.
2. Yield control, where vehicles on the minor approach yield to vehicles on the major route.
3. Stop control, where vehicles on either the minor or all approaches must stop prior to entering the intersection.
4. Signal control, where all approach legs of the intersection are controlled by a traffic signal.

The **Traffic Engineering Division** conducts an engineering study to evaluate the operation of an intersection and to determine the appropriate traffic control to be provided. It is essential to coordinate geometrics and traffic control design with the **Traffic Engineering Division**. See A Policy on Geometric Design of Highways and Streets, (Reference 4.1c, Chapter 9), and the Manual on Uniform Traffic Control Devices for Streets and Highways, (Reference 4.2, Part IV), for further discussion.

1.A.1 Unchannelized Intersections

The most common type of intersection consists of the crossing of two roadways at the same elevation, connected by radius returns to accommodate the wheel paths of turning vehicles. With the exception of lane lines and some infrequent corner islands there are no channelizing devices. Typical characteristics of unchannelized intersections are low turning movements and low overall traffic volumes.

1.A.2 Channelized Intersections

Channelization is the separation of conflicting traffic movements into definite paths of travel by pavement markings or curbs. A primary purpose of channelization is to provide reference points to enable a driver to predict the path of intersecting vehicles. Channelization also serves to store and protect turning and crossing vehicles. Median and island channelization also provides a location for the erection of traffic control devices. See Section 3 for further discussion of channelization.

1.A.3 Roundabouts

Roundabouts are circular intersections in which the traffic flows around a central island. All entry and exit to/from a roundabout is a low speed right turn, yielding to the traffic already in the roundabout, which substantially reduces the number, type and severity of traffic accidents in the intersection. Sidewalks should be set back from the radius of the roundabout and provide pedestrians an unobstructed view of oncoming vehicles. For additional information see Chapter Ten, Miscellaneous Design Issues, Section 4.B, Chapter 9 of A Policy on Geometric Design of Highways and Streets, (Reference 4.1c) and Roundabouts: An Informational Guide, FHWA-RD-00-67, (http://www.tfhrc.gov/safety/00068.htm).

1.B. Intersection Locations

1.B.1 Rural Intersections

Topography plays a major role in the design of a rural intersection. The terrain may be rolling or the roadway may be winding, with the imposition of no-passing zones for considerable distances. The placement of an intersection within a length of roadway with impaired sight distance should be avoided. When an intersection in a hilly or curved region is unavoidable, the **Traffic Engineering Division** should be consulted regarding the advisability of adding auxiliary lanes to separate the through movements from the turning traffic.

A rural intersection often consists of the crossing of a low volume roadway with a regional arterial or higher type roadway. The low volume roadway may carry agricultural equipment or other slow-moving, heavily laden vehicles across or onto the main roadway. If the accident records indicate that a disproportionate percentage of accidents at this intersection involve slow-moving vehicles, the vertical and/or horizontal alignment should be investigated for the possibility of increasing the sight distance, (See Chapter Three: Roadway Alignment, Section 1).

1.B.2 Urban Intersections

There is limited opportunity for new intersection locations in urban areas due to existing development and roadways. The design of most urban at-grade intersections must be coordinated with and tied to the geometrics of the existing roadway system. Grades, widths, and return radii should match those already present when no other options are available.

Urban intersection operation may be affected by:

- Significant directional traffic flow during peak periods.
- Intersection spacing.
- Adjacent intersection operation.
- Mid-block traffic generators.
- Pedestrian and/or bicycle traffic.
- On-street parking, etc.

Sight distance at urban intersections may be impeded by vehicle stop-line setback for pedestrian crosswalks, trees, fencing, signage or other development. The design of urban intersection improvements should include field surveys to ascertain whether the desired intersection sight distances can be achieved, (See Section 1.C.2).

1.B.3 Frontage Roads

The use of frontage roads allows capacity on the main road to remain at a higher level of service by combining driveway and/or minor road access into one intersection with the main roadway. In areas experiencing a transition from rural to urban character or from agricultural to commercial use, designers should anticipate possible future congestion and consider frontage roads.

Frontage roads can be designed to accommodate parking, transit services and bicycle traffic for a developed corridor. The flowchart in **EXHIBIT 4.1** explains the roadway widths of frontage and access roads and the width of hard surfacing. Thickness, as described in the pavement recommendation, will be shown on the plans. **EXHIBIT 4.2** shows a typical frontage road connection off of a major roadway.

If the frontage road intersection is taken off of a crossroad rather than the major roadway the edge of the pavement of the frontage road should be a minimum distance of 220 ft. (67 m) from the edge of the through driving lane of the major roadway, to provide sufficient distance for the development of left-turn lanes and for signage, (See **EXHIBIT 4.3**). The **Traffic Engineering Division** should be consulted to determine if traffic signals are warranted at the frontage road intersection based on the traffic volumes.

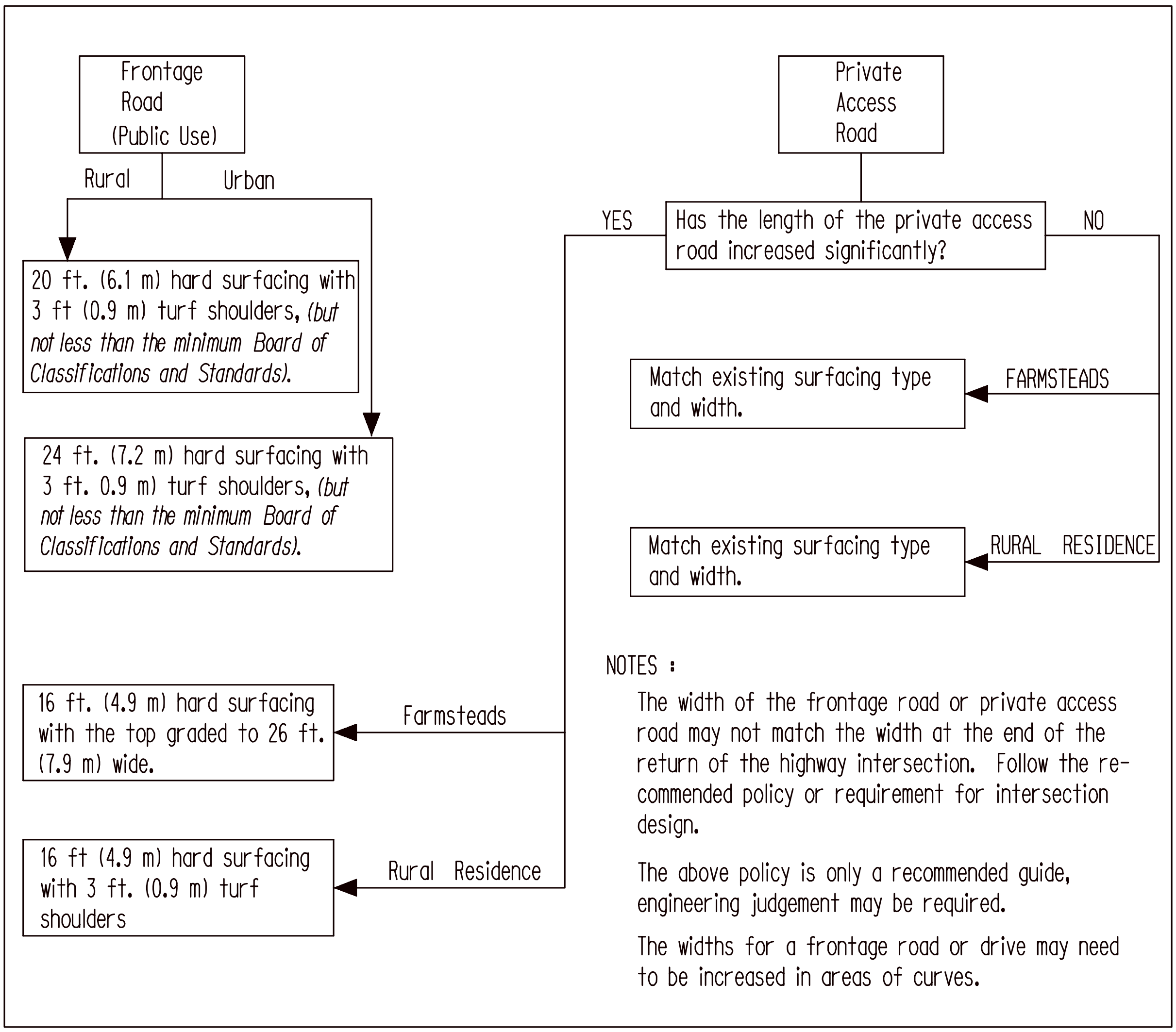


Exhibit 4.1 Flowchart for Roadway Widths of Frontage Roads and Access Roads

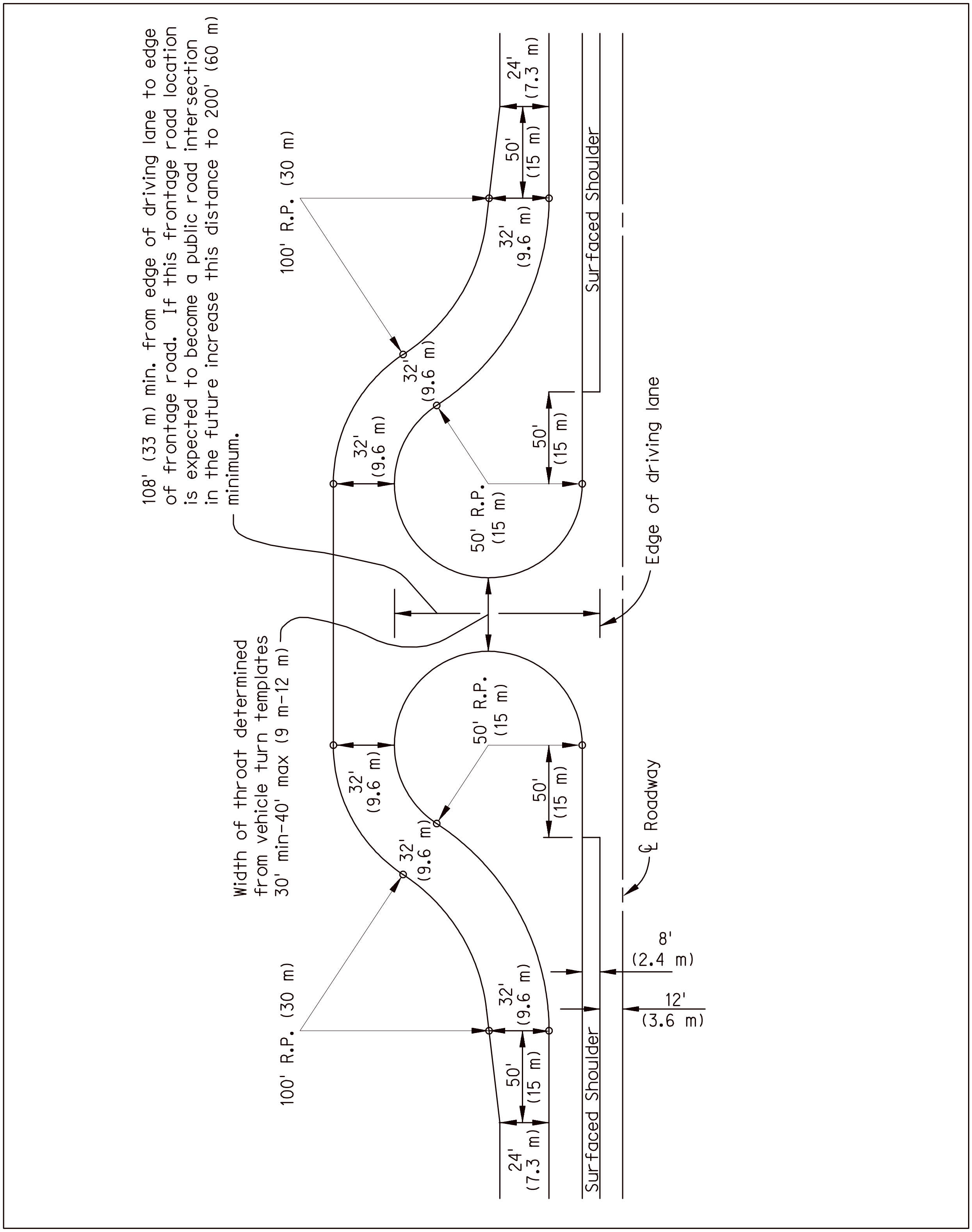


Exhibit 4.2 Typical Frontage Road Connection off of a Major Roadway

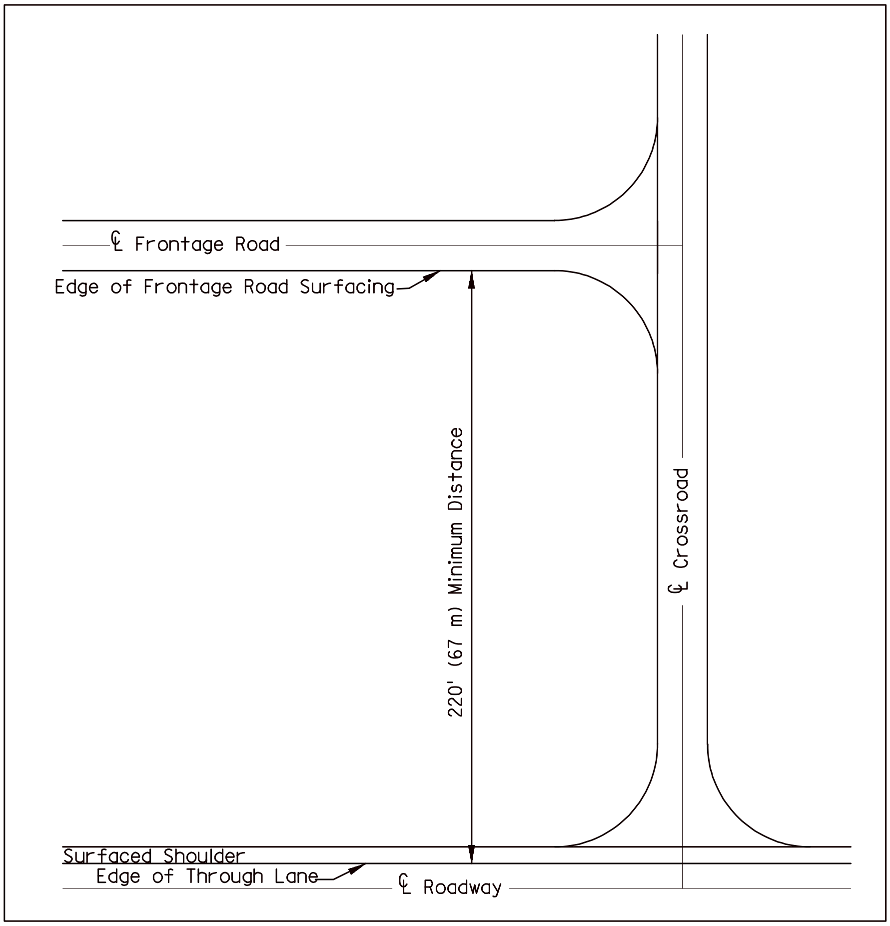


Exhibit 4.3 Typical Frontage Road Connection off of a Crossroad

1.C Intersection Design Considerations

1.C.1 Capacity and Level of Service

The capacity of an intersection and the performance of traffic passing through it vary considerably depending on the traffic controls used. Capacity analysis and intersection design should go hand-in-hand. The **Traffic Engineering Division** performs capacity analysis with input from **Roadway Design**. **Roadway Design** in turn utilizes the capacity analysis results for the geometric design of the intersection.

Capacity at two-way stop and at yield-controlled intersections is a function of:

- The gaps in the major traffic stream, allowing vehicles from the controlled approaches to cross or turn through the stream; and
- Driver judgment in selecting gaps to complete the desired maneuvers (gap acceptance).

For uncontrolled and four-way stop-controlled intersections, capacity analysis must consider the fact that each approach seeks gaps in all of the other conflicting traffic streams.

At unsignalized locations, methods of traffic control such as stop or yield signs will generally be installed well before the theoretical capacity of an intersection is reached. As the operation of the intersection deteriorates, the designer should look at other methods of traffic control in order to maintain flow. See Chapter 10 of the Highway Capacity Manual (Reference 4.5) for further discussion.

Signalized intersection capacity is evaluated for each approach or lane group (i.e., lanes serving a particular movement or movements), and level of service is based on the intersection as a whole.

Level of service at signalized intersections is measured in terms of average stopped delay per vehicle for a 15-minute analysis period in seconds. Delay is a function of the quality of progression throughout the signal system, the signal cycle length, the ratio of green time to the cycle length, and the volume to capacity ratio (v/c) for the lane(s) being analyzed. **EXHIBIT 4.4** shows the delay associated with each level of service. The **Traffic Engineering Division** will determine the stopped delay per vehicle.

Level of Service	Stopped Delay per Vehicle (sec)
A	≤ 5.0
B	5.1-15.0
C	15.1-25.0
D	25.1-40.0
E	40.1-60.0
F	> 60.0

Exhibit 4.4 Level of Service Criteria for Signalized Intersections (Source: Reference 4.5)

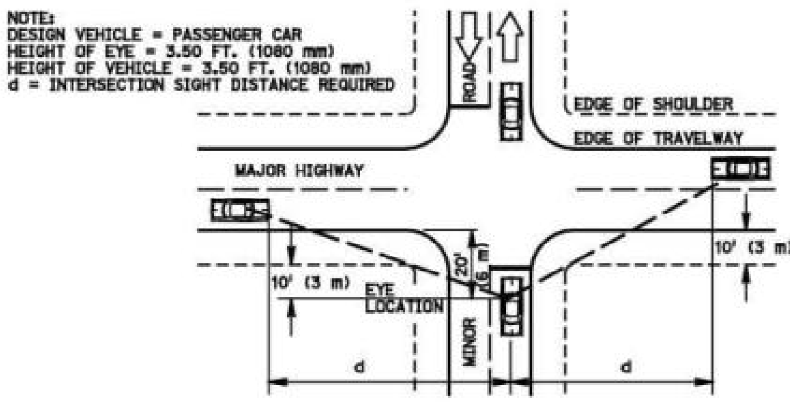
Level of service A represents very low delay when most vehicles arrive during the green light cycle and do not stop. It should be noted, however, that the relationship of capacity and delay is complex. It is possible to have very high delays when the v/c ratio is less than 1.0 and also to have the reverse situation, i.e., low delays when v/c = 1.0.

The **Traffic Engineering Division** conducts intersection capacity studies and makes intersection design recommendations based on those studies and on the minimum design standards (See the Nebraska Minimum Design Standards, Reference 4.6) (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf). At a minimum, rural intersections are designed to provide level of service C, and urban intersections are designed for level of service D for the project design year (the year 20 years after the completion of the project).

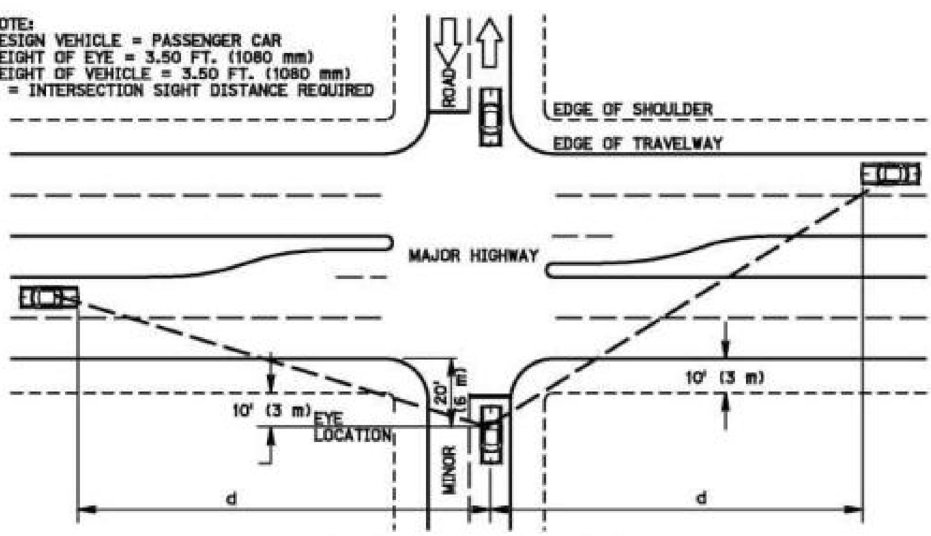
Capacity analysis is complex and normally is performed using computerized programs. Further discussion of signalized intersection capacity analysis concepts and techniques may be found in the Highway Capacity Manual, (Reference 4.5).

1.C.2 Sight Distance

Intersection sight distance consists of the provision of sight triangles along each leg of an intersection, which are free of visual obstacles, giving a driver sufficient time and distance to avoid conflicts at the intersection, (See **EXHIBIT 4.5**). Minimum stopping sight distance will be provided on each leg of an intersection consistent with its design speed; desirable stopping sight distance should be provided wherever possible, (See **EXHIBITS 3.12 & 3.18** for stopping sight distances). 3R projects shall be evaluated using Case B1 from Chapter 9 of A Policy on Geometric Design of Highways and Streets, (Reference 4.1c).



TWO LANE HIGHWAY



DIVIDED FOUR LANE HIGHWAY

Exhibit 4.5 Intersection Sight Triangles

In addition to observing the requirements for minimum stopping sight distance, the designer should provide for maximum visibility between the drivers of vehicles on opposing approaches. The location of each intersection should be reviewed to ensure that sight restrictions do not create a hazardous situation. All intersections should also be checked for intersection sight distance for left-turns from a major roadway (Case F from Chapter 9 of A Policy on Geometric Design of Highways and Streets, Reference 4.1c).

For additional information, see A Policy on Geometric Design of Highways and Streets, (Reference 4.1c), Chapter 9 and So You Want Access to the Highway?, (Reference 4.16), (http://www.nebraskatransportation.org/roway/pdfs/accesshwy.pdf).

1.C.3 Horizontal Alignment

All legs of an intersection should be on a tangent alignment. When roadways intersect on a horizontal curve the geometric design of the intersection becomes significantly more complicated. Horizontal alignment at intersections requires special consideration of intersection sight distance, accident history, superelevation development and other related factors. See Chapter Three: Roadway Alignment, Section 3, for additional information.

1.C.3.a Intersection Skew w/Stop Control on Minor Roadway

Roadways should intersect at approximately 90°. A right angle intersection provides a driver with the best conditions for judging the desired lane orientation and the speed of vehicles on other approaches. Right angle intersections provide a minimum distance for vehicles crossing through the intersection and equalize turning maneuvers in all four quadrants. When the intersection angle changes to something other than perpendicular, or when an intersection occurs on a curved alignment, the potential for accidents increases. Wet pavements and reduced lighting conditions also increase the difficulty in traversing an intersection.

The intersection skew angle is defined as the degree of deviation from a 90° intersection (**EXHIBIT 4.6**). When designing new and reconstructed projects an intersection skew of 15° does not unreasonably increase the intersection crossing distance or decrease the driver's field of vision and is usually considered an acceptable design. **EXHIBIT 4.7** shows the maximum recommended allowable skew for new and reconstructed projects.

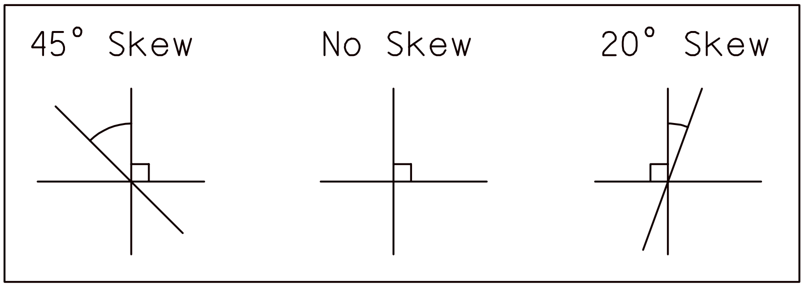


Exhibit 4.6 Skew Angle Definition

DR Number	Maximum Recommended Intersection Skew
DR2 and DR3	30º
DR4	45º
DR5 and DR6	60º

(Based on the Guidelines for Realignment of Skewed Intersections, Reference 4.7).
A maximum skew of 60º is allowed for DR3 through DR6 with **Assistant Design Engineer** approval.
A maximum skew of 60º is allowed for county roadways that are rarely used, regardless of DR number.

Exhibit 4.7 Guidelines for Recommended Maximum Allowable Intersection Skew New and Reconstructed Projects (Stop Control on Minor Roadway)

Skewed intersections on major highways should be realigned to 90º, where feasible, as illustrated EXHIBIT 4.8. Method B is the preferred intersection realignment while methods C and D should only be used under very low volume conditions or, if in urban areas, where a minimum distance is provided between the offset intersections. The **Traffic Engineering Division** will analyze the intersection configuration for left turn conflicts, etc. and will determine the minimum required distance. The design values given in EXHIBIT 4.8 are recommendations only. The designer is responsible for the final design of the realignment, with **Roadway Design Project Manager** review and approval.

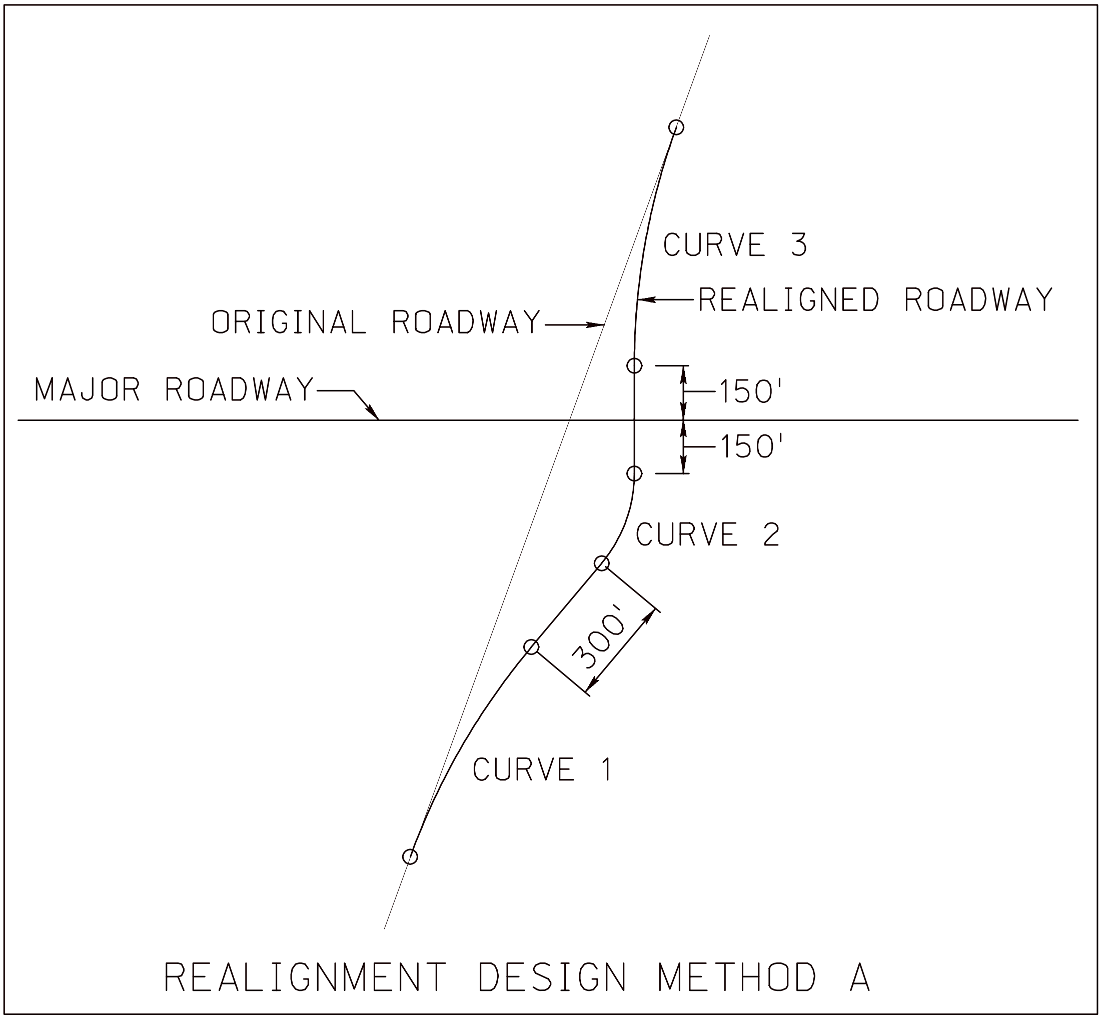
At intersection locations where the topography or where right-of-way damages precludes intersection realignment to 90º, the designer should investigate the feasibility of realigning the intersection to a 30º angle of intersection. It may be possible to realign a 60º intersection skew or a 45º skew to 30º without adding unreasonable cost to the project.

1.C.3.b Intersections on Curved Alignments

An intersection on a curved roadway alignment requires additional design consideration. The superelevation on the mainline curved roadway should not cause vehicles to slide across wet or icy pavement during slowing or turning maneuvers. The superelevation for state highways on horizontal curvature at intersections with other state highways or paved county roads is desirably 4% or less. The maximum breakover, (the algebraic difference in cross slope between the driving lane and the shoulder), at the intersected pavement edge is 7%.

When the minor roadway intersects the mainline on a horizontal curve, the minor roadway should be realigned to provide as close to a 90° intersection as possible at the local tangent to the mainline curve. Intersection sight distance shall be investigated because the curve of the roadway may cause an unacceptable line of sight or cause the driver to have to look too far back over his/her shoulder (especially the right shoulder) to see oncoming traffic.

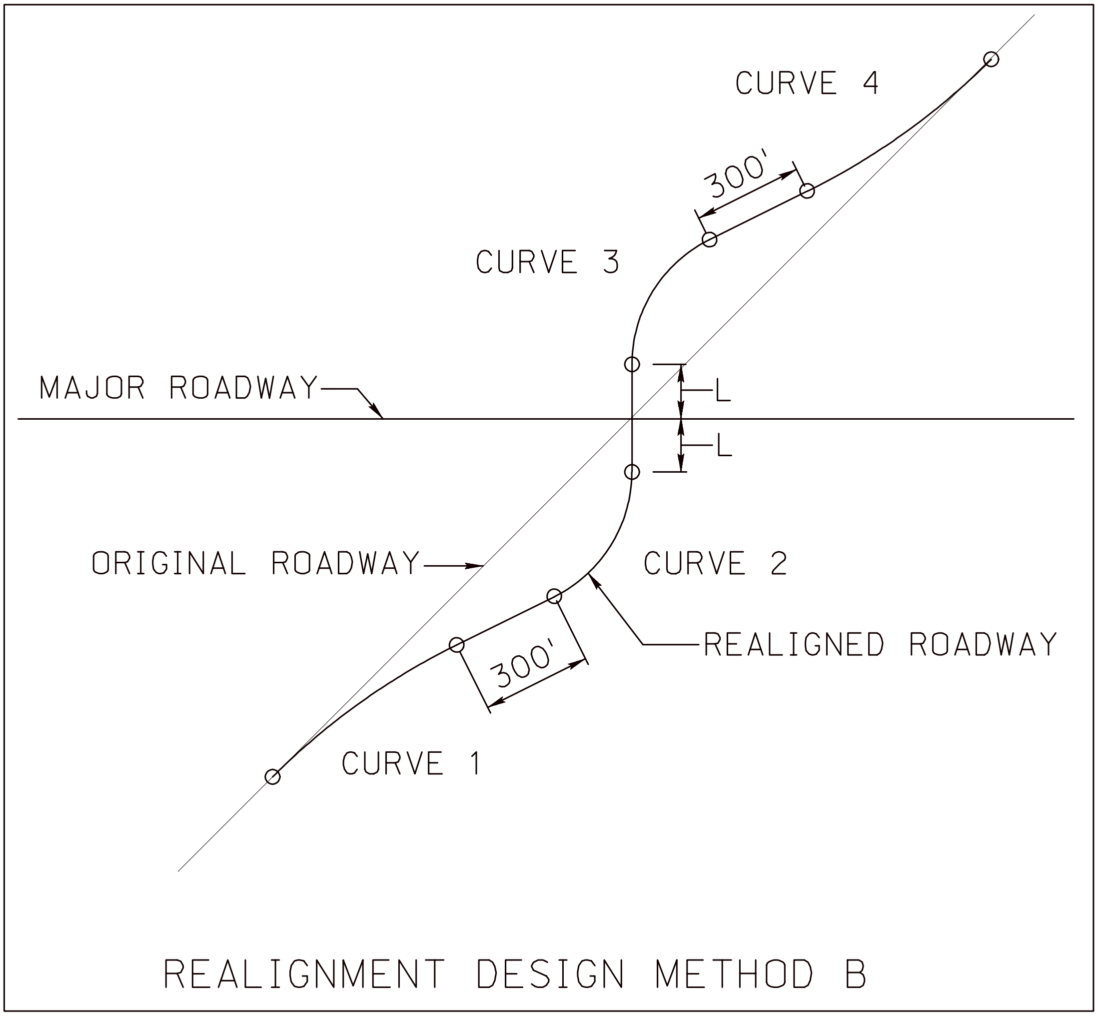
The superelevation of stop-controlled approaches on curved alignments should be flattened to allow vehicles to retain control during slowing and stopping. A short tangent section should be provided on the approach to allow for superelevation runoff. Under urban conditions superelevation, if used, should be limited to 2% at signalized intersections. For further information regarding horizontal alignment see Chapter Three: Roadway Alignment, Section 3. For further discussion of intersection realignment, see the Guidelines for Realignment of Skewed Intersections, (Reference 4.7).



Intersection Skew Angle	**Curve 1**			**Curve 2**			**Curve 3**		
	Radius Ft. (m)	**Deflection Angle Δ**	**Curve Length Ft. (m)**	**Radius Ft. (m)**	**Deflection Angle Δ**	**Curve Length Ft. (m)**	**Radius Ft. (m)**	**Deflection Angle Δ**	**Curve Length Ft. (m)**
20º	1910 (582)	20º	667 (203)	382 (116)	40º	267 (81)	1910 (582)	20º	667 (203)
30º	1910 (582)	30º	1000 (305)	382 (116)	60º	400 (122)	1910 (582)	30º	1000 (305)
45º	1910 (582)	45º	1500 (457)	382 (116)	90º	600 (183)	1910 (582)	45º	1500 (457)

Note: All dimensions and curve values shown above are recommended design values. The designer is responsible for the final design of the realignment.

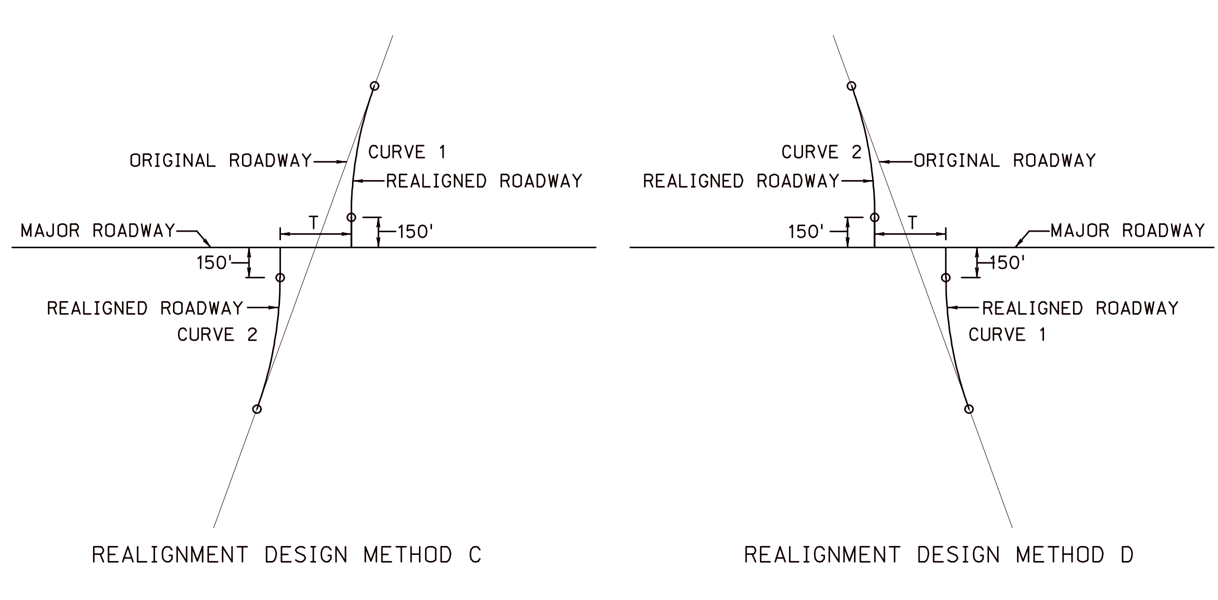
Exhibit 4.8a Intersection Realignment Design Method A



Intersection Skew Angle	L Ft. (m)	Curves 1 and 4			Curves 2 and 3		
		Radius Ft. (m)	Deflection Angle Δ	Curve Length Ft. (m)	Radius Ft. (m)	Deflection Angle Δ	Curve Length Ft. (m)
20º	152 (46)	1910 (582	9º	300 (91)	382 (116)	29º	193 (59)
30º	150 (46)	1910 (582	13º	433 (132)	382 (116)	43º	287 (87)
45º	150 (46)	1910 (582	18.75º	625 (190)	382 (116)	63.75º	425 (130)
60º	155 (47)	1910 (582	24.25º	808 (246)	382 (116)	84.25º	562 (171)

Note: All dimensions and curve values shown above are <u>recommended</u> design values. The designer is responsible for the final design of the realignment.

Exhibit 4.8b Intersection Realignment Design Method B



Intersection Skew Angle	T Ft. (m)	Curve 1			Curve 2		
		Radius Ft. (m)	Deflection Angle Δ	Curve Length Ft. (m)	Radius Ft. (m)	Deflection Angle Δ	Curve Length Ft. (m)
20º	354 (108)	1910 (582)	20º	667 (203)	1910 (582)	20º	667 (203)
30º	764 (233)	1910 (582)	30º	1000 (305)	1910 (582)	30º	1000 (305)
45º	1882 (574)	1910 (582)	45º	1500 (457)	1910 (582)	45º	1500 (457)
60º	4339 (1322)	1910 (582)	60º	2000 (610)	1910 (582)	60º	2000 (610)

Note: All dimensions and curve values shown above are recommended design values. The designer is responsible for the final design of the realignment.

Exhibit 4.8c Intersection Realignment Design Methods C and D

1.C.4 Profile

The gradients of intersecting highways should be as flat as possible, with a consistent gradient through the intersection to facilitate traffic turning movements and to deter stopping vehicles from sliding into the mainline road when the pavement is wet or icy. Any gradient through an intersection must reflect the practicalities of matching the basic profiles of the intersecting roadways.

Appreciable changes in elevation at intersections with existing side roads and driveways should take into consideration the extent of reconstruction that will be required along the cross road or driveway to match the elevation of the new alignment profile. A profile that results in excessive grades for side roads and driveways is not a desirable design. Profile adjustment of side roads should meet the standards of the appropriate city/county.

Consideration should be given to the placement of intersections with respect to vertical curves. Intersections should be placed as near to the top of a crest vertical curve as possible. When located slightly past a crest vertical curve, inadequate sight distance may be a problem for both the motorist approaching on the minor road, who cannot see oncoming mainline traffic, and for motorists on the major roadway who cannot see the intersection until they are directly upon it. Where practical, the PI's of crest vertical curves for urban streets should be located at or near the intersection of the roadway centerlines. Chapter Three: Roadway Alignment, Section 4.C, discusses design controls for crest vertical curves (Also see A Policy on Geometric Design of Highways and Streets, Reference 4.1c, Chapter 3).

1.C.5 Design Vehicle

The physical characteristics of the various vehicle types using the approach roadways are the primary controls in geometric design. A design vehicle is a theoretical motor vehicle whose weight, dimensions and operating characteristics are used to establish highway design controls such as radius returns and turning roadways. Examples of turning templates for a passenger car (P), a single-unit truck or bus (SU) and a 60 ft. (18.3 m) wheelbase semi-trailer combination (WB-62) are shown in A Policy on Geometric Design of Highways and Streets, (Reference 4.1c), Exhibits 9-21, 9-22, and 9-26). See **EXHIBIT 4.9** for the appropriate minimum design vehicle to be used under various intersection conditions.

RURAL HIGHWAYS	
INTERSECTING HIGHWAY OR ROADWAY	**MINIMUM DESIGN VEHICLE ***
INTERSTATE / RAMP TERMINALS	WB-62
EXPRESSWAY / MAJOR ARTERIALS	WB-62
LOCAL ROADS / COUNTY ROADS / FRONTAGE ROADS	SU-30
COMMERCIAL DRIVE / FARM EQUIPMENT DRIVE	SU-30
PRIVATE / FARM RESIDENCE DRIVE	P

MUNICIPAL HIGHWAYS	
INTERSECTING HIGHWAY OR ROADWAY	**MINIMUM DESIGN VEHICLE ***
INTERSTATE / RAMP TERMINALS	WB-62
EXPRESSWAY / MAJOR ARTERIALS	WB-62
RESIDENTIAL / LOCAL STREETS	SU-30 OR P
COMMERCIAL DRIVE	SU-30
RESIDENTIAL DRIVE	P

*** Use for drive geometrics only, not to be used in the calculation of intersection sight distance.**

Exhibit 4.9 Guidelines for the Selection of Intersection Design Vehicles

1.C.6 Radius Returns

Urban intersections should have a minimum radius return of 30’ (9 m) for 90° intersections. Rural intersections should have a minimum radius return of 50’ (15 m) for 90° intersections. For other intersecting angles, special circumstances and for more guidance refer to A Policy on Geometric Design of Highways and Streets, (Reference 4.1c), Exhibit 9-19.

Where it is necessary to provide for low-speed turning vehicles within the limited space of an intersection, the determination of turning radius should be based on turning path templates of the appropriate design vehicles. These templates indicate wheel paths under ideal conditions; therefore, allowances should be made to provide a margin of error on the part of the driver. The design vehicle should not encroach on any opposing traffic lanes. Right turn lanes are often widened to encompass the entire wheel path of the design vehicle.

A graphical procedure may be used to determine radius returns by placing the appropriate vehicle turning template on the intersection base map and establishing island and roadway edge size and placement from the turning paths on the templates. A computer turning template program, such as *AutoTrack*, may also be used to obtain the appropriate values.
For some right-angled intersections, the radius return may consist of a single circular arc joining the tangent edges of pavement. However, to fit the WB-62 (WB-19) turning template, a combination of circular arc and short tapers is the best solution.

The minimum allowable distance between the lane edge and the edge of tires is 2 ft. (0.6 m). The distance between the pavement edge and the edge of tires should be a minimum of 3 ft. (0.9 m).

1.C.7 Parking

Curb parking in the immediate vicinity of an intersection tends to impede traffic flow and contributes to the potential for accidents. The line of sight should not be obstructed. Parking should not be placed within 20 ft. (6 m) of the radius return of any unsignalized intersection. Parking near signalized intersections will be controlled by the requirements for dedicated turn lanes. See Chapter Ten: Miscellaneous Design Issues, Section 14, for additional information.

1.C.8 Transit Services

Urban intersections that carry bus services should be designed to coordinate the operation of bus stops with the movement of through traffic. The location of the bus stop can be placed on the near side or far side of the intersection, depending on the preference of the transit service and the availability of space for passenger access. In either case, bus service may interfere with the intended operation of an intersection. Bus turnouts, merging tapers or passenger loading space of sufficient length to accommodate the maximum number of buses anticipated at any given time should be provided to minimize interference with intersection operation.

1.C.9 Signs

The placement of signs at or near an intersection must be in accordance with the MUTCD (Reference 4.2). The designer should coordinate the design of the typical section and approach roadway geometrics with the **Traffic Engineering Division** to allow for proper sign placement. The designer should also insure that intersection sight distance is not compromised either by the nature or the number of signs installed (or already in place).

1.C.10 Pedestrian Crosswalks

Curb ramps will be constructed or reconstructed to meet the "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities" (Reference 4.8), (http://www.access-board.gov/adaag/html/adaag.htm) on all "New and Reconstructed" projects and on all "3R" and "Maintenance" projects in municipalities, residential developments and sanitary and improvement districts beyond the zoning jurisdictions of municipalities where there are existing sidewalks and/or where sidewalk construction is a part of the project. For further information, see Chapter Ten: Miscellaneous Design Issues, Section 10.B.3 and Chapter Fourteen: Traffic Engineering, Sections 1.G and 4.A.

1.C.11 Bikeway-Highway Intersections

In general most auto/bicycle accidents occur at intersections. Bikeway design at intersections should allow both motorists and bicyclists to operate following normal rules of the road with a minimum of confusion. Intersections without bike lanes but with significant bicycle traffic may require additional traffic control study. Refer to Chapter Ten: Miscellaneous Design Issues, Section 10.B.2, and the Guide for Development of Bicycle Facilities, (Reference 4.9), (http://lakesammfriends.org/AASHTOCyclingGuide.PDF) for additional information.

1.C.12 Railroad-Highway Crossings

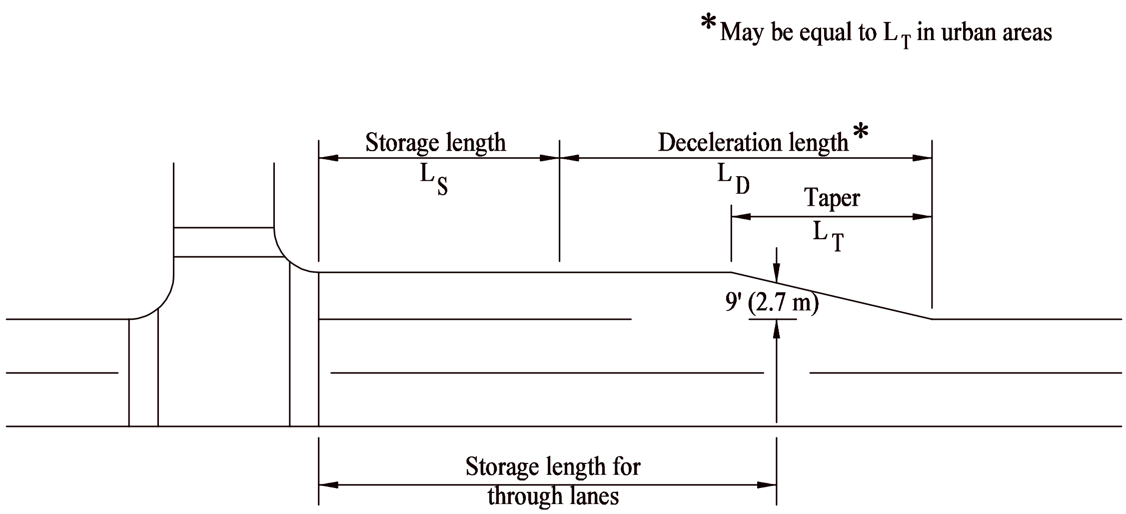
Railroad-highway crossing design must consider approach grades, sight distance, drainage, highway traffic volumes and the frequency of train movements. See Section 3.A and Chapter Ten: Miscellaneous Design Issues, Section 1, for information regarding railroad-highway grade crossings.

1.D Auxiliary Lanes

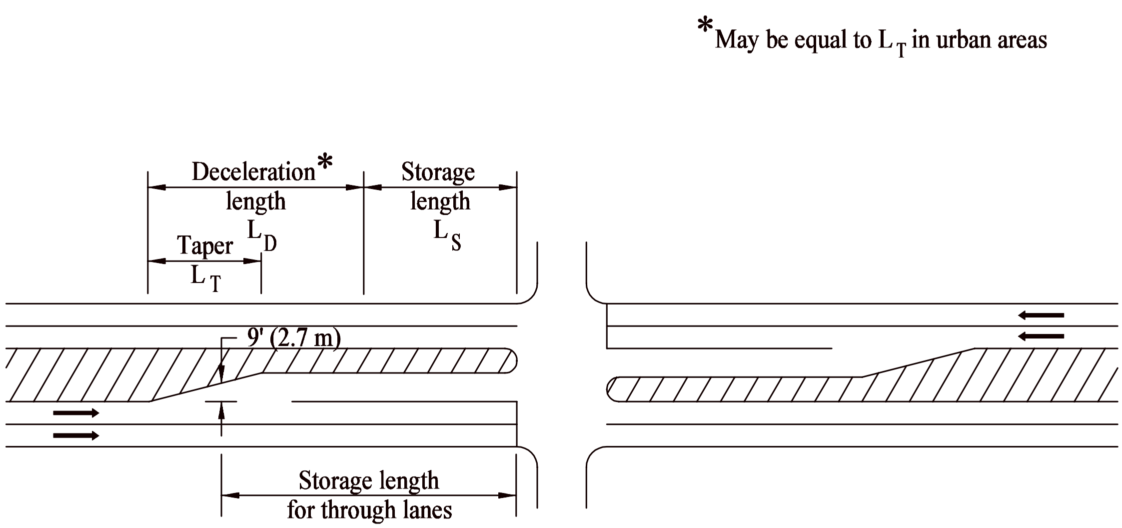
When the **Traffic Engineering Division** has determined that specific turning movements should be separated from through movements, an assigned auxiliary lane will be established. The use of an auxiliary lane can be shown to increase the capacity of an intersection. Roadway widening for auxiliary lanes requires additional space and sometimes will impact adjacent properties, drainage patterns and driveway operations in the vicinity of the intersection. Widening is achieved and removed through the use of tapers that match the approach and departure speed of the through traffic.

Desirably, auxiliary lanes should not be within or adjacent to any portion of a channelizing device, (island or median), while in transition. Shoulders adjacent to 12 ft. (3.6 m) auxiliary lanes should be 4 ft. (1.2 m) wide when surfaced and 2 ft. (0.6 m) when turf.

Auxiliary lanes may be used for designated left turn lanes, right turn lanes, or free flow right turn lanes as warranted (See **EXHIBIT 4.10**). The "Intersection Channelization Design Guide" (Reference 4.3) provides warrants and guidelines for auxiliary lane design.



Typical Right-Turn Lane
(Stop or Signal Control)



Typical Left-Turn Lane

Exhibit 4.10 Typical Auxiliary Lanes

1.D.1 Turn Lanes

The **Traffic Engineering Division** may recommend the addition of a right turn lane for the following reasons:

- To serve right turn vehicles required to slow for the turn, alleviating rear-end accident potential as well as delays to arterial traffic.
- To move the stop bar position back on the minor approach thus widening the throat entry for left turning vehicles from the arterial roadway—this serves to provide better visual “targeting” for the driver, aids larger vehicles to avoid edge runoff, and permits faster turning, thus reducing the through lane clearance time requirements.

Left turn lanes are provided on the mainline at signalized intersections if warranted. The following situations may necessitate provision of an exclusive left turn lane:

- Where fully protected left turn signal phasing is to be provided.
- Where left turn volumes exceed 100 vph and space is available.
- Where left turn volumes exceed 300 vph, a double left turn lane should be considered.

Left turn treatments may be necessary on two-lane highways where traffic volumes are high and safety considerations are sufficient to warrant them.

Left turn lanes should be provided on divided arterials at intersections and at other median breaks where left turn volumes and/or vehicle speeds are high. To reduce the opposing traffic obstruction of the line of sight, the left turn lanes in 16 ft. (4.8 m) raised medians should be designed with a 1 ft. (0.3 m) offset. Wide striping on the right side of the left turn lane should be used to encourage traffic to move closer to the median (See **EXHIBIT 4.11**).

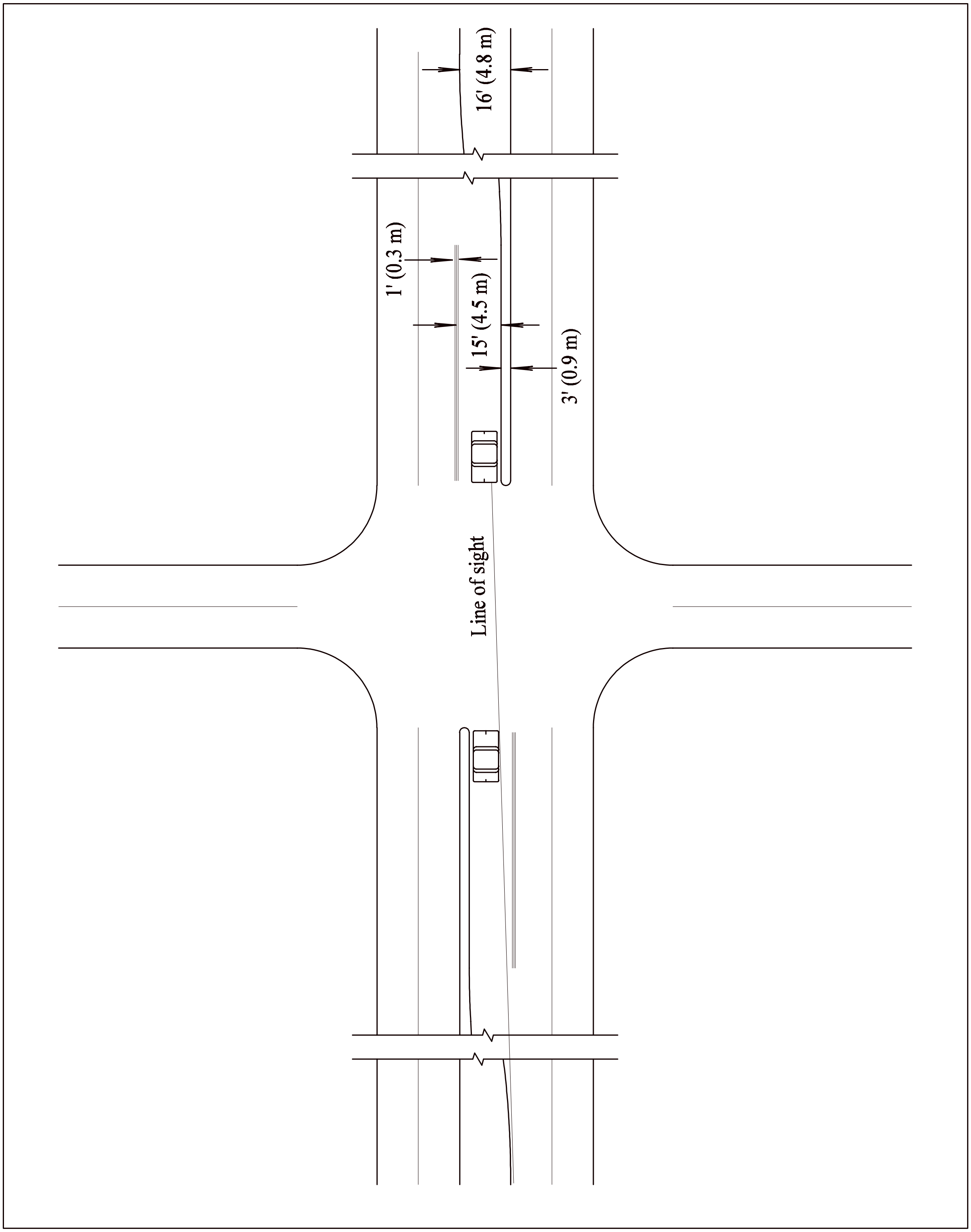


Exhibit 4.11 16 Foot Median, Left-Turn Lane

1.D.2 Turn Lane Length

Turn lane length is a function of the:

- Turning traffic volume;
- Required storage length;
- Approach design speed;
- Length required to decelerate from the approach design speed to a stop; and
- Type of intersection control.

Turn lane length has three components: entering taper, deceleration length, and storage length. Whenever feasible, a deceleration length should be provided for motorists to slow from the highway design speed to a comfortable stop. Minimum deceleration lengths (excluding taper) for auxiliary lanes on arterial streets with grades of ≤ 2% are:

Design Speed		Minimum Deceleration Length	
mph	**(km/h)**	**ft.**	**(m)**
30	(50)	230	(70)
	(60)		(100)
40		330	
45	(70)	430	(130)
50	(80)	550	(165)
55	(90)	680	(205)

In urban areas, with lower design speeds and more closely spaced intersections, it may not be practicable to provide full-length deceleration. In those areas, deceleration must take place prior to entering the auxiliary lane. The storage length should provide sufficient space so that neither turning nor through traffic blocks the other. Storage space for at least two passenger cars should be provided. If truck traffic exceeds 10%, storage for at least one car and one truck should be provided (i.e., 25 ft. (7.5 m) for each car and 75 ft. (22.5 m) for each truck). At signalized intersections the required storage length depends on the signal cycle length, phasing, and rates of arrivals and departures of turning vehicles. The roadway designer should consult with the **Traffic Engineering Division** to determine the required storage length at an intersection.

The storage length of a turn lane should be designed so that the number of vehicles desiring to make a turn during any interval will exceed the turn lane capacity only 5% of the time without reducing the safety or capacity of the approach. A procedure for determining the storage length (L) of a turn lane, based on a Poisson probability distribution, is as follows:

Step 1:

Calculate:

$m = D \times I \times (1/3600)$ Eq. 4.1

where:

m = the average number of vehicles per interval;
D = design hourly volume (DHV) of vehicles making the turn;
I = interval, 60 seconds in rural areas, 90 seconds in urban and suburban areas.

Step 2:

Enter **EXHIBIT 4.12** with the calculated value of "m" and read off the corresponding value of "x," the probable maximum number of vehicles appearing during the given interval. Appropriate values of "x" have been obtained from a Poisson distribution so that the probability of "x" being exceeded is 0.05, or 5%.

Step 3:

Allowing a distance of 25 ft. (7.5m) for each stored vehicle, multiply "x" by 25 (7.5) to obtain "L," the required turn lane storage length, in ft. (meters).

Example:

Given a DHV of 486 left turning vehicles in an urban area and using Eq. 4.1, the average number of vehicles per interval, m, equals 486 x 90 x (1/3600) or 12.2.

From **EXHIBIT 4.12**, with an average number of vehicles per interval of 12.2, the number of vehicles arriving during the given interval will exceed 19 only 5% of the time.

The storage length of the left turn lane should be:

in English,

L = 25 ft x 19 = 475 ft.

or in metric,

L = 7.5 x 19 = 142.5 m (say 143 m)

Designers should confirm the length of turn lanes with the **Traffic Engineering Division**.

1.D.3 Left Turn Radii

A typical at-grade intersection does not have a continuous edge of pavement delineating the left turning path. The motorist has a guide at the beginning and at the end of the left turn movement provided by pavement markings or channelization. The turning maneuver is accomplished across the open space of the intersection. In some instances, pavement markings are provided to guide turns across wider intersections.

The design values for left turn radii are a function of the design vehicle, angle of intersection, number of lanes and median width. Generally, left turn radii should be larger than the minimum design vehicle turning radius since the turning radius is based on a 10 mph (15 km/h) operating speed, and this speed can often be exceeded in actual operations. For roadways intersecting at right angles, left turn radii that range between 60 and 75 ft (18 and 23 m) will normally satisfy all of the controlling factors. For two-lane turning movements, a desirable minimum radius of 90 ft. (28 m) should be applied to retain a satisfactory capacity in the outer lane.

Average Number of Vehicles per Interval (m)	95% Probable Maximum Number of Vehicles during the Same Interval (x)	Length of Turn Lane, ft. (m) (L)
0.1 to 0.3	2	50 (15)
0.4 to 0.8	3	75 (23)
0.9 to 1.3	4	100 (30)
1.4 to 1.9	5	125 (38)
2.0 to 2.6	6	150 (45)
2.7 to 3.3	7	175 (53)
3.4 to 4.0	8	200 (60)
4.1 to 4.7	9	225 (68)
4.8 to 5.4	10	250 (75)
5.5 to 6.2	11	275 (83)
6.3 to 7.0	12	300 (90)
7.1 to 7.8	13	325 (98)
7.9 to 8.6	14	350 (105)
8.7 to 9.4	15	375 (113)
9.5 to 10.2	16	400 (120)
10.3 to 11.0	17	425 (128)
11.1 to 11.8	18	450 (135)
11.9 to 12.6	19	475 (143)
12.7 to 13.4	20	500 (150)
13.5 to 14.2	21	525 (158)
14.3 to 15.0	22	550 (165)

Exhibit 4.12 Turn Lane Length

1.D.4 Transition

The addition or deletion of a turn lane is accomplished through a taper length that depends on the operating speed of the approach roadway and the width of the offset. Typically, a 1:20 taper ratio is used for left-turn lanes on expressways and a 1:15 taper ratio is used for right-turn lanes on expressways and for right and left-turn lanes on rural roadways. Right and left-turn lanes will have a 1:10 taper rate in urban areas with speeds less than 50 mph (80 km/h). A right turn lane may be continued onto the intersecting roadway, if necessary, and transitioned at a point downstream from the intersection where a merge may safely occur. See A Policy on Geometric Design of Highways and Streets, (Reference 4.1c, Chapter 9), for additional information.

1.D.5 Free Right-Turn Lanes

Turning roadways are channelized turn lanes at at-grade intersections to provide free flow turn movements. Turning roadways are classified for the following types of operation:

Case I - One-lane, one-way operation without provision to pass a stalled vehicle.

Case II - One-lane, one-way operation with provision to pass a stalled vehicle.

Case III - Two-lane operation.

A Policy on Geometric Design of Highways and Streets, (Reference 4.1c, Exhibit 3-55), lists pavement widths for these three cases.

Case I pavement widths are normally used for minor turn movements. A 16 ft. (4.8 m) turning roadway is normally sufficient for the range of selected radii and design speeds. Case I widths are also used for left turn lanes, where the width of the turning path is normally not delineated, and for channelized approaches adjacent to center islands, where a width of 14 ft. (4.2 m) is adequate. Case II widths apply to turning movements of moderate to heavy traffic not exceeding one-lane capacity. Case III turning roadway widths are influenced by the edge of pavement design. Widths of 24 to 28 ft. (7.2 to 8.4 m) are common. The design at the edges of the turning roadway is critical to control the tracking of turning vehicles. Designers should receive **Traffic Engineering Division** approval for application of Cases II and III.

Several guidelines should be used regarding the use and design of free right turn lanes at unsignalized rural intersections on rural two-lane highways:

- Use design year, (the year twenty years after project construction), right turn volumes and the percent trucks as indicators to evaluate whether a free right turn lane is warranted. **EXHIBIT 4.13** depicts this relationship. For example, a design year right turn volume of 625 vehicles per day with 15% trucks may warrant a free right turn lane.
- Use a design speed of at least 40 mph (70 km/h) for the free right turn lane.
- Provide an acceleration lane for the free right turn lane (See A Policy on Geometric Design of Highways and Streets, Reference 4.1c, Chapter 9).
- The use of free right turn lanes should be considered for operational efficiency. They should not be regarded as a safety enhancement (See “Guidelines for Free Right-Turn Lane at Unsignalized Intersections on Rural Two-Lane Highways”, Reference 4.10).

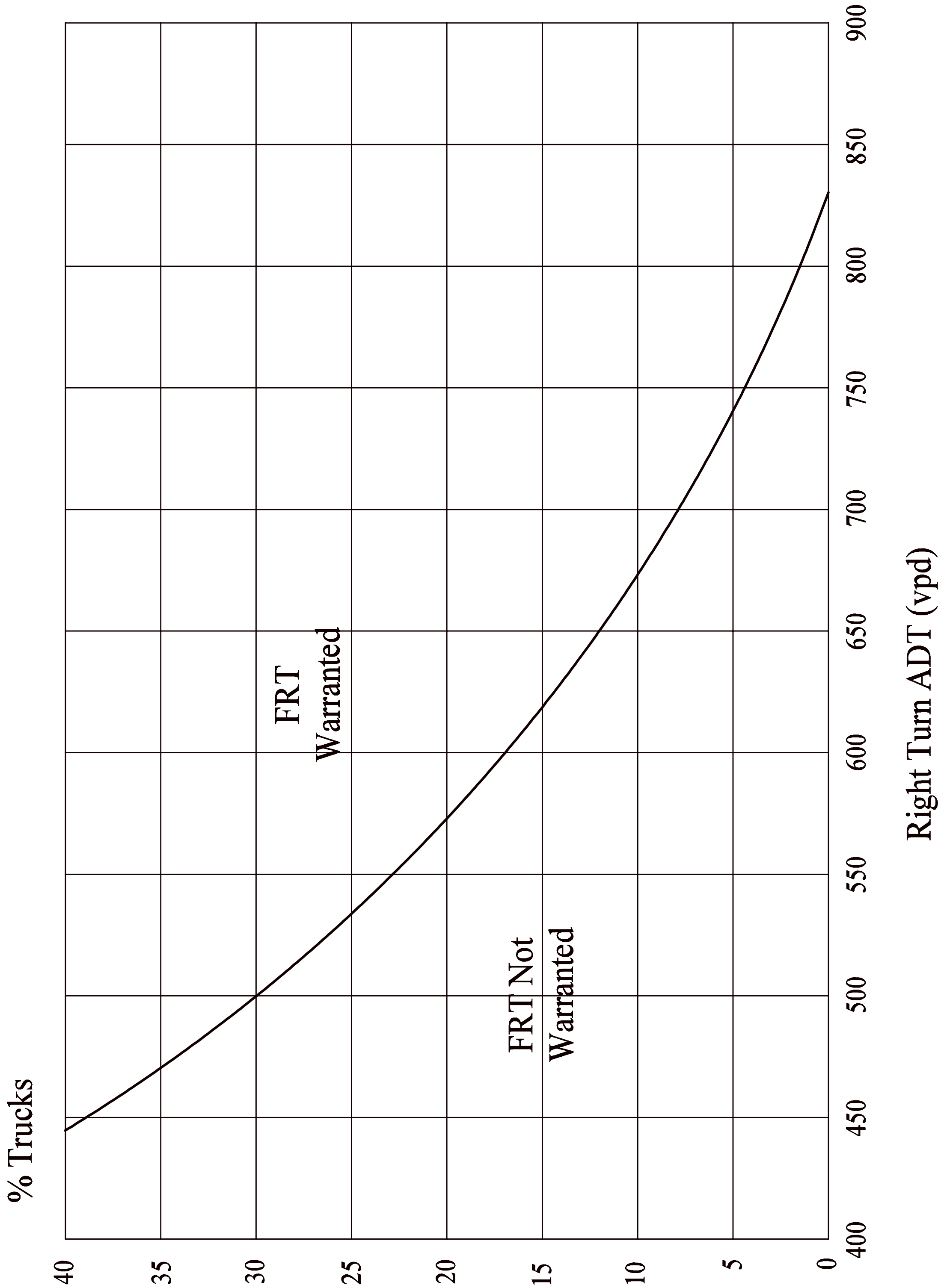


Exhibit 4.13 General Guidelines for Free Right Turn Lanes at Intersections of Rural Two-Lane Highways (Source: Reference 4.10)

1.E Traffic Control

Traffic control devices regulate, warn, and guide traffic safely and efficiently through intersections. In general, only urban intersections require signalization. Signalization design is governed by warrants discussed in MUTCD, (Reference 4.2). Signal design is the responsibility of the **Traffic Engineering Division.**

It is essential that the roadway designer coordinate with the **Traffic Engineering Division** regarding roadway geometry, intersection capacity, and traffic operations (See Chapter Fourteen: Traffic Engineering). Coordination with railroads is also required where highway intersection signals are interconnected with rail-highway crossing signals, (See Chapter Thirteen: Planning and Project Development, Section 5.G). The **Roadway Design Division** furnishes base plans to the **Traffic Engineering Division** showing the number of approach lanes, length and width of storage lanes, location and position of turning roadways, spacing of other intersections, access connections and the location and size of islands to accommodate signal posts, etc. The **Traffic Engineering Division** will review the base plans and make necessary recommendations regarding traffic operations.

1.E.1 Unsignalized Intersections

The simplest form of traffic control at an intersection is the use of a yield sign for the roadway having the lower traffic volume. As the traffic volume increases, the minor street can be controlled by a stop sign. All roadway approaches at an intersection may be controlled with a "four-way stop." In these situations, a left turn bay for the channelization and storage of vehicles may be required.

The unsignalized intersection does not normally require additional lanes for the storage of vehicles or channelization for the guidance of opposing movements on the minor street. The time required for each vehicle to accelerate and pass through an average intersection after stopping or slowing to yield is typically 3-4 seconds. When this delay increases (e.g., when truck traffic has limited opportunity to clear the intersection), as queues become commonplace for the minor street, or when an accident history is established as drivers take more risks to enter perceived gaps in traffic, the level of service of the intersection declines. In some instances, an auxiliary turn lane may be provided to accommodate a portion of the traffic. Contact the **Traffic Engineering Division** regarding traffic control.

1.E.2 Signalized Intersections

Where large volumes of traffic must be accommodated, traffic signals usually provide more efficient traffic operation by allocating time to specific movements instead of operating on a single vehicle at a time, queued basis. Essentially, signalization moves vehicles in groupings or "platoons" in order to reduce delays caused by starting and stopping of individual vehicles.

In urban areas with multiple signalized intersections, the designer must be aware of the progressive nature of traffic signal system coordination, where it is desirable to move vehicle platoons from one intersection to the next. Each succeeding intersection must be configured to handle the approach volumes and to store or channelize the required turning movements. The designer must coordinate with the **Traffic Engineering Division** to insure that the proposed approach lanes are capable of accommodating the design year traffic volumes.

2. DRIVEWAYS

Access will be provided to all properties but it may be from joint access locations or from frontage roads. When consolidating access locations, driveways on one side of the highway should be located opposite driveways on the other side of the highway in rural areas. Access shall conform to the Access Control Policy to the State Highway System, (Reference 4.11), (http://www.nebraskatransportation.org/roway/pdfs/accesscontrol.pdf).

Care should be taken to avoid excessive numbers of entrances. Keep in mind that:

- Approaches are expensive.
- Some existing field entrances may no longer be required.
- Each driveway presents a potential conflict with highway traffic.
- Each driveway could represent an obstruction in the recovery area.

Recommendations for driveway locations will be made during the plan-in-hand inspection. If there is any question about the need for access, the situation should be investigated during the plan-in-hand or other field inspection. The **Right-of-Way Division** will document the final access determination during right-of-way negotiations.

Any field entrance or driveway location change in rural areas needs to be coordinated through the **Utilities Section** to see if there are any utility conflicts before moving the access. Location changes of urban driveways should be coordinated through the **Utilities Section**, the **Lighting Section**, and the **Traffic Engineering Division** if the driveway is near a signalized intersection.

As a general guide to driveway location, refer to the **AASHTO** publication, An Informational Guide for Preparing Private Driveway Regulations for Major Highways, (Reference 4.12), the Access Control Policy to the State Highway System, (Reference 4.11), and Chapter Fifteen: Right-of-Way, Section 3.

2.A Rural Driveways

The following items should be considered when designing entrances and driveways in rural locations:

- Prior to locating or designing driveways, check the project file or consult the **Roadway Design Project Manager** for the requirements regarding access control on the project.
- To discourage wrong-way movement, rural access openings and driveways should not be located within 300 ft. (90 m) of a median opening, unless the access opening or driveway is directly opposite the median opening.
- Joint access to adjoining properties should be provided where possible, with the access opening centered on the property line. Such openings normally will require purchase of a permanent right-of-way easement.
- Approaches should not be hidden behind crest vertical curves.
- The desirable grade for rural access openings should not exceed ± 8%. In a high cut or deep fill situation, a maximum grade of ± 15% is allowable.
- The shoulder slope or flatter should be continued for a minimum of 20 ft. (6 m) beyond the edge of the shoulder before breaking to a steeper slope.

Depending upon traffic conditions, driveways in rural locations may be considered minor intersections and may include provisions for deceleration, turning movements and acceleration. Providing adequate driveway length to allow agricultural equipment to pull completely off of the roadway should be considered. See the "Intersection Channelization Design Guide", (Reference 4.3), for additional discussion.

EXHIBITS 4.15 & 4.16 show typical rural driveway designs. If a permanent easement is to be purchased for access, access openings are 40 ft. (12 m) wide. See **EXHIBIT 4.14** for rural driveway design criteria.

Driveway Type	Rural Driveway Width *	
	Residential Drive	**Commercial Drive**
Single	Grade 26' (8 m) Surface 24' (7.2 m) R=25' (7.5 m)	Grade 42' (13 m) Surface 40' (12 m) R=40' (12 m)
Joint Use (Driveway on property line)	Grade 26' (8 m) Surface 24' (7.2 m) R=25' (7.5 m)	Grade 42' (13 m) Surface 40' (12 m) R=40' (12 m)
Field Entrances	Grade 26' (8 m) R=25' (7.5 m)	

Note: The width of the surfaced shoulder will not be subtracted from the driveway radius.

* Measured at the throat of the driveway

Exhibit 4.14 Rural Driveway Width Criteria

2.A.1 Rural Driveway Culvert Pipes

Driveway culvert pipes will be provided, where required, as a grading item. The following items should be considered in the design of rural driveway culvert pipes:

- Driveway culvert pipe locations should be noted on the Plan-In-Hand field inspection.
- The preferred driveway culvert pipe location is at the back of the flat-bottomed ditch, outside of the lateral clear zone (See **EXHIBITS 4.15 AND 4.16**).
- A minimum of 1 ft. (300 mm) of cover shall be provided over the culvert at the shoulder break point, (**EXHIBIT 4.17**).
- The normal driveway culvert pipe diameter is 24 in. (600 mm). Larger culvert pipe diameters may be required based on the ditch hydrology, [See the Drainage Design and Erosion Control Manual, Chapter One, Sections 11 and 12 (Reference 4.14)].
- Driveway culvert pipes shall meet the requirements of the pipe material policy, [See the Drainage Design and Erosion Control Manual, Chapter One, Section 14 (Reference 4.14)], and of Section 721 of the Standard Specifications for Highway Construction, (Reference 4.15) (http://www.nebraskatransportation.org/ref-man/).

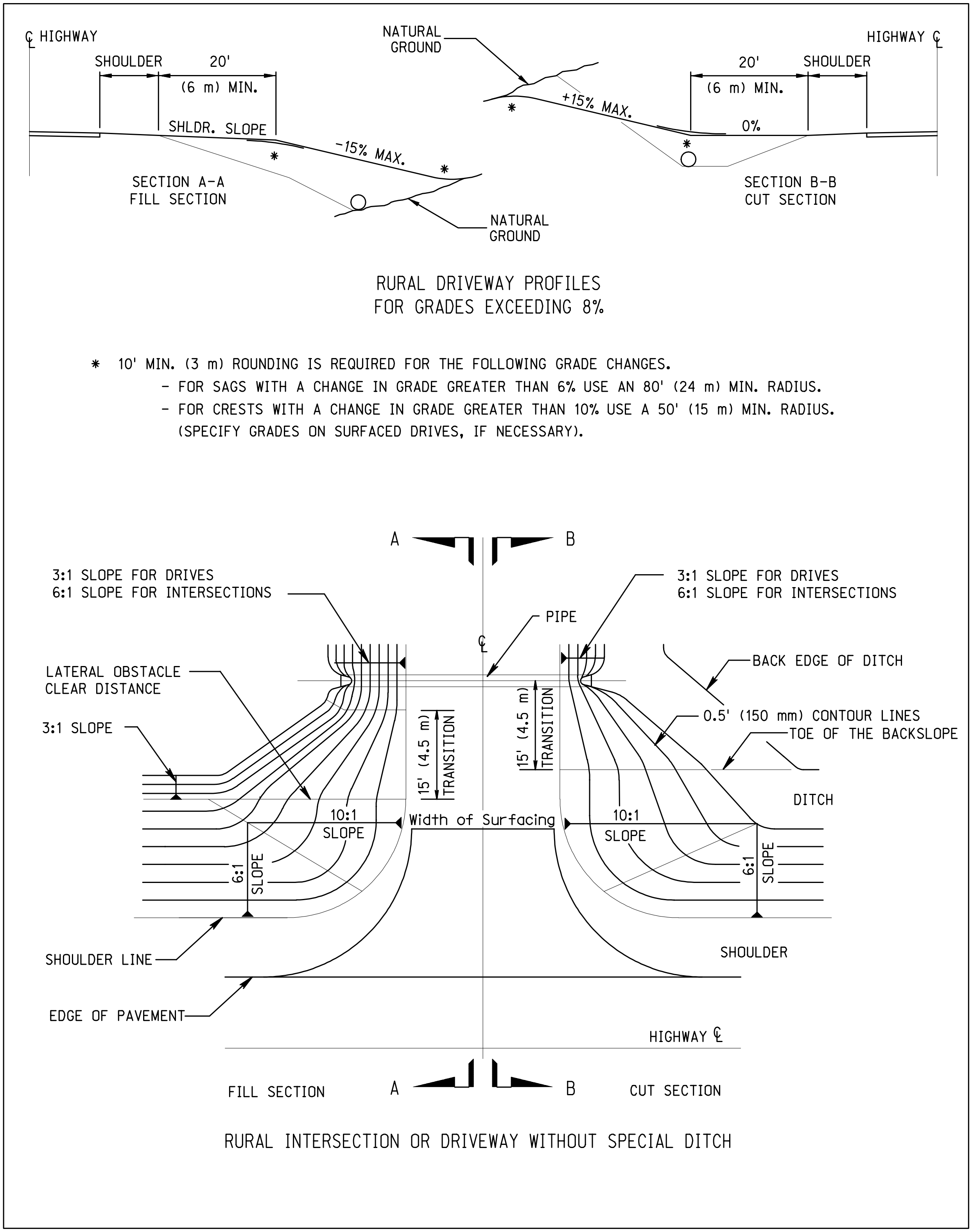


Exhibit 4.15 Rural Driveway Without a Special Ditch

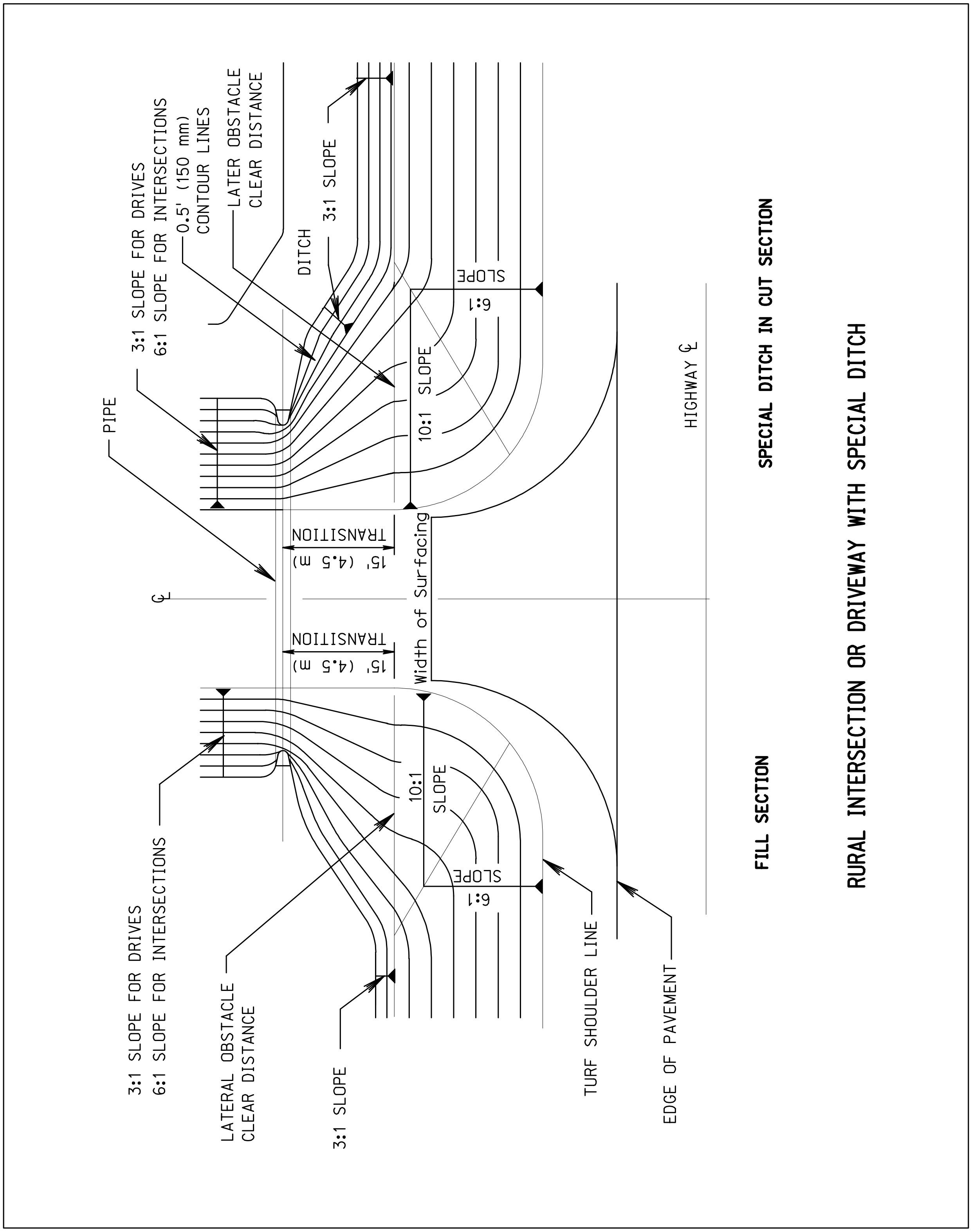
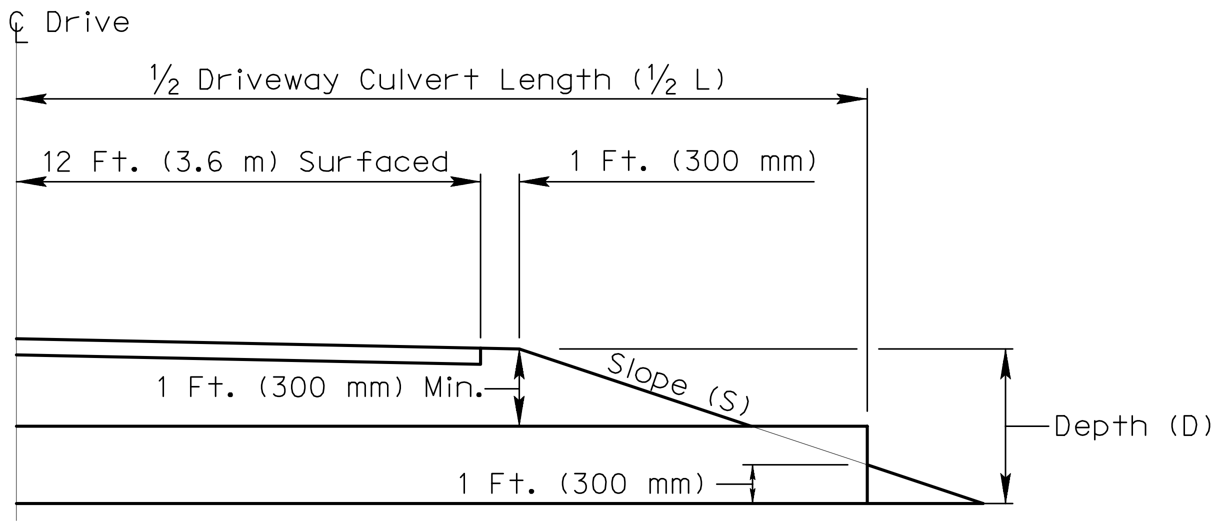


Exhibit 4.16 Rural Driveway With a Special Ditch



26 ft. WIDE DRIVEWAY *				
	SIDE SLOPE (S)			
DEPTH (D)	3:1 [1]	4:1 [2]	6:1 [3]	10:1 [4]
3 ft. (Min. D for 24" Culv.)	38 ft.	42 ft.	50 ft.	66 ft.
3.5 ft. (Min. D for 30" Culv.)	41 ft.	46 ft.	56 ft.	76 ft.
4 ft. (Min. D for 36" Culv.)	44 ft.	50 ft.	62 ft.	86 ft.
4.5 ft. (Min. D for 42" Culv.)	47 ft.	54 ft.	68 ft.	96 ft.
5 ft. (Min. D for 48" Culv.)	50 ft.	58 ft.	74 ft.	106 ft.
5.5 ft. (Min. D for 54" Culv.)	53 ft.	62 ft.	80 ft.	116 ft.
6 ft.	56 ft.	66 ft.	86 ft.	126 ft.
6.5 ft.	59 ft.	70 ft.	92 ft.	136 ft.
7 ft.	62 ft.	74 ft.	98 ft.	146 ft.
7.5 ft.	65 ft.	78 ft.	104 ft.	156 ft.
8 ft.	68 ft.	82 ft.	110 ft.	166 ft.
	MINIMUM DRIVEWAY CULVERT PIPE LENGTH (L)			

* To determine the driveway culvert length for the maximum driveway width of 42 ft, add 16 ft. to L.

For ditch depths other than those given:

1. Add 6 ft. to L for each additional 1 ft. of depth.
2. Add 8 ft. to L for each additional 1 ft. of depth.
3. Add 12 ft. to L for each additional 1 ft. of depth.
4. Add 20 ft. to L for each additional 1 ft. of depth.

Exhibit 4.17 Rural Driveway Culvert Pipe Lengths

2.B Urban Driveways

The number of urban driveways should be minimized to reduce the hazard potential and to maintain highway capacity. Joint use driveways are desirable in urban locations to limit conflict points. Whenever possible, driveway access should be located outside of the storage length at signalized intersections in order to avoid conflicting movements and false signal actuations. Driveway design with signal controls requires a traffic analysis by the **Traffic Engineering Division** to coordinate signal design and pavement geometrics.

A major part of design work on private entrances in urban areas involves improvements to existing locations. Factors to be considered are:

- Accommodation of existing access.
- Development of abutting property.
- Up-to-date information on adjacent development.
- Access control regulations and requirements.
- Location of curb inlets.

All new urban driveway design will be in accordance with the criteria shown in **EXHIBIT 4.18** and in Access Control Policy to the State Highway System, (Reference 4.11). See **EXHIBIT 4.19** for a typical urban driveway design. Driveway geometrics are referenced to the project centerline. Major driveways that are signalized should be designed as intersections.

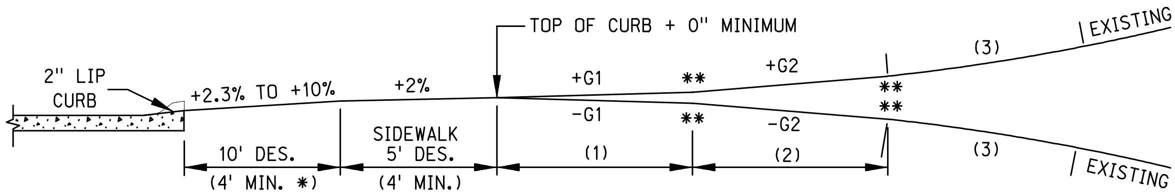
The allowable driveway grade between the 2" (50 mm) lip curb and the sidewalk, not including sidewalks located directly behind the curb, shall be between +2.3% and +10%, with a maximum allowable grade of +15% with **Assistant Design Engineer** approval.

Driveway Type	Urban Driveway Width *	
	Residential Drive	**Commercial Drive**
Single	12 ft. (3.6 m) minimum	40 ft. (12 m) maximum
Double	24 ft. (7.2 m) maximum, in existing locations only. Use single in new locations.	---
Joint Use (Driveway on property line)	24 ft. (7.2 m) desirable	40 ft. (12 m) maximum

Note: The minimum urban driveway radius is 10 ft. (3 m) with 15 ft. (4.5 m) desirable and 25 ft. (7.5 m) maximum for commercial driveways.

* Measured at the throat of the driveway.

Exhibit 4.18 Urban Driveway Width Criteria

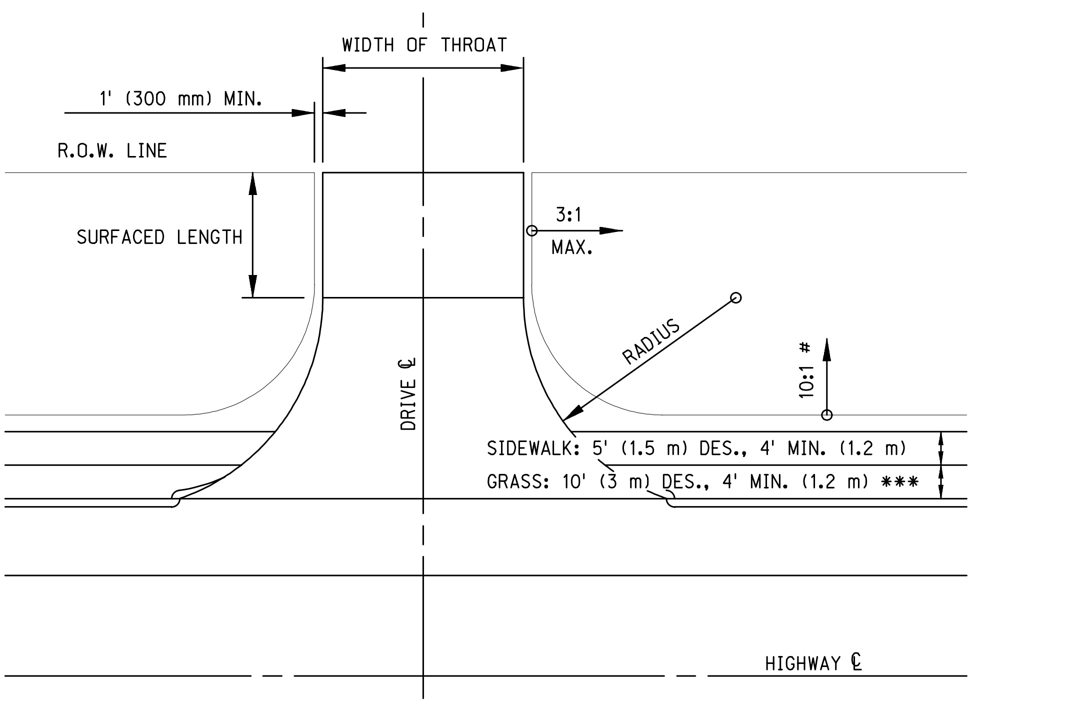


PROFILE URBAN DRIVEWAY WITH SIDEWALK OR FUTURE SIDEWALK
(MAXIMUM ALLOWABLE PERCENT OF GRADE)

1. 10' MIN. (3 m) IS REQUIRED WHEN THE EXISTING GRADE IS GREATER THAN 8%.
2. 10' MIN. (3 m) IS REQUIRED WHEN THE EXISTING GRADE IS GREATER THAN 15%.
3. 10' MIN. (3 m) ROUNDING IS REQUIRED WHEN THE EXISTING GRADE IS GREATER THAN 22%.

* 0' IS ALLOWED IN URBAN BUSINESS DISTRICTS WITH SIDEWALKS OF 6' (1.8 m) MIN.
** 10' MIN. (3 m) ROUNDING DESIRABLE FOR THE FOLLOWING GRADE CHANGES.
- FOR SAGS WITH A CHANGE IN GRADE GREATER THAN 7% USE AN 80' (24 m) MIN. RADIUS.
- FOR CRESTS WITH A CHANGE IN GRADE GREATER THAN 10% USE A 50' (15 m) MIN. RADIUS.

DRIVEWAY TYPE	G1 (MAX.)	G2 (MAX.)
COMMERCIAL, INDUSTRIAL	+/- 5%	+/- 8%
DWELLINGS (RESIDENTIAL)	+/- 8%	+/- 15%



\# 10:1 DES., 6:1 MIN. WITHIN LATERAL OBSTACLE CLEARANCE DISTANCE, THEN TRANSITION TO 3:1 IN 15' (4.5 m).
*** 0' ALLOWED IN URBAN BUSINESS DISTRICTS WITH SIDEWALKS OF 6' MIN. (1.8 m) WIDTH.

URBAN DRIVEWAYS

Exhibit 4.19 Urban Driveway

In urban settings, curb cuts for residential as well as for commercial entrances may occur frequently along any given street. At intersections in high traffic areas, zoning ordinances typically allow for the development of commercial establishments that can generate large traffic volumes. The presence of one or more driveways in each quadrant of an intersection increases the number of potential conflict points within an intersection. The Access Control Policy to the State Highway System, (Reference 4.11), and local ordinances govern the curb cut locations.

Driveway traffic may adversely affect intersection operation. Traffic intended in theory to queue in a right turn lane may be interrupted by driveway traffic. The result could be a reduction in intersection capacity. The combination of driveways and channelization can also have negative effects on intersection operation as vehicles seek to gain access to corner properties via illegal turns. Driveway design involving shopping centers, truck stops, schools and plants with large parking lots require a special traffic analysis by the **Traffic Engineering Division** to coordinate the number of lanes, traffic controls and required storage lengths.

3. SURFACING

Determination of surfacing type for intersections and driveways is site specific. There are no absolute rules governing this topic. Surfacing type for intersections and drives should be discussed and determined at plan-in-hand meetings utilizing the district’s local experience.

The following surfacing type guidelines apply for intersections, medians and driveways:

1. If surfacing is desired, asphaltic concrete is the material of choice. Surface intersections and driveways with asphaltic concrete if the mainline road and shoulders are surfaced with asphaltic concrete. Residential drives should be surfaced with asphaltic concrete except as indicated below.
2. Concrete will be specified only if:
   a) The mainline is concrete and an appreciable amount of truck traffic exists or is anticipated for the intersection or drive;
   b) The existing driveway or intersection is surfaced with concrete; or
   c) The driving lane and shoulders are surfaced with concrete and there is no asphalt available on the project.
3. For new residential driveways, the landowners’ choice will be either concrete, asphaltic concrete or gravel/rock depending on the availability of the material on the project.
4. Field entrances will not be surfaced except in the Sandhills Region. In the Sandhills Region, consider using millings to surface field entrances wherever possible.
5. The roadway designer should provide input on the type and estimated amount of traffic on driveways, if available, to the **Materials and Research Division** for surfacing thickness determination.

3.A Intersection Surfacing

Intersection surfacing thickness should be a minimum of 6 in. (150 mm). Unless otherwise determined at the plan-in-hand field inspection, the limit of surfacing will be to the end of the intersection return. Where parallel railroad tracks run within 200 ft. (60 m) of the edge of the pavement, the crossroad should be surfaced to the tracks, (See **EXHIBIT 4.20**). Placement of rushed rock or gravel surfacing is normally required behind the surfaced intersection or drive as shown in **EXHIBIT 4.20**.

3.B Driveway Surfacing Guidelines

- Concrete driveway surfacing thickness should be 6 in. (150 mm) unless the driveway is a commercial drive with heavy vehicles, where thicker material will be used and shown on the plans. Drives are surfaced with concrete only when traffic is heavy.
- Asphaltic concrete driveway surfacing thickness should be 6 in. (150 mm) but the designer may specify a thicker asphalt surface, [8 in. (205 mm)], if conditions warrant.
- Concrete drives should be replaced with asphalt unless the landowner insists on a concrete drive or there is no asphalt on the project.
- In most cases, the limit of surfacing will be either to the end of the return or to the existing driveway surface.
- With the exception of the Sandhills Region, field entrances should not be hard surfaced even if they are at unrestricted access breaks. Consult with the **District Engineer** at the plan-in-hand field inspection to verify.

There is no substitute for good judgment when administering these guidelines. Some things to consider when deciding to deviate from them:

- Will the traveling public receive genuine benefit in terms of safety or operational enhancement?
- Access maintenance is the responsibility of the landowner.
- Availability and effectiveness of surfacing material.
- Fairness to other landowners on the project or in the area.

3.B.1 Rural Driveways

When placing concrete driveways against existing pavement, the following practices should be followed (See **EXHIBIT 4.21**):

- For a concrete driveway abutting a concrete shoulder, the driveway should be lugged out (the driveway pavement at the end of the return near the mainline is offset 2 ft. (600 mm) from the mainline at the beginning of the radius).
- For concrete driveways abutting an asphalt road with asphalt shoulders, the driveway should be lugged out.
- For concrete driveways abutting a concrete road with asphalt shoulders, the existing shoulder shall be removed from the end of return to end of return and placed as concrete for the full width of the shoulder.
- For concrete driveways abutting an asphalt or concrete road with turf shoulders, the driveway shall be lugged out from the edge of the driving lane.

When placing asphalt driveways, the following practices should be followed:

- For an asphalt driveway abutting an asphalt or concrete shoulder: the driveway return should be tangent with the edge of the shoulder.
- For an asphalt driveway abutting an asphalt or concrete road with turf shoulder: the driveway return should be tangent with the edge of the roadway.

Consult with the **District Engineer** regarding the lug in/lug out options.

3.B.2 Urban Driveways

The limits of surfacing in urban areas generally will be to:

- The end of the return;
- The existing surface; or
- The right-of-way line;

Whichever is the least distance from the edge of the pavement, allows a suitable driveway grade, and matches into the remaining portion of the driveway (See **EXHIBIT 4.19**). Check with the **District Engineer** at the plan-in-hand for verification.

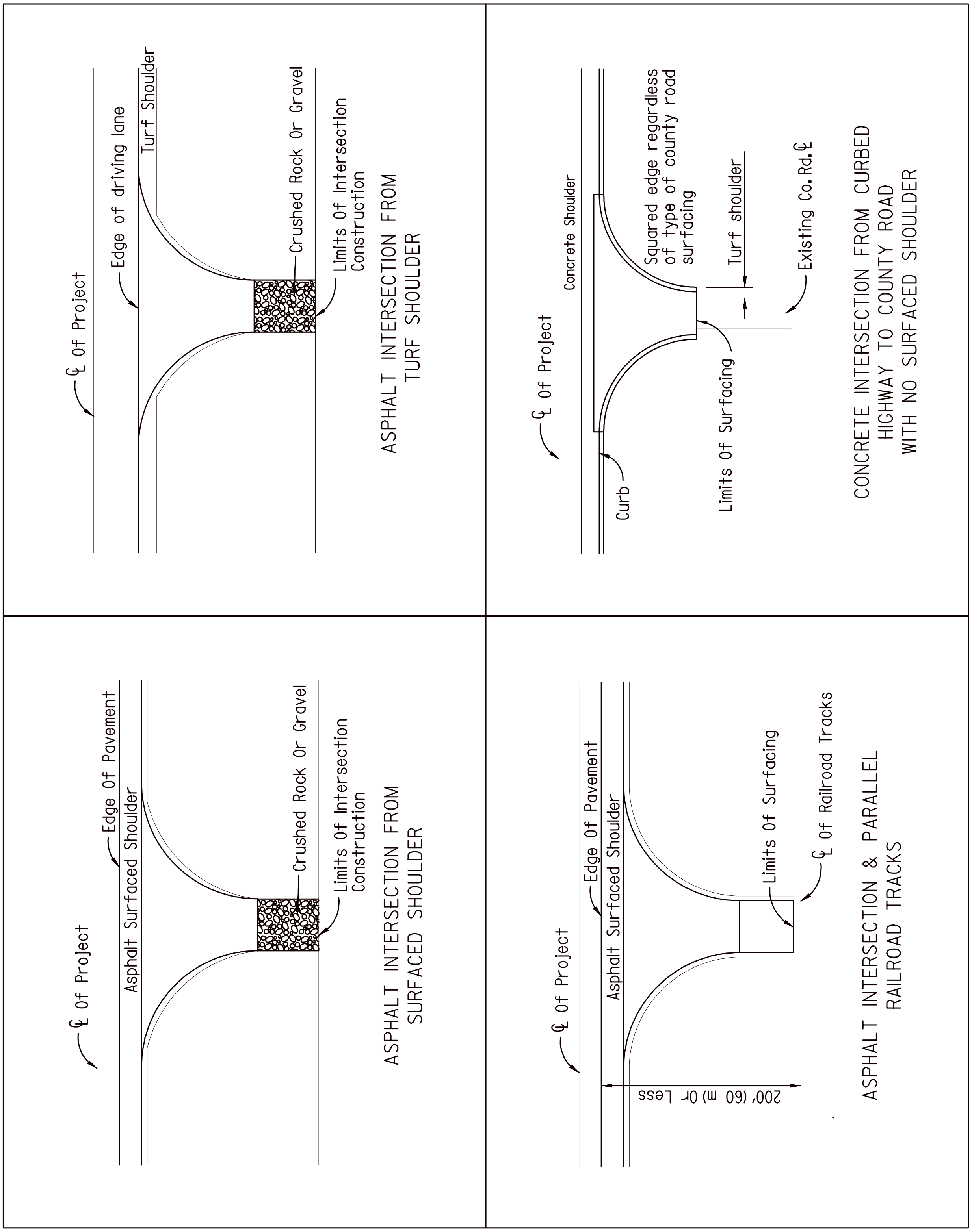


Exhibit 4.20 Limits of Surfacing at Co. Road Intersections and Other Public Roads

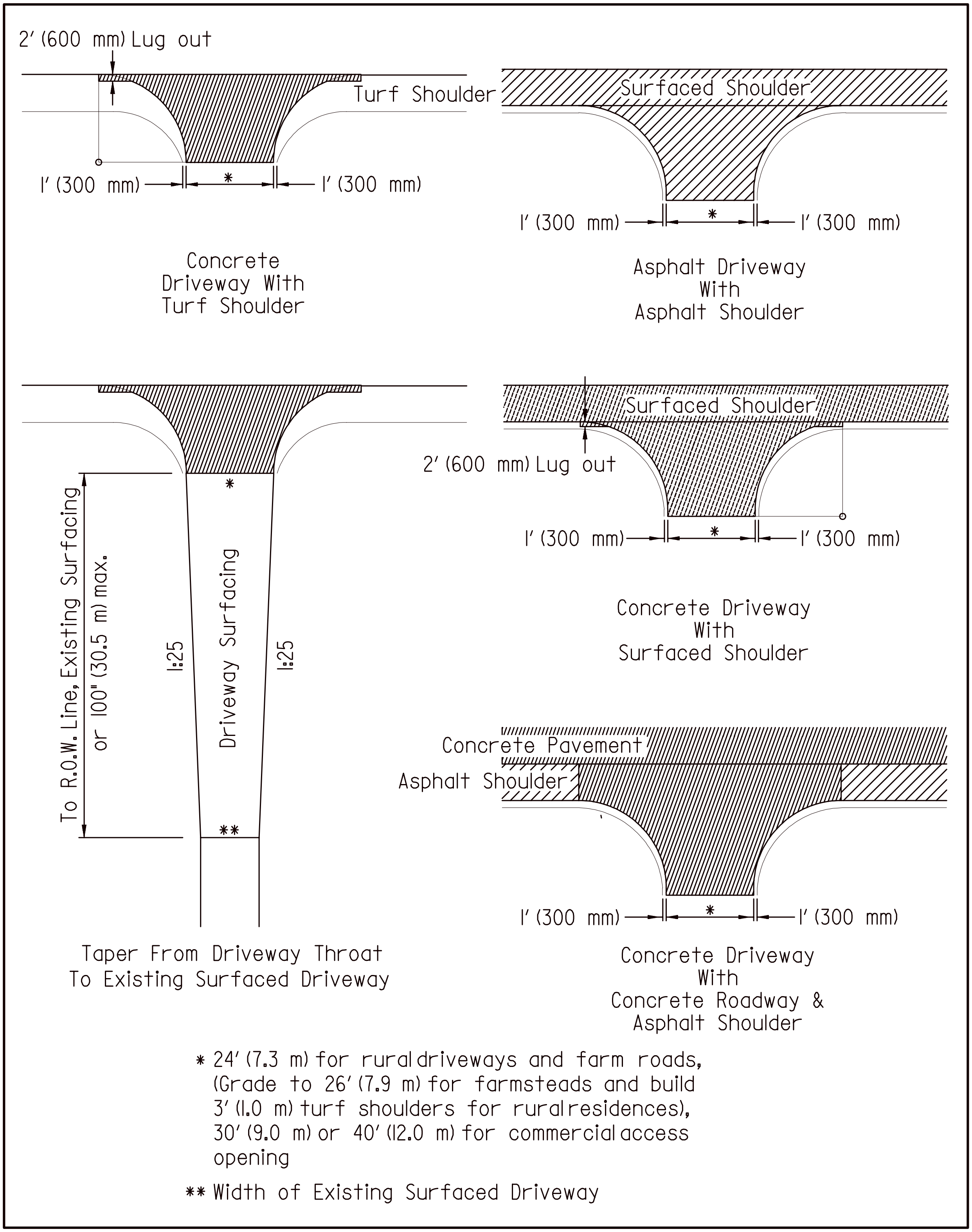


Exhibit 4.21 Surfacing Criteria for Rural Driveways

4. BUILD NOTES FOR INTERSECTIONS AND DRIVEWAYS

The following guidelines have been established for build notes for intersections and driveways:

1. Use BUILD in the note for driveways and intersections if any of the following conditions are present:

   - A new drive or intersection is being constructed.
   - A drive or intersection is being relocated.
   - The top width of the intersection or driveway is being changed.
   - A new driveway pipe is being laid or an existing pipe is being relaid.
   - A new culvert pipe is being constructed within the radii of an existing surfaced intersection.
   - According to New & Reconstruction Standards, side slopes are being graded.
   - Driveway sideslopes are flattened within the lateral obstacle clearance distance.

2. Use SURFACE in the note for driveways and intersections if none of the above conditions are present. On resurfacing projects without surfaced shoulders, do not consider roadway grading that warps around an existing intersection as a change in the top width.

3. If a BUILD note is used for an intersection note, the words "and surface" shall not be in the note. If a BUILD note is used for a driveway note and the driveway is also to be surfaced, then the words "and surface" shall be included in the note.

4. With regard to two three-way intersections that intersect the project centerline close to each other, show two three-way notes.

5. CHANNELIZATION

The patterns and volume of both vehicular and pedestrian traffic movement during peak periods will be factors in the degree of channelization required. A traffic analysis, identifying the relative importance of conflicting movements, is generally performed to establish the type of channelization to be used. Giving preference to major movements is a good practice. This may require the control or even the elimination of minor movements such as stopping or parking. Examples of channelized intersection designs are shown in **EXHIBITS 4.22 AND 4.23**. Close liaison should be maintained with the **Traffic Engineering Division** throughout intersection design regarding channelization and other issues.

The following principles should be applied when designing a channelized intersection:

1. Motorists should be confronted with no more than one decision at a time.
2. Unnatural paths requiring turns greater than 90° and sudden sharp reverse curves should be avoided.
3. Areas of vehicle conflict should be reduced as much as possible.
4. Traffic streams that cross without merging and weaving should desirably intersect at skew angles less than 10°. Skew angles up to 15° are acceptable with a maximum skew angle up to 30° allowable for new construction depending upon traffic volumes.
5. The angle of intersection between merging traffic streams should provide adequate sight distance.

6. Points of crossing or conflict should be evaluated for other possible treatments such as separation or consolidation with appropriate control devices.
7. Storage areas for turning vehicles should be provided clear of through traffic.
8. Approach road designs based on refuge for vehicles in medians, to either turn left or to pass straight through, will not be considered.
9. Prohibited turns should be blocked wherever possible.
10. Location of essential control devices should be established as a part of the channelization design.
11. Channelization may be desirable to separate various traffic movements where multiple phase signals are used.

The need for roadway illumination increases as channelization is introduced at an intersection. The driver needs to have an intended path clearly defined within the limits of approach sight distance in order to adjust speed, align with tapers and avoid median or island noses and corners.

Islands and medians can be used as divisional and directional devices. The designer should weigh the benefits of positive vehicle control versus the hazard presented by a barrier adjacent to a travel lane when considering an island or a raised median.

A Policy on Geometric Design of Highways and Streets, (Reference 4.1c, Chapter 9), and the "Intersection Channelization Design Guide", (Reference 4.3), should be consulted for further information about channelization.

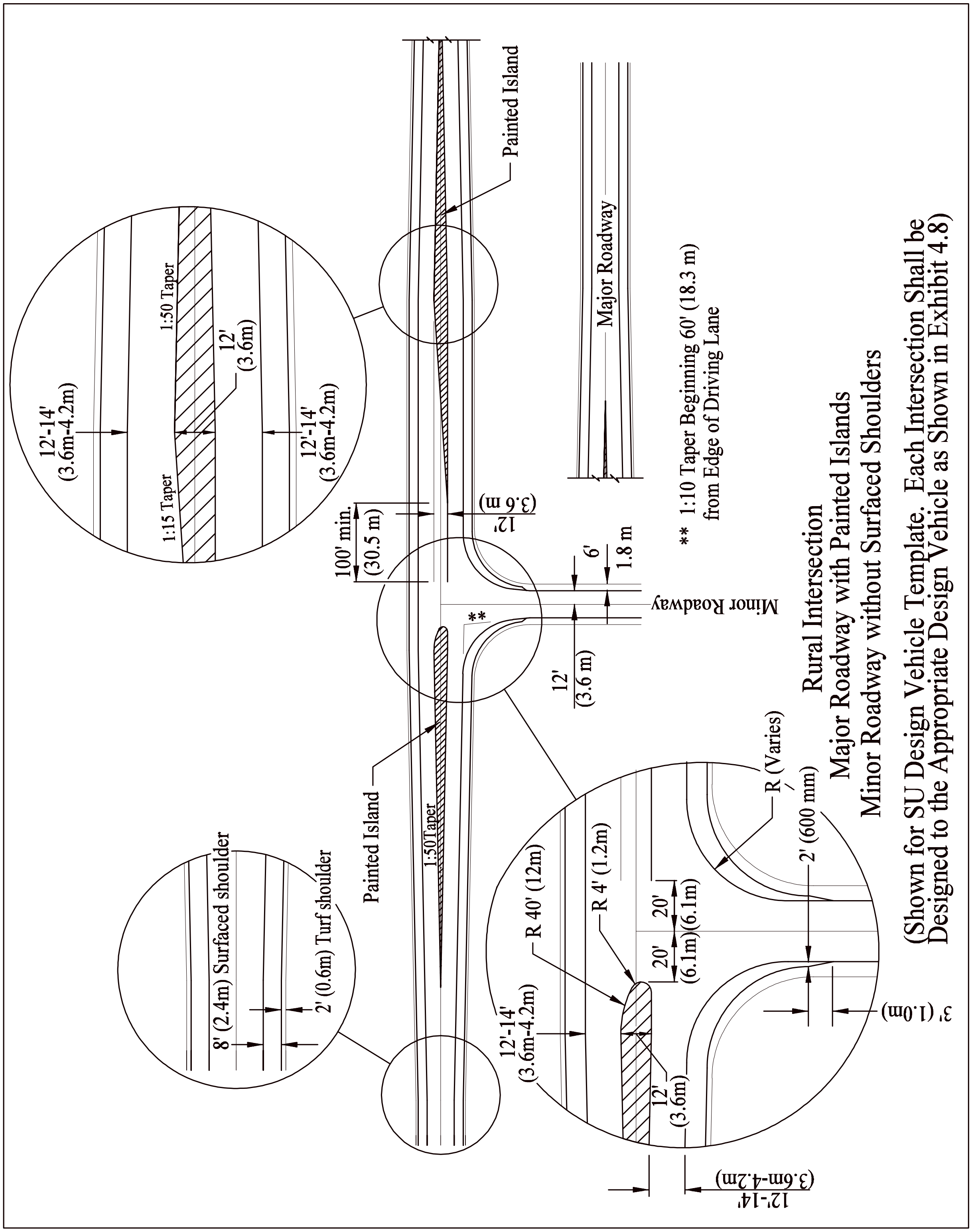


Exhibit 4.22 Example of Rural Three-Leg Intersection with Minor Roadway Without Surfaced Shoulder

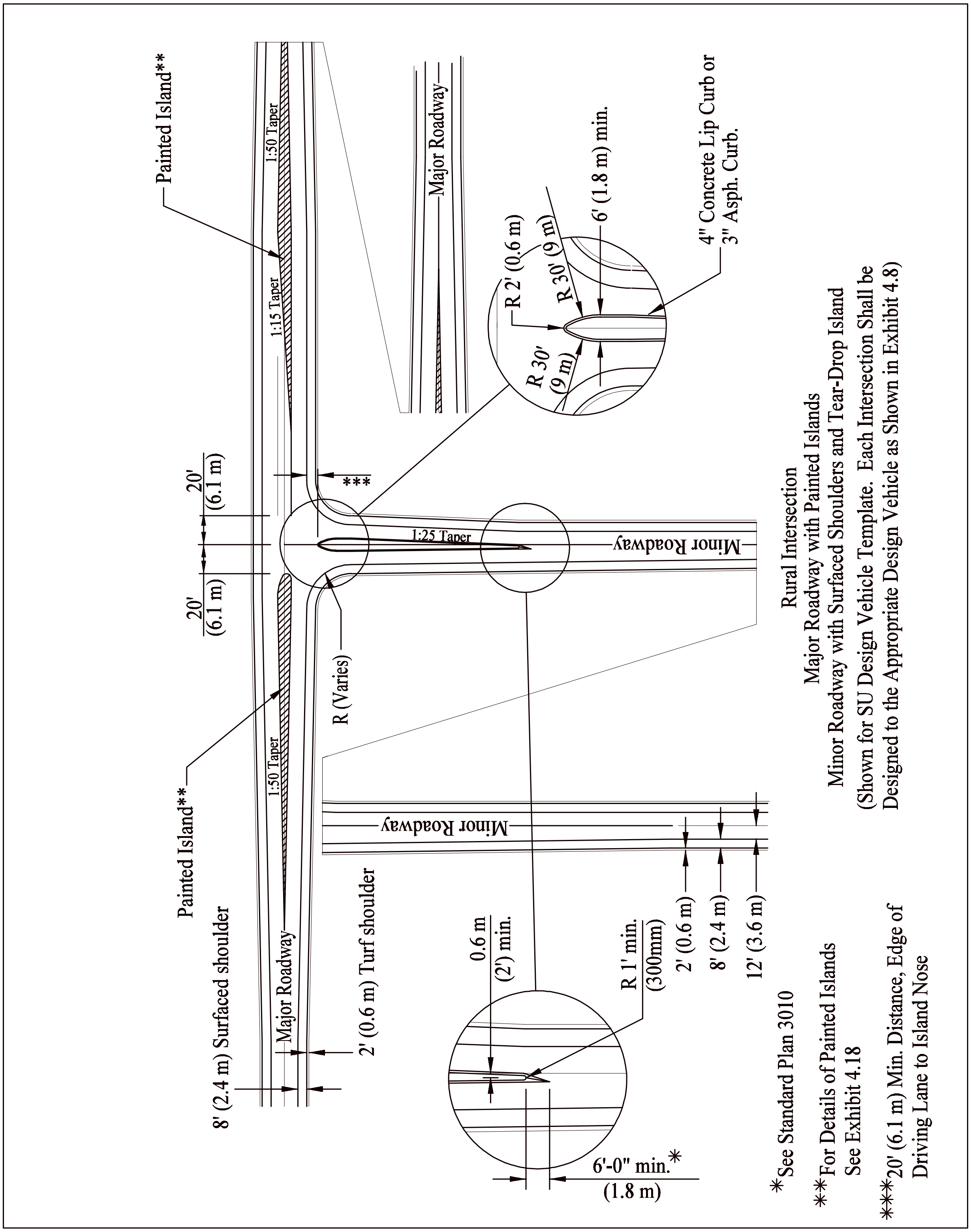


Exhibit 4.23 Example of a Rural Three-Leg Intersection with Minor Roadway With Surfaced Shoulder

5.A <u>Islands</u>

Islands should be designed to define the driving path. Channelizing islands may be flush islands of the same material as the travel lanes or of concrete imprinted brick, and they may be outlined by raised, painted, or thermoplastic pavement markings.

Teardrop raised islands on the minor approach are acceptable at state highway crossings and high-volume county roads (See **<u>EXHIBIT 4.23</u>**). These islands are to be installed when the intersection radius must be increased to accommodate turning trucks, moving the stop sign too far to the right. The designer must remember to design the island so that it does not conflict with trucks turning off the mainline roadway. The island for the mainline approach will be painted and 12 ft. (3.6 m) wide.

For non-developed suburban crossroads, the following guidelines apply:

1. If the intersection warrants signalization within five years of the programmed construction, the project will include signals. A raised or flush median (determined on a project-by-project basis) with a left turn lane will be constructed. If access control is purchased on the mainline, it shall extend up the cross road approximately 200 ft. (60 m) from the centerline of the mainline.
2. If signals are not warranted five years from construction, but are warranted sometime within 20 years of construction, the grading and right-of-way will be accomplished for future islands, but the paving will be constructed to two-lane, stop-control geometrics.

For urban and developed suburban crossroads, the following guidelines apply:

1. If signals are warranted within five years of construction, the project will include signals. An island with a left turn lane will be designed and it will be flush (painted) unless the city or county has requested that it be raised.
2. If signals are not warranted within five years of construction, then a standard two-lane intersection will be constructed. When signals are installed, the intersection will be reconstructed as required.

In highly developed urban settings, raised islands provide the most positive delineation.

The use of a raised concrete island for pedestrian refuge should be considered if a crosswalk traverses the channelization. Raised islands with mountable curb may also be used for the placement and protection of traffic signals at right turn lanes. See the <u>Standard/Special Plan Book</u>, (Reference 4.13), for concrete island details and curb ramps, and see Chapter Ten: <u>Miscellaneous Design Issues</u>, Section 10.B.3, for information regarding pedestrian crosswalks.

Curb height on raised islands on urban roadways is a function of design speed. The following curb policy applies:

- On high-speed facilities [design speed ≥ 45 mph (70 km/h)], 4 inch (100 mm) mountable concrete curb and 3 inch (75 mm) asphaltic concrete curb are permitted in both urban and rural settings.
- Use 4 inch (100 mm) and 3 inch (75 mm) mountable curb on teardrop islands.
- On low speed facilities [design speed ≤ 45 mph (70 km/h)], 6 inch (150 mm) mountable curbs are permitted.

In rural areas, raised islands should be limited to locations such as channelized cross roads at interchanges or at locations with high visibility. In high-speed locations raised islands should be avoided or, if they cannot be avoided, they should be supplemented by roadway illumination. Flush islands with pavement markings should be used in areas where operating speeds and traffic volumes are high.

5.B Medians

A median is defined as the portion of a divided highway separating the travel way for traffic in opposing directions. Medians are highly desirable on arterials carrying four or more lanes.

5.B.1 Median Uses

Medians on multilane highways and roadways provide the following:

- Separation from opposing traffic.
- A recovery area for errant vehicles.
- Facilitate drainage on crowned multilane sections.
- Prevent undesirable turning movements.
- Provide deceleration lanes and storage for left turning vehicles.
- Provide width for future lanes.

The Nebraska Minimum Design Standards (Reference 4.6) indicates the facility classifications for which medians are required. The decision to include a median on a multilane facility is often controversial and may be decided during the engineering review, the plan-in-hand field inspection or during the public hearing process.

5.B.2 Median Types

Flush or Painted Medians - Flush or painted medians are typically used on urban highways and streets. These medians are often used as two-way left-turn lanes in urban areas.

Raised Medians - Raised medians are typically used on urban highways and streets to control access and left turns. The Standard/Special Plans Book, (Reference 4.13) shows a typical detail of a raised concrete median. The decision of whether or not to surface a raised median, and surfacing type, will be made on the plan-in-hand field inspection. Mow strips, a 2 ft. (600 mm) surfaced section between the curb and the turf, may also be considered. As general policy, designers should not design raised medians without approval from the **Roadway Design Division Engineer**.

Depressed Medians - Depressed medians are typically used where practicable on freeways and other divided arterials. Depressed medians have better drainage characteristics.

EXHIBIT 4.24 illustrates the different median types.

5.B.3 Median Design Considerations

Median Width - The width of the median is the distance between the inside edges of the inside travel lanes or from back of curb to back of curb for raised medians (See **EXHIBIT 4.24**). In general, the median should be as wide as can be provided advantageously. The width depends on the type of facility, costs, existing and future development, and right-of-way limitations. Median widths for standard roadway typical sections are shown in the Nebraska Minimum Design Standards, (Reference 4.6). Variations in median widths are considered on a case-by-case basis at the plan-in-hand inspection.

Flush/Raised Median Selection – The designer should first design new non-expressway mainline roadways with flush or painted medians (three or five-lane section). If raised medians provide a better design for a given situation, then they may be used in lieu of flush or painted medians with the approval of the **Roadway Design Division Engineer**.

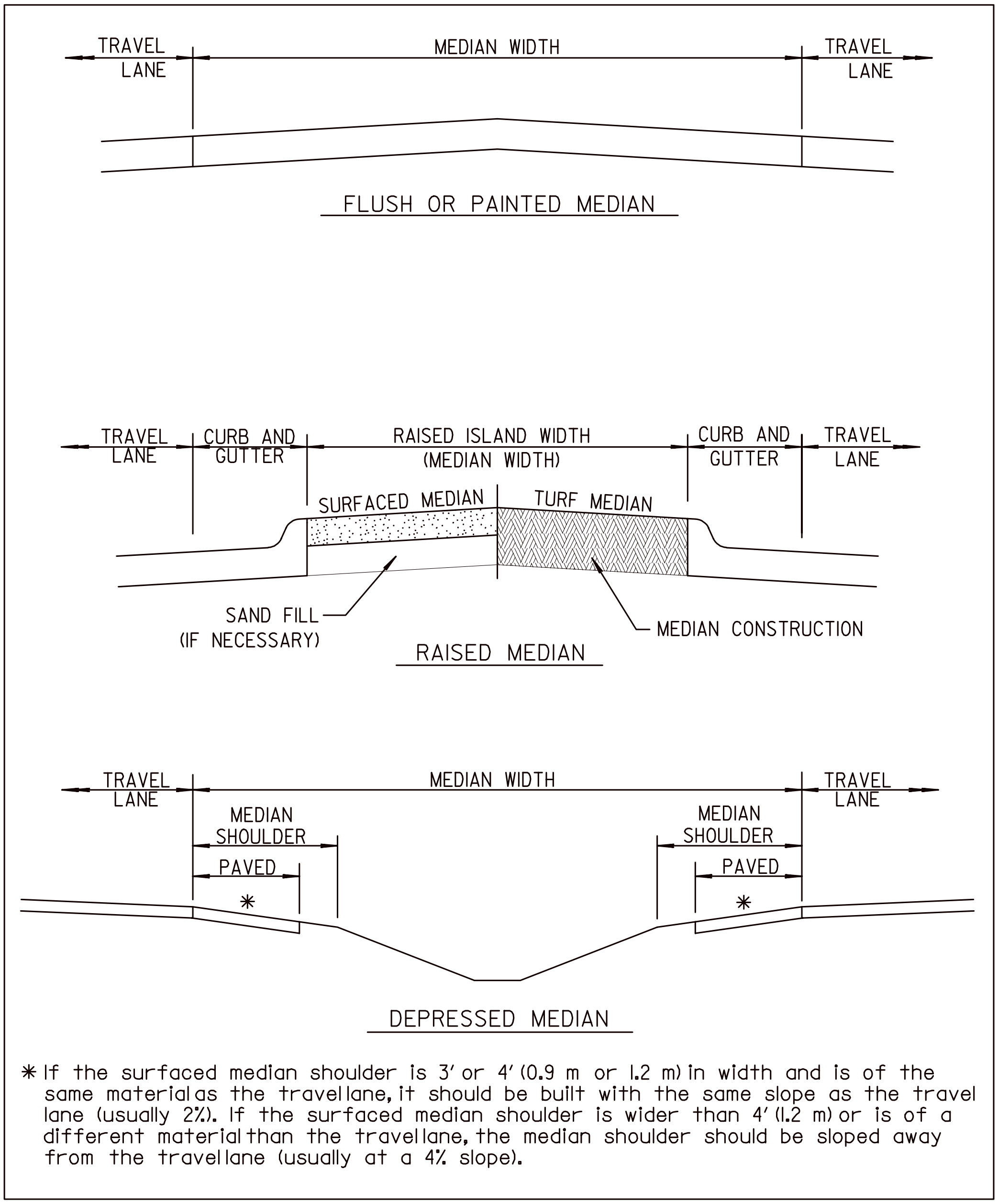


Exhibit 4.24 Median Types

5.B.4 Median Breaks

Depending upon the functional classification of the roadway, median breaks may be provided for cross roads. The median break opening width shall be a minimum of 72 ft. (22 m) (See EXHIBITS 4.25 TO 4.27 for Median Breaks Type A, B and C). Turning templates for the appropriate design vehicle shall be used for the final opening width determination. The designer should also check the effects of median channelization on driveway access in the vicinity of the intersection. Median openings for all types of crossings shall be graded so that this pavement area drains away from the driving lanes.

Three types of median breaks may be used on four-lane roadways with 40 ft. (12.2 m) medians. Type A median breaks (EXHIBIT 4.25) may be used at intersections of the mainline with major county roads, streets and major state highway intersections where there is high probability of turning vehicles blocking the opposing turning driver's view. The left turn lanes are offset so that the line of sight will not be obstructed. The **Traffic Engineering Division** must be consulted when considering this median break type. A special traffic study will be required to justify the use of this type of intersection and for signing and striping warrants. Roadway designers also should consult their supervisors or the **Roadway Design Division Engineer** when proposing the use of Type A median breaks.

Type B median breaks (EXHIBIT 4.26) are appropriate for use at mainline intersections with low-volume county roads and with residential and light commercial drives. Type C median breaks (EXHIBIT 4.27) are used at intersections with field entrances.

5.C Two-Way Left-Turn Lanes

In commercial urban areas, two-way left turn lanes (TWLTL) have been constructed in lieu of 16 ft. (4.8 m) raised medians. The **Traffic Engineering Division** will determine when TWLTL treatment is appropriate. In comparison to no median, TWLTL treatments provide the advantages of:

- Reduced travel time.
- Improved capacity.
- Ability to use the median as a travel lane during closure of a through lane.
- Wide acceptance from abutting property owners.

Providing a TWLTL may be preferable to having vehicles make U-turns at intersections or traveling around the block to reach a destination. Median widths of 12 ft. to 16 ft. (3.6 m to 4.8 m) wide are most adaptable to TWLTL conversion.

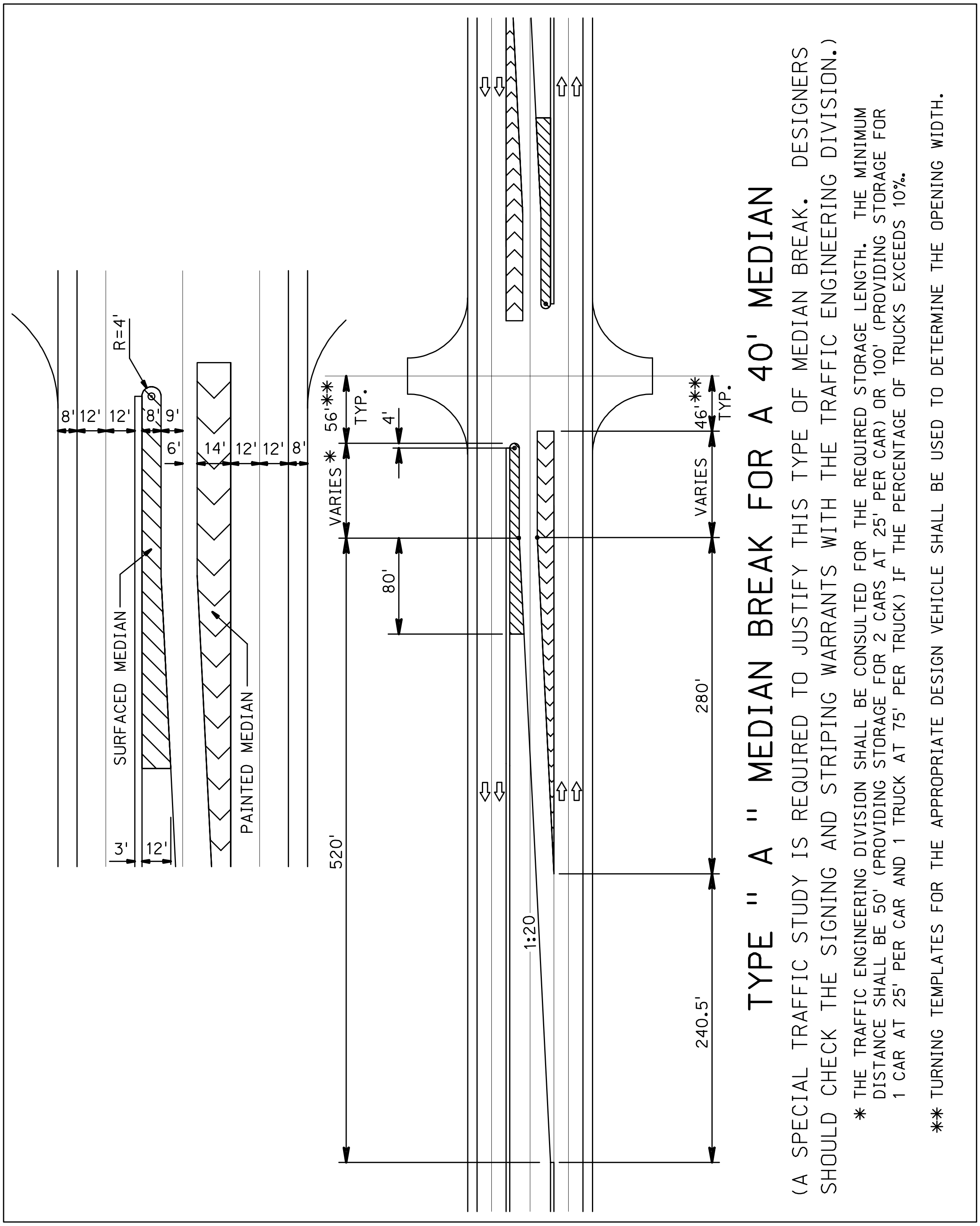


Exhibit 4.25a Median Break Type A (English Units)

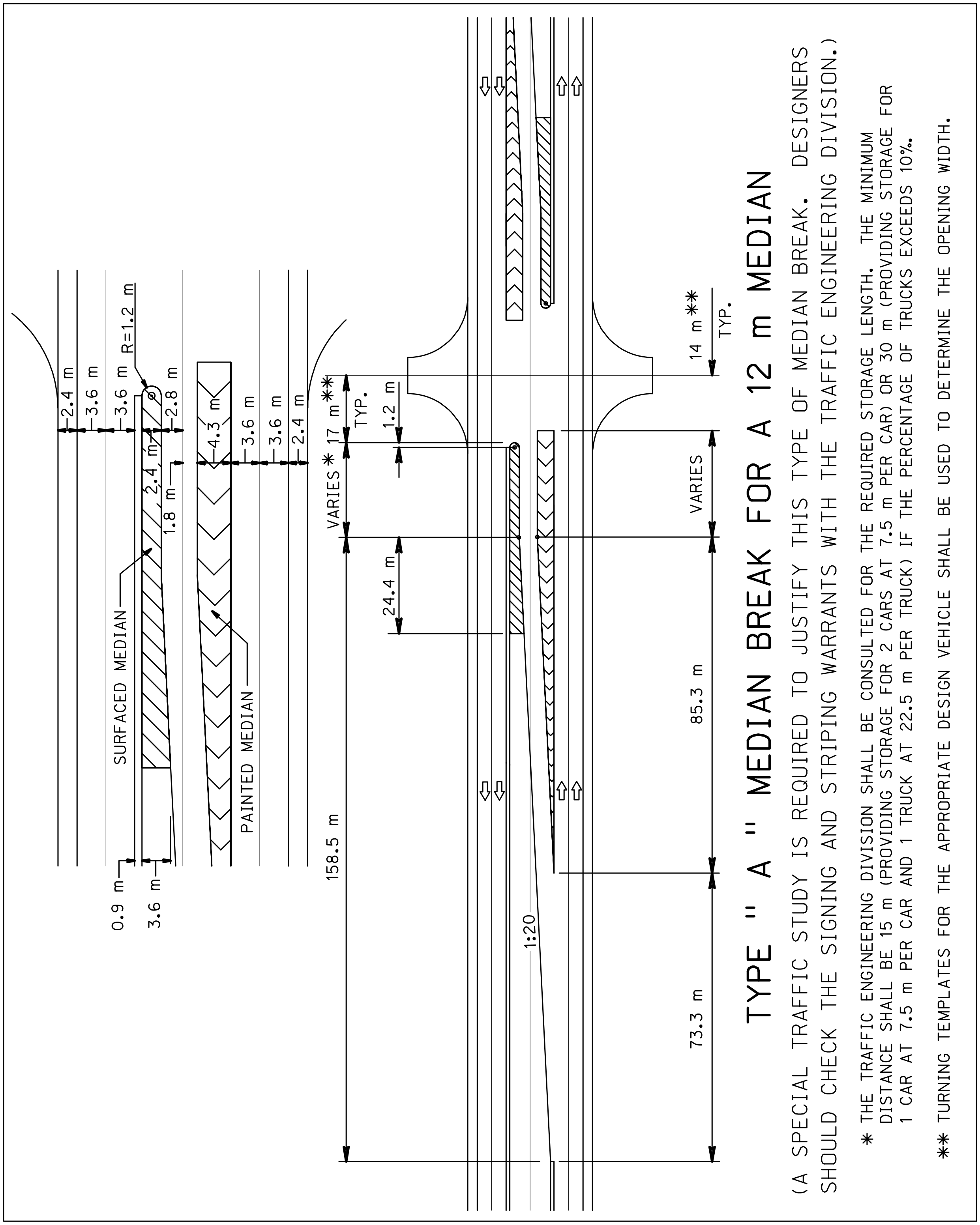


Exhibit 4.25b Median Break Type A (Metric Units)

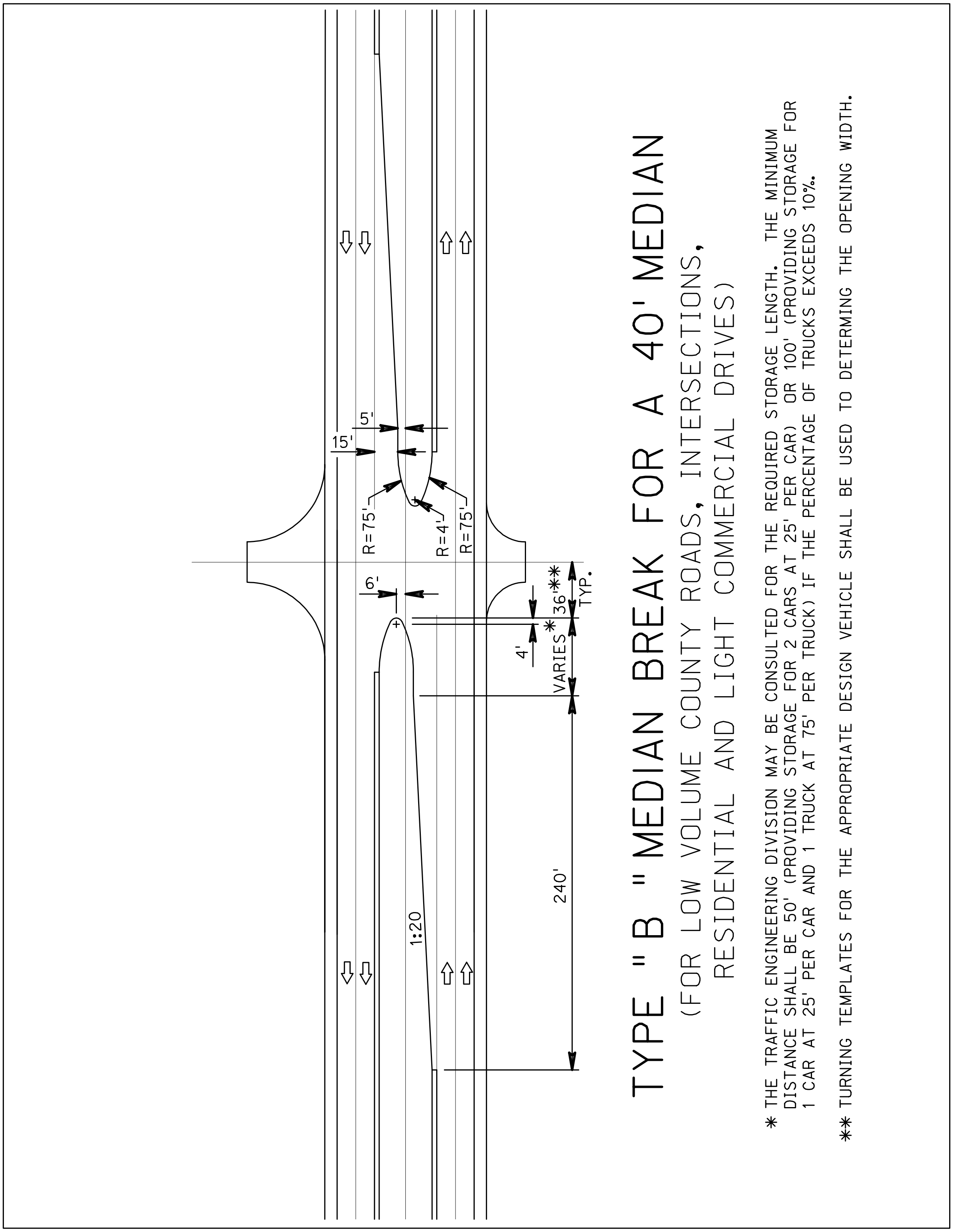


Exhibit 4.26a Median Break Type B (English Units)

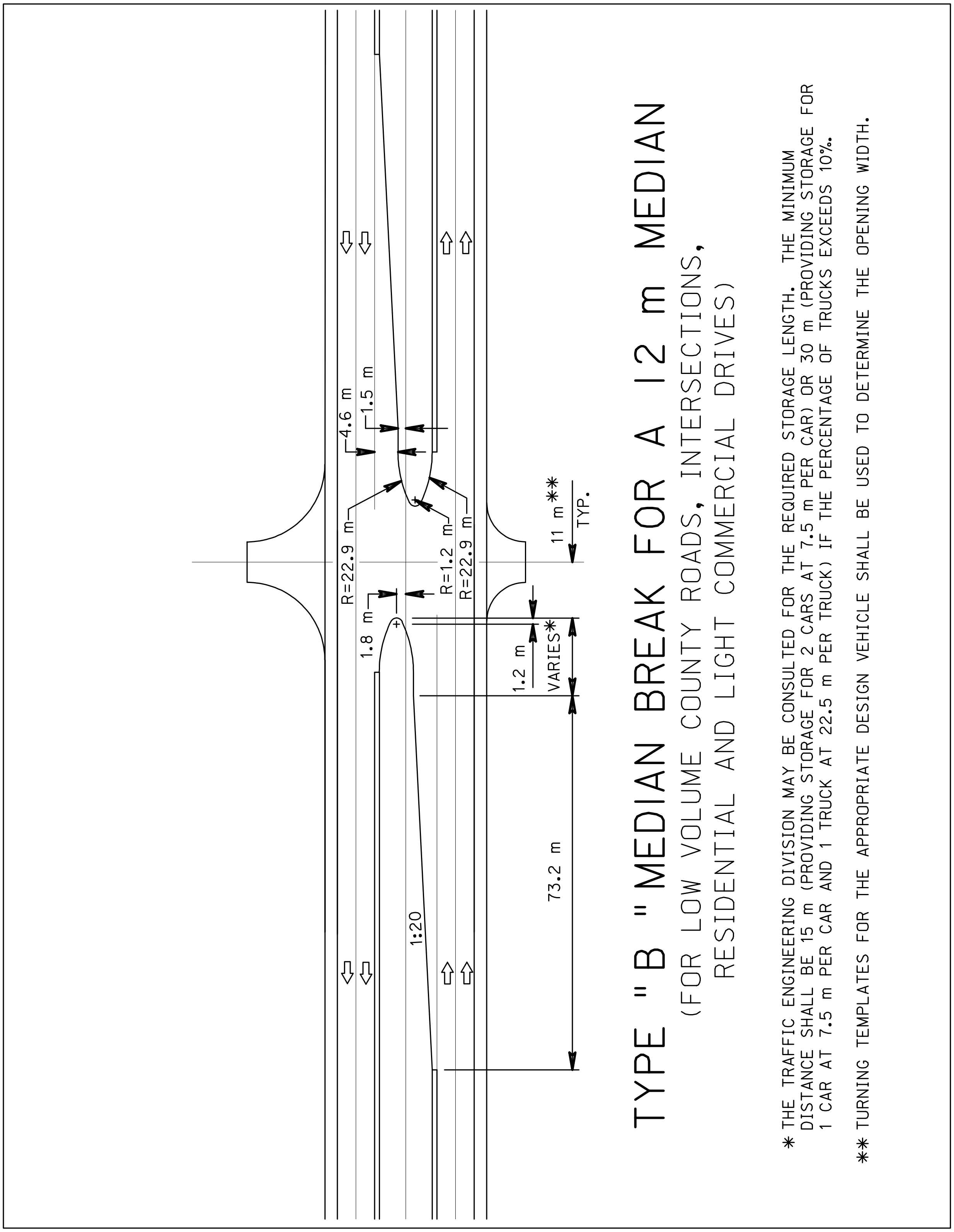


Exhibit 4.26b Median Break Type B (Metric Units)

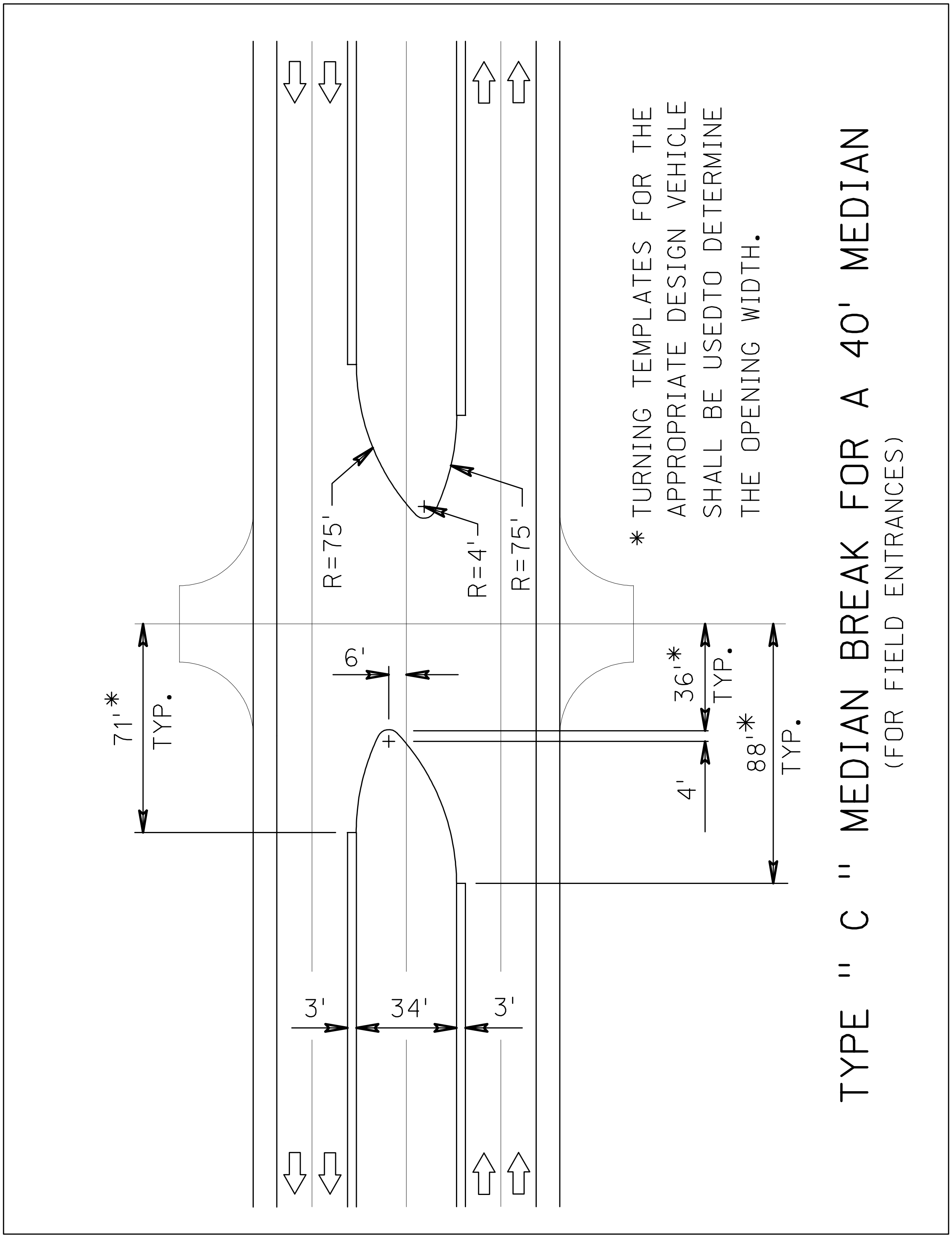


Exhibit 4.27a Median Break Type C (English Units)

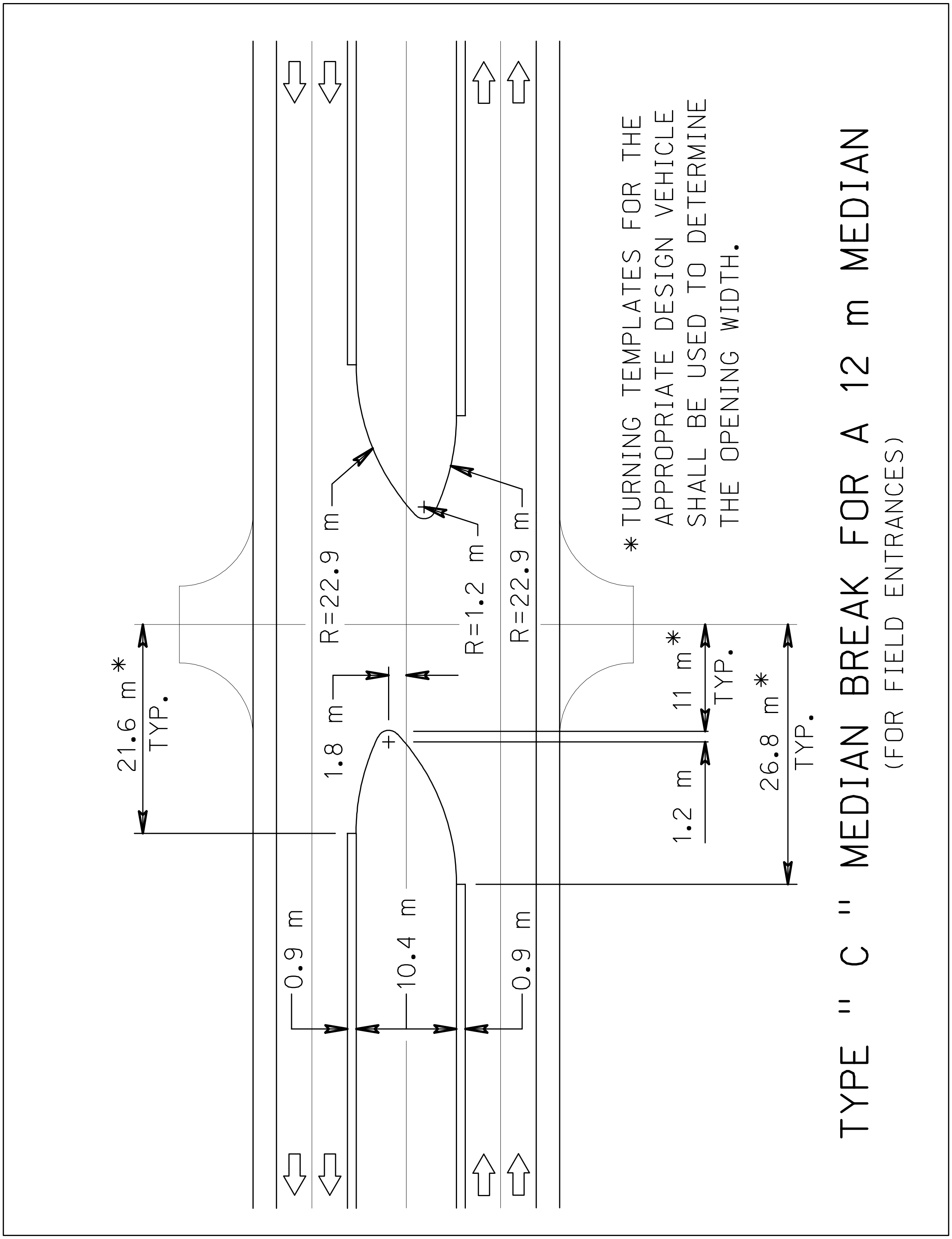


Exhibit 4.27b Median Break Type C (Metric Units)

6. REFERENCES

4.1a American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, DC, 1990. (English units)

4.1b American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, DC, 1994. (Metric units)

4.1c American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, DC, 2001.

4.2 U.S. Department of Transportation, Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, Washington, DC, 2000. (http://mutcd.fhwa.dot.gov/kno-millennium.htm)

4.3 Transportation Research Board, "Intersection Channelization Design Guide", National Cooperative Highway Research Program Report 279, Washington, DC, 1994.

4.4 Transportation Research Board, "Impacts of Access Management Techniques", NCHRP Report 420, Washington, DC, 1999

4.5 Transportation Research Board, National Research Council, Highway Capacity Manual, Special Report 209, Third Edition, Washington, DC, 1998.

4.6 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

4.7 McCoy, Patrick, Eric Tripi and James Bonneson, "Guidelines for Realignment of Skewed Intersections," NDOR Research Project Number RES1 (0099) P471 Transportation Research Studies, University of Nebraska - Lincoln, June 1994.

4.8 S. Architectural and Transportation Barriers Compliance Board (Access Board), "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities," Federal Register, Volume 59, No. 117, Washington, DC, June 20, 1994, and current updates. (http://www.access-board.gov/adaag/html/adaag.htm)

4.9 American Association of State Highway and Transportation Officials, Guide for Development of Bicycle Facilities, Washington, DC, 1999. (http://lakesammfriends.org/AASHTOCyclingGuide.PDF)

4.10 McCoy, Patrick, et al., "Guidelines for Free Right-Turn Lane at Unsignalized Intersections on Rural Two-Lane Highways," TRP-02-32, NDOR Research Project Number RES 1(0099)P603, University of Nebraska - Lincoln, March 1995.

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4.12 American Association of State Highway and Transportation Officials, An Informational Guide for Preparing Private Driveway Regulations for Major Highways, Washington, DC, 1960.

4.13 Nebraska Department of Roads, Standard/Special Plan Book, Current Edition

4.14 Nebraska Department of Roads, Drainage Design and Erosion Control Manual, Current Edition.

4.15 Nebraska Department of Roads, Standard Specifications for Highway Construction, 1997 and current supplemental updates. (http://www.nebraskatransportation.org/ref-man/)

4.16 Nebraska Department of Roads, So You Want Access to the Highway?, Current Edition. (http://www.nebraskatransportation.org/roway/pdfs/accesshwy.pdf).

CHAPTER UNDER CONSTRUCTION

CHAPTER SIX
THE TYPICAL ROADWAY CROSS-SECTION

LIST OF EXHIBITS

CHAPTER SIX
THE TYPICAL ROADWAY CROSS-SECTION

Chapter Six
The Typical Roadway Cross-Section

1. CROSS-SECTION ELEMENTS

The standard typical roadway cross-sections are provided in the Nebraska Minimum Design Standards, (Reference 6.1), (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf). Any variations in the roadway standards must be documented and submitted for approval following the relaxation procedure provided in Chapter One: Design Standards, Section 6.B.

EXHIBIT 6.1 illustrates the basic roadway cross-section elements for curbed and uncurbed facilities. These elements are discussed in the following sections.

1.A Travel Lanes

1.A.1 Travel Lane Widths

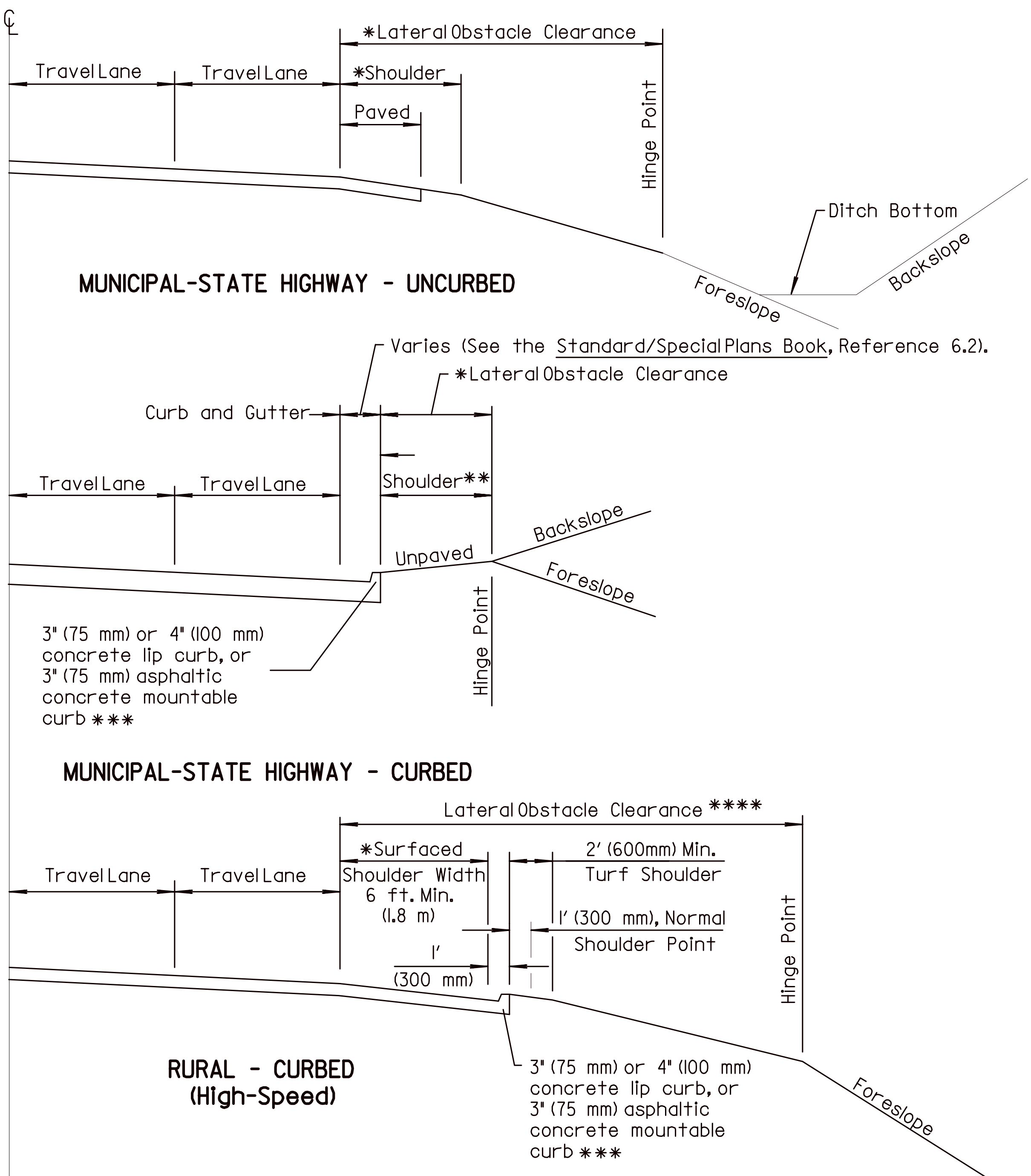
Through lane surface widths vary from 10 ft. to 20 ft. (3 m to 6 m). The normal lane width is 12 ft. (3.6 m) and is determined by the roadway functional classification, traffic volumes and design speed. Required lane widths are presented in the Nebraska Minimum Design Standards, (Reference 6.1).

1.A.2 Travel Lane Cross Slopes

Crowned cross slopes are preferred for multi-lane divided interstates and expressways with depressed medians, which allow for proper drainage. Proper drainage consists of a minimum median width of 36 ft. (11 m) and a minimum median depth of 2 ft. (600 mm). The crowned typical section has the high point of the pavement located at the center of the travel lane and slopes to both shoulders, usually at 2%, minimizing the amount of storm water runoff on the roadway, (See **EXHIBIT 6.2**).

Tangent cross slopes may be used for multi-lane divided interstates and expressways when the median width is too narrow for proper drainage or when future lanes are to be added to the inside (median side) of the travel lanes, as shown in **EXHIBIT 6.3**. The tangent typical section has the high point of the pavement on the inside (median) edge of the travel lane and slopes continuously from the inside shoulder to the outside shoulder, typically at a 2% cross slope. Tangent cross slopes should be used for multi-lane roadways with raised medians or when building two-way-left-turn-lanes on 3-lane or 5-lane undivided highways, (See Chapter One: Design Standards, **EXHIBITS 1.2 and 1.3**).

For additional information see the Nebraska Minimum Design Standards, (Reference 6.1).



*As defined in the Nebraska Minimum Design Standards, (Reference 6.1).
A minimum surfaced shoulder width of 8 ft. (2.4 m) is required for a 4 in. (100 mm) curb.
**A paved Sidewalk may also be provided, see Chapter One: Design Standards, Exhibit 1.2.
***See Section 1.G and 2.A.2
****Rural curbed lateral obstacle clearance distance is the same as for rural uncurbed. See the Nebraska Minimum Design Standards, (Reference 6.1).

Exhibit 6.1 Roadway Cross-Section Elements - New and Reconstructed

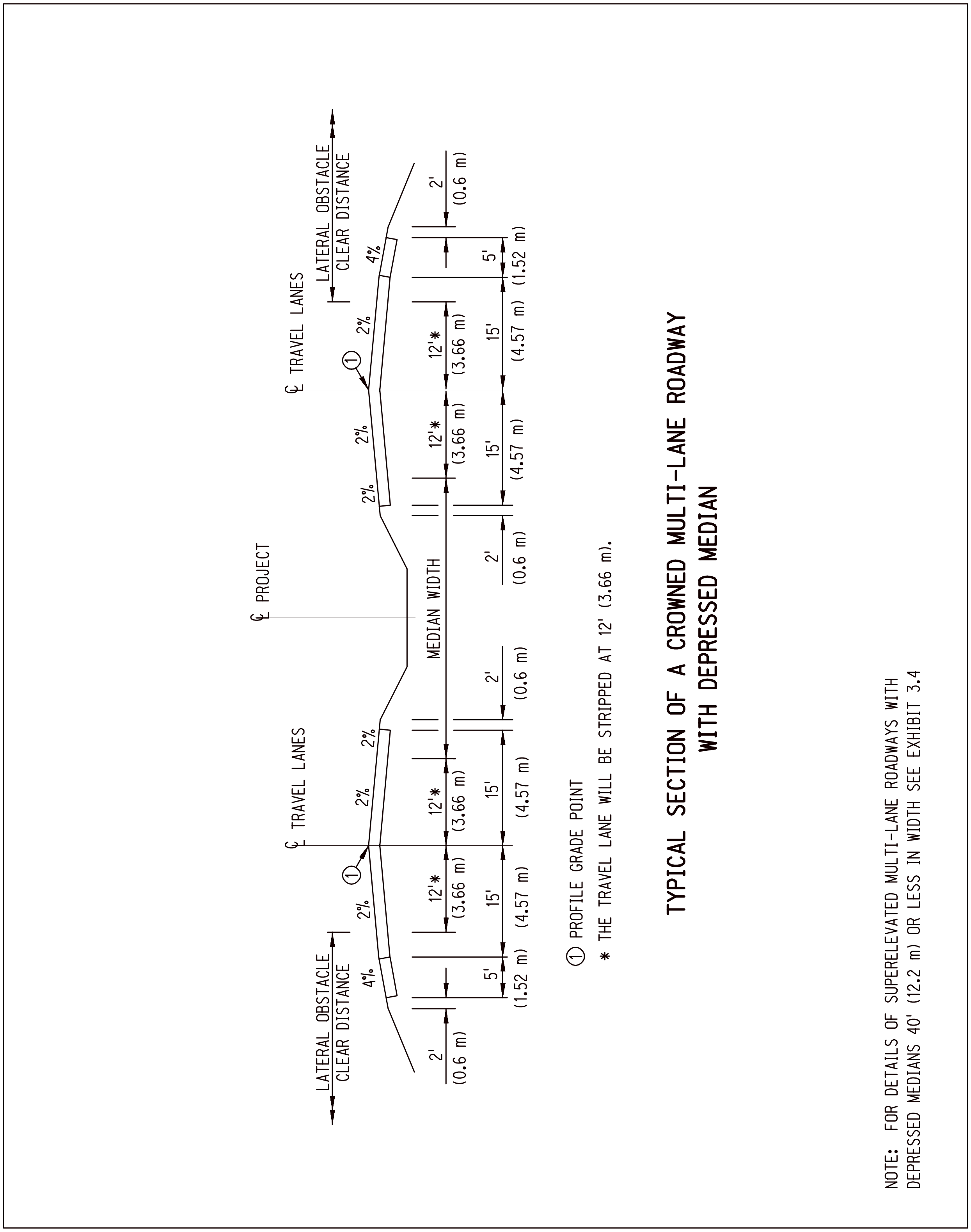


Exhibit 6.2 Typical Section of a Crowned Multi-Lane Roadway With a Depressed Median

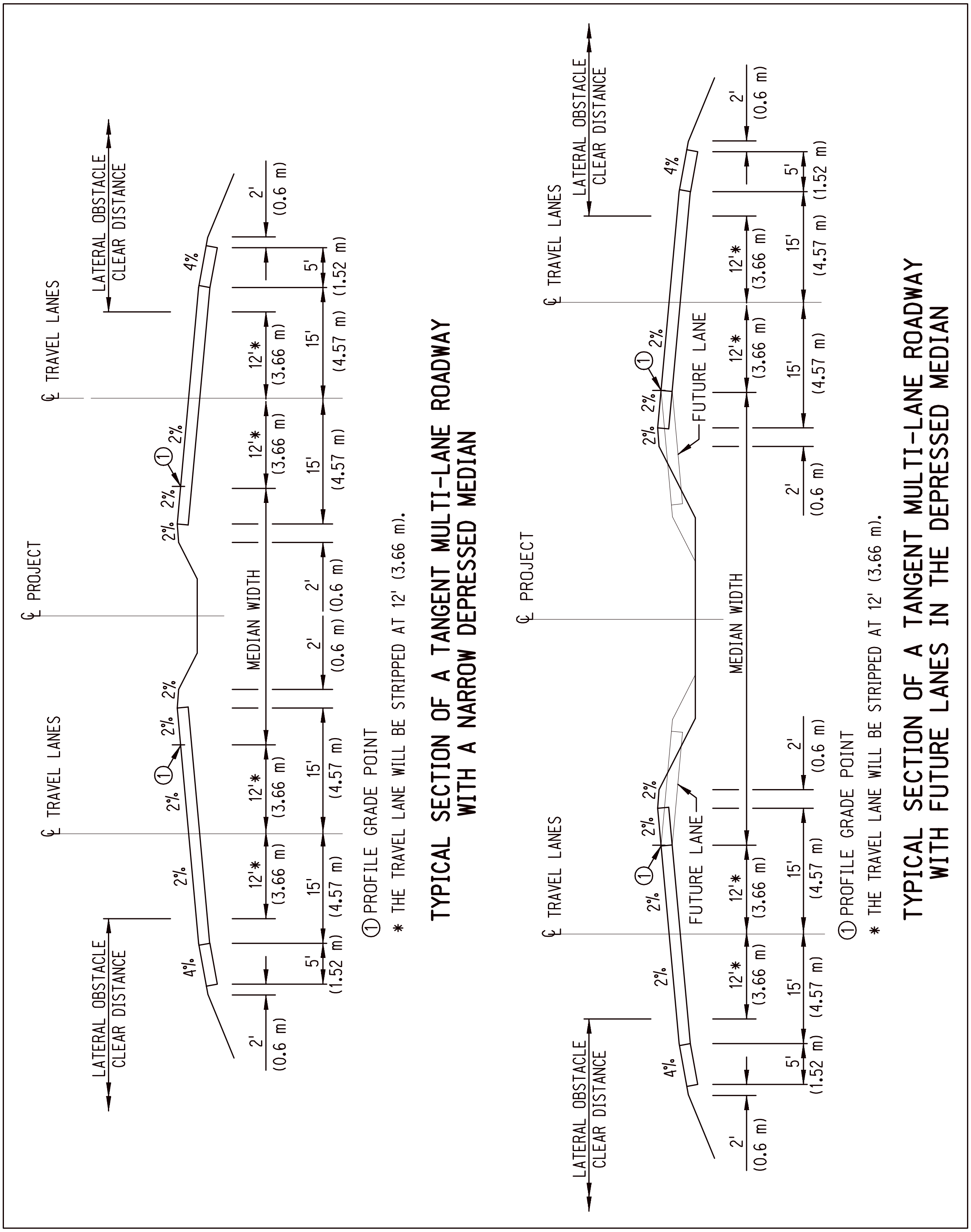


Exhibit 6.3 Typical Sections of Tangent Multi-Lane Roadways With Depressed Medians

1.B Shoulders

1.B.1 Shoulder Width

Shoulder widths vary from 4 ft. to 12 ft. (1.2 m to 3.6 m) and are determined by the roadway functional classification, traffic volumes and design speed. Required shoulder widths are given in the Nebraska Minimum Design Standards, (Reference 6.1). Where sidewalks are to be included in urban areas, a minimum 10 ft. (3 m) shoulder width is desirable, (See Chapter One: Design Standards, **EXHIBITS 1.1, 1.2 and 1.3**).

1.B.2 Shoulder Cross Slopes

Shoulder cross slopes depend on the functional classification of the roadway and the type of shoulder construction (paved or earth). Typically, shoulder cross slopes are 4% on paved shoulders and 6% on earth shoulders.

Surfaced median shoulders that are 3' or 4' (0.9 m or 1.2 m) wide and are of the same material as the traffic lanes should be sloped with the traffic lanes (normally 2%). Wider shoulders and shoulders of a different material than the traffic lanes should be sloped away from the traffic lanes (normally at 4%). This addresses the problem of excess water flowing across the traffic lanes and melted snow piles causing hazards in the winter.

1.B.3 Shoulder Construction

Shoulders may be surfaced to provide a better all-weather load support than that afforded by native soils. The current edition of the Nebraska Minimum Design Standards, (Reference 6.1), should be consulted for shoulder width and composition.

1.C Rollover Rates

The maximum rollover rate, the algebraic difference in rate of cross slope between adjacent travel lanes, for facilities with design speed ≥ 35 mph (60 km/h) is 4%. The maximum rollover rate between roadway and shoulder is 7%. Treatment of roadway and shoulder rollover through superelevated sections is illustrated in the Standard/Special Plans Book, (Reference 6.2).

1.D New Four-Lane Expressway Section Using Existing Two-Lane Highway

When constructing a four-lane expressway facility that utilizes the existing two-lane roadway, the following special design considerations apply:

1. The new lanes and median will be constructed to DR 2 crowned standards, (See the Nebraska Minimum Design Standards, (Reference 6.1). The existing crowned section will be utilized until it becomes deteriorated and subsequently replaced with a new crowned section.
2. On existing crowned sections with 8 ft. (2.4 m) surfaced shoulders in relatively good condition, the inside (median) 8 ft. (2.4 m) surfaced shoulder should remain in place in lieu of removing a portion of it to provide a 3 ft. (0.9 m) wide surfaced shoulder. If a significant amount of patching and/or an overlay is required to salvage the existing shoulder, then the excess shoulder width should be removed to provide a standard 3 ft. (0.9 m) wide inside surfaced shoulder. The decision to retain an existing 8 ft. (2.4 m) wide surfaced shoulder,

or to remove excess width to provide a 3 ft. (0.9 m) standard inside shoulder width, should be made on a project-by-project basis.

3. The profile grade for the new roadway is at the center line of the travel lane.
4. Median width (edge of the driving lane to edge of the driving lane) should be 40 ft. (12 m) minimum in rural areas.

1.E Auxiliary Lanes

Auxiliary lanes are any lanes added to the basic through travel lanes that are intended for use by vehicular traffic for specific functions. These functions include:

- Left and right turn lanes at intersections.
- Two-way left-turn lanes.
- Truck climbing/passing lanes.
- Acceleration/deceleration lanes at interchanges.
- Weaving lanes within an interchange.
- Continuous auxiliary lanes between two closely spaced interchanges.

Auxiliary lanes will be at least as wide as the adjacent through lanes. For further information, see Chapter Four: Intersections, Driveways and Channelization, Section 1.D, Chapter Five: Interchanges and Grade Separations, Section__, and A Policy on Geometric Design of Highways and Streets, (Reference 6.3).

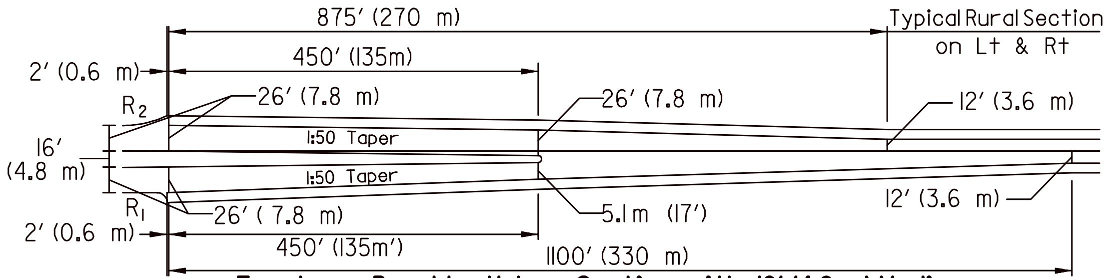
1.F Transition

Transition sections are required when one roadway section must transition to another type of roadway section. The following examples indicate where transition sections are required:

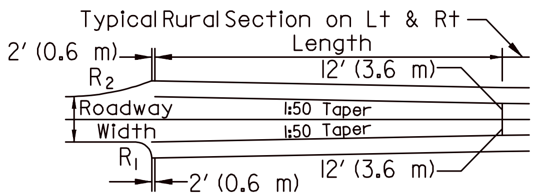
- From standard roadway sections to roadway sections with auxiliary lanes.
- From multilane facilities to two-lane facilities.
- At narrow existing bridge structures.
- To exiting roadway sections.
- From rural to urban sections.

EXHIBIT 6.4 illustrates common lane transition configurations.

Transitions for auxiliary lanes, especially turning lanes, often depend on the space available for the transition. Specific criteria for auxiliary lane transition sections and taper rates are discussed in A Policy on Geometric Design of Highways and Streets, (Reference 6.3).

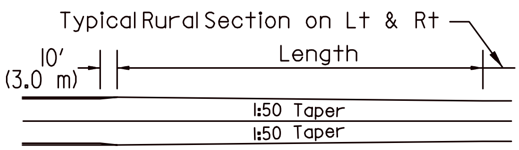


Two Lane Rural to Urban Section with 16' (4.8 m) Median (With Surfaced Shoulders)

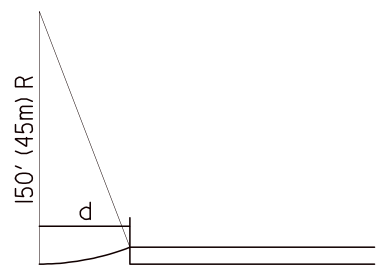


Two Lane Rural to Urban Section - Undivided (With Surfaced Shoulder)

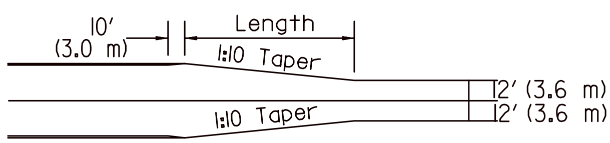
Width of Surfaced Shoulders	R_1	R_2	d
8' (2.4 m)	8'	150'	48.35'
	(2.4 m)	(45 m)	(14.45 m)
10' (3.0 m)	10'	150'	53.85'
	(3.0 m)	(45 m)	(16.16 m)



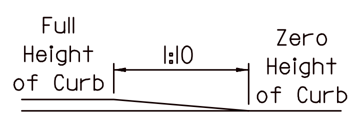
Two Lane Rural to Four Lane Urban Section - Undivided (Non Surfaced Shoulders)



Sketch of Entrance Curb Terminal



Two Lane Rural to Two Lane Urban - Undivided (Non Surfaced Shoulders)



Longitudinal Section Along Curb at Terminal End

NOTES:

1. The principles illustrated here should be applied as nearly as possible to individual situations.
2. Urban shoulders are turf and should match the outside of the turf shoulder on the rural section.
3. Intersections, driveways or flume discharge structures will also suffice as a curb terminal point if their location permits.
4. Uniform width sections for geometrics and joint layouts should be obtained whenever possible for ease of construction.

Exhibit 6.4 Examples of Rural to Urban Roadway Transitions

1.G Curbs

The type and location of curbs affect driver behavior and the safety and utility of a highway. Most commonly found in urban areas, curbs facilitate drainage, pavement edge delineation, pavement edge support, delineation of pedestrian walkways, traffic channelization, access control and aesthetics. In rural areas, mountable curbs and flumes protect earth shoulders and side slopes from stormwater runoff in regions (such as the Sandhills Region and peorian areas) where native soils are commonly susceptible to soil erosion, on steep grades, or on the low side of superelevated curves.

1.G.1 Curb Warrants

The selection of a curbed or an uncurbed section depends on many factors including vehicular speeds, urban/rural location, drainage, future or ultimate development, and construction costs.

Urban Locations - Because of restricted right-of-way, access control, driveway control, drainage requirements and other constraints, curbed sections are typically used in urban locations.

Rural Locations - Curbed sections are preferably not utilized in rural areas. Curbs on rural highways may be warranted for the following conditions:

- Where a raised median is constructed.
- Where it is absolutely necessary to control drainage (i.e., soil erosion).
- Where restricted right-of-way prevents construction of side slopes as per Nebraska Minimum Design Standards, (See Reference 6.1).

The final determination for curbed or uncurbed sections will be made on the plan-in-hand inspection.

1.G.2 Curb Types

The three general classes of concrete curbs are barrier, mountable and lip curbs. Barrier curbs are relatively steep-faced and are designed to inhibit encroachment on state right-of-way. Mountable and lip curbs are designed so that errant vehicles can cross them easily. Lip curbs are preferred over mountable due to ease of hand construction and safety. Curbs are constructed of either portland cement concrete or asphaltic concrete. Details of various types of concrete curbs are shown in the Standard/Special Plans Book, (Reference 6.2), and in **EXHIBIT 6.5**.

The following policy should be used for determining concrete curb height:

- High-speed roadways [design speed ≥ 45 mph (70 km/h)]: 3 in. (75 mm) asphaltic concrete curb, (or 3 in. (75 mm) concrete lip curb), and 4 in. (100 mm) concrete lip curb. A minimum surfaced shoulder width of 8 ft. (2.4 m) is required for a 4 in. (100 mm) curb.
- Low-speed roadways [design speed ≤ 45 mph (70 km/h)]: 6 in. (150 mm) curb (asphalt or concrete).
- Teardrop islands inside of the lateral obstacle clearance of the mainline: 3 in. (75 mm) asphaltic concrete curb, (or 3 in. (75 mm) concrete lip curb), and 4 in. (100 mm) concrete lip curb.

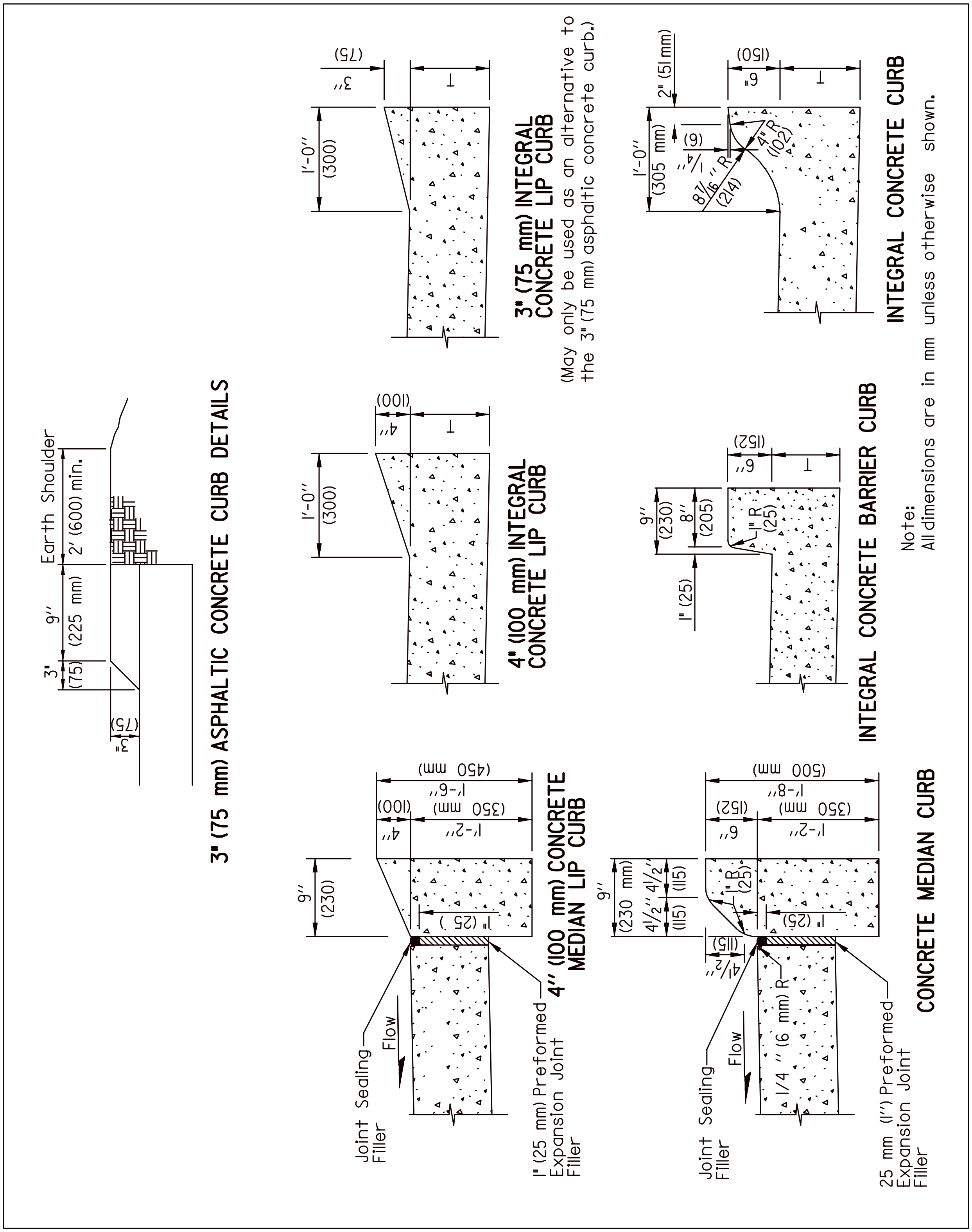


Exhibit 6.5 Curbs

1.G.3 Curb Design Considerations

Drainage - Curb height influences hydraulic design and analysis (See the Drainage Design and Erosion Control Manual, (Reference 6.4), Chapter One, Section 9).

Roadside Geometry and Safety - Side slope configuration is based on whether a curbed or uncurbed section is used. See **EXHIBIT 6.1**.

Transitions – **EXHIBIT 6.4** illustrates the standard procedure for curbed to uncurbed transition.

Erosive Soils - 3 in. (75 mm) asphaltic concrete curbed shoulders, (or 3 in. (75 mm) concrete curbed shoulders), with concrete flumes may be installed on a project for erosion control, [See the Drainage Design and Erosion Control Manual (Reference 6.4) Chapter Two, Section 6.C and the Standard/Special Plans Book (Reference 6.2)]. The following guidelines have been developed for the design of curbed roadway sections in the Sandhills Region or in any other areas susceptible to excessive soil erosion as determined by **Roadside Development**:

(1) Curbs and flumes should be installed on:
- (a) the low side of all superelevated curves;
- (b) grades between 2% and 2.5% extending for over 1500 ft. (450 m);
- (c) grades of 3% or greater.

(See the Drainage Design and Erosion Control Manual, (Reference 6.4), Chapter Two, Section 6.C).

(2) When curbs are added to surfaced shoulders, the gutter line of the 3 in. (75 mm) curb shall be located 2 ft. (600 mm) in from the normal shoulder point, but the width of the paved shoulder from the edge of the travel lane to the gutter line shall never be less than 6 ft. (1.8 m), (See **EXHIBIT 6.1**).

(3) When curbs are constructed in rural areas, the typical section should show the earth portion of the shoulder to be at least 2 ft. (600 mm) wide and finished to the top of the curb. 4 ft. (1.2 m) earth shoulders are preferred if there is an erosion problem, or if the project is in the Sandhills region. A wider turf shoulder is necessary if guardrail is installed at curb sections.

(4) When curbs are constructed in rural areas, delineators should be placed every 200 ft. (60 m). There should also be an object marker placed on the curb at the approach end of each flume and the approach end of each curb section. See the Manual on Uniform Traffic Control Devices, (Reference 6.5), (http://mutcd.fhwa.dot.gov/kno-millennium.htm).

(5) When curbs are constructed in urban areas the top of the curb should be at the same elevation as the abutting turf or sidewalk, allowing the surface drainage to flow into the roadway gutter.

(6) Curbs placed at the edge of the shoulder do not change the lateral obstacle clearance requirements shown in the Nebraska Minimum Design Standards, (Reference 6.8).

Curb Cuts - Curb cuts should be provided as required for existing and future pedestrian ramps and for access drives, (See Chapter Ten: Miscellaneous Design Issues, Section 10.B.3, and Chapter Four: Intersections, Driveways and Channelization, Section 2.B).

1.H Medians

A median is defined as the portion of a divided highway separating the opposing traffic movements. Medians are highly desirable on arterials carrying four or more travel lanes. For additional information see Chapter Four: Intersections, Driveways and Channelization, Section 5.B.

2. LATERAL OBSTACLE CLEARANCE (CLEAR ZONE)

In the late 1960's, the forgiving roadside concept was introduced, recognizing that motorists do run off the roadway and that serious accidents and injuries could be lessened if a traversable recovery area were provided. Ideally, this recovery area, or the lateral obstacle clearance, should be free of obstacles such as unyielding sign and luminaire supports, trees, non-traversable drainage structures, utility poles, and steep slopes. Design options for the treatment of these features have generally been considered in the following order:

- Remove the obstacle or redesign it so it can be safely traversed.
- Relocate the obstacle outside the clear zone, or where it is less likely to be struck.
- Reduce impact severity by using an appropriate breakaway device.
- Redirect a vehicle by shielding the obstacle with a longitudinal traffic barrier and/or impact attenuator.
- Delineate the obstacle if other alternatives are not appropriate.

The lateral obstacle clearance is the unobstructed, relatively flat area provided beyond the edge of the traveled way for the recovery of errant vehicles. Traffic volume, design speed and the side slopes of the roadway section influence the width of the clear zone.

The Nebraska Minimum Design Standards, (Reference 6.1), gives the recommended minimum lateral obstacle clearances for various roadway types. Lateral obstacle clearance distance varies with roadway functional classification, project type, design speed and roadway location. For additional information on clear zones see the Roadside Design Guide, (Reference 6.6), Chapter 3.

2.A Roadside Geometry (Side Slopes)

The roadside geometry (foreslopes and backslopes) depends on the functional classification of the roadway, fill height, urban/rural location, and the presence of curbs. Criteria for roadside geometry are illustrated in the standard typical sections in the Nebraska Minimum Design Standards, (Reference 6.1), and in Chapter One: Design Standards, **EXHIBITS 1.1 – 1.3**. Proposed variations in the standard typical sections should be documented and submitted in accordance with the relaxation procedure outlined in Chapter One: Design Standards, Section 6.B.

2.A.1 Fill Slopes (Parallel) - Uncurbed

Fill slopes within the lateral obstacle clear distance should be recoverable slopes with no protruding fixed objects. Recoverable slopes are defined as slopes of 4:1 or flatter. Motorists on recoverable slopes generally can stop their vehicles or slow them to enable a safe return to the roadway. Nebraska minimum design standards require 6:1 slopes to the lateral obstacle clear distance, which is also known as the hinge point.

A non-recoverable traversable slope is defined as a slope steeper than 4:1, but equal to or flatter than 3:1. Motorists on non-recoverable traversable slopes generally will not be able to stop their vehicles or return to the roadway but generally will reach the bottom of the slope without overturning. A section of non-recoverable traversable slope may be contained within the clear zone as long as a clear runout area (which is 4:1 or flatter) is provided beyond the non-recoverable slope. The clear runout will be included in the total recovery area. The use of this slope treatment will require a design exception as described in Chapter One: Design Standards, Section 6.B.

A slope steeper than 3:1 is considered a critical slope (i.e., non-recoverable and non-traversable, one on which a vehicle is likely to overturn) and should not be included within the clear zone. If a critical slope or a fixed object cannot be eliminated from the clear zone area, the slope or object will require an economic analysis using an applicable computer program, such as RSAP, to determine if a safety barrier system is warranted.

2.A.2 Fill Slopes (Parallel) – Curbed

It is not desirable to use curbs on high-speed roadways. The curb may cause a vehicle to overturn or the vehicle may hit the curb and become airborne, causing loss of control. If a curb must be used in high-speed conditions, it should be placed at the edge of the shoulder or it should be located flush with or behind a bridge railing or guardrail. If curbs are used in front of the guardrail they may cause the vehicle to become airborne and go over the guardrail.

For high-speed conditions, curbs placed at the edge of a shoulder without guardrails are warranted only when required as mitigation to erosion of the roadway side slopes from stormwater runoff, (See Section 1.G and the Drainage Design and Erosion Control Manual, (Reference 6.4), Chapter 2).

2.A.3 Fill Slopes (Transverse)

Transverse fill slopes caused by crossroads, drives, median crossings or dikes are generally more critical to vehicles traveling on the mainline than parallel slopes, since errant vehicles tend to run into the transverse slopes head on.

Cross slopes of 10:1 or flatter are required for transverse fill slopes on high-speed roadways within the lateral obstacle clearance distance. The 10:1 transverse fill slope shall be carried to the lateral obstacle clearance distance and then warped to a 3:1 foreslope in 15 ft. (4.5 m).

The recommended typical cross-sections for rural access and urban drives are shown in Chapter Four: Intersections, Driveways and Channelization, **EXHIBITS 4.15, 4.16 & 4.19**, and in the Standard/Special Plans Book, (Reference 6.2).

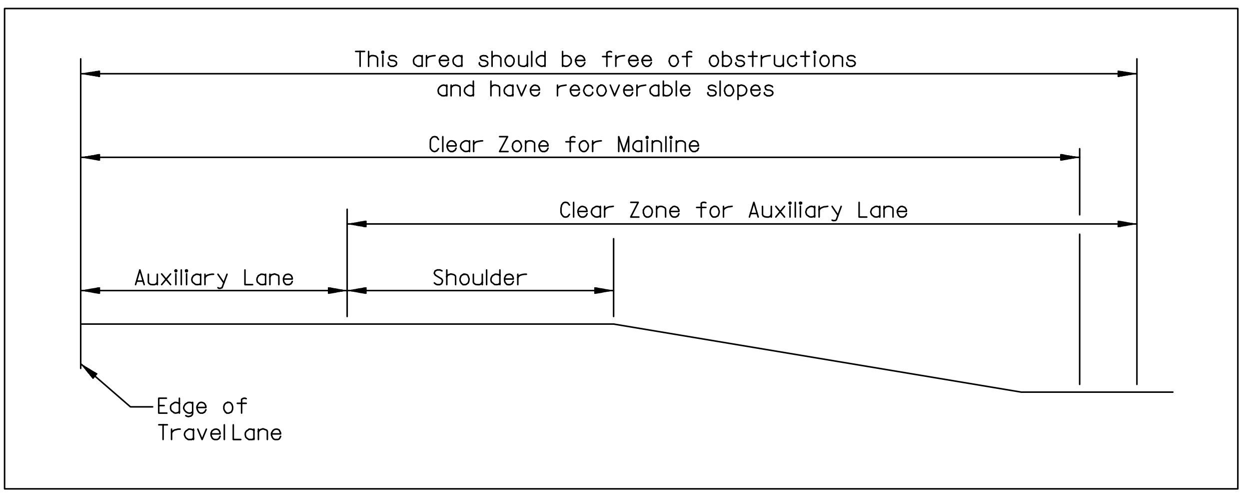
2.A.4 Cut Slopes

Typical cross-sections of cut slopes can be found in the Nebraska Minimum Design Standards, (Reference 6.1). The 10 ft. (3 m) “normal” ditch bottom width shown in Reference 6.8 should be considered as the desirable ditch width. This width should be reduced when encountering front yards, mature shelterbelts or trees, center pivots and at other locations where there would be major damages to the property if the right-of-way would be acquired based on the “normal” ditch width. The designer should consider curb and/or culvert pipe, when possible, to reduce right-of-way damages, however, right-of-way must be acquired to or beyond the lateral obstacle clear distance. Clear zone applications for cut slopes including foreslopes, ditch bottoms, and backslopes are discussed in the Roadside Design Guide, (Reference 6.6), Chapter 3. Figures 3.6 and 3.7 in Reference 6.6 may be used, with a design exception (See Chapter One: Design Standards, Section 6.B), when building the “normal” ditch cross-section found in the Nebraska Minimum Design Standards, (Reference 6.1), would cause excessive right-of-way damages.

The foreslope of the cut section, and a special ditch section, should meet the same slope and height criteria as the fill slope requirements given in the Nebraska Minimum Design Standards (Reference 6.1). Ditches with steep backslopes, such as bench cuts through rock, should be designed so that the backslope is outside of the lateral obstacle clearance distance.

2.B Clear Zone Requirements for Auxiliary Lanes

In some instances, it will be necessary to calculate clear zone requirements for both the mainline driving lane and for an auxiliary lane. The clear zone must be calculated for each lane independently, based on the projected traffic volumes and design speeds of the individual lanes (See the Roadside Design Guide, (Reference 6.6), Table 3.1). The clear zone will be set at the greater of the two distances from the edge of travel way as shown in **EXHIBIT 6.6**.



Note: Use the larger clear zone as measured from the edge of the travel lane or from the edge of the auxiliary lane.

Exhibit 6.6 Clear Zone Application for Auxiliary Lanes Adjacent to Mainline

2.C Roadside Barriers and Median Barriers

The purpose of barriers is to protect traffic from obstacles along the roadside. The barrier is an obstacle itself and should not be used when it is a greater obstacle than the object or condition being "protected." See Chapter Nine: Guardrail and Roadside Barriers, Section 2, and the Roadside Design Guide, (Reference 6.6), Chapters 5 and 6, for further information.

3. OTHER ELEMENTS AFFECTING ROADWAY CROSS-SECTION

3.A Snow Control

Ditches may be widened and the backslope laid back from its normal 3:1 slope to provide more area for snow accumulation, widening the roadway cross-section. See Chapter Ten: Miscellaneous Design Issues, Section 5, for a discussion of snowdrift abatement techniques.

3.B Earthwork Balances

Ditches or shoulders may be widened to provide for additional excavation or fill in order to balance the project, (See Chapter Seven: Earthwork, Section 1).

3.C Daylighting

Daylighting occurs when the roadway backslope is flattened to intersect with the natural ground at a lower elevation than the normal backslope (See **EXHIBIT 6.7**). When daylighting is used to gain excavation, to improve sight distance or to eliminate snow drifting, the following considerations should be taken into account:

- Current drainage patterns shall be maintained.
- The consequences of removing the earth barrier related to noise pollution, off-roadway glare, driver distraction, view from the road and from off the road, and other aesthetic considerations.
- Additional right-of-way may be necessary.

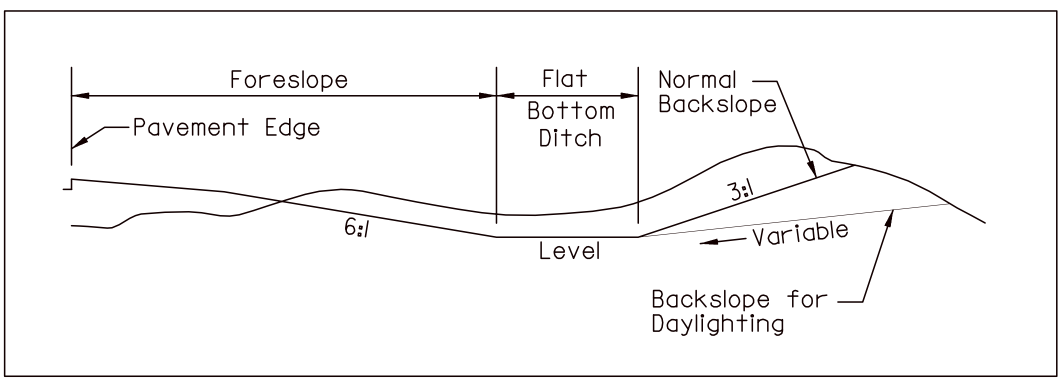


Exhibit 6.7 Daylighting

3.D Right-of Way

Right-of-way requirements for street and highway design are discussed in detail in Chapter Fifteen: Right-of-Way, Section 2.C.1. Right-of-way considerations that may impact the roadway cross-section design are:

- Restricted Right-of-Way - Areas where right-of-way is restricted may require the use of steeper side slopes, retaining walls, or may require adjustments to the vertical grade to reduce fill heights.
- Sight Distance - At horizontal curves and intersections, additional right-of-way may be warranted to ensure that horizontal sight distances used for design are not reduced by future development.
- Constructability – Construction easements may be required for construction of bridge structures, for construction equipment access and storage, for materials storage and for other activities required for the construction of the project.

3.E Utilities

Highway and street improvements, whether within the existing right-of-way or entirely on new right-of-way, generally entail adjustments of utility facilities. See Chapter Thirteen: Planning and Project Development, Section 6, for further information.

3.F Bridges

The **Bridge Division** is responsible for the design of the structure. Any projects involving bridges will require coordination with them.

3.F.1 New and Reconstructed Bridges

Reconstructed bridges are existing structures to be widened or significantly rehabilitated. For new and reconstructed bridges, the full approach roadway width, including turf shoulders, will be carried across the structure. Bridge roadway widths for the different functional classifications are provided in the Nebraska Minimum Design Standards, (Reference 6.1).

3.F.2 Bridges to Remain in Place

A bridge to remain in place is any bridge that does not require widening or other extensive superstructure or substructure modifications to provide the required roadway width. Special study may allow bridges to remain in place if the existing roadway is within 4 ft. (1.2 m) of the required roadway width, (See the Nebraska Minimum Design Standards, Reference 6.1, and the needs study criteria provided in Chapter One: Design Standards, Section 3). The **Bridge Division** must be consulted when determining whether to use an existing bridge in place.

3.F.3 Underpasses

The cross-section through an underpass should be the same as the approach roadway cross-section, including the lateral obstacle clearance. Future expansion of the facility should be considered, i.e., provide sufficient additional width for an additional lane in each direction to be added at a later date if significant traffic volume increases are anticipated in the foreseeable future.

3.G Guardrail

Grading for guardrail will affect the roadway cross-section. See Chapter Nine: Guardrail and Roadside Barriers, Section 1.B.9, and the Standard/Special Plans Book, (Reference 6.2), for further information.

3.H Drainage

For uncurbed facilities, the depth of a roadside ditch should generally ensure that the allowable headwater for the design discharge is at least 1 ft. (300 mm) below the finished shoulder point. Normal ditch depths are shown on the typical roadway cross-sections in the Nebraska Minimum Design Standards, (Reference 6.1).

Ditches of greater than normal depth are referred to as special ditches. When placing a special ditch the designer shall use a 6:1, 4:1 or a 3:1 foreslope as specified in the Nebraska Minimum Design Standards, (Reference 6.1). The grading should not go directly to a 3:1 foreslope from the hinge point until the depth of the slope requires it, but this is permissible with **Roadway Design Project Manager** approval. A minimum special ditch length of 150 ft. (46 m) will be shown on the Plan and Profile Sheet, (See Chapter Eleven: Plan Preparation, Section_). The grading contractor will build shorter special ditches based on the project slope stake data, (See Appendix D, “Earthwork Books”). The roadway designer shall inform the **Roadside Development Unit** of the location and slope of all ditches for their use in the design of the erosion control.

For curbed facilities, the type of facility limits the maximum width or spread of stormwater from the curb onto the roadway. Curb height, superelevation and longitudinal slope all impact drainage design for curbed facilities.

Drainage design is discussed in the Drainage Design and Erosion Control Manual, (Reference 6.4), Chapter One.

3.I Erosion Control

Erosion control considerations that may impact the design of the roadway cross-section include the following:

- In the Sandhills Region, and other areas where roadway side slopes are susceptible to erosion, provide flatter side slopes where practical.
- Provide curb and flume on steep grades, on wide sections, and in the Sandhills Region, to reduce erosion of the roadway side slope, (See Section 1.G.3).
- In areas to be re-sodded and maintained by the property owner, provide a 4:1 or flatter slope for ease of maintenance.

See the Drainage Design and Erosion Control Manual, (Reference 6.4), Chapter Two, Section 6, for additional information.

3.J Geotechnical Features

Geotechnical features within a project may impact cross-section design. The designer should review the soil, subgrade, and materials surveys from the **Materials and Research Division** (See Chapter Seven: Earthwork, Section 6). Features that may require special consideration include the following:

- Cut or fill sections where the maximum height of cut or fill exceeds 20 ft. (6 m) or where embankment is to be constructed on a weak and compressible foundation material (These concerns are generally discussed in the foundation report and will affect construction phasing.)
- Soil and rock instability in cut/fill or natural slopes that are presently or potentially unstable, slide areas, slip plains and unusual groundwater conditions (mitigations for unstable conditions, such as geotextile soil reinforcement, permanent ground anchors, wick drains, stone columns, etc., may warrant special consideration.)
- Retaining walls where the maximum height at any point along the length of a geotechnical feature exceeds 30 ft. (9 m). Retaining wall design is discussed in Chapter Ten: Miscellaneous Design Issues, Section 8).

3.K Landscaping

Landscape Architects in **Roadside Development** should be consulted about any specific problem areas associated with the roadside landscape. Typical landscaping considerations that may impact cross-section design include:

- Established vegetation on existing slopes should be saved, where possible, in the Sandhills Region.
- Special procedures are sometimes warranted to save existing trees, which are outside of the lateral obstacle clear zone but are within the project construction limits.

Excavation of the area inside the dripline of a tree will damage its roots and should be avoided if the tree is to be saved, (the dripline is the perimeter of the area directly under the crown of the tree).

See Chapter Ten: Miscellaneous Design Issues, Section 4, for further information.

4. 3R PROJECTS

NDOR has adopted minimum criteria and needs study criteria for resurfacing, restoration and rehabilitation (3R) projects, (See the Nebraska Minimum Design Standards, Reference 6.1, and Chapter One: Design Standards, Section 2.B). Where cost-effective, cross-section improvements should be incorporated into 3R projects using the following procedures:

- Review the "Needs Study Decision Process", Chapter One: Design Standards, **EXHIBIT 1.4**.
- Check the existing fill slopes for guardrail warrants, (See Chapter Nine: Guardrail and Roadside Barriers, Section 1.K).
- For interstate projects, provide a 3:1 slope for the outside shoulder slope (past the hinge point) and a 4:1 slope for the median shoulder slope.

5. REFERENCES

6.1 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

6.2 Nebraska Department of Roads, Standard/Special Plans Book, Current Edition.

6.3a American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington D.C., 1990. (English units)

6.3b American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington D.C., 1994. (Metric units)

6.3c American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington D.C., 2001.

6.4 Nebraska Department of Roads, Drainage Design and Erosion Control Manual, Current Edition.

6.5 Federal Highway Administration, Manual on Uniform Traffic Control Devices, 2000. (http://mutcd.fhwa.dot.gov/kno-millennium.htm)

6.6 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington D.C., 1996.

CHAPTER SEVEN
EARTHWORK

LIST OF EXHIBITS

CHAPTER SEVEN
EARTHWORK

Chapter Seven
Earthwork

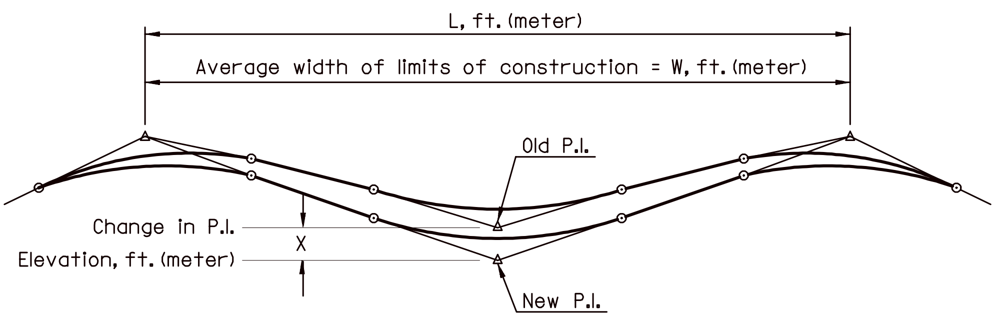
The following items **are not** earthwork items; **do not** include these items in your grading quantities:

- Shoulder Construction (Surfacing pay item, See Chapter Eight: Surfacing, Section 3.C).
- Median Construction (Surfacing pay item, See **EXHIBIT 4.24** and the Standard Specifications for Highway Construction, (Reference 7.2), Section 308), http://nebraskatransportation.org/ref-man/
- Excavation for Box Culverts (Culverts pay item, See the Drainage Design and Erosion Control Manual, (Reference 7.1), Chapter One, Section 12.T).
- Excavation for Culvert Pipes and Headwalls (Culverts pay item, See the Drainage Design and Erosion Control Manual, (Reference 7.1), Chapter One, Section 12.T).

1. EARTHWORK

Earthwork is composed of two main components, excavation and embankment. Excavation is the amount of material that must be "cut" to construct the proposed roadway, ditches, channels, entrances, and other associated components. Embankment is the amount of material that must be "filled" or placed to construct the proposed roadway and its associated components.

Projects should be designed to produce balanced earthwork, material excavated from within the limits of the section should equal the amount needed to construct embankments to the designed grade. To attain balanced earthwork grade adjustments are generally preferable to ditch widening. The approximate change in elevation of a vertical PI required to produce a given volume of material can be computed using the formula found in **EXHIBIT 7.1**. In some instances, where grade controls are critical, it will not be possible to adjust grades to attain balanced earthwork. Provisions must be then made to borrow or waste material as necessary, see Section1.B.



If the volume of additional excavation required is V, cu. yd. (cubic meter)

then $X = \frac{V}{1.85\ W\ L}$ (english) $X = \frac{V}{0.5\ W\ L}$ (metric)

Exhibit 7.1 Earthwork Computation Formula

Adjustment to the roadway side slopes and adjustments to the grading within loops and ramps, to either slightly reduce fill requirements or gain excavation, should be weighed against safety criteria, possible aesthetic damage and maintenance problems in these areas. The following summarizes the earthwork considerations associated with mainline alignment design:

1. Urban/Rural. Earthwork balance is generally practical only in rural areas. In urban areas other considerations such as limiting right-of-way impacts and matching elevations of existing development may have a higher priority than balancing earthwork.
2. Borrow Sites. The availability and quality of borrow sites in the vicinity of the project will impact the feasibility of balancing earthwork. Environmental, archaeological and historical considerations can prevent the use of otherwise acceptable sites. Generally, the use of borrow should be minimized. When borrow cannot be avoided, borrow sites should be discussed at the plan-in-hand. Costs should be held to a minimum by obtaining borrow from wetland mitigation sites, existing borrow pits, snow control areas, etc.
3. Balance Points. Wherever practical, earthwork should be balanced at bridges, railroad crossings, roadway intersections, and at other manmade or natural interruptions in the roadway. Short balances of 100 to 300 ft. (30 to 100 m) should generally not be shown on the plans but should be shown as part of a combined larger balance. The desirable length of balances should be from 0.5 mile to 1 mile (0.80 km to 1.6 km), with one mile (1.6 km) being the preferred balance length.

1.A Computations

Currently, there are a variety of computer programs available for earthwork computations. Although the methods may vary, the basic approach is the same:

- Identify existing ground cross-sections with elevations.
- Specify proposed roadway templates with centerline subgrade elevations.
- Compute cross-section end areas of cut and fill.
- Compute volumes of excavation and embankment.
- Establish balance points and perform an earthwork distribution analysis.

Regardless of the program used, earthwork computations are used to determine pay quantities and to verify final calculations in the field. **NDOR** designers should refer to the **Roadway Design Computer Applications Unit** for assistance with the earthwork calculations computer programs.

1.A.1 Data Requirements

The following information is needed to perform earthwork calculations, regardless of the method used:

- Proposed horizontal and vertical alignments.
- Cross-sections of the existing terrain every 100 feet (25 meters) or where the terrain changes.
- Proposed design-cross-sections.

1.A.2 Manual Computations

The end areas, in sq. ft. (m^2), may be measured with a planimeter. Due to the variation in scales used on cross-section sheets, the factor relating the planimeter reading to the scaled end area must initially be determined by measuring a square or rectangle of know area with the planimeter. An additional check is ensured if the end area to be measured is circumscribed twice by the planimeter.

End areas of cut and fill, in whole numbers, will be recorded on the cross-section sheet below the station (See **EXHIBIT 7.2**) and on an earthwork computation sheet (See **EXHIBIT 7.3**).

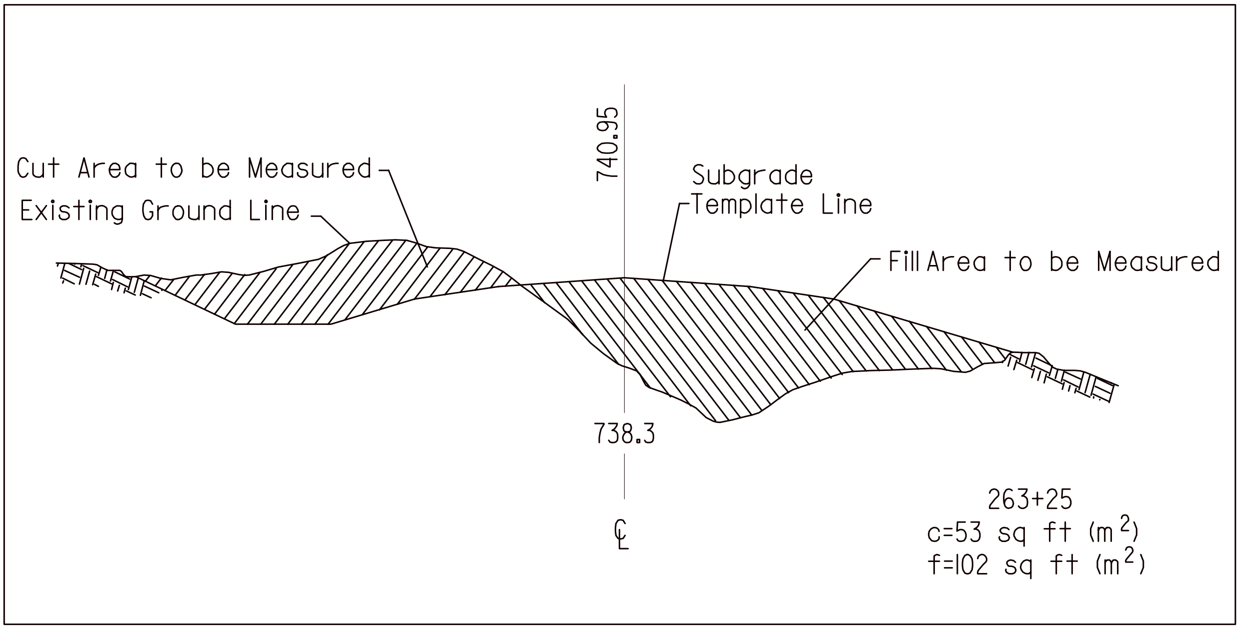


Exhibit 7.2 Cross-Section End Areas

1.A.2.a Manual Computation of Excavation and Embankment Quantities

When manual computation of excavation and embankment is required, the following average-end-area formula will be used

$V = ((A1 + A2)/2) X (D/27)$ Eq. 7.1

or in Metric,

$V = ((A1 + A2)/2) X D$

The volume of earthwork can also be computed using the following version of the average-end-area formula (English units only):

$V = 1.85185 X (A1 + A2) X D$ Eq.7.2

or

$V = \frac{(A1 + A2) X D}{0.54}$ Eq. 7.3

where:

V = volume, in cubic yards (cubic meters);
A1 + A2 = sum of cut or fill end areas of adjacent sections, in sq. ft. (m^2);
D = the distance between sections, in ft. (m);
27 = conversion factor from cu. ft. to cu. yds.

STATE OF NEBRASKA
DEPARTMENT OF ROADS

EARTHWORK COMPUTATIONS

Project No. F-312(23)
Preliminary-Final Quantities
Sheet No. 11 of 17

STATION	DIS-TANCE Sta.	EXCAVATION End Area Sq. Ft.	EXCAVATION Sum End Areas Sq. Ft.	EXCAVATION Sum End Areas Corrected For Distance	EXCAVATION Cubic Yards	EMBANKMENT End Area Sq. Ft.	EMBANKMENT Sum End Areas Sq. Ft.	EMBANKMENT Sum End Areas Corrected For Distance	EMBANKMENT Cubic Yards	Existing Hwy. U.S. 77
4+28Bk		0				2				
+73	0.45	0				2	4	1.8	3	
+80	0.07	0				1	3	0.2	0	
5+00	0.20	0				1	2	0.4	1	
+10	0.10	0				2	3	0.3	0	
+15	0.05	0				0	2	0.1	0	
+22	0.07	14	14	1.0	2	4	4	0.3	0	
+31	0.09	17	31	2.8	5	5	9	0.8	2	
+37	0.06	17	34	2.0	4	3	8	0.5	1	
+69	0.32	20	37	11.8	22	8	11	3.5	6	
+76	0.07	20	40	2.8	5	11	19	1.3	2	
+87	0.11	18	38	4.2	8	6	17	1.9	4	
6+00	0.13	22	40	5.2	10	9	15	2.0	4	
+20	0.20	17	39	7.8	14	6	15	3.0	6	
+40	0.20	19	36	7.2	13	2	8	1.6	3	
+55	0.15	15	34	5.1	10	2	4	0.6	1	
+70	0.15	12	27	4.1	8	4	6	0.9	2	
+85	0.15	17	29	4.4	8	6	10	1.5	3	
7+00	0.15	16	33	5.0	9	6	12	1.8	3	
8+00Bk	1.00	11	27	27.0	50	7	13	13.0	24	
2+39Ah	---	11	22	---		7	14	---		
3+00	0.61	7	18	10.9	20	6	13	7.9	15	
4+00	1.00	16	23	23.0	43	2	8	8.0	15	
5+00	1.00	24	40	40.0	74	0	2	2.0	4	
6+00	1.00	15	39	39.0	72	0				
7+00	1.00	18	33	33.0	61	0				
8+00	1.00	21	39	39.0	72	0				
9+00	1.00	0	21	21.0	39	0				
10+00	1.00	0				0				
11+00	1.00	0				0				
12+00	1.00	0				0				
						0				
				296.3	549			53.4	99	

Computed by ____________________

Checked by ____________________

DR Form 99, Oct 70

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Exhibit 7.3a Earthwork Computation Sheet (English)

Station	Distance	Excavation			Embankment		
Station	**Distance (m)**	**End Area (m^2)**	**Sum End Area (m^2)**	**Volume (m^3)**	**End Area (m^2)**	**Sum End Area (m^2)**	**Volume (m^3)**
14 + 28.000		0			0		
14 + 40.000	12	0	0	0	3	3	18
14 + 60.000	20	3	3	30	4	7	70
14 + 80.000	20	2	5	50	8	12	120
14 + 86.000	6	2	4	12	6	14	42
14 + 95.000	9	5	7	31.5	3	9	40.5
15 + 00.000	5	5	10	25	3	6	15
15 + 20.000	20	7	12	120	2	5	50
15 + 40.000	20	7	14	140	0	2	20
15 + 60.000	20	9	16	160	0	0	0
15 + 75.000	15	15	24	180	0	0	0
15 + 80.000	5	16	31	77.5	0	0	0
16 + 00.000	20	12	28	280	0	0	0
16 + 20.000	20	6	18	180	0	0	0
16 + 40.000 BK	20	4	10	100	0	0	0
3 + 20.000 AH	---	4	8	---	0		---
3 + 40.000	20	2	6	60		0	0
3 + 45.000	5	0	2	5		0	0
3 + 60.000	15	0	0	0		6	45
3 + 80.000	20	0	0	0		14	140
3 + 90.000	10	0	0	0	8	16	80
4 + 00.000	10	0	0	0	2	10	50
4 + 20.000	20	0	0	0	0	2	20
4 + 40.000	20	0	0	0	0	0	0
Total					1451.00		710.50

Exhibit 7.3b Earthwork Computation Sheet (Metric)

1.A.2.b Curve Correction for Earthwork Determined from Cross-Sections

Often hand calculated earthwork end areas must be corrected to account for horizontal alignment curvature. The following method is used for calculating earthwork for loops. For radii larger than 500 ft. (150 m), the curve correction is usually negligible, unless the dimension, D, is very large. The curve correction equation is defined below:

CC = (D X A)/R Eq. 7.4

Where:

CC = curve correction, sq. ft. (m^2);
D = distance from the centerline to center of gravity or center of mass of cut or fill, ft. (m);
A = area of cut or fill in section, sq. ft. (m^2);
R = radius of the horizontal curve in the alignment, ft. (m).

If the center of gravity is between the centerline and the radius point, then the CC is subtracted from the end area. If the centerline is between the center of gravity and the radius point, then the CC is added to the end area. The following example and **EXHIBIT 7.4** illustrate use of the curve correction equation.

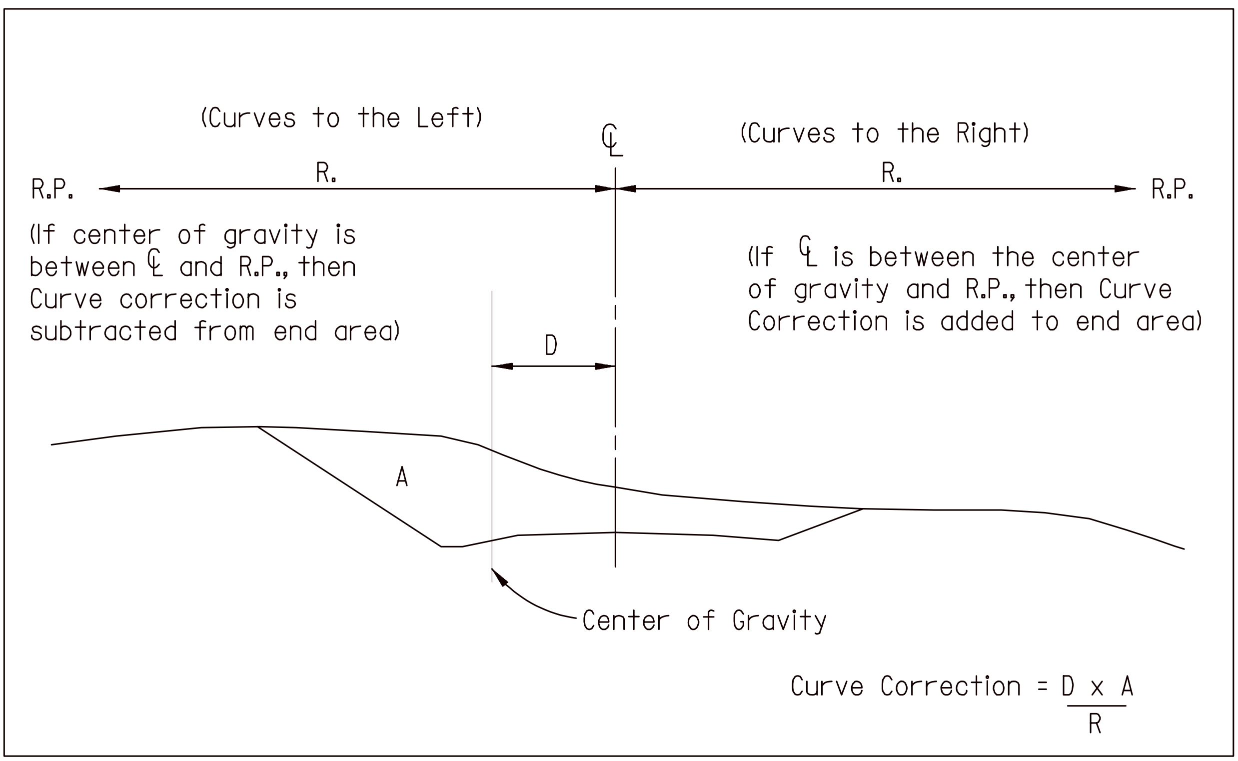


Exhibit 7.4 Curve Correction

Given: The end area of cut, A, is 750 sq. ft. (m^2) and the radius of the curve, R, is 500 ft. (100 m). The distance from the centerline to the center of gravity, D, is 15 (ft. or m).

Determine the curve correction value and the adjusted end area, given the center of gravity is on the inside or outside of the horizontal curve.

Solution: By inspection of the cross section, it is determined the center of gravity is 15 ft. (m) left of the centerline (the center of gravity is the line where the area right of the center of gravity, 375 sq. ft. (m^2), is equal to the area left of the center of gravity, 375 sq. ft. (m^2)). Therefore,

(15 ft X 750 sq. ft.)/500 ft. = 22.5 sq. ft.

Or in Metric: CC = (D X A)/R = $\frac{15\ (750)}{100}$ = 112.5 m^2.

If the center of gravity is on the "inside" of the horizontal curve (the center of gravity is between the centerline and the radius point of the curve), then the curve correction is subtracted from the end area:

Adjusted area = 750 sq. ft. - 22.5 sq. ft. = 727.5 sq. ft.

Or in Metric: A - CC =750 - 112.5 = 637.5 m^2.

If the center of gravity is on the "outside" of the horizontal curve (the centerline is between the center of gravity and the radius point), the curve correction is added to the end area:

Adjusted area = 750 sq. ft. + 22.5 sq. ft. = 772.5 sq. ft.

Or in Metric: A + CC = 750 + 112.5 = 862.5 m^2

1.A.3 Balance Factors

Balance factors are multipliers applied to the embankment (fill) volumes to adjust for the shrinkage or swell of the soils used for the embankment. When soil is excavated, hauled and compacted into an embankment, the final volume of the compacted soil is usually less than when it is in its natural state. This difference in volume is usually defined as shrinkage. When rock is excavated, broken and placed into an embankment, it will occupy more space than rock in solid form due to the increase in void spaces. This increase in volume is known as swell.

The amount of shrinkage and swell are quantified as balance factors and are percentages of the original volume. In most cases, one balance factor is used for an entire project; therefore, an average balance factor must be determined for the various materials encountered over the length of a project. At the plan-in-hand field inspection possible balance factors can be discussed based on previous similar projects and individual design experience. The **Materials and Research Division** may also be consulted for recommendations on specific adjustments.

1.A.4 Distribution Analysis

Distribution analysis helps the designer to determine if the earthwork is going to be balanced, borrowed or wasted. A balance in earthwork is obtained when the amount of available excavation equals the amount of embankment needed in-place (after compaction).

The amount of adjusted embankment needed is the measured volume of embankment times the balance factor. Sometimes the adjusted embankment required exceeds the amount of excavation available. In those instances, borrow, from either contractor or state-furnished borrow pits, is required.

Waste occurs when the amount of available excavation exceeds the amount of needed embankment. The leftover material must be disposed of at approved waste sites or it may be used for shoulder construction (shoulder construction **is not** a part of the earthwork, it is a surfacing item and is paid for by the station, see Chapter Eight: Surfacing, Section 3.C).

It will be determined at the plan-in-hand field inspection if a project is to be balanced with material from the right-of-way, using contractor-furnished borrow, using state-furnished borrow, or if it will be necessary to waste excess material.

Considerations in determining if earthwork balance is practical for a given project include:

- Right-of-way limitations.
- Matching existing elevations of cross roads, bridges or existing roads.
- The availability and quality of borrow sites within the vicinity of the project.
- Will the borrow be State-furnished or contractor-furnished.
- Would earthwork balance require crossing bridges or going through towns with earth hauling equipment.
- The availability of waste sites within the vicinity of the project.
- Environmental, archaeological and historical considerations.

Information regarding the distribution of earthwork is required. Whether distribution analysis is generated manually or electronically, the following information must be shown in the distribution analysis for each station:

- End areas in sq. ft. (m^2) of excavation and embankment.
- Accumulated volume of excavation.
- Accumulated volume of embankment.
- Added quantities for intersections, large driveways, etc.
- Balance factor(s).
- Mass ordinate.

The above information, together with the identification of approximate balance points, is considered adequate. Mass diagrams generally are not plotted. The computer program provides a summary of earthwork distribution analysis.

The following guidelines should be used when doing the earthwork distribution analysis:

- Desirable balance lengths should be from one half mile (0.80 km) to one mile (1.6 km) with one mile being the preferred length.
- Short balances of 300 ft. (100 m) or less should not generally be shown on the plans, they should be shown as part of a combined larger balance.
- For rural projects constructed under traffic, earthwork distribution analysis for the left and right side of the roadway should be computed separately, for information only. This shows earthwork for each side so that the contractor knows how much material must be hauled across traffic.
- Earthwork should balance at major highway intersections, both sides of towns, rivers or major streams or other natural breaks. Do not haul across bridges or through towns if possible.
- An earthwork analysis should be developed and quantities shown on plans for each phase of construction, for information only.
- Haul distances should be kept to a minimum.
- The volume of existing pavement to be wasted or salvaged shall be eliminated from the earthwork run.
- Earthwork in urban areas should be either "Excavation Established Quantity" or "Earthwork Measured in Embankment." Urban projects usually will not be balanced.
- Earthwork quantities for temporary roads may be determined using established quantities. Temporary road material is put in as embankment and removed as excavation specified for the temporary road. Earthwork quantities for temporary roads may also be incorporated in the roadway earthwork if the designer includes the temporary road structure in the computer calculations.

1.A.4.aHaul Considerations

Haul is the distance excavated material is moved, as shown on the plans, from the location where the material is obtained to the location where the material is to be deposited. When distribution analysis is performed, the following questions should be considered in order to keep haul distances to a minimum:

- Is waste available from the other side of the road?
- Is waste available from adjacent balances?
- Could contractor-furnished borrow be used?
- Could balance points be adjusted?

1.A.5 Moisture Content

The moisture content of soil at the time of compaction shall be within the moisture range designated in the Soils and Situation Report (See Section 6.A.3). When the moisture content is not within the acceptable range, water must be added or the soil must be aerated depending upon the moisture content of the soil. **EXHIBIT 7.5** should be used to estimate the amount of water that may need to be applied to obtain optimum moisture content when estimating grading costs. **EXHIBIT 7.5** is based on excavation quantities; adjustments are required when paying for the quantity “Earthwork Measured in Embankment”, (See Section 1.A.6.a).

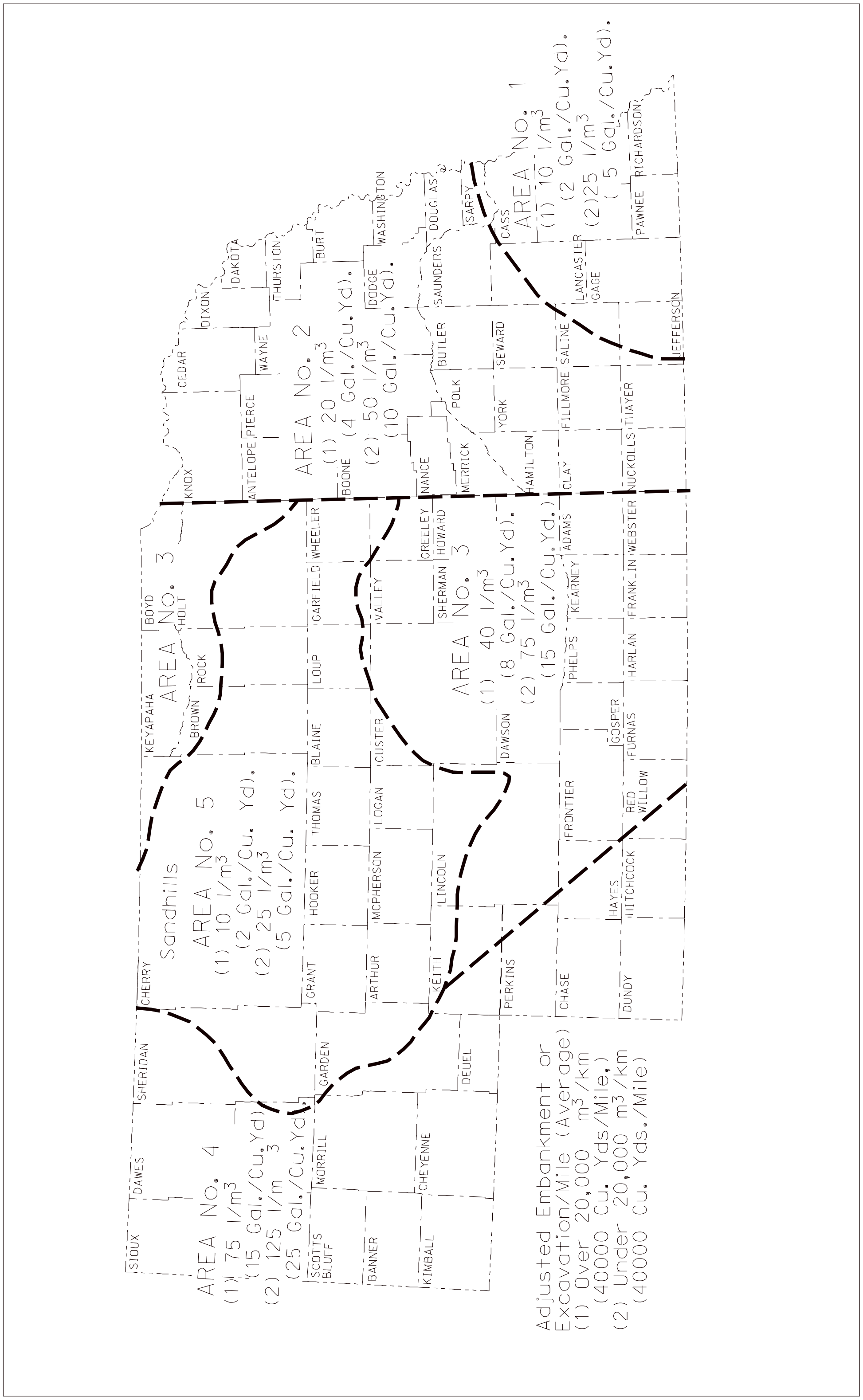


Exhibit 7.5 Map for Estimating Water Needed for Compaction

Types of Quantities	Case No. 1 Embankment Only	Case No. 2 Unbalanced - Mostly Embankment	Case No. 3 Balanced - Considerable Borrow	Case No. 4 Balanced - No Borrow	Case No. 5A Urban - More Excavation
Excavation			31,830	176,410	
Excavation- Borrow			144,580		
Excavation (Established Quantity)					10,000
Earthwork Measured in Embankment	38,110	11,910			
Water Applied, Mgal (kL)	745 (3715)	160 (805)	4,410 (22,050)	4,410 (22,050)	45 (220)

Exhibit 7.6 Example Grading Pay Items

Additional Requirements for Earthwork Calculations
ITEM 1: If an informational sheet is supplied with the plans showing a borrow pit where the contractor can obtain the embankment (optional or required pit), cross-sections should be provided showing the desired drainage and the computations made to reflect the available quantity.
ITEM 2: When earthwork is measured in embankment and there is a substantial anticipated subsidence, consideration should be given to furnishing soil information or allowing additional quantities for settlement such as surcharge on top of the fill.
ITEM 3: On projects involving embankments constructed with granular material obtained from river borrow pits, dewatered borrow areas, etc., whether borrow is state- or contractor-furnished, the earthwork should also be paid as "earthwork measured in embankment." No separate pay item is required for contractor-furnished borrow.
ITEM 4: Post construction cross-sections will be taken and the excavation to be paid for will be the material actually removed, measured by volume in its original position.
ITEM 5: Pre- and post-construction cross-sections will be taken on borrow pits to determine the actual quantity of borrow.
ITEM 6: Balance points should be shown on the plan and profile sheets or 2-S sheets.
ITEM 7: Post-construction cross-sections will not be taken and the contractor will only be paid for the quantity that is shown in the plans. No balance factor will ever be applied for earthwork measured in embankment but will be applied for excavation (established quantity).
ITEM 8: The volume of existing concrete/asphalt pavement removal shall be considered in all earthwork computations. See Section 1.C for discussion of removal of existing surfacing.

Exhibit 7.7 Additional Requirements for Earthwork Calculations

1.A.6 Example Calculations

In this section, different situations are described related to computing embankment and excavation quantities for highway projects. Grading items are summarized for the example cases in EXHIBIT 7.6. Except for the item "Water Applied", the same quantities, without conversion, are used for both the English standard and for the metric project examples. For example, in Case No. 1 "Earthwork Measured in Embankment" is either 38,110 cu. yds. or 38,110 m^3.

1.A.6.a Case 1: Embankment (Fill) Only

Many bridge and shoulder widening projects have only a fill quantity. No excavation is required for the roadway. Either the contractor or the state will be required to furnish borrow.

Given: An existing rural two-lane highway with 6 ft. (1.8 m) shoulders on level terrain in Buffalo County is to be improved to a two-lane highway with 10 ft. (3.0 m) shoulders for 5 miles (2.5 km). The highway is in fill for the full length of the project with 38,110 cu yds (m^3) of embankment calculated. At the plan-in-hand review it was determined that the balance factor should be 1.30. Determine the earthwork quantity for payment and the amount of water needed.

Station to Station (Metric)		**Station to Station (English)**		**Excavation Available**	**Earthwork Measured in Embankment**
0 + 00	22 + 86	0 + 00	75 + 00	0	10,975
22 + 86	45 + 72	75 + 00	150 + 00	0	11,310
45 + 72	68 + 58	150 + 00	225 + 00	0	11,780
68 + 58	80 + 48	225 + 00	264 + 00	0	4,045
Total				0	38,110

Exhibit 7.8 Earthwork Quantities - Case 1

Solution: The earthwork quantity and pay item will be 38,110 cu yds (m^3) of "Earthwork Measured in Embankment." It is the measured volume of embankment on the cross-sections and **is not** multiplied by the balance factor to obtain the pay item quantity, (Earthwork analysis is run at a 1.00 balance factor when paying for "Earthwork Measured in Embankment"). It is an established quantity and is not verified by field personnel after construction.

Water may be required in the compaction process to attain the proper density in the new embankment. To determine the quantity of water that needs to be applied for compaction, the measured volume of embankment must be adjusted for shrinkage by multiplying it by the balance factor, since EXHIBIT 7.5 is based on excavation quantities, (for "Embankment", a balance factor of 1.5 shall be used when calculating "Water Applied").

38,110 cu yds (m^3) X 1.50 = 57,165 cu yds (m^3).

The quantity of water that needs to be applied is determined by multiplying the adjusted volume of embankment by the number of gallons (liters) of water per cu. yd. (m^3) as indicated in **EXHIBIT 7.5** for the area in which the project is located. For this example, Buffalo County is in Area 3 and the project averages less than 40,000 cu. yds. of excavation per mile (20,000 m^3/km). The rate at which water should be applied for compaction is 15 gal of water per cu. yd. (75 liters of water per m^3) of embankment:

57,165 cu. yds. X 15 gal/cu. yd. = 857,475 gal (call 857 Mgal),

or in Metric: 57,165 m^3 X 75 l/m^3 = 4,287,375 liter [call 4287 kL (reads kiloliter)]

1 Mgal equal 1000 gallons (1000 liters of water = 1 kL).

According to the specifications, the contractor is paid for the quantity of "Earthwork Measured in Embankment" as shown on the plans (38,110 cu yd (m^3)) and the quantity of "Water Applied" in Mgal (kL).

The following standard note should be shown on the plans:

STANDARD NOTE 12
THE CONTRACTOR WILL BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

EXHIBIT 7.8 shows a typical earthwork table that should be included on the plans. See items 2, 3, 7 and 8 in **EXHIBIT 7.7** for additional information pertaining to this example.

1.A.6.b Case 2: Unbalanced - Mostly Embankment

Some major projects have the majority of the earthwork in fill and just a small cut quantity. This may occur on projects that involve adding a lane to an existing road.

Given: An existing rural two-lane highway on mostly level terrain in Madison County is to be improved to a four-lane highway with a median. The project begins at Sta. 1+00 (0+00.000) and ends at Sta. 72+89 (21+91.867). There is a major crossroad at Sta. 27+32 (8+01.431), a stream crossing at Sta. 57+15 (17+10.686) and the city limits at Sta. 68+40 (20+53.467). At the plan-in-hand review, it was determined that the balance factor should be 1.35.
Given the earthwork quantities in **EXHIBIT 7.9**, determine balance points for distribution analysis, the earthwork quantities for payment and the amount of water needed.

Solution: For this example, balance points should be at the following locations:

- Sta. 27+32 (8+01.431) - cross road
- Sta. 57+15 (17+10.686) - stream crossing
- Sta. 68+40 (20+53.467) - city limits

Since these balance points occur at intervals of approximately 0.5 mile (0.80 km), no intermediate balance points are needed.

Station to Station (English)		Station to Station (Metric)		Excavation Available	Earthwork Measured in Embankment
1+00	27+32	0+00.000	8+01.431	1,050	3,520
27+32	57+15	8+01.431	17+10.686	500	5,340
57+15	68+40	17+10.686	20+53.467	0	2,640
68+40	72+89	20+53.467	21+91.867	0	415
Total (cu yds (m^3))				1,550	11,915

Exhibit 7.9 Earthwork Quantities - Case 2

The pay item will be 11,915 cu. yds. (m^3) of "Earthwork Measured in Embankment" of which 1,550 cu. yds. (m^3) will be excavated as shown on cross-sections (See Case 1, which explains “Earthwork Measured in Embankment” in greater detail).

For the amount of water that needs to be applied for compaction, the embankment quantity needs to be adjusted for shrinkage by multiplying it by the balance factor:

11,915 cu. yds. X 1.35 = 16,085 cu. yds. (m^3)

The quantity of water that needs to be applied is determined by multiplying the adjusted volume of embankment by the number of gallons (liters) of water per cu. yd. (m^3) as indicated in **EXHIBIT 7.5** for the area in which the project is located. For this example, Madison County is in Area 2 and the project averages less than 40,000 cu. yds. per mile (20,000 m^3/km) of excavation. The rate at which water should be applied for compaction is 10 gallons (50 liters) of water per cu. yd. (m^3) of embankment:

16,085 cu. yds. X 10 gal/cu. yd. = 160,850 gal (call 161 Mgal.)

or in Metric: 16,085 m^3 X 50 l/m^3 = 804,250 liters (call 804 kL)

In this case, the following standard note should be shown on the plans:

STANDARD NOTE 12
THE CONTRACTOR WILL BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

EXHIBIT 7.9 shows an example of an earthwork table that shall be included on the plans. See items 2, 3, 7 and 8 in **EXHIBIT 7.7** for additional information pertaining to this example.

1.A.6.c Case 3: Balanced – Considerable Borrow Furnished by Contractor

Often on major grading projects, such as adding lanes to an existing highway, the earthwork is paid as excavation even though a considerable amount of contractor-furnished borrow is required to complete the project.

Given: An existing two-lane highway in Cheyenne County is to be widened to a four-lane highway. The project begins at Sta. 100+00 (0+00.000) and ends at Sta. 497+00 (121+00.165). There is a side road at Sta. 363+00 (80+16.084), and improvements along the side road run from Sta. 3001+00 to Sta. 3077+00 (3000+00.000 to Sta 3020+42.041). There are no other side road crossings or major stream crossings. At the plan-in-hand inspection, it was determined that the balance factor should be 1.45. Given the earthwork quantities in **EXHIBIT 7.10**, determine the balance points for the distribution analysis, the earthwork quantities for payment, and the amount of water needed.

Solution: For this example, balance points should be at the location of the side road and approximately every mile between the start and the side road and between the side road and the end:

- Sta 152+00 (15+84.484)
- Sta 204+00 (31+69.838)
- Sta 257+00 (47+85.254)
- Sta 310+00 (64+00.669)
- Sta 363+00 (80+16.084) - side road
- Sta 416+00 (94+48.522)
- Sta 467+00 (111+85.922)

The pay items will be:

- The measured excavation is 31,830 cu. yds. (m^3) and will be paid for as "Excavation."
- Since there is more embankment than excavation available, contractor-furnished borrow is necessary and is calculated by subtracting the excavation from the adjusted embankment. For the adjusted embankment volume, multiply the measured embankment by the balance factor:

121,665 cu/ yds. X 1.45 = 176,415 cu. yds. (m^3)

Then subtract the measured excavation from the adjusted embankment:

176,415 cu. yds. (m^3) - 31,830 cu. yds. (m^3) = 144,585 cu. yds. (m^3)

The quantity and pay item will be 144,585 cu. yds. (m^3) of "Excavation-Borrow."

The quantity of water that needs to be applied is determined by multiplying the adjusted volume of embankment by the number of gallons of water per cu. yd. (liters per m^3) as indicated by **EXHIBIT 7.5** for the area the project is located. For this example, Cheyenne County is in Area 4 and the project averages less than 40,000 cu. yds. of excavation per mile (20,000 m^3/km). The rate at which water should be applied for compaction is 25 gal/ cu. yd. (125 liters of water per m^3) of embankment:

176,415 cu. yds. X 25 gal/cu. yd. = 4,410,375 gal (call 4,410 Mgal.)

or in Metric: 176,415 m^3 X 125 l/m^3 = 22,051,875 liters (call 22,051 kL)

In this situation, post-construction roadway cross-sections will be taken and the excavation to be paid for will be the material actually removed, measured by the cu. yd. (m^3) in its original position. Also pre- and post-construction cross-sections will be taken on the borrow pit to determine the actual quantity of borrow used. Pay items in Case 3 shall be "Excavation" and "Excavation Borrow."

The standard note that should appear on the plans for this situation is:

STANDARD NOTE 12
THE CONTRACTOR WILL BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

EXHIBIT 7.10 shows an example of an earthwork table that shall be included on the plans. See items 1, 4, 5, 6 and 8 in **EXHIBIT 7.7** for additional information pertaining to this example situation.

Earthwork							
Station to Station (English)		**Station to Station (Metric)**		**Excavation**	**Excavation-Borrow**	**Embankment**	**Balance Factor**
100+00	152+00	0+00	15+85	745	11,405	8,380	1.45
152+00	204+00	15+85	31+70	1,635	20,775	15,455	1.45
204+00	257+00	31+70	47+85	495	16,870	11,975	1.45
257+00	310+00	47+85	64+00	2,275	14,420	11,515	1.45
310+00	363+00	64+00	80+16	8,345	24,085	22,365	1.45
363+00	416+00	80+16	94+50	3,710	22,940	18,380	1.45
416+00	467+00	94+50	111+85	13,155	17,750	21,315	1.45
467+00	497+00	111+85	121+00	1,455	12,670	9,740	1.45
3001+00	3077+00	3000+00	3020+42	15	3,670	2,540	1.45
Total				31,830	144,585	121,665	

Exhibit 7.10 Earthwork Quantities - Case 3

1.A.6.d Case 4: Balanced - No Borrow

A balanced project with no borrow occurs when the material excavated from within the limits of the section is sufficient to construct embankments to the designed grade.

Given: The same existing highway, improvements and conditions as in Case 3 except that the earthwork quantities are those shown in **EXHIBIT 7.11**, determine the earthwork quantities and pay items.

Earthwork							
Station to Station (English)		**Station to Station (Metric)**		**Excavation**	**Embankment**	**Balance Factor**
100+00	152+00	0+00	15+85	12,150	8,380	1.45
152+00	204+00	15+85	31+70	22,410	15,455	1.45
204+00	257+00	31+70	47+85	17,365	11,975	1.45
257+00	310+00	47+85	64+00	16,695	11,515	1.45
310+00	363+00	64+00	80+16	32,430	22,365	1.45
363+00	416+00	80+16	94+50	26,650	18,380	1.45
416+00	467+00	94+50	111+85	30,905	21,315	1.45
467+00	497+00	111+85	121+00	14,125	9,740	1.45
3001+00	3077+00	3000+00	3020+42	3,685	2,540	1.45
Total				176,415	121,665	

Exhibit 7.11 Earthwork Quantities - Case 4

Solution: Adjust the embankment volume for shrinkage by multiplying it by the balance factor:

121,665 cu. yds. (m^3) X 1.45 = 176,415 cu. yds. (m^3).

Since the adjusted embankment volume is equal to the measured excavation quantity, the earthwork is balanced, additional excavation is not needed and no borrow is required; therefore, the only earthwork quantity and pay item will be 176,415 cu. yds. (m^3) of "Excavation." The quantity of “Water Applied” in this example is 4,410 Mgal (22,051 kL), similar to the quantities calculated in case 3.

The standard note that should appear on the plans for this situation is:

STANDARD NOTE 13
THE CONTRACTOR WILL NOT BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

EXHIBIT 7.11 shows an example of an earthwork table that shall be included on the plans. See items 4, 6, and 8 in EXHIBIT 7.7 for additional information pertaining to this example.

It should be noted that balance points for this example were shown at one-mile stations for simplicity. For actual projects, the designer should refer to the mass ordinate in the distribution analysis to determine locations of natural balances, i.e., balance points that naturally occur in the station-by-station accumulated volumes listing. Natural balances between 0.5 mile and 1.0 mile (0.80 km and 1.6 km) apart should be used whenever possible. Minor balance points between larger balances should be ignored. Often a designer will modify the template to increase embankment, excavation or both to balance the project (See Section 1.B.1).

Depending on the scope of the project, the profile grade elevations and/or location may also be modified to balance the earthwork.

1.A.6.e Case 5: Excavation or Embankment in Urban Areas

In urban areas, where it is difficult to determine the quantity of earthwork performed because of curb/gutter and driveways, the earthwork will be paid for as "Excavation (Established Quantity)" or "Earthwork Measured in Embankment." For additional information, see Section 4.B.

1.A.6.f Case 5A: More Excavation than Embankment in Urban Areas

Given: An existing four-lane urban highway is being widened to six lanes in Douglas County. The project begins at Sta. 1+00 (1+00.000) and ends at Sta. 55+00 (17+45.831). At the plan-in-hand inspection, it was determined that the balance factor should be 1.45. Given the information in **EXHIBIT 7.12**, determine earthwork quantities, pay items and the water that should be applied.

Station to Station (English)		Station to Station (Metric)		Balance Factor	Excavation (Established Quantity)	Embankment	Waste
1+00	55+00	1+00.000	17+45.831	1.45	10,000	3,000	5,650
Total					10,000 cu yd (cubic meter)	3, 000 cu yd (cubic meter)	5,650 cu yd (cubic meter)

Exhibit 7.12 Earthwork Quantities - Case 5A

Solution: For the adjusted embankment, multiply the measured embankment by the balance factor:

3,000 cu. yds. (m^3) X 1.45 = 4,350 cu. yds. (m^3).

Since the adjusted embankment is less than the measured excavation, the quantity and pay item will be 10,000 cu. yds. (m^3) of "Excavation (Established Quantity)." There will be no cross-sections taken in the field to verify this quantity. There will be waste, the amount of which will be determined by subtracting the adjusted embankment from the excavation:

10,000 cu. yds. (m^3) - 4,350 cu. yds. (m^3) = 5,650 cu. yds. (m^3) of waste.

The quantity of water that needs to be applied is determined by multiplying the adjusted volume of embankment by the number of gallons of water per cu. yd. (liters per m^3) as indicated in **EXHIBIT 7.5** for the area in which the project is located. For this example, Douglas County is in Area 2 and the project averages less than 40,000 cu. yds. of excavation per mile (20,000 m^3/km). The rate at which water should be applied for compaction is 10 gallons of water per cu. yd. (50 l/m^3) of embankment:

4,350 cu. yds. X 10 gal/cu. yd. = 43,500 gal (call 44 Mgal.)
or in Metric: 4,350 m^3 X 50 l/m^3 = 217,500 liters (call 218 kL)

The following notes should be shown on the plans:

STANDARD NOTE 13
THE CONTRACTOR WILL NOT BE REQUIRED TO FURNISH BORROW ON THIS PROJECT.

STANDARD NOTE 14
THE CONTRACTOR WILL BE REQUIRED TO FURNISH WASTE AREAS FOR EXCESS EXCAVATION ON THIS PROJECT.

See item 8 in EXHIBIT 7.7 for additional information pertaining to this example.

1.A.6.g Case 5B: More Embankment than Excavation in Urban Areas

Use the procedures described in Section 1.A.6.b.

1.B Borrow Pits and Waste Sites

Borrow pits are sources of approved material required for the construction of embankments or other portions of earthwork requirements.

Waste sites are areas established for the disposal of excess excavation or unsuitable materials.

The following items should be considered for state-furnished borrow pits and waste sites on new and reconstructed projects:

- The designer should consider all available options to balance the project or reduce borrow and/or waste.
- When borrow pits and/or waste sites are unavoidable, they should be discussed on the plan-in-hand field inspection.
- Locations for borrow and waste sites should be determined before L.O.C. plans (Activity #5335) are transmitted to **Right-of-Way Design**.
- Borrow pits and waste sites require clearance for historical and environmental impacts. If there are any changes to these sites after the R.O.W. Appraisal Plans have been designed, the roadway designer shall notify the **State Historical Preservation Officer** and the **Environmental Section Manager** in the **Planning and Project Development Section**, (See Chapter Thirteen: Planning and Project Development, Section 4).

1.B.1 Alternatives to Providing Borrow or Waste Sites

NDOR prefers that borrow and waste sites not be used if there are alternatives available that eliminate the need for borrow/waste sites.

1.B.1.a Borrow Alternatives

- Daylighting: Daylighting is the flattening of the roadway backslope so that it intersects the natural ground at a lower elevation than the normal backslope. See Chapter Six: The Typical Roadway Cross-Section, Section 3.C.

- Ditch Widening: If adequate right-of-way is available ditches may be widened to provide additional excavation. When ditch widening is used, it should be uniform and consistent over long stretches with gradual transitions between widths.
- Flattening Backslopes: If adequate right-of-way is available, backslopes on ditches may be flattened. As with ditch widening, flattening should be uniform and consistent over long stretches with gradual transitions between slope changes. Backslopes in cut sections may be flattened from 3:1 to a flatter slope up to 4:1.
- Special Ditches: A special ditch is any ditch that varies in slope or depth from the standard ditch shown on the typical cross-section. If adequate right-of-way is available, special ditches may be designed to increase the available excavation as well as to provide better drainage.
- Modify Alignments: The horizontal and vertical alignments may be shifted along the entire length of the project or in isolated areas to help eliminate the need for borrow.

1.B.1.b Waste Alternatives

- Flattening Fill and Foreslopes: If adequate right-of-way is available, fill and foreslopes may be flattened from 6:1 up to 10:1 to help eliminate the need to waste material. Flattened slopes should be uniform and consistent over long stretches, with gradual transitions between changes in slopes. The designer should try to increase embankment while keeping the required additional right-of-way to a minimum.
- Fill Low Areas: Additional excavation may be placed in low areas outside of the construction limits and within the right-of-way, provided that the fill does not adversely affect drainage or aesthetic conditions. Wetlands should be avoided (See Chapter Thirteen: Planning and Project Development, Section 4.B).
- Modify Alignments: The horizontal and vertical alignments may be shifted along the entire length of the project or in isolated areas to help eliminate waste.

1.B.2 Borrow Pit Restoration

If state-owned land is used for a borrow pit, restoration is required. See the Standard Specifications for Highway Construction, (Reference 7.2), Section 207.

1.C Removal of Existing Surfacing

If surfacing material is to be salvaged, removal is generally a pay item, (See Chapter Eight: Surfacing, Section 4.B for further information).

1.C.1 Rural Projects

The existing asphalt surface on full grading projects will normally be salvaged. Existing concrete surfacing may also be salvaged. The roadway designer should check with the **Materials and Research Division** during the pre-design of the project to find out the depth, width and length of the material that is to be salvaged. The preliminary cross-sections should then be recoded to reflect the void left by the existing surface that is to be removed. The removal of this material will be paid for directly as a separate pay item.

If the existing asphalt surface is not to be salvaged, this surfacing may be placed in the outer slopes of the embankment 1 ft. (300 mm) below the finished shoulders and foreslope. No deductions to the earthwork quantities are required for the volume occupied by this surfacing.

If the existing surfacing is concrete and is not to be salvaged but is to be removed, the roadway designer should deduct the volume occupied by this surfacing in computing the earthwork balance, and the removal should be paid for directly. If the concrete is to be removed, crushed and replaced as foundation course, the removal is subsidiary to the crushed concrete foundation course item as long as the crushed concrete is solely used for foundation course (i.e., has one use only).

When less than 3 ft. (1 m) of embankment is to be placed over an existing concrete pavement or base course, the existing surfacing shall be removed and paid for. When the embankment is greater than 3 ft. (1 m), the grading contractor shall break the concrete into pieces of approximately 4 sq. ft. (0.4 m^2) in size and leave them in place. This activity is paid for as the item, "breaking pavement."

1.C.2 Urban Projects

Normally, there is no place to bury existing surface material on urban projects, therefore removal is usually specified. In this case, the roadway designer should deduct the volume occupied by this surfacing in computing the earthwork balance, and the removal should be paid for directly.

Alternatively, asphalt may be milled and salvaged. In this case, it is paid for as milling and the quantity is deducted from the earthwork.

If the project covers both rural and urban areas, the plans shall show the physical limits of asphalt removal to be paid for and the physical limits of asphalt removal, which is subsidiary to excavation.

2. STAGED CONSTRUCTION/PHASING

A distribution analysis shall be done for each separate phase of construction for a project. Cross-section cut and fill areas should reflect the staged construction and should correspond with the distribution analysis performed. Projects with phased construction, expressway projects for example, will show earthwork quantities on the cross-sections for each phase of construction. This distribution analysis shall be for information only, unless the given quantities are “Established Quantities”. In cases where the project requires more than one construction season, cover crop seeding will be calculated for each phase of construction. The 2N sheet will show the quantity of cover crop seeding required for each phase. The 2N sheet will also have a table showing the earthwork quantities for each phase of construction. Although it is the roadway designer's responsibility to provide reasonable phasing, the actual construction phasing is left to the discretion of the contractor with the approval of the **Project Engineer**. For additional information, see Chapter Ten: Miscellaneous Design Issues, Section 11.

3. MISCELLANEOUS EARTHWORK CONSIDERATIONS

3.A Unsuitable Materials

Unsuitable materials are materials that are inappropriate for use in the embankment. They include rock, organic muck or any foreign objects, such as garbage, car bodies, etc. The Soil and Situation Report will list the location, type of material and treatments for the unsuitable material found. Often rock can be used in the toe of the fill. If organic muck is encountered unexpectedly by the contractor, a change order, (a written order to the contractor covering changes in the contract), will be necessary to excavate the unsuitable material and to haul in acceptable material to replace the unsuitable material, (See Chapter Thirteen: Planning and Project Development: Section 4.H for additional information).

3.B Contaminated Soils

See Chapter Thirteen: Planning and Project Development: Section 4.H.3.

3.C Guardrail

Additional embankment and grading may be required for the installation of guardrail. This earthwork is not considered subsidiary and should be calculated and included in earthwork quantities. Refer to Chapter Nine: Guardrail and Roadside Barriers, Section 1.B.9, and the guardrail special plans (Standard/Special Plans Book, Reference 7.3).

3.D Driveways

The method of handling the earthwork required for driveway construction varies according to the pay item, as shown below:

- "Excavation" or "Excavation-Borrow": The designer does not need to calculate the earthwork required to build the drives. The contractor will be paid for any necessary additional excavation as it is measured on the project.
- "Earthwork Measured in Embankment" or "Excavation (Established Quantity)": The designer shall calculate and add to the earthwork quantities all earthwork required to build all intersections, drives and earth dikes.

3.E Settlement

When embankment is placed on existing ground, the weight of the embankment causes the existing ground to settle and thus the embankment also will settle. An excess of embankment may be placed to overcome the effects of consolidation. The Embankment Foundation Report (See Section 6.C) will usually indicate when additional embankment is necessary. The designer shall coordinate the design of the project in areas of embankment settlement with the **Soils Engineer** in the **Materials and Research Division**.

3.F Shear Lines

Shear lines are used for calculating earthwork volumes at intersections where side road alignments connect with the mainline alignment. Earthwork volumes are calculated along the mainline to a set distance from the centerline, assuming that the earthwork has a vertical line at that location (See **EXHIBITS 7.13a AND 7.13b**). Earthwork is then computed for the area outside of the shear line along the side road alignment. Shear lines may also be used at other locations where irregular excavations or embankments may be caused by channel changes, access roads, etc.

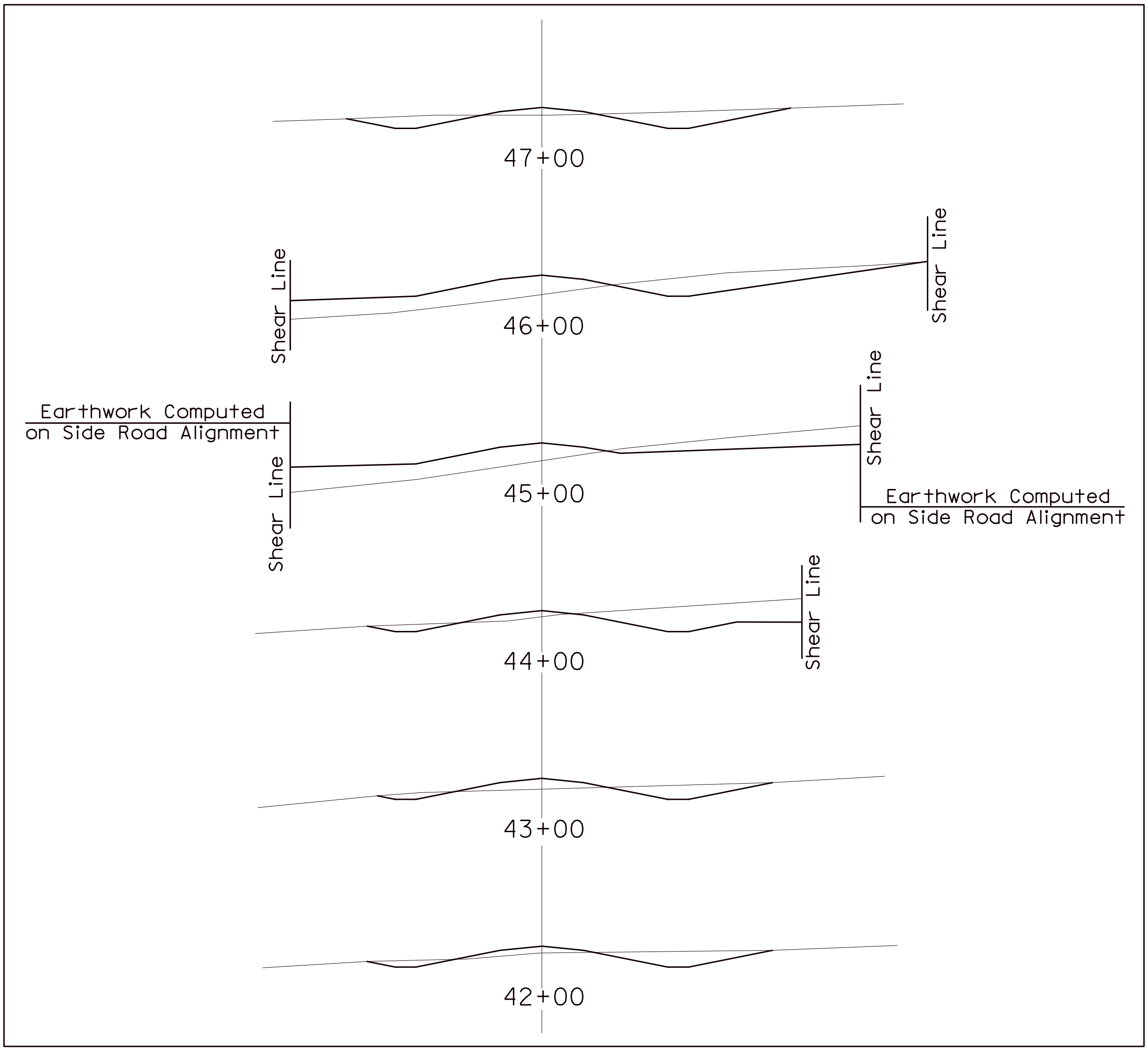


Exhibit 7.13a Shear Lines (Cross-Section)

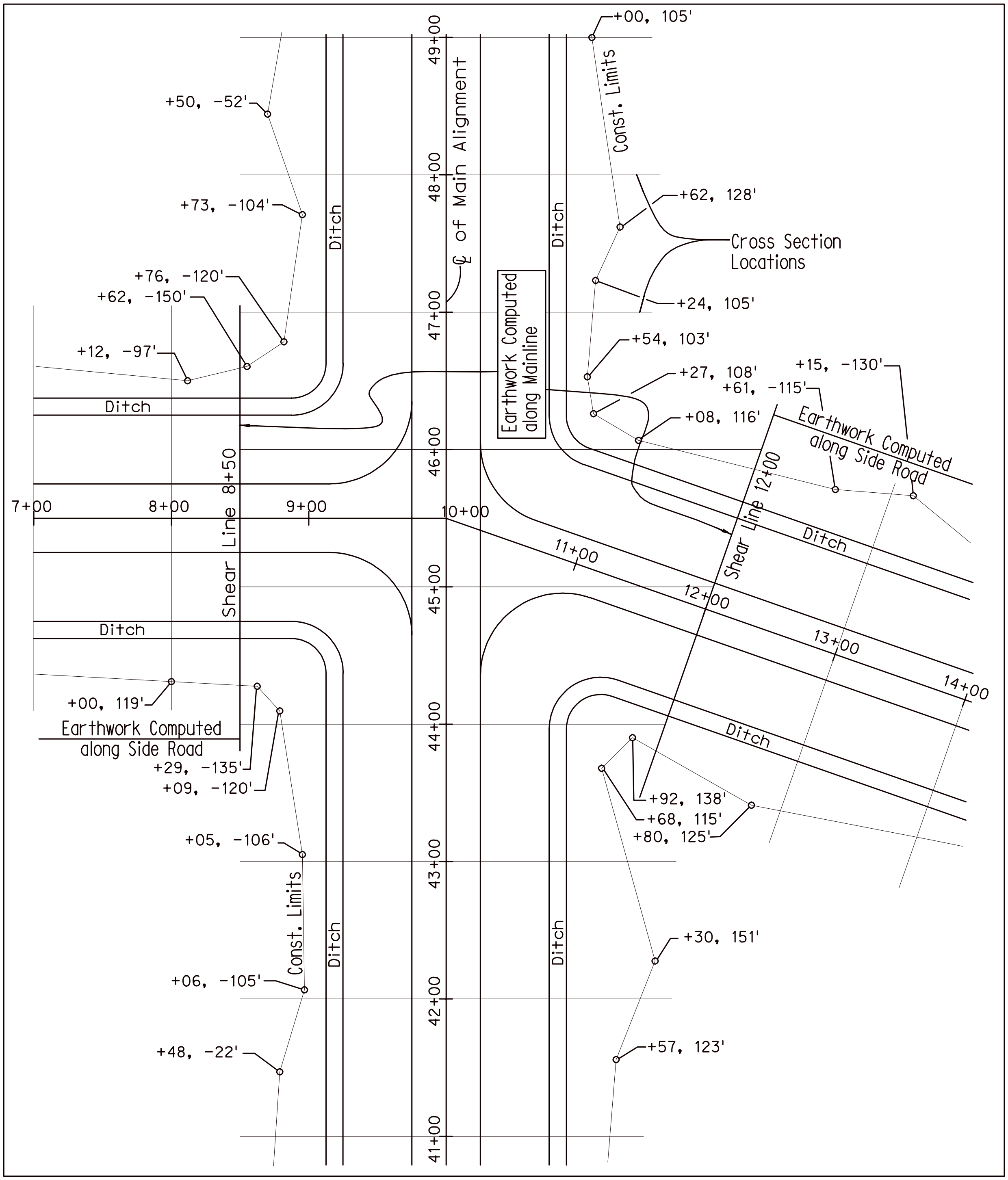


Exhibit 7.13b Shear Lines (Plan)

4. METHODS OF PAYMENT

4.A “Excavation” and “Excavation-Borrow”

“Excavation” and “Excavation-Borrow” are the preferred method of earthwork payment on projects with large quantities. Generally, grading projects that average more than 5000 cu. yds. per mile (2375 m^3 per km) will be paid for as “Excavation”. On major grading projects where the earthwork is paid for as “Excavation” and where the contractor is required to furnish borrow, the excavation quantity within the right-of-way and the easements shall be calculated separately from what the contractor will furnish. A separate pay item, “Excavation-Borrow”, will be used for the contractor furnished borrow. The quantities for these pay items will be measured in the field and then calculated for payment.

4.B “Established Quantities”

Sometimes it is difficult to determine in the field the quantity of earthwork performed. In this situation, earthwork should be paid for as an established quantity, which is determined by roadway design from the cross-sections. This measured “established” quantity is used for payment of earthwork instead of field-measured quantities. Established quantities can be in excavation or embankment. This method of payment is most often used for urban roadway projects and for temporary roadways. In the Omaha area and on urban projects where the contractor will be required to furnish borrow, the earthwork pay item will be an “Established Quantity”, with no separate pay item for contractor furnished borrow.

4.B.1 “Earthwork Measured in Embankment” and “Excavation (Established Quantity)”

“Earthwork Measured in Embankment” is paid for according to the embankment measured from the cross-sections. It does not include excavation, nor is it adjusted by a balance factor. When earthwork is measured in embankment and there is a substantial anticipated settlement, consideration should be given to furnishing soil information or allowing additional quantities for the settlement. This method of payment is typically used on projects that have embankment only or on projects that are mostly embankment with very little excavation. On projects involving embankments constructed with granular material obtained from river borrow pits, dewatered borrow areas, etc. (whether borrow is state or contractor-furnished), the earthwork should be paid for as “Earthwork Measured in Embankment”, with no separate pay item for contractor-furnished borrow.

“Excavation (Established Quantity)” is paid for according to the measured excavation from the cross-sections. A balance factor is included if there is any calculated embankment.

4.C Roadway Grading

For roadways constructed with only a typical section and without cross-sections, the appropriate pay item is “Roadway Grading”. “Roadway Grading” consists of the furnishing, excavating, loading, hauling, placing, compacting, and finishing of all materials necessary for the completion of the roadway, including its embankments, intersections, driveways, and approaches as shown in the plans. For further information, see the Standard Specifications for Highway Construction, (Reference 7.2), Section 206.

4.D Added Quantities

Earthwork for earth dikes, large drives and intersections should be added to the computer-generated quantities as an added quantity.

4.E Subsidiary Earthwork

Subsidiary earthwork is earthwork that is not paid for directly but is included in other earthwork or other construction items.

- Often on small urban projects with small amounts of earthwork, all earthwork is made subsidiary.
- The construction of small earth dikes is subsidiary to the pay item “Excavation”.
- Earthwork for the construction of larger earth dikes should be calculated as “Earthwork Measured in Embankment” where no balance factor is considered, or they may be built as roadway embankment from a borrow pit, which will be paid for as “Excavation Borrow.”

For further discussion of earthwork payment, refer to the Standard Specifications for Highway Construction, (Reference 7.2).

5. EARTHWORK/CROSS-SECTION CHECK POLICY

5.A General

The following checks shall be made on earthwork and cross-section computations.

- Preliminary plans: the **Roadway Design Project Manager** will review the earthwork checklist with the roadway designer and supervisor and ask special questions if applicable on plan-in-hand.
- Functional plans: the **Roadway Design Project Manager**, designer and supervisor will review the checklist again and note anything that will need to change from the plan-in-hand plans.
- Limits of construction plans: The roadway designer, supervisor, and **Roadway Design Project Manager** should double check earthwork.
- Final plans submittal:
  1. Check the computer generated earthwork output.
  2. Check the earthwork data (stick-up) sheets.
  3. Final cross-sections: transfer work sheet data to final cross-sections.
  4. Check the field books.

Refer to **EXHIBIT N** of the Design Process Outline, (Reference 7.4), for the earthwork checklist (http://www.nebraskatransportation.org/roadway-design/#designprocess)

6. SOIL, SUBGRADE AND SITUATION REPORTS

The soil, subgrade and materials surveys are essential to preliminary engineering for location and design purposes. Information about the distribution of soils and groundwater conditions is required input for a reasonable and economic roadway design.

The **Materials and Research Division** reports provide pertinent information on the following aspects of highway design:

- Location of the grade line, both vertically and horizontally.
- Location and selection of borrow material for fills and subgrade treatment.
- Design and location of ditches and underdrains.
- Design of the roadway section.
- Need for subgrade treatment and type of treatment required.
- Location of local sources of construction material.
- Selection of the surface type and its design (See Chapter Eight: Surfacing, Section 1).

6.A Soil Survey/Soil and Situation Report

The soil survey will research the soil profile, soil horizons and the uniformity of the profile throughout the project, soil compaction and other soils characteristics by station, the water table condition and other concerns such as underground wet zones. The **Materials and Research Division** uses the following criteria to determine the minimum finished grade elevation above the expected high water table:

- 4 ft (1.2 meters) above the expected high water table if the entire profile is sand.
- 7 ft (2.1 meters) above the expected high water table if there is to be silt-clay within 4 ft (1.2 meters) of the finished grade elevation.

6.A.1 Soil Survey

A soil survey is usually performed with preliminary plans, which have the approximate grade line, prior to the final preparation of the grading plans. It usually consists of the research of soils maps, aerial photographs, geology reports and condition reports, preliminary field reconnaissance of the project, previous project reports, soil borings in areas of excavation and embankment, and recordings of water table locations. Laboratory soil tests are made on the samples taken and results are tabulated.

6.A.2 Preliminary Soil and Situation Report

If the soil survey reveals a condition that may present problems for the design or construction of a project, a Preliminary Soils and Situation Report is submitted to the **Roadway Design Division.** The preliminary report usually addresses water table concerns. It may include locations of usable quantities of sand in a silt-clay region or locations of borrow pits. Settlement and unsuitable material issues may also be addressed. Unless there is a big cut or fill, a preliminary report is not normally sent to **Roadway Design**.

6.A.3 Soil and Situation Report

The Soil and Situation Report presents the results of the soil survey in a standardized format. It includes the following:

- The location and length of the project.
- The topography and drainage situation.
- The water table.
- The geology of the project area.
- Soil horizons and formations.
- Soil descriptions, including engineering characteristics.
- Recommendations for subgrade treatments.
- Compaction requirements.

If selective handling of excavated materials is planned for the project, recommendations for the handling are also included. Selective handling is generally restricted to five general cases:

1. To produce embankment sections of uniform material, i.e., all silt-clay soils or all sandy materials in the upper embankment.
2. To place materials suitable for use in a bituminous sand base course in the upper subgrade.
3. To place highly undesirable materials at depth or in the outer slopes of the embankment.
4. To place select materials over heavy clay materials to reduce moisture problems.
5. To use select granular materials in lieu of a foundation course on Portland cement concrete pavement projects.

The Soil and Situation Report will divide the project, if necessary, into sections of one or more balances according to soil type or other factors. A detailed discussion of soil materials to be excavated is then developed for each section. The selective soil placement notes always reflect the surfacing plans for the project. The soil survey may also identify locations for possible sources of shoulder material, topsoil to support subsequent vegetation or soil binder material. It is the responsibility of the designer to ensure that the recommendations of the Soil and Situation Report, and the resulting design, are detailed on the project plan sheets.

6.B Subgrade Survey/Subgrade and Situation Report

6.B.1 Subgrade Survey

The subgrade survey is conducted on previously graded roads for which rigid or flexible pavement is being designed. Its principal objectives are:

- To sectionalize the project according to the type of soil in the upper subgrade.
- To locate and explore any portions of the project where the subgrade may be of questionable stability due to springs, seepage or wet zones.
- To evaluate gravel windrow or crust which may have been placed or developed under traffic with temporary gravel surfacing or clay surfacing.
- To obtain a check on the conditions resulting from the selective placement required by the grading plans.

6.B.2 Subgrade and Situation Report

The Subgrade and Situation Report is prepared for those projects where there is a period of time between grading and the preparation of paving plans. Whenever grading and paving are let in the same contract, the design of the base and surface courses is based on information obtained from the soil survey.

The Subgrade and Situation Report usually contains the following:

- A description of the existing surface conditions.
- The proposed construction.
- The foundation course requirements.
- The existing topography and pedology.
- A description of and recommendations for the surface and subsurface drainage.
- Compaction requirements.
- Any subgrade distress.
- Any embankment and/or slope stability problems.

The compaction requirements list will be added to the plans.

6.C Embankment Foundation Report

In known areas of poor foundation soils, a field investigation of foundation soils is made by the **Soils Mechanics Unit** to develop recommendations to minimize settlement and slope stability problems. An Embankment Foundation Report is submitted to the **Roadway Design Division** to advise of possible adverse conditions and to recommend possible remedies. The two most common solutions to correct settlement problems are:

- Construct surcharges to speed up settlement.
- Delay paving until settlement has reached a satisfactory level.

Other possible corrective measures include:

- Use of temporary bituminous paving until settlement has reached a satisfactory level, when permanent paving may be placed.
- Excavation of unsuitable material.
- Use of vertical sand drains to speed settlement.
- Lower the height of the fill.
- Realign the road to avoid the unsuitable area.
- Bridging over the unsuitable area.

To correct embankment stability problems during and after grading construction, several possible solutions are available (See the Earthwork Engineering Guide, Reference 7.5):

- Require special compaction of the embankment material, e.g., higher minimum density and lower maximum moisture content.
- Flatten side slopes of the embankment from 3:1 to 5:1.
- Build berms.

- Staged construction, the process of bringing fill up to maximum height in several stages over a period of time (usually two or more years).
- Excavate unsuitable material.
- Lower the height of the fill.
- Realign the road.
- Bridging.
- A combination of the above, e.g., special compaction and stage construction.

The recommendations contained in the Embankment Foundation Report, and the resulting design, will be detailed on the project plan sheets.

7.3R PROJECT EARTHWORK

The following items pertain to earthwork for 3R projects:

- Calculate all earthwork quantities using the overlay thickness. Do not include the template correction in the GeoPak offset profile.
- If the shoulder construction plus the embankment is less than 500 cu. yds. per mile (240 m^3 per km), pay for shoulder construction only (See Chapter Eight: Surfacing, Section 3.C).
- If paying for embankment, use a balance factor of 1.0 and use “Earthwork Measured in Embankment (EQ)” as the pay item.
- When using “Earthwork Measured in Embankment (EQ)” as the pay item, multiply the embankment by a balance factor of 1.5 when calculating the pay item “Water Applied”.
- Provide design data and earthwork quantity sheets for the plans on all projects with surveys.
- Show all grading on the cross-sections; i.e. for culverts, guardrail, etc.
- For Maintenance and PEP projects, consult with the **District** to determine if the shouldering/seeding work will be done by the **District** or by the contractor.
- On interstate projects flatten the slopes of earth dikes within the lateral obstacle clearance, which are perpendicular to the traffic, to a 10:1 slope facing the traffic. A 6:1 slope is acceptable for the offside, (downstream), face of the dike. Dikes constructed within the median shall have 10:1 slopes on both faces of the dike.

8. REFERENCES

7.1 Nebraska Department of Roads, Drainage Design and Erosion Control Manual, Current Edition.

7.2 Nebraska Department of Roads, Standard Specifications for Highway Construction, 1997, and current supplemental updates. (http://nebraskatransportation.org/ref-man/)

7.3 Nebraska Department of Roads, Standard/Special Plan Book, Current Edition.

7.4 Nebraska Department of Roads, Design Process Outline, Current Edition. (http://www.nebraskatransportation.org/roadway-design/#designprocess)

7.5 Nebraska Department of Roads, Earthwork Engineering Guide, 1990.

CHAPTER EIGHT
SURFACING

LIST OF EXHIBITS

CHAPTER EIGHT
SURFACING

Chapter Eight
Surfacing

This chapter presents general design considerations for surfacing elements in roadway design. The **Materials and Research Division** will provide surfacing recommendations to the **Roadway Design Division.**

1. PAVEMENT DESIGN DETERMINATION

Pavement design recommendations include the type and thickness of pavement for a project, whether a foundation course is required, types of subgrade drainage and the shoulder treatment to be used.

1.A Pavement Design Input

The **Materials and Research Division** uses design-year traffic projections, project type, subgrade soil types and environmental factors (roadbed swelling and frost heave) to develop pavement recommendations.

The roadway designer furnishes design-year average daily traffic (ADT) projections and the percent heavy commercial vehicles to the **Materials and Research Division** to develop pavement recommendations, (the design year is the year 20 years after the completion of the project). Design year ADT and percent heavy commercial vehicle information is available from the **Planning and Project Development Division**.

The **Materials and Research Division** also uses information about the type of project (new, reconstructed, overlay), the number of lanes, the design speed and the shoulder treatment as input into the pavement design determination.

1.B Procedure to Request Pavement Determination

EXHIBIT 8.1 shows the form to use to request a pavement determination from the **Materials and Research Division**. The request for pavement determination should be submitted during preliminary roadway design, Activity 5307/5309. The surfacing recommendation is then submitted to the **Roadway Design Engineer, District Engineer, Deputy Director-Engineering and Deputy Director-Operations** for their concurrence (See **EXHIBIT 8.2**).

Nebraska
Department of Roads Inter-Office Correspondence

DATE:
TO: Materials & Research Engineer_______________________________

FROM:_______________________________

THRU:_______________________________

SUBJECT: Request for Pavement Determination

PROJECT:______________________________________

CONTROL NO.:_________________________HIGHWAY NO.:_________________________

LOCATION:____________________________________
LENGTH:__________ MILES (KM)

REFERENCE POST: BEGIN_____________ END:_____________

DISTRICT:______________________________
COUNTY:_____________________________

SURFACED SHOULDERS: YES________ NO______
WIDTH:______________________

TRAFFIC:	20____	20____
ADT	______	______
DHV	______	______
% HEAVY TRUCKS	______	______
DESIGN SPEED	______	______

COMMENTS:

cc: File

Exhibit 8.1 Request for Pavement Determination Form

Nebraska
Department of Roads Inter-Office Correspondence

DATE:______________________

TO:____________________________, Project Designer, Roadway Design

FROM:__________________________, Pavement Design Engineer

THRU:__________________________, Materials & Research Engineer

SUBJECT: Pavement Determination for Wahoo South
Project No. BRF-77-2 (127)

This is a short section of surfacing required because of a bridge replacement over Wahoo Creek, just south of Wahoo.

Since it is a Federal-aid project with relatively high traffic, any asphaltic concrete section would require an open graded or "M" type mix, which would be quite expensive for a short project length.

The 40-year analysis indicates that concrete pavement would be more economical, even though the initial construction cost would be more. Also, since Wahoo Creek frequently goes out of its banks and there seems to be little possibility of any upstream flood control structures which might reduce the flooding, concrete pavement is recommended as being best during possible overflow.

No surfaced shoulder recommendations are being made in this determination for the following reasons:

1. It might be best to place surfaced shoulders later when projects to the north or south are completed to lower the costs.
2. If a severe threat of flooding still exists in the area of the bridge, then concrete shoulders might provide the best service with the least chance of washing out under flood flow.

Recommendation:
(A) 9” (230 mm) plain pavement on granular foundation course with no shoulders at this time, or asphalt shoulders placed now.
or
(B) 8½” (220 mm) plain pavement and 8½” (220 mm) concrete shoulders, if the area is still subject to flood flow.

Concurrence (A or B)_______________________Roadway Design Engineer Date______________

Concurrence (A or B)_________________________District Engineer Date______________

Approved (A or B)___________________________Deputy-Director, Engineering Date__________

Approved (A or B)___________________________Deputy-Director, Operations Date__________

Exhibit 8.2 Example Pavement Determination Recommendation

2. PAVEMENT TYPES AND THICKNESSES

In general, there are two types of pavements: rigid and flexible. The **Materials and Research Division** recommends the pavement type and thickness.

2.A Rigid (Concrete) Pavement

Rigid pavement is designed to distribute loads to the subgrade, having as one course a Portland cement concrete slab of relatively high bending resistance. Rigid pavement is assumed to bridge any minor irregularities in the base or subgrade upon which it rests.

2.A.1 Portland Cement Concrete Pavement Design Policy

1. Rigid Pavement Design – All rigid pavements will be plain jointed Portland cement concrete including dowel bars at transverse joints as follows:
   a. Rural Areas – In rural areas epoxy coated dowel bars at 12 in. (300 mm) centers will be placed at all transverse joints.
   b. Urban Areas – In urban areas each section will be analyzed by the **Materials and Research Division** to determine the need for dowel bars. If dowel bars are required they will be of the same design as in rural areas.
2. Minimum Pavement Thickness – The minimum pavement thickness of Portland cement concrete pavement on the State Highway System shall be as follows:
   - Interstate System, I-76 Junction East...12 in. (305 mm)
   - Interstate System, I-76 Jct. West, and the Expressway System..........10 in. (255 mm)
   - All Other Highways...9 in. (230 mm)

   The concrete thickness shall not be shown in the plan build note unless necessary to describe the locations of different surfacing thickness, within the same project, which cannot be adequately defined on the typical cross-section sheet, (See Chapter Eleven: Plan Preparation, Section _).
3. Transverse Joint Spacing – Transverse joints will be at 16'-6" (5.0 m) centers, placed perpendicular to the centerline of the roadway.
4. Tied Concrete Shoulders – If Portland cement concrete shoulders are used they will be tied to the travel lane and will be included in the design calculations, (See the Standard/Special Plans Book, Reference 8.1).

2.A.2 Pavement Joints

Portland cement concrete surfacing plans require diagrams showing joint locations. Typical joint diagrams for concrete pavement are available, (See the Standard/Special Plans Book, Reference 8.1). A joint diagram plan will need to be developed, however, for complicated intersections and/or lane drops. When plans call for the widening of existing surfacing, and the new joints are to match existing joints, a note to that effect on the plans will be sufficient. Ideally, joints should follow pavement markings. The **Materials and Research Division** and the **Traffic Engineering Division** shall review the joint diagrams.

To ensure proper joint alignment between bridge approach slabs and the roadway lane configuration, the designer should specify where the construction joints are to be located when requesting the pavement approach slabs from the **Bridge Division**. The designer is responsible for checking the plans for compliance when they are completed by the **Bridge Division** and before submitting the project to the **Plans, Specifications and Estimates Unit** in the **Construction Division.**

Portland cement concrete pavement requires several types of joints to control cracking from the stresses induced by volume changes in concrete.

- Contraction joints are located in the pavement to relieve tensile stresses from temperature changes in the slab. Joint spacing generally divides the pavement into sections of approximately the same length and width, (the length to width ratio shall not exceed 1.5). Longitudinal contraction joints are normally located between traffic lanes. Transverse contraction joints are perpendicular to the centerline and will include load transfer devices across the joint.
- Expansion joints are used primarily to provide separation between the pavement and other structures such as bridges and inlets or at other pavement sections such as pavement slabs at intersections.
- Construction joints will be placed at the end of each day's work or whenever paving ceases for over 30 minutes. Construction joint location is determined in the field.

Load transfer devices, (e.g., smooth steel dowel bars), may be used at transverse joints to properly distribute the load stresses and should offer little resistance to any longitudinal movement at the joint. Tie bars, (e.g., deformed reinforcing steel), are used to hold the faces of adjacent slabs in firm contact with one another. They are not designed to act as load transfer devices.

The following joints will have the specified connections:

Transverse Joints

Joint Type	Connection Type
Construction	Dowel bar
Contraction	Dowel bar
Expansion	Dowel bar

Longitudinal Joints

Joint Type	Connection Type
Construction	Tie bar
Between lanes	Tie bar

See the Standard/Special Plans Book (Reference 8.1) for details of bars at joints and joint spacing.

2.A.3 Joining Existing Pavement

When a project includes new concrete pavement to be placed adjacent to existing concrete pavement, it will be necessary to install tie bars on longitudinal joints. It is not necessary to write build notes for tie bars, information on the summary of quantities sheet is sufficient. Tie bars are pay items when joining to existing pavement, (but not on longitudinal construction joints), the designer needs to calculate tie bar quantities. When joining an existing pavement at a transverse joint, dowel bars are needed. Dowel bars are not paid for directly but are subsidiary to concrete pavement.

2.A.4 Tining

All concrete pavements with posted a speed limit of 40 mph (65 km/h) or greater shall be tined. When a mainline is tined, intersections, acceleration lanes, deceleration lanes, left turn lanes and ramps shall also be tined.

The Standard/Special Plans Book (Reference 8.1) has tining details. If only part of a project is to be tined, then a note should be placed on the 2-T sheet describing those areas that do not receive tining, (See Chapter Eleven: Plan Preparation, Section _).

2.B Flexible Pavement

Flexible pavement is characterized by a structure that depends on aggregate interlock, particle friction and cohesion for stability. Flexible pavement generally will consist of one of the following types:

- Asphaltic concrete surface course of varying types.
- Bituminous sand base course (BSBC) with either an asphaltic concrete wearing course or armor-coat wearing course.

2.C Surfacing Aggregates

Crushed rock or gravel may be used to surface driveways, at the end or drive returns, for temporary roads and for temporary access to properties during project construction. When gravel is specified for a temporary road, the designer should require gravel embedment.

2.D Pavement Subdrains

Because drainage is an important factor in pavement performance, subgrade drainage is an important consideration in pavement design. Pavement subdrains will vary with the plasticity index (PI) of the subgrade. The **Materials and Research Division** determines the required drainage during the pavement determination process. The measurement spacing between outlets should begin from outlets at sag locations. Outlets shall be constructed at intervals of 500’ (150 m) where the grade is 1% or greater and at intervals of 250’ (75 m) on grades of less than 1%.

3. SHOULDERS

Chapter One: Design Standards and the Nebraska Minimum Design Standards, (Reference 8.2), (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf), outline the functional highway classifications that determine shoulder width and composition.

3.A Concrete Shoulders

Concrete shoulders will be paid for as "** inch (mm) Concrete Pavement." The item, "Subgrade Preparation", should be used for concrete shoulders. Shoulder construction must be paid for and must be shown on the Typical Section (2T) sheet, (See Chapter Eleven: Plan Preparation, Section _). The plans must also indicate where material for shoulder construction (see Section 3.C) is available to the surfacing contractor. A shoulder dimension must be shown on the typical section sheet.

In the unusual case of concrete shoulders being of a different design thickness than that of the mainline, the **Materials and Research Division** should be consulted for appropriate special provisions for subgrade preparation. A note shall be included on the typical section referring to the material to be removed by the surfacing contractor.

3.B Salvaging Existing Paved Shoulders on 4-Lane Divided Highways

When a new four-lane divided highway is being designed utilizing an existing 2-lane roadway with 8 ft. (2.4 m) surfaced shoulders that are in good condition, attempts should be made to use the existing inside paved shoulders in place. See Chapter Six: The Typical Roadway Cross-Section, Section 1.D, for additional discussion.

3.C Shoulder Construction

The subgrade on all projects that have new surfacing shall be designed an additional 2” (50 mm) high so that when the surfacing contractor completes subgrade trimming there will be enough material trimmed to complete the shouldering operation, as shown in **EXHIBITS 8.3a and 8.3b.** Soil materials used for shoulder construction must have the capability to support vegetation. Sources of shoulder materials include:

- Undercutting, leaving the grade high for use in shoulders after the trimming operation.
- Excess excavation.
- Located sites within state right-of-way (station-to-station).
- Locations outside the state right-of-way (contractor's responsibility).

Areas designated as sources of shoulder material should not be disturbed, if at all possible. All disturbed areas should be protected from erosion through seeding, sodding, cover crop, etc. See Chapter Two of the Drainage Design and Erosion Control Manual, (Reference 8.3), Section 5 for additional information.

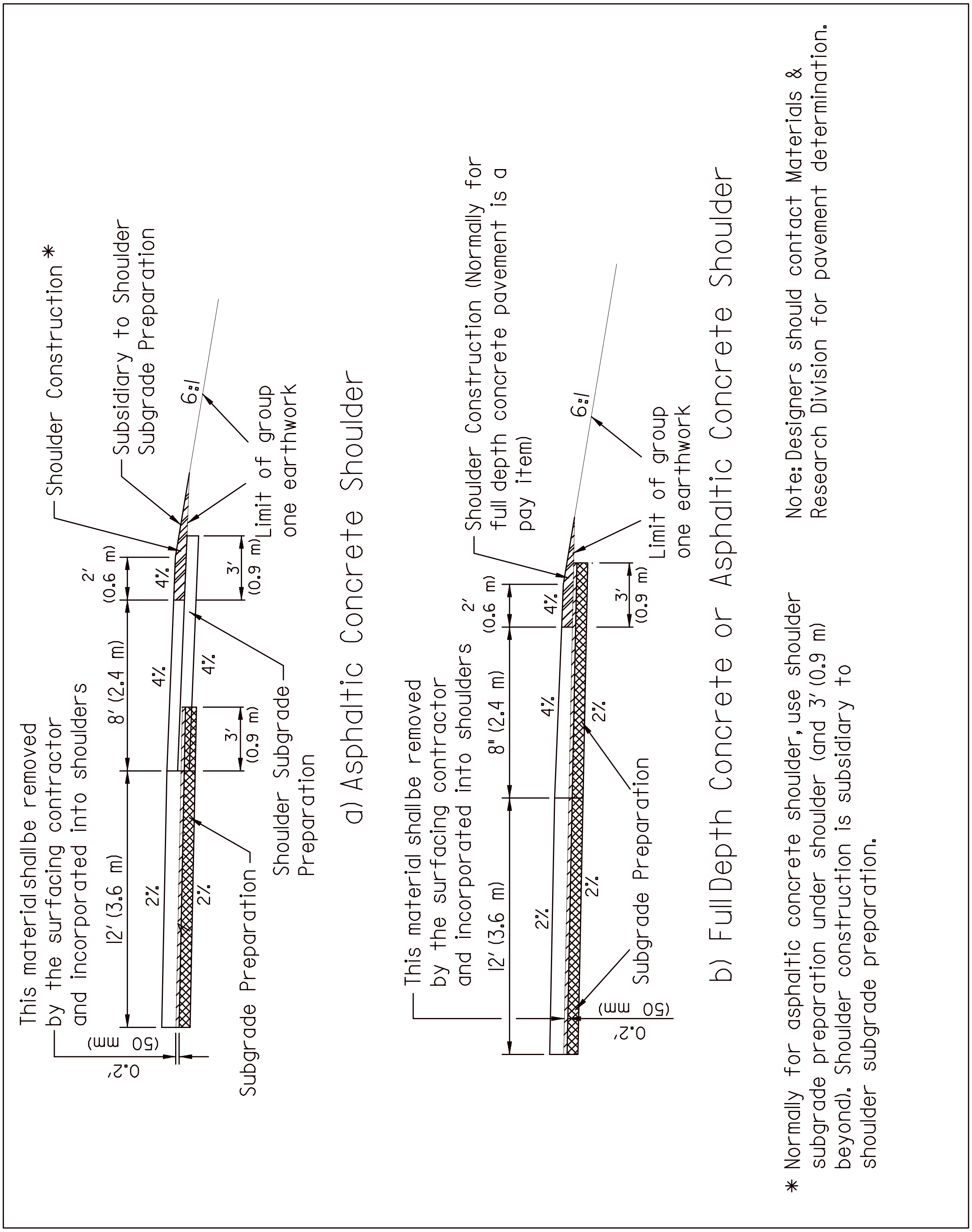


Exhibit 8.3a Typical Shoulder Construction (Uncurbed Section)

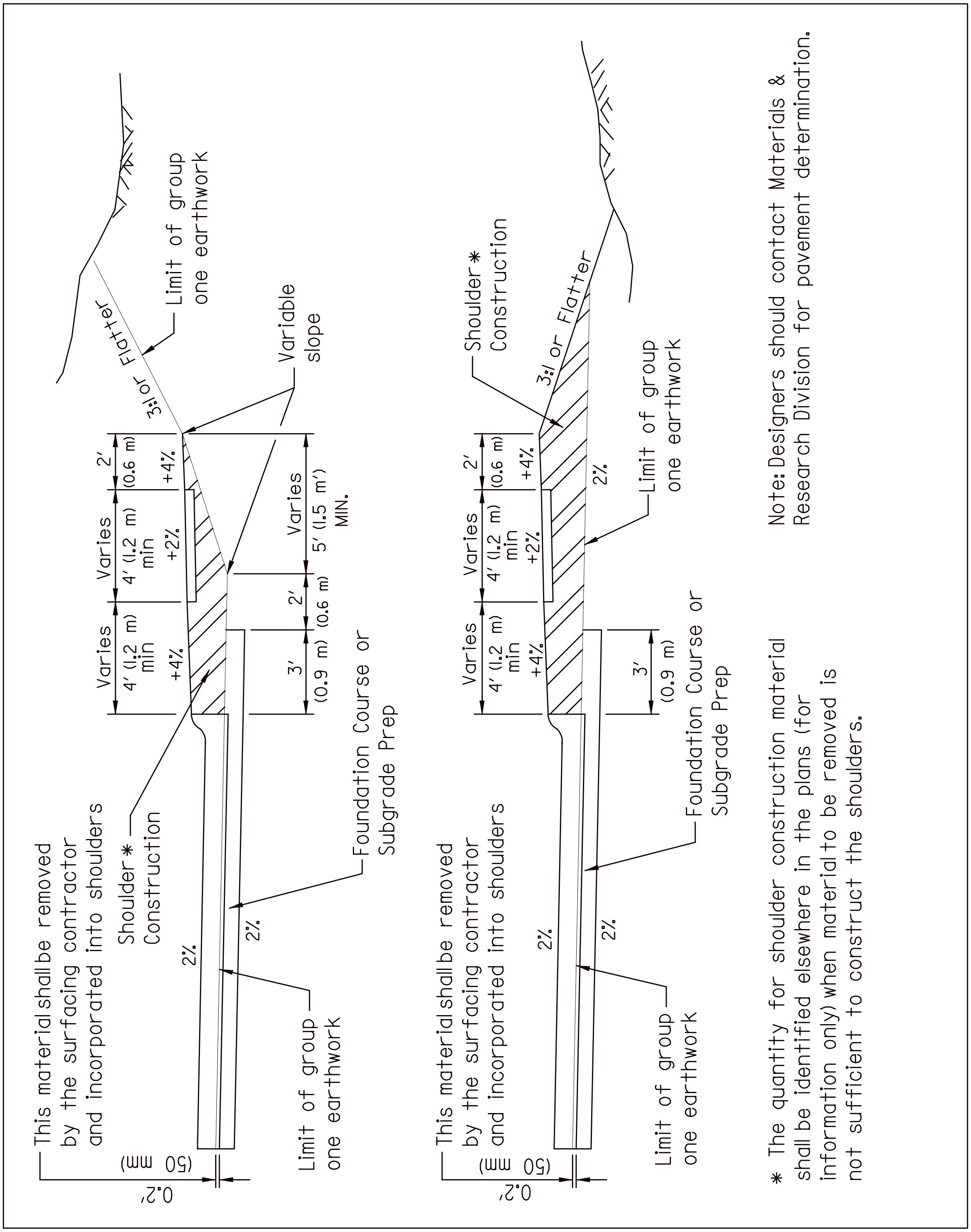


Exhibit 8.3b Typical Shoulder Construction (Curbed Section)

4. PAVEMENT REHABILITATION

The goal of pavement design is to provide a long-lasting, smooth-riding, cost-effective roadway surface for the traffic levels forecast over the anticipated life of the surfacing. Sometimes higher than anticipated traffic levels, less durable materials or other factors cause pavement to deteriorate at an accelerated rate. Pavement rehabilitation techniques have been developed to extend or enhance the service life of roadways. Pavement rehabilitation analysis is performed to:

- Determine the cause(s) of pavement distress(es).
- Develop a list of possible solutions to cure and prevent recurrence of the problem(s).
- Select the preferred rehabilitation method, given economic and other project constraints.

Data used to determine the cause(s) of the problem(s) include those items described in Section 1.A and also pavement condition-distress severity and extent. The pavement serviceability index and the needs study analysis are used to develop rehabilitation recommendations for existing surfacing conditions.

4.A <u>Types of Rehabilitation</u>

Major rehabilitation is any work undertaken to significantly extend the service life of an existing pavement. This differs from periodic maintenance activities, which are primarily designed to preserve existing pavement so it may carry its anticipated design loading. Rehabilitation techniques include, but are not limited to:

- Overlay of existing surfacing.
- Full depth pavement repair.
- Partial depth patching.
- Joint or crack sealing.
- Subsealing.
- Grinding and milling.
- Subdrainage treatments.
- Pressure relief joints.
- Load transfer restoration.
- Surface treatments.

4.B <u>Removal of Existing Surfacing</u>

Existing surfacing may be removed to correct grade elevations; to accommodate surfacing thickness requirements at railroad crossings, project ends, bridge ends or other locations shown on the plans; or to recycle. The thickness of surfacing to be removed will not be shown on the plans.

Existing surfacing may be salvaged. The decision whether or not to salvage the existing surfacing should be addressed on the plan-in-hand field inspection. If the existing surfacing is to be salvaged, the roadway designer should check with the **Materials and Research Division** during the pre-design of the project to find out the depth, width and length of the material to be salvaged. The preliminary cross-sections should then reflect the void left by the existing surfacing that is to be removed. Removal of surfacing will be paid for as "Remove Pavement” for pavement that includes any concrete pavement (including composite pavement) or “Cold Milling” for asphaltic concrete pavement.

If the existing surfacing is asphalt and is not to be salvaged this surfacing may be disposed of in the fill, where possible, after review by the **Location Studies Unit** in the **Planning and Project Development Division**, (See Chapter Thirteen: Planning and Project Development, Section 4.H.1). No deductions to the earthwork quantities are required for the volume occupied by this surfacing and no direct payment will be made for the removal. See the Standard Specifications for Highway Construction, (Reference 8.4), (http://nebraskatransportation.org/ref-man/).

If the existing surfacing (concrete or asphalt) will not be salvaged but is to be removed from the project, the designer should deduct the volume occupied by this surfacing in computing the earthwork balance, and the removal should be paid for directly.

If there is to be over 3 ft. (1.0 m) of embankment placed on top of the existing concrete surfacing, the concrete is to be broken into approximately 4 ft. (1.2 m) square pieces and left in place. The pay item, "Breaking Pavement," is paid for by the sq. yd. (m^2).

When some pavement is to be salvaged and some removed, the areas should be shown on the plans with different crosshatching. Both areas of pavement will have quantities indicated.

If the project covers both rural and urban areas, the plans shall show the limits of asphalt removal which is subsidiary, (rural), and the physical limits of asphalt removal for which payment will be made, (urban).

4.B.1 Cold Milling

Cold milling is the removal and salvaging of existing asphalt surfacing material. Depending on the depth of milling and slope requirements outlined in the pavement determination letter from the **Materials and Research Division**, cold milling may be one of several different types. The different types vary from milling to remove surface irregularities to milling to remove the entire depth of existing surfacing. Milling is paid for at the contract unit price per station or per sq. yd. (m^2). See the Standard Specifications for Highway Construction, (Reference 8.4), Section 510.

4.B.2 Brick

Whenever brick surfacing is to be removed and salvaged, a special provision will be required. The roadway designer will note the need for this provision in the plans, specifications and estimates (PS&E) package.

4.C Pavement Patching

Quantities for pavement patching must be included in the project cost estimate (See Chapter Twelve: Cost Estimating, Section _). See the Standard Specifications for Highway Construction (Reference 8.4), Sections 516 and 605, for additional information.

Concrete Pavement - Patching of concrete pavement consists of the removal and replacement of irregular areas of existing concrete pavement, including any overlaying bituminous surfacing, and any unstable or disintegrated base course. In general, patching of concrete pavement is limited to those areas where vertical displacement or failure has developed in the existing concrete pavement. Irregularities and depressions encountered in the resurfacing of existing concrete pavement, which do not involve the underlying concrete, are not considered pavement patching but are corrected as a part of the resurfacing work.

Asphaltic Concrete Pavement - Patching of asphaltic concrete pavement consists of the removal and disposal of unstable or disintegrated materials (including base course, if necessary) and the placing and compacting of the appropriate type of asphaltic concrete. The designer shall include the pay items for rental of loader, motor grader and dump truck with all asphalt patching, (See Chapter Twelve: Cost Estimating, Section _).

4.D Recycling Materials

Removal of asphaltic material is paid for by the item, "Cold Milling Class **," regardless of how the milled material is used. If removed concrete is to be used for other purposes, such as foundation course or riprap, the removal (including hauling and stockpiling) is paid for separately. See the Standard Specifications for Highway Construction, (Reference 8.4), Section 312.

4.E Overlays

Asphaltic concrete overlays are used in a variety of situations. Generally, a specified depth or grade line of existing bituminous material is removed by cold milling and then the overlay is put down. The **Materials and Research Division** will design overlays and provide the designer with typical sections.

4.E.1 Template Correction

Template correction **will not** be added to the asphaltic concrete overlay depth to arrive at the centerline grade elevation. For example, if the resurfacing recommendation is to cold mill approximately 1” (25 mm) and to overlay at a depth of 4” (100 mm) + ½” (13 mm) T.C., the centerline grade raise will be 3” (75 mm). Template correction depth **will** be added to the overlay depth when calculating asphaltic concrete quantities, (See Chapter Twelve: Cost Estimating, Section_).

4.F Pavement Edge Dropoffs

It is the responsibility of the roadway designer to inform the **Traffic Engineering Division** of any projects being constructed under traffic, with grading operations adjacent to the existing roadway. The Standard/Special Plans Book, (Reference 8.1), covers the signing of dropoffs created during surfacing operations.

4.G Pavement Widening

Pavement widening may be incorporated into an asphaltic concrete overlay project. The **Materials and Research Division** will design the material type and cross-section of the widened pavement.

5. SURFACING QUANTITY COMPUTATIONS

The procedure for computing quantities of surfacing material depends on the type of pavement to be placed. Cost estimates will be made based on the computed quantities (See Chapter Twelve: Cost Estimating, Section _).

5.A Rigid Pavement

The roadway designer is responsible for computing concrete surfacing pay items, including the following quantities:

- Concrete pavement, including intersections, (See Chapter Four: Intersections, Driveways and Channelization, Section 3.A), for each design pavement thickness.
- Each design thickness for driveways, (See Chapter Four: Intersections, Driveways and Channelization, Section 3.B).
- Concrete and lbs (kg) of rebar for bridge approaches.
- Concrete curb.

The designer computes separate total areas of surfacing, including mainline, intersections, driveways, approaches and turnouts. The area, in sq yds (m^2), thus obtained is the estimated pay item quantity.

Concrete pavement quantities shall be itemized and shown on the computation sheets in such a manner that the segment of pavement they represent can be easily recognized. In cases where the design is very complex, sketches may need to be included with the computation sheets. The designer submits all essential project information to the **Materials and Research Division** for quantity computations. The designer should refer to **EXHIBIT C** of the Design Process Outline (Reference 8.5), (http://www.nebraskatransportation.org/roadway-design/#designprocess), for a list of surfacing pay items.

5.B Flexible Pavement

The designer submits all essential project information, including typical sections, complete plan and profile sheets, driveway sketches and locations, and the summary of asphaltic concrete quantities to the **Materials and Research Division**, which is responsible for computing the final pay quantity.

The roadway designer shall ensure that the flexible pavement quantities include all asphaltic concrete surfacing used for driveways and intersections (See Chapter Four: Intersections, Driveways and Channelization, Section 3); mailbox turnouts (See Chapter Ten: Miscellaneous Design Issues, Section 12); surfacing under guardrails (See Chapter Nine: Guardrail and Roadside Barriers, Section 1.B.10); surfacing for detours, temporary roads, crossovers and temporary pavement (See Chapter Ten: Miscellaneous Design Issues, Section 11); and asphaltic concrete curb. For a complete list of surfacing pay items, see **EXHIBIT C** of the Design Process Outline (Reference 8.5).

5.C Surfacing Aggregates

Aggregates used for surfacing are computed either by mass unit of ton (Mg) or by volume unit of cu. yd. (m^3). The method used varies by district. In **Districts 1 and 2** surfacing aggregate estimates should be calculated in tons (Mg). When surfacing aggregates are needed in other districts, consult with the **District Engineer** during the plan-in-hand to determine the unit of measurement (cu. yd. or ton (m^3 or Mg)). The designer should also consult with the **District Engineer** during the plan-in-hand to determine the type of aggregate to use (either rock or gravel) for their respective districts. The following weight to volume factors should be used in estimating:

Crushed rock for surfacing:	1.25 tons/cu yd (1.50 Mg/m^3)
Gravel for surfacing:	1.35 tons/cu yd (1.60 Mg/m^3)

On new and reconstructed projects where major grading disrupts property access the designer should discuss the use of gravel, crushed rock or millings on the plan-in-hand field inspection to provide temporary access to the impacted properties. The designer should include a lump sum for these quantities in the preliminary project estimates. The quantities should vary between 100 to 200 tons per mile (60 Mg to 120 Mg per kilometer) depending on the size of the access and the type of roadway, (2-lane vs. 4-lane, urban vs. rural). These quantities are for design purposes only. Depending on the number of accesses these values may increase of decrease. Quantities shall be shown to the nearest ton (Mg).

For a complete list of surfacing pay items see **EXHIBIT C** of the Design Process Outline (Reference 8.5).

5.D Foundation, Base and Surface Courses

Pay item quantity units and methods of measurement for other roadway base and surfacing materials are found in the Standard Specifications for Highway Construction (Reference 8.4), Division 300.

5.E Saw Cut

A pay item for sawing must be included when removing pavement, sidewalk, driveway, integral curb or similar flatwork when the removal does not extend to an existing joint. The pay item for sawing includes both full depth and partial depth sawing.

Sawing is not required when removing full depth asphalt surfacing, however sawing is required when removing concrete overlaid with asphalt.

For estimating, the designer should estimate the length of transverse cut and any longitudinal integral cuts required to remove curb, portion of a lane, or similar cuts. The quantity should be rounded to the nearest 10 ft. (3 m). Do not calculate sawing when the removal coincides with existing joints. Sawing notes should not be shown in the plans.

6. RUMBLE STRIPS

Rumble strips shall be constructed on the shoulders for all interstate and expressway projects. Rumble strips are not normally used in urban or suburban areas, due to the noise that they generate.

A shoulder rumble strip is a dip ground into the shoulder surfacing in a longitudinal pattern. This feature is installed on a paved roadway shoulder near the travel lane. Rumble strips are used to wake sleeping drivers and to warn inattentive drivers of vehicles leaving the driving lanes of our highways. They are highly effective in areas where the terrain is uniform and fairly monotonous.

The Standard/Special Plans Book, (Reference 8.1), illustrates rumble strip dimensions and spacing on surfaced shoulders. Details of milled rumble strips should be placed on the plan set 2N sheets, (See Chapter Eleven: Plan Preparation, Section _). Note that rumble strips should not be milled on joints, as this may remove joint filler material.

7. SURFACING ELEVATIONS

See Chapter Eleven: Plan Preparation, Section _, for details showing the required accuracy for surfacing elevations of concrete pavement.

8. REFERENCES

8.1 Nebraska Department of Roads, Standard/Special Plans Book, Current Edition.

8.2 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

8.3 Nebraska Department of Roads, Drainage Design and Erosion Control Manual, Current Edition.

8.4 Nebraska Department of Roads, Standard Specifications for Highway Construction, 1997, and current updates. (http://nebraskatransportation.org/ref-man/)

8.5 Nebraska Department of Roads, Design Process Outline, Current Edition. (http://www.nebraskatransportation.org/roadway-design/#designprocess)

CHAPTER NINE
GUARDRAIL AND ROADSIDE BARRIERS

LIST OF EXHIBITS

CHAPTER NINE
GUARDRAIL AND ROADSIDE BARRIERS

Chapter Nine
Guardrail and Roadside Barriers

1. GUARDRAIL

The purpose of guardrail is to protect traffic from obstacles along the roadside. Guardrail is an obstacle itself and should not be used when it is a greater obstacle than the object or condition being "protected." The following sections summarize the warrants for guardrail, guardrail design procedures and the types of guardrail in use in Nebraska.

1.A Warrants for Guardrail and the Benefit/Cost Analysis

Warrants for guardrail are based on the premise that guardrail should be installed only if it will reduce the severity of potential accidents. The warrant analysis is generally based upon a benefit/cost analysis, which considers the costs of the guardrail, maintenance of the guardrail, accidents involving the guardrail, the potential costs of accidents involving the roadside obstacle, and the cost of removing or minimizing the obstacle. In some cases it may be more cost effective to leave the obstacle unshielded. **EXHIBIT 9.1** lists general considerations for barriers for non-traversable and fixed object obstacles.

In some cases, guardrail may be installed to protect pedestrians and bicyclists from motor vehicle traffic. If significant pedestrian and/or bicycle traffic is anticipated special attention shall be paid to the deflection characteristics of the barrier to be provided. Guardrail placement should also take snow drifting into consideration. Under some circumstances, the guardrail may act as snow fence, causing drifting. Check with the **District Engineer** for problem areas.

Obstacles	**Decision Considerations**
Backslopes	Consider the slope and the lateral obstacle clearance distance. Shielding not generally required.
Bridge piers, abutments and end of bridge rail	Shielding generally required.
Boulders	Consider the nature of the obstacle and the likelihood of impact.
Culverts, pipes, headwalls	Crossroad culverts 36 in. (900 mm) or less in diameter with flared end sections and round-equivalent culverts 36 in. (900 mm) or less in width with flared end sections may be included within the lateral obstacle clearance distance without protection. Larger culverts will require either a traversable end section, extension outside of the lateral obstacle clearance distance or a benefit/cost analysis to determine if barrier protection is economically warranted. **EXHIBIT 9.2** should be used to determine the need for guardrail for culvert protection. Drive pipes parallel to the highway should be placed at the back of the ditch, outside of the lateral obstacle clearance distance.
Ditches (parallel)	Consider the foreslope, backslope, and the lateral obstacle clearance distance.
Ditches (transverse)	Consider the transverse slope and the likelihood of head-on impact.
Embankment	Consider the fill height, length, slope and lateral obstacle clearance distance (See **EXHIBITS 9.3 & 9.4**). The minimum length of embankment requiring protection should be 100 ft. (30 m) for semi-rigid guardrail (W-Beam and Thrie-Beam) and 150 ft. (46 m) for cable guardrail. When very large obstacles exist on the embankment slope, the slope is no longer the controlling factor: benefit/cost analysis should be based on the severity of the large obstacle (i.e. large culverts).
Retaining walls	Consider the relative smoothness of the wall, anticipated maximum angle of impact, structural integrity of the wall when impacted, and the cost of repairs.
Sign/luminaire supports	Locate outside of the lateral obstacle clearance distance whenever possible. Where feasible, all sign/luminaire supports should be a breakaway design regardless of their distance from the roadway if there is a reasonable likelihood of their being hit by an errant motorist. The placement and locations of breakaway supports should also consider the safety of pedestrians from potential debris resulting from impacts. Shielding is generally required for non-breakaway supports.
Traffic signal supports	Isolated traffic signals within the lateral obstacle clearance distance on high-speed rural facilities may warrant shielding with barrier or crash cushion.
Trees	Consider the site-specific circumstances.
Utility poles	Utility poles should be relocated outside of the lateral obstacle clearance distance whenever possible. If utility poles cannot be relocated, a benefit/cost analysis should be performed and, if appropriate, they should be shielded. See Chapter Thirteen: Planning and Project Development, Section 6, for information regarding coordination with utilities.
Permanent bodies of water	Consider the location and depth of the water and the likelihood of encroachment.

Note: Shielding a non-traversable or a fixed object roadside obstacle is usually only warranted if the obstacle is located within the lateral obstacle clearance distance and the obstacle cannot be economically or practically removed, relocated or made breakaway and it is determined that the barrier provides a safety improvement over the unshielded condition.

Exhibit 9.1 Considerations for Barriers for Non-traversable and Fixed Object Obstacles

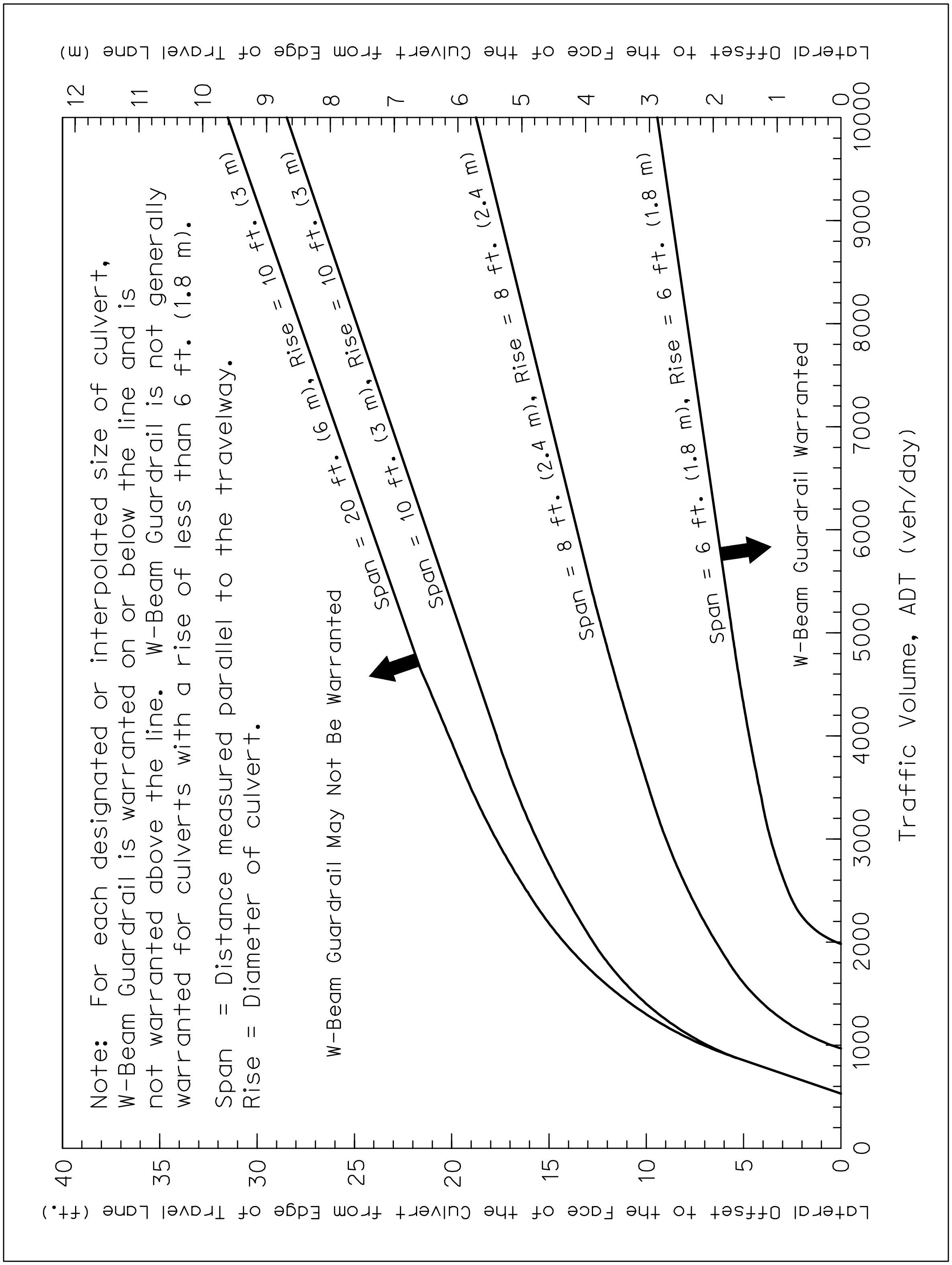


Exhibit 9.2 W-Beam Guardrail Warrants for Culverts
[Headwall or Parapet not exposed more than 4 in. (100 mm)]
Source: TRR Report No. 1599 (Reference 9.5)

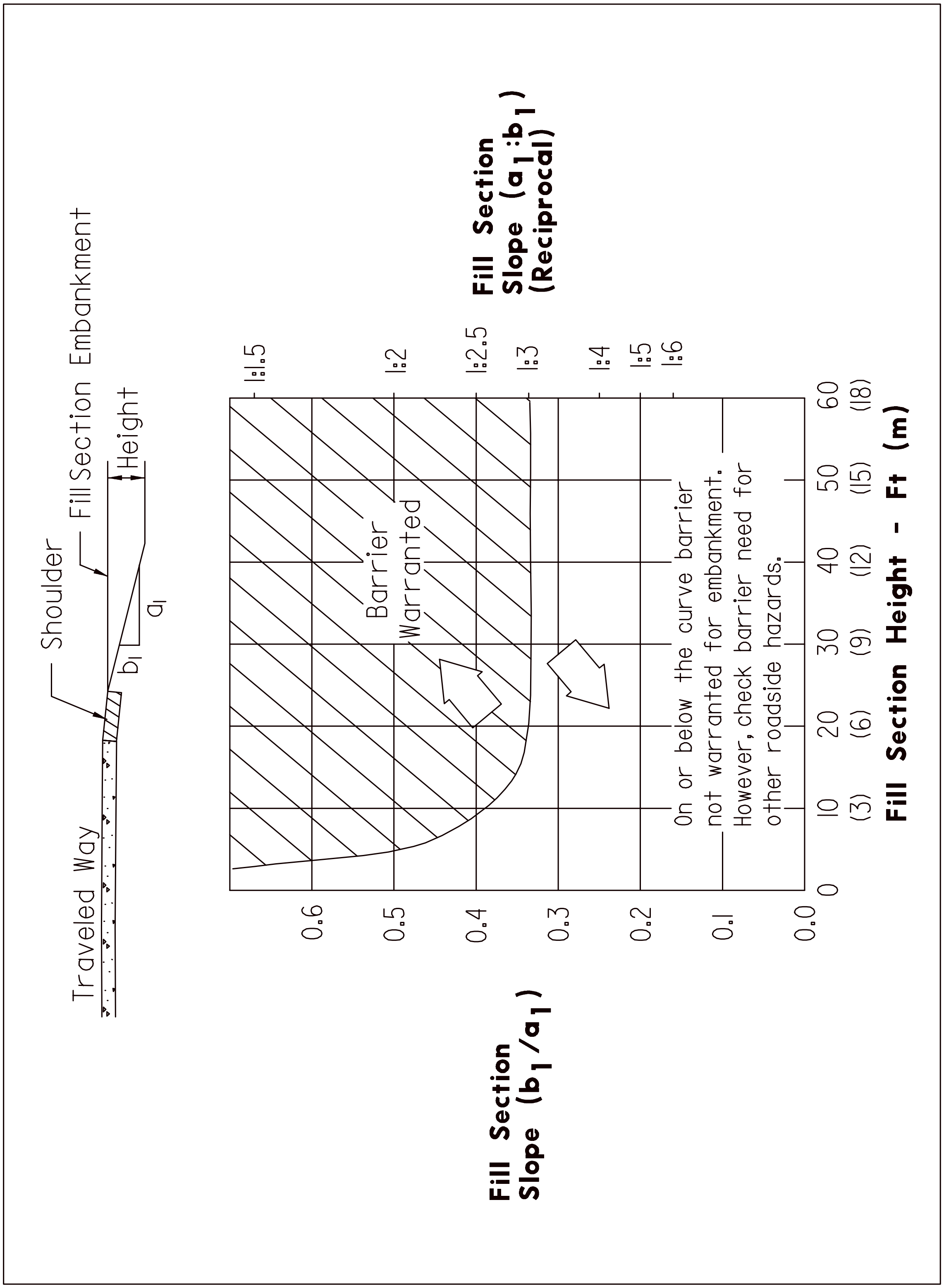


Exhibit 9.3 Barrier Warrants for Fill Section Embankments
Source: Roadside Design Guide (Reference 9.2)

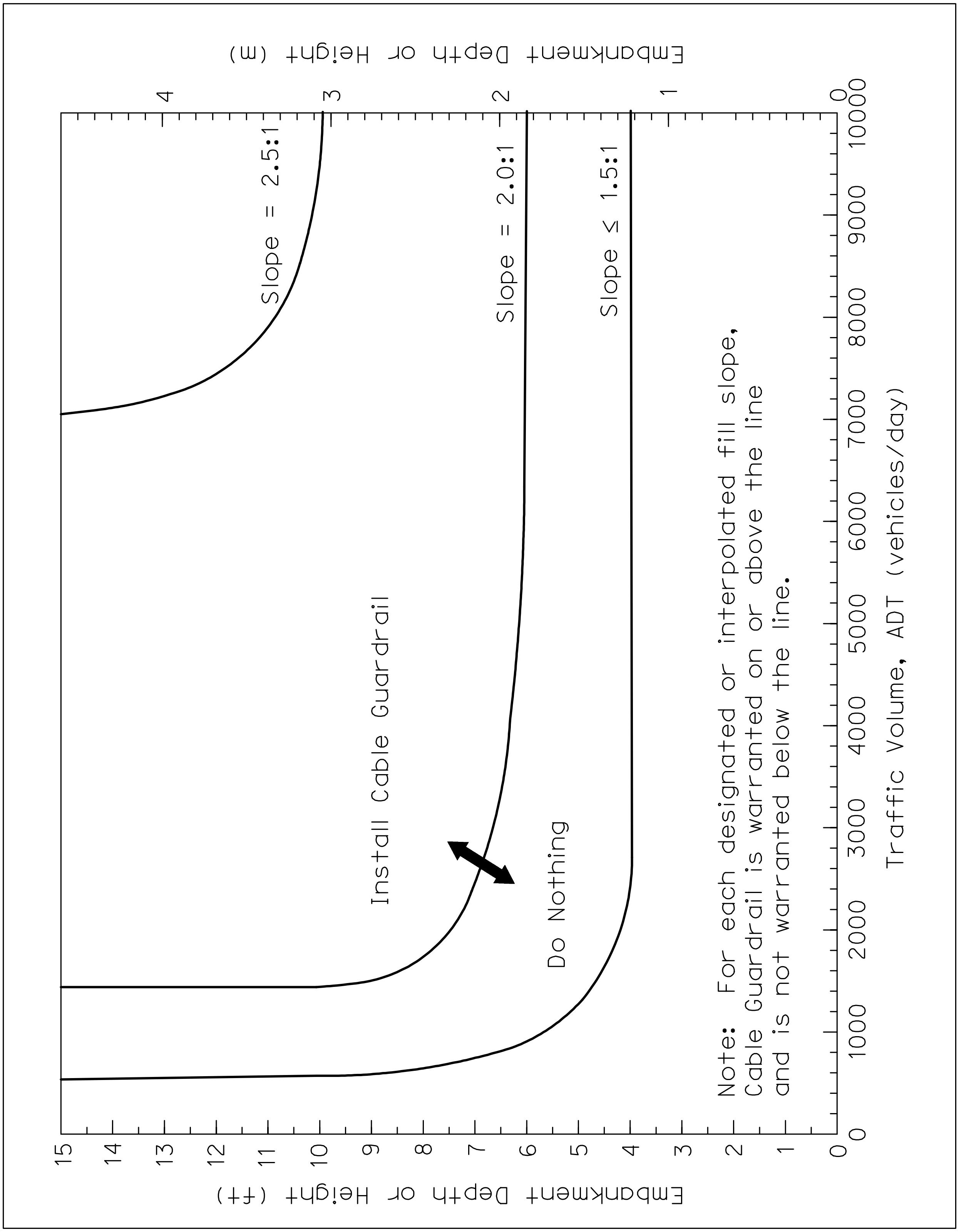


Exhibit 9.4 Cable Guardrail Warrants for Fill Section Embankments
Source: <u>TRR Report No. 1599</u> (Reference 9.5)

1.B Guardrail Design Procedures - A Graphical Solution

The following steps should be used for guardrail design:

1. Determine the lateral obstacle clearance (clear zone).
2. Identify the obstacle.
3. Consider your options.
4. Determine the runout length, L_R, and the lateral extent of the obstacle, L_H.
5. Plot the runout path.
6. Determine the shy distance and the appropriate flare rate.
7. Select the guardrail components.
8. Graphically locate the guardrail components on the plan.
9. Design the earthwork around the guardrail.
10. Determine the details of surfacing under guardrail.
11. Determine pay item quantities.

These steps are expanded upon in the following sections. See **EXHIBITS 9.7 THROUGH 9.10** for examples of guardrail installations. Further examples may be found in Appendix B, "Guardrail Design Examples".

1.B.1 Determine the Lateral Obstacle Clearance (Clear Zone)

The lateral obstacle clearance distance, L_H, (or clear zone) is the area (6:1 or flatter), measured from the edge of the through driving lane, provided for the recovery of errant vehicles. The lateral obstacle clearance is established by roadway type in the Nebraska Minimum Design Standards (Reference 9.1), (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf). This clear zone distance also applies on curved roadway segments in the following cases:

- When the obstacle is outside a flat curve, [R > 2860 ft. (900 m)], in low accident areas.
- When the obstacle is inside the curve.

For cases where the obstacle is on the outside of a sharp curve, [R ≤ 2860 ft. (900 m)], the lateral obstacle clearance for the tangent condition should be multiplied by the appropriate curve correction factor (K_{cz}), which may be obtained from **EXHIBIT 9.11**, to arrive at the appropriate lateral obstacle clearance, L_{HO}, to be used in plotting the runout path (See Section 1.B.5 and **EXHIBIT 9.10**).

For further information, see Chapter Six: The Typical Roadway Cross-Section, Section 2.

1.B.2 Identify the Obstacle

EXHIBIT 9.1 is a list of potential roadside obstacles. On bridges, the obstacle is not necessarily aligned with the end of the bridge floor or the end of the bridge rail. The designer should review topographic information for the design site and identify any critical obstacles that may exist.

1.B.3 Consider Your Options

Before deciding to install guardrail, consider alternatives for reducing hazards:

- Remove the obstacle.
- Redesign the obstacle so it can be safely traversed.
- Relocate the obstacle to a location where it is less likely to be hit.
- If the obstacle is a sign support or utility pole that cannot be relocated, use breakaway devices.

1.B.4 Determine Runout Length, L_R, & Lateral Extent of Obstacle, L_H

Once it has been determined that guardrail is appropriate for a given location, its placement, length, type, etc. must be determined. The length of guardrail is a function of several variables:

- Runout length (L_R).
- Lateral extent of the obstacle (L_H).
- The tangent length of barrier upstream from the obstacle.
- The barrier's lateral distance from the edge of the traveled way.
- The flare rate for the specific type of barrier to be installed.

L_R is the theoretical distance needed for a vehicle that has left the roadway to come to a stop. L_H is the distance from the edge of the traveled way to the far side of the obstacle if the obstacle is a fixed object, or to the outside edge of the clear zone if the obstacle is an embankment or a fixed object that extends beyond the clear zone. In general, the higher the ADT and the higher the design speed, the longer the runout length (L_R) should be. Using **EXHIBIT 9.5**, L_R may be determined based on the design speed and traffic volume. Designers should use the desirable L_R when designing projects and only use the minimum values when, due to site restrictions, the desirable values are not practical.

On two-way, two-lane roadways the length of need of the barrier to shield opposing traffic from the obstacle must also be determined. The same design procedures are used but the lateral dimensions are measured from the centerline of the two-way roadway (See the Roadside Design Guide, Reference 9.2).

Short guardrail lengths, i.e., less than 100 ft. (30 m), provide little protection and should be avoided if possible. Similarly, short gaps between guardrail, i.e., less than 200 ft. (60 m), are also undesirable.

For W-beam and Thrie-beam guardrail installations, the last 12.5 ft. (3.8 m) of the guardrail end treatment shall not be included in the length of need. The runout path must intersect these end treatments at a distance of 12.5 ft. (3.8 m) or more from the end post, (See **EXHIBIT 9.7**).

For a cable guardrail system, the runout path must not intersect the guardrail within 40 ft. (12.2 m) of the end of the terminal anchorage system, (See **EXHIBIT 9.8**).

Design Speed mph	ADT							
	>3000		1700-3000		850-1699		<850	
	Min.	Desirable	Min.	Desirable	Min.	Desirable	Min.	Desirable
80	480	480	400	480	340	480	290	480
70	360	360	300	360	260	360	220	360
60	260	260	210	260	180	260	170	260
50	210	210	170	210	150	210	130	210
40	160	160	130	160	110	160	100	160
30	110	110	90	110	80	110	70	110

(a) English Units

Design Speed km/h	ADT							
	>3000		1700-3000		850-1699		<850	
	Min.	Desirable	Min.	Desirable	Min.	Desirable	Min.	Desirable
110	105	105	87	105	75	105	65	105
100	92	92	76	92	65	92	56	92
90	78	78	64	78	56	78	48	78
80	65	65	52	65	46	65	40	65
70	55	55	45	55	39	55	34	55
60	45	45	38	45	32	45	28	45
50	35	35	29	35	25	35	22	35

(b) Metric Units

Exhibit 9.5 Minimum and Desirable L_R Values

1.B.5 Plot the Runout Path

On tangent roadway segments, the runout path runs from the lateral extent of the obstacle (L_H) to a point on the outside edge of the nearest driving lane, which is the runout length (L_R) distance from the obstacle, (L_R is measured along the edge of the pavement). The same procedure should be used on curved roadway segments where the curve is flat [R > 2860 ft (900 m)] and for obstacles on the inside of the curve, (See **EXHIBITS 9.7, 9.8 AND 9.9**).

On sharp curves [R ≤ 2860 ft. (900 m)], plot the runout path tangent to the outside edge of the driving lane so that it intersects the obstacle at the adjusted lateral obstacle clearance (L_{HO}), (See Section 1.B.1 and **EXHIBIT 9.10**).

1.B.6 Determine the Shy Distance and the Appropriate Flare Rate(s)

Shy distance is the distance from the edge of the traveled way beyond which the typical driver will not perceive a roadside object as an immediate obstacle. Shy distance is a function of design speed. **EXHIBIT 9.6** provides shy distance values. If the barrier in front of the obstacle, where it is closest to the roadway, is within the shy distance a 30:1 flare rate will be used for W-beam and Thrie-beam installations, changing to a 15:1 or a 25:1 flare rate beyond the shy distance, depending on the roadway classification and guardrail end treatment.

Flare is generally incorporated into guardrail installations to locate the terminal section at a greater distance from the roadway and to shorten the length of the barrier. Flare rate is a function of design speed and barrier type. Flatter flare rates are often used when extensive grading would be required to ensure an appropriate approach grade from the travel lanes to the barrier. A flatter flare rate increases the required length of the barrier.

The Standard/Special Plans Book (Reference 9.3) includes guardrail post locations for the various flare rates and Appendix B contains example guardrail layouts. Generally, no flare is used on projects where a limited amount of earthwork is desired. A 25:1 flare rate is generally used for Type I Guardrail End Treatments (primarily installed on W-beam guardrail on multi-lane divided roadways) and a 15:1 flare is used for Type II Guardrail End Treatments (generally used on W-beam guardrail on 2-lane, 2-way roadways). See Section 1.E for further information.

SHY LINE OFFSET VALUES			
ENGLISH UNITS		**METRIC UNITS**	
Design Speed (mph)	Offset (ft.)	Design Speed (km/h)	Offset (m)
75	11	120	3.3
70	9	110	3.0
60	8	100	2.4
55	8	90	2.4
50	7	80	2.1
45	6	70	1.8
40	5	60	1.5
30	4	50	1.2

Exhibit 9.6 Shy Line Offset Values
(Source: Roadside Design Guide, Reference 9.2)

1.B.7 Select the Guardrail Components

Several factors influence guardrail selection:

- Traffic volume.
- The nature of the obstacle.
- Roadway geometry.
- Allowable deflection.
- Cost.

In general, the following guidelines should be followed:

- Choose cable guardrail where possible.
- All concrete bridge rails within the clear zone should be connected to either a Thrie-beam guardrail or to a W-beam guardrail with an acceptable transition section.
- Use the appropriate terminal sections for the guardrail system and roadway classification.
- Design W-beam and Thrie-beam guardrail length of need in multiples of 12.5 ft. (3.8 m), which is the standard beam length. The designer should keep in mind that the Bridge Approach Section (See Section 1.F) includes 6.25 ft. (1.9 m) of semi-rigid guardrail. W-beam or Thrie-beam guardrail may be designed in an odd multiple of 6.25 ft. (1.9 m) if that satisfies the required runout length, L_R, (See Section 1.B.4).
- Design cable guardrail length of need to the nearest foot (305 mm).

1.B.8 Graphically Locate the Guardrail on the Plan

Locate the guardrail components on the plan. For W-beam and Thrie-beam installations, the components may consist of the bridge approach section, the appropriate guardrail radius section for the design flare rate, the tangent guardrail section and the applicable guardrail end treatment(s), (See Section 1.E). The runout path should not intersect the guardrail less than 12.5 ft. (3.8 m) from the end of the guardrail end treatment.

Cable guardrail components are the cable guardrail, the terminal anchorage sections and the intermediate anchorage sections (if required). The runout path should not intersect the cable guardrail nearer than 40 ft. (12.2 m) to the end of the terminal anchorage section.

See the Standard/Special Plans Book, (Reference 9.3), for details of the guardrail components.

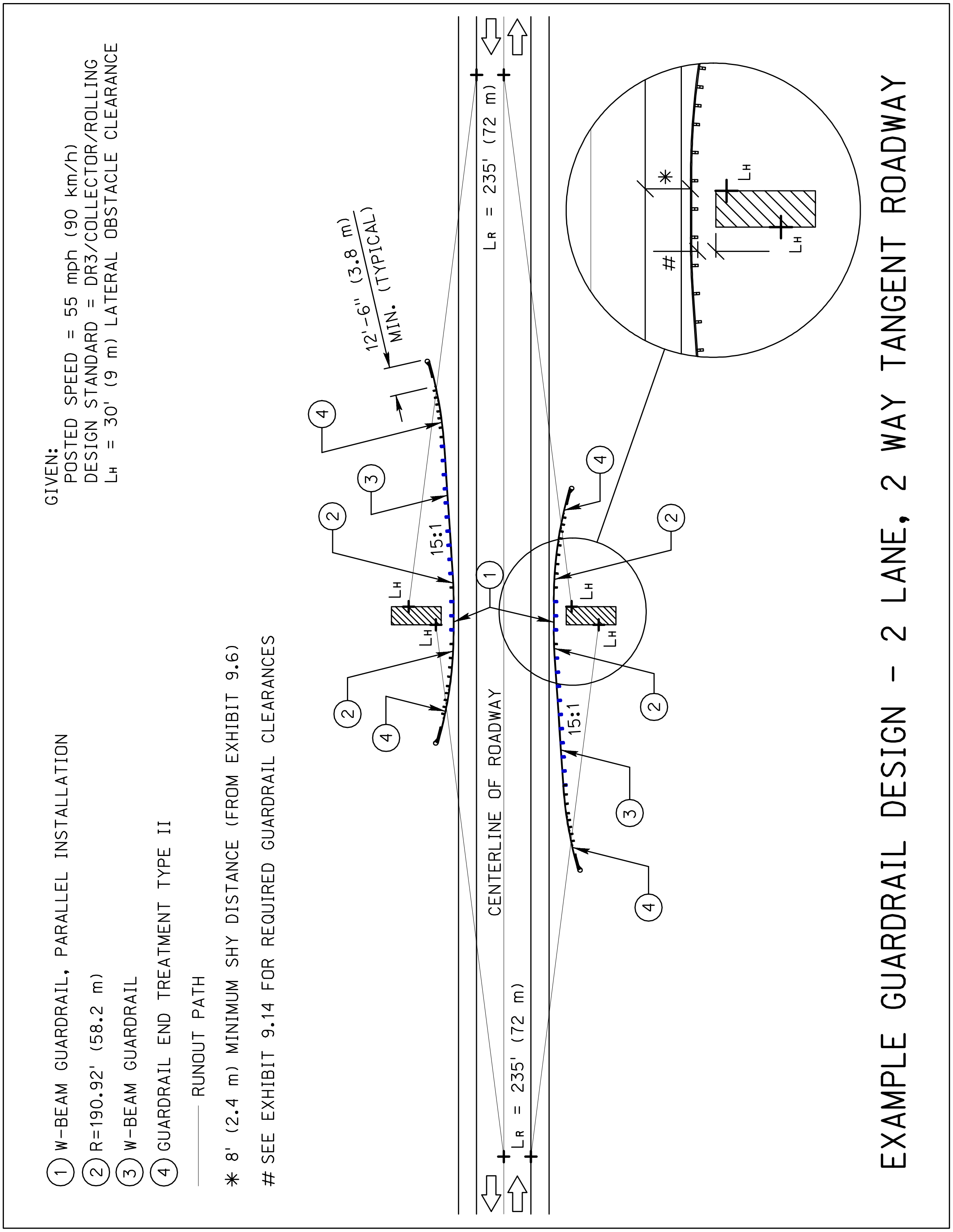


Exhibit 9.7 Example W-Beam or Thrie-Beam Guardrail Design: 2-Lane, 2-Way Tangent Roadways

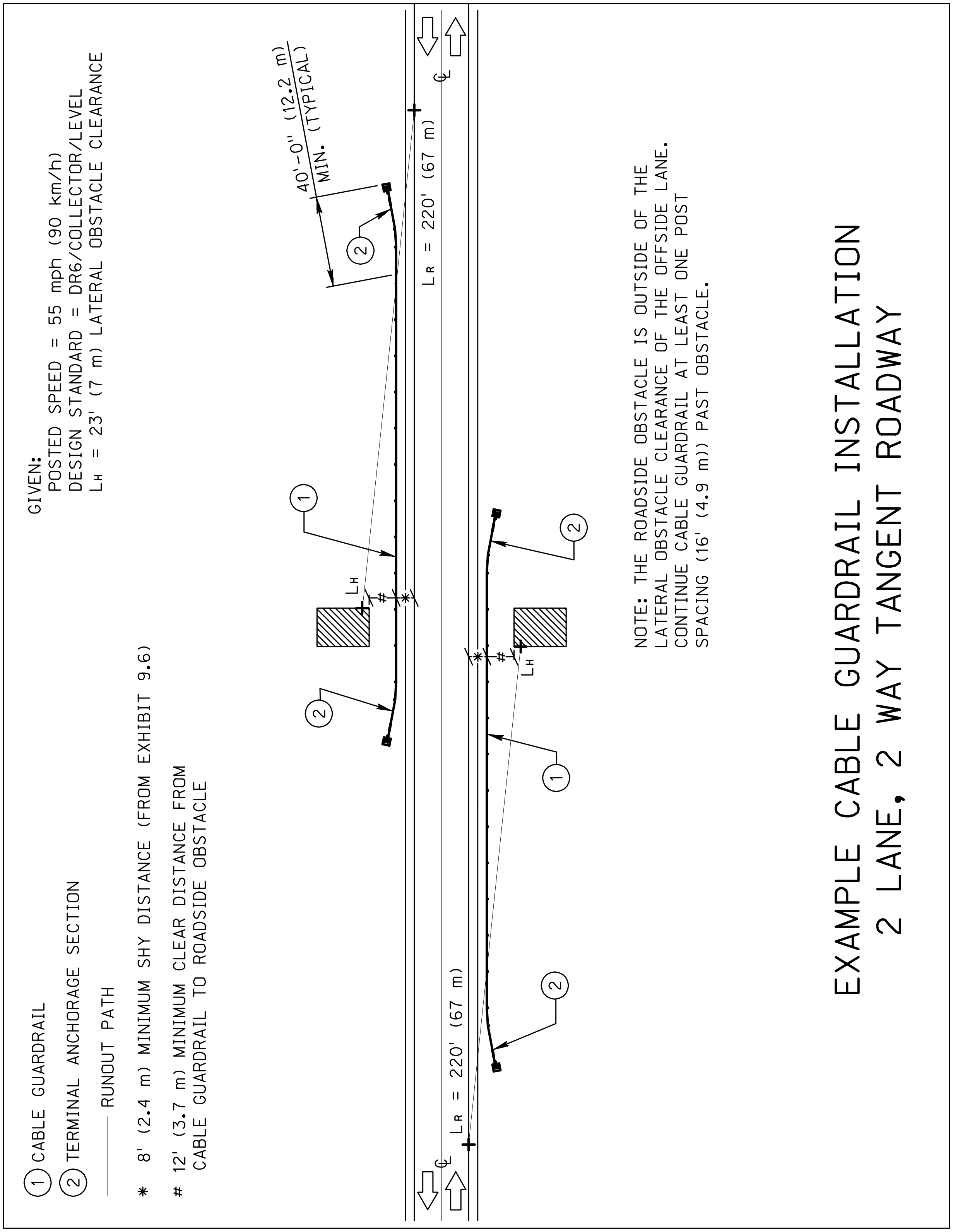


**Exhibit 9.8 Example Cable Guardrail Design:
2-Lane, 2-Way Tangent Roadways**

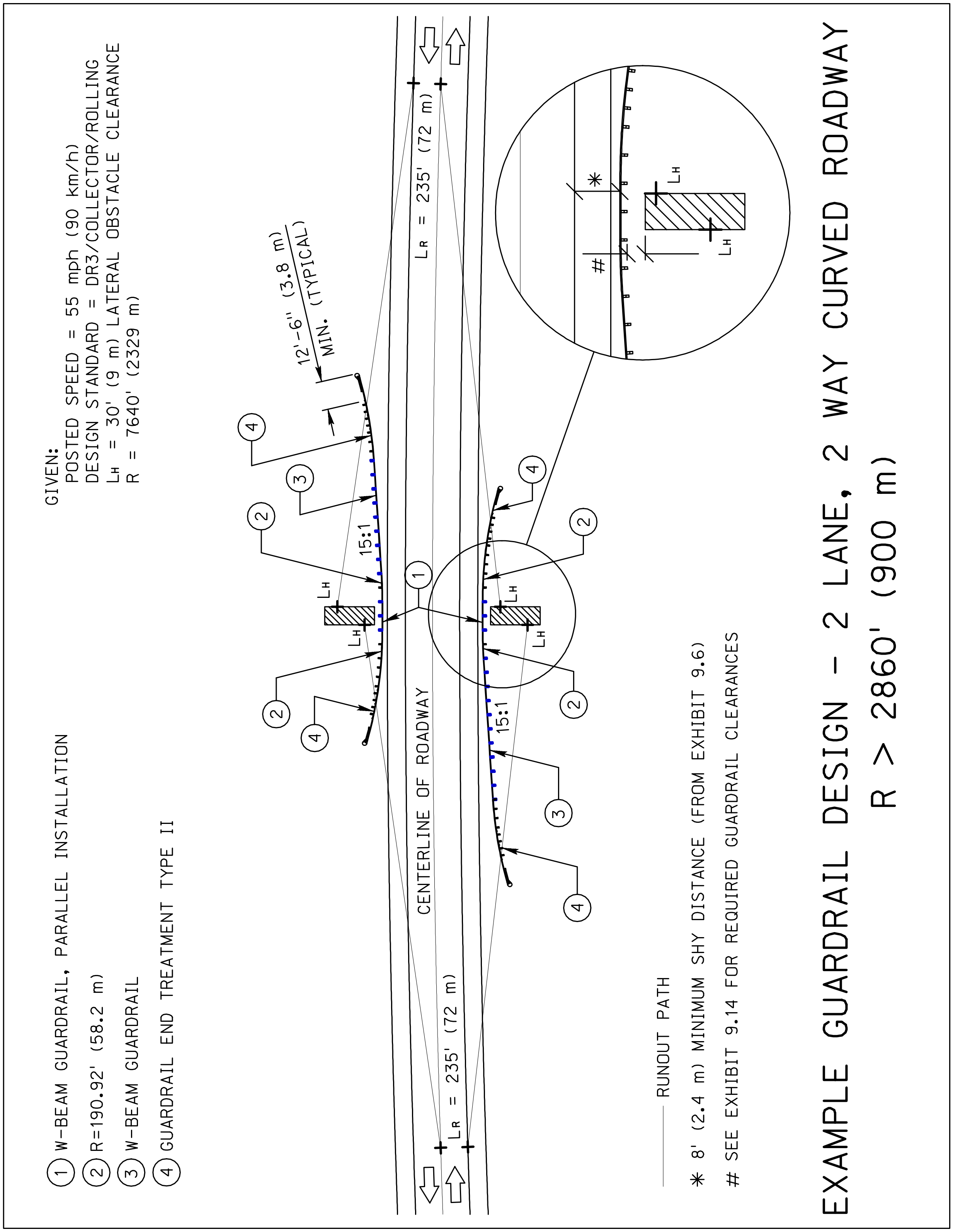


Exhibit 9.9 Example W-Beam or Thrie-Beam Guardrail Design: 2-Lane, 2-Way Curved Roadways; R > 2860' (900 m)

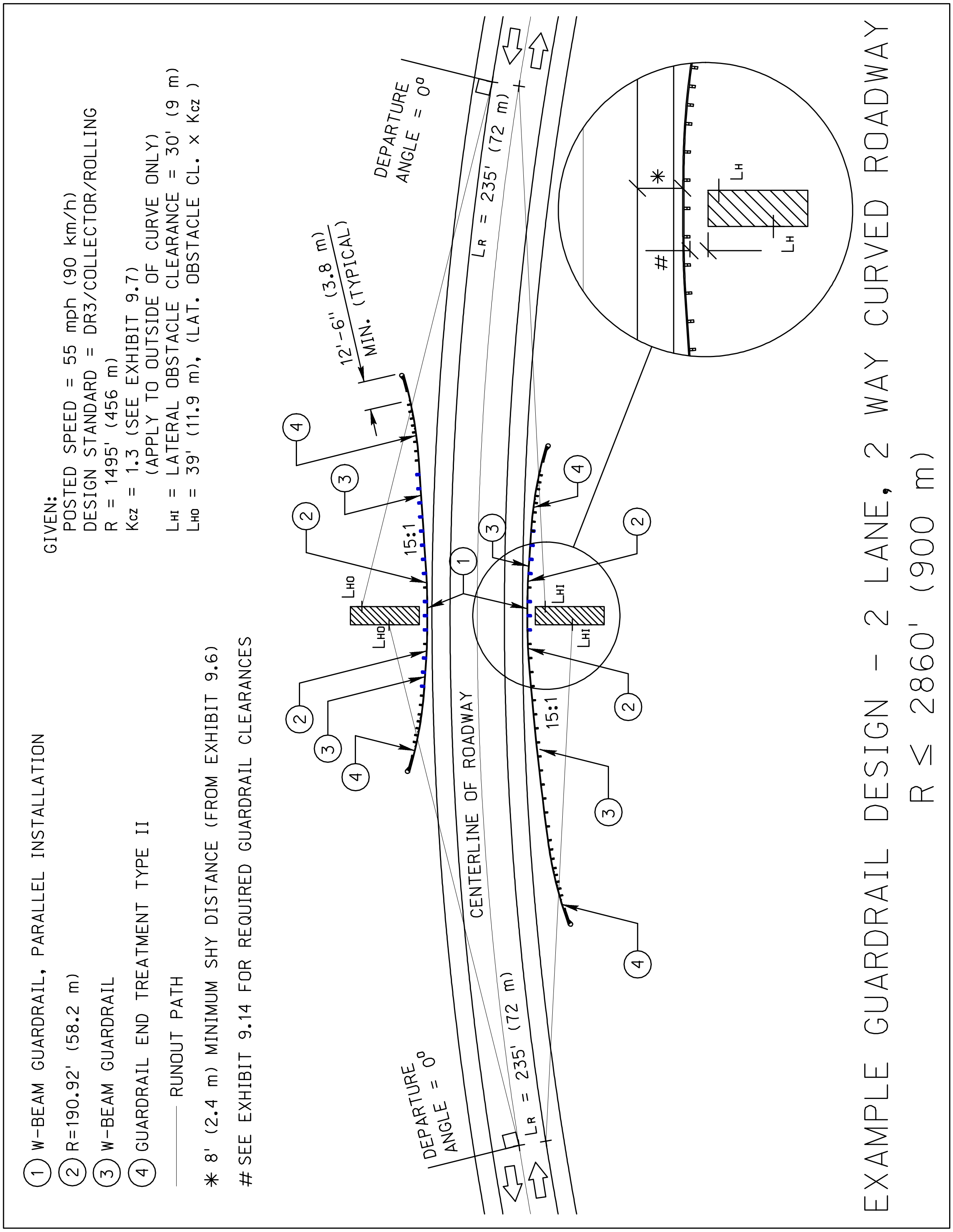


Exhibit 9.10 Example W-Beam or Thrie-Beam Guardrail Design: 2-Lane, 2-Way Curved Roadways; R ≤ 2860' (900 m)

Radius (ft)	Design Speed (mph)						
	40	45	50	55	60	65	70
2860	1.1	1.1	1.1	1.2	1.2	1.2	1.3
2290	1.1	1.1	1.2	1.2	1.2	1.3	1.3
1910	1.1	1.2	1.2	1.2	1.3	1.3	1.4
1640	1.1	1.2	1.2	1.3	1.3	1.4	1.5
1430	1.2	1.2	1.2	1.3	1.4	1.4	---
1270	1.2	1.2	1.3	1.3	1.4	1.5	---
1150	1.2	1.2	1.3	1.4	1.5	---	---
950	1.2	1.3	1.4	1.5	1.5	---	---
820	1.3	1.3	1.4	1.5	---	---	---
720	1.3	1.4	1.5	---	---	---	---
640	1.3	1.4	1.5	---	---	---	---
570	1.4	1.5	---	---	---	---	---
380	1.5	---	---	---	---	---	---

(a) K_{CZ} (Curve Correction Factor) English Units

Radius (m)	Design Speed (km/h)					
	60	70	80	90	100	110
900	1.1	1.1	1.1	1.2	1.2	1.2
700	1.1	1.1	1.2	1.2	1.2	1.3
600	1.1	1.2	1.2	1.2	1.3	1.4
500	1.1	1.2	1.2	1.3	1.3	1.4
450	1.2	1.2	1.3	1.3	1.4	1.5
400	1.2	1.2	1.3	1.3	1.4	---
350	1.2	1.2	1.3	1.4	1.5	---
300	1.2	1.3	1.4	1.5	1.5	---
250	1.3	1.3	1.4	1.5	---	---
200	1.3	1.4	1.5	---	---	---
150	1.4	1.5	---	---	---	---
100	1.5	---	---	---	---	---

(b) K_{CZ} (Curve Correction Factor) Metric Units

$L_{HO} = (L_C)\ (K_{CZ})$

Where:
- L_{HO} = clear zone on outside of curve.
- L_C = clear zone distance (See the Nebraska Minimum Design Standards, Reference 9.1).
- K_{CZ} = curve correction factor.

Note: The clear zone correction factor is applied to the outside of curves only. Curves flatter than 2860 ft (900 m) do not require an adjustment to the clear zone.

Exhibit 9.11 Curve Correction Factors for Lateral Obstacle Clearance on Sharp Curves (Source: Roadside Design Guide, Reference 9.2)

1.B.9 Design the Earthwork Around the Guardrail

The designer should refer to the Standard/Special Plans Book (Reference 9.3) for guidance in designing earthwork for guardrail. Details of earthwork around the guardrail should be provided on guardrail layout sheets for the benefit of the contractor and inspector.

1.B.10 Determine the Details of Surfacing under the Guardrail

Surfacing under guardrail is placed as a method to control weeds. During the plan-in-hand inspection, the **District** will determine if surfacing under guardrail is desired and the choice of material to be used. Surfacing may be concrete, asphaltic concrete or millings. When concrete or asphaltic concrete surfacing is used, the posts shall be blocked out and backfilled with suitable materials, (See the Standard/Special Plans Book, (Reference 9.3) and the Standard Specifications for Highway Construction, (Reference 9.4), (http://www.nebraskatransportation.org/ref-man/).
The typical sections in **EXHIBITS 9.12 AND 9.13** show asphalt surfacing under guardrail for curbed and non-curbed conditions. On projects where new surfaced shoulders are constructed, which will be widened at guardrail locations, a minimum of a 1 ft. (300 mm) or, desirably a 2 ft. (600 mm), earth shoulder should be built outside of the surfacing throughout the state. In the Sandhills region, it is desirable to build 4 ft. (1.2 m) earth shoulders outside of the surfacing at guardrail locations.

Designers shall submit detailed plans, typical sections and estimates for all surfacing under guardrail locations to the **Materials and Research Division**.

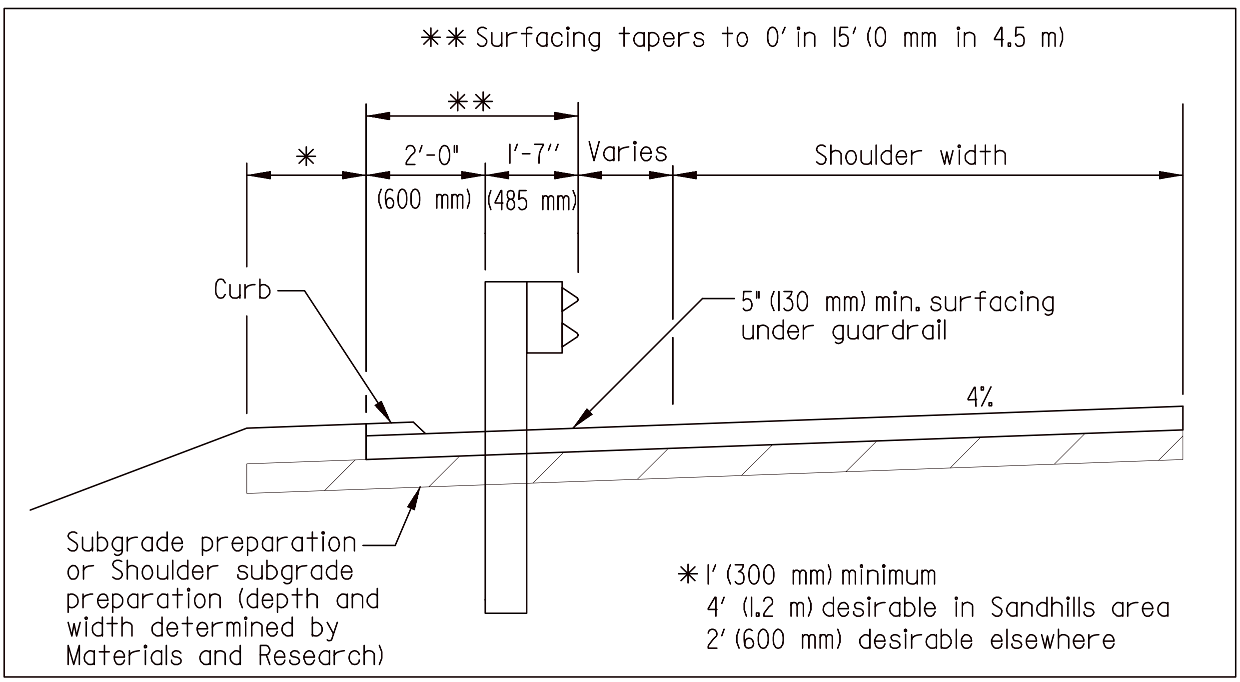


Exhibit 9.12 Surfaced Shoulder with Curb at Safety Beam Guardrail Location

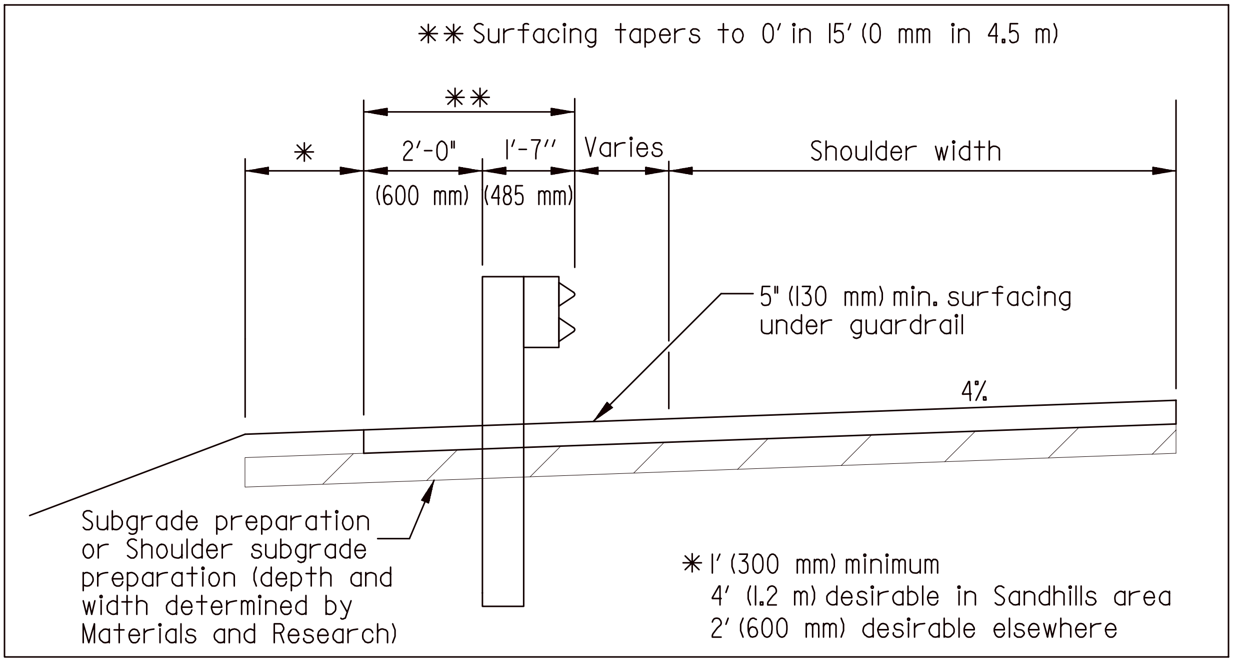


Exhibit 9.13 Surfaced Shoulder at Safety Beam Guardrail Location

1.B.11 Determine the Pay Item Quantities

Guardrail pay items include, but are not limited to, the following:

- Remove Guardrail: Paid for by the linear foot (meter). Used for the removal of both cable and semi-rigid guardrail. The removal length includes the approach and terminal sections for each continuous length of guardrail.
- Semi-Rigid Guardrail (W-Beam and Thrie-Beam): Paid for by the linear foot (meter). Measure the semi-rigid guardrail from the center to the center of the end posts (from the bridge approach section to the guardrail end treatment or from the guardrail end treatment to the guardrail end treatment). The semi-rigid guardrail length will include the guardrail radius section, if applicable. The semi-rigid guardrail length should be a multiple of 6.25 ft. (1905 mm). This pay item includes the guardrail posts, offset blocks and hardware required for installation.
- Cable Guardrail: Paid for by the linear foot (meter). Measure the cable guardrail from terminal anchorage section to terminal anchorage section (excluding intermediate anchorage sections). The cable guardrail length should be a multiple of 16 ft. (4900 mm). This pay item includes the guardrail posts and hardware required for installation.
- Bridge Approach Sections/Special Bridge Approach Sections: Paid for by each. Four bridge approach sections (BAS) are required for each two-lane, two-way bridge. The number of BAS required for a divided highway depends on the design, phasing, and future overlay operations. The BAS connects the concrete bridge rail to W-Beam guardrail. The Special BAS connects the concrete bridge rail to Thrie-Beam guardrail.
- W-Thrie Beam Transition Section: Paid for by each. Used to connect W-Beam guardrail to Thrie-Beam guardrail. This is a separate pay item when it is used separately from a bridge approach section.

- Cable Guardrail Transition to W-Beam Guardrail: Paid for by each. Used to transition from cable guardrail to W-Beam guardrail for long guardrail runs.
- Guardrail End Treatments: Paid for by each. Divided into the pay items Guardrail End Treatment Type I, Guardrail End Treatment Type II, SRT-75 and MELT.
- Cable Guardrail Anchorage: Paid for by each. The designer shall also include two anchorage units for each intermediate anchorage, if applicable.
- Culvert Mounted Guardrail Posts: Paid for by each. When the designer specifies culvert mounted guardrail posts, the posts are a separate pay item from the semi-rigid guardrail.
- Crash Cushions and Impact Attenuators: Paid for by each. Primarily used to protect fixed objects that cannot be removed or adequately protected by a longitudinal barrier.
- Concrete Median Barriers: Paid for by the linear foot (meter). Use when barrier deflection is not allowable.
- Bullnose: Paid for by each. The pay item refers to the entire system from post 10 on the left to post 10 on the right and includes all Thrie-Beam guardrail, posts, cables, blockouts and hardware necessary to complete the Bullnose installation.
- Surfacing Under Guardrail: Paid for by the sq. ft. (m^2) when the surfacing is concrete. When the surfacing is asphaltic concrete, the quantity shall be included in the asphaltic concrete quantities for the project. The pay item for millings is "Special Surface Course" and shall be measured and paid by the sq. yd. (m^2).

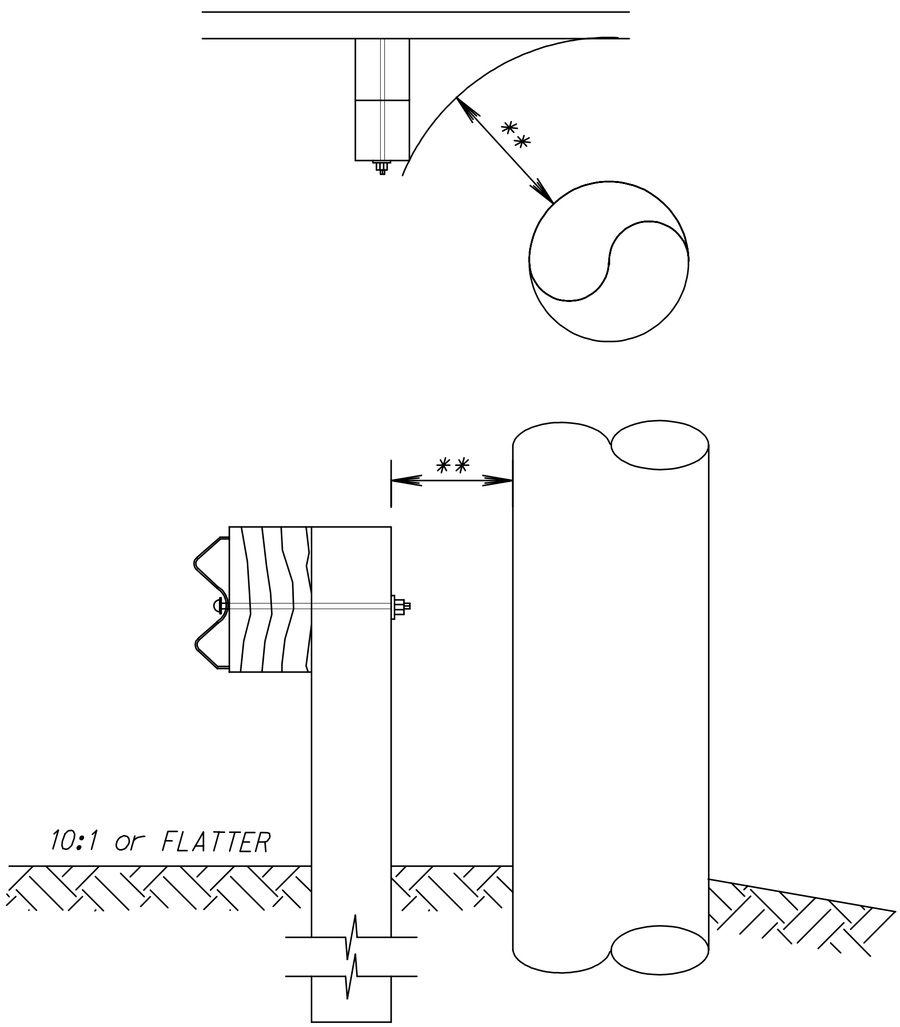
For further information, see the Standard/Special Plans Book, (Reference 9.3), the Standard Specifications for Highway Construction, (Reference 9.4), and Chapter Twelve: Cost Estimating, Section _.

1.C Deflection Distance

Selection and placement of guardrail is a function of the distance it will deflect upon impact. If the guardrail is shielding a rigid object, the distance between the guardrail and the object should be sufficient to avoid an errant vehicle snagging the object.

In protecting traffic from a rigid object, guardrail will not function properly if the guardrail post(s) come in contact with the hazard. See **EXHIBIT 9.14** for the required guardrail clearances.

If the hazard is an embankment, the distance between the guardrail and the slope should be sufficient to prevent the vehicle's wheels from dropping over the edge. Cable guardrail deflects the farthest distance, in some cases, as much as 11.5 ft. (3.5 m) so cable guardrail will be designed with a 12 ft. minimum deflection. Concrete (rigid) barriers are designed for virtually no deflection and, thus, may be used where space is limited between the hazard and the travel lanes. Deflection characteristics of semi-rigid systems, (W-beam or Thrie-beam guardrail), vary depending upon the strength of the post. Semi-rigid systems will be designed with a minimum of 2 ft. (600 mm) from the back of the post to the non-traversable slope. See the Standard/Special Plans Book (Reference 9.3) and the Roadside Design Guide (Reference 9.2) for further information.



** ADJUST THE POSTS LONGITUDINALLY SO THAT THEY WILL NOT BE PLACED DIRECTLY OPPOSITE A PIER COLUMN. THE MINIMUM OFFSET BETWEEN THE BACK OF THE POST AND A PIER OR A SOLID MASS MAY BE FOUND IN THE FOLLOWING TABLE.

MINIMUM REQUIRED GUARDRAIL OFFSET FROM BACK OF POST TO FACE OF FIXED OBSTACLE	
GUARDRAIL INSTALLATION TYPE	**MINIMUM OFFSET ***
Three Strand Cable Guardrail	12.0 ft. (3.66 m)
W-Beam Guardrail	3.5 ft. (1.07 m)
Thrie Beam Guardrail	2.25 ft. (0.70 m)

* Based on the dynamic deflections from the NCHRP Report 350 standard strength test for the 4,400 lb (2000 kg) pickup truck impacting a barrier at an angle of 25º at a velocity of 60 mph (100 km/hr).

Exhibit 9.14 Minimum Guardrail Offsets When Adjacent to a Fixed Obstacle

1.D Types of Guardrail Used in Nebraska

The types of guardrail used in Nebraska are detailed in the Standard/Special Plans Book (Reference 9.3). The type of guardrail, terminal end treatment and transition sections (such as bridge approach rail) to be used shall be determined by the roadway designer. Selection criteria include such things as: barrier performance, deflection, site conditions, compatibility with other features, cost, ease of maintenance, field experience, aesthetics, etc. Types of guardrail used in Nebraska include:

- W-Beam guardrail (wood and steel posts).
- Thrie-Beam guardrail (wood and steel posts).
- Cable guardrail.
- Cable guardrail to W-Beam guardrail transition section.
- Concrete protection barrier.
- Vertical concrete barrier.
- Bridge Approach Section/Special Bridge Approach Section.
- A variety of bridge rails.

EXHIBIT 9.15 summarizes guardrail use.

Barrier	Location	Comments
Semi-rigid Guardrail (W-beam and Thrie-beam)	Used to shield motorists from fixed objects such as bridge piers. Must not be placed on slopes.	Semi-rigid guardrail relies on energy absorption of posts rotating in soil. Posts should be placed to maximize available deflection distance around bridge piers and other point hazards.
Cable Guardrail	Most effective method of treating slopes and protecting objects. Can be placed within 2 ft (0.6 m) of slope break point when slope is 2:1 or flatter. Should not be placed within 10 ft (3 m) of a slope steeper than 2:1 or within 12 ft (3.7 m) of a fixed object.	Relies on tensile forces in cables and the ability of impacting vehicles to ride down weak posts. Should not be place on the inside of curves with radii less than 1910 ft. (580 m) unless additional space at 6:1 or flatter slopes, free of obstacles, is provided. Do not place on inside of curve with an R < 716 ft (220 m).
Cable Guardrail Transition to W-Beam Guardrail	Used to transition from cable guardrail to W-Beam guardrail for long runs of guardrail.	Not cost effective if the length of need is less than 350 ft. (107 m).
Permanent 32” (810 mm) Concrete Protection Barrier	Used in areas where barrier deflections are intolerable, truck capacity is required or barrier repair is difficult. Should only be placed adjacent to flat surfaced shoulders or medians.	Barrier will cause the impacting vehicle to lift and may cause a rollover. Rigidity causes somewhat higher injury rate.
42” (1070 mm) Concrete Protection Barrier	Used when ability to contain large trucks is primary concern. Locations with high volumes and narrow medians or where widening into a median is planned are most common applications.	Same performance as 32” (810-mm) high barrier. Height helps to reduce glare somewhat and holds up a semi-trailer to keep it from tipping over.
Vertical Concrete Barrier	Used where barrier deflections are intolerable, truck capacity is required or barrier repair is difficult. Can be built to any height $\geq$ 32 in (812 m).	Barrier provides high strength and low repair costs without high rollover rates. Rigidity causes somewhat higher injury rate. When initially taller than 32” (812 m), overlays do not affect performance.
Bridge Approach Section/Special Bridge Approach Section	Should be used any time semi-rigid guardrail is transitioned to a bridge rail.	End shoe should be lapped with adjacent traffic to minimize snag potential. Posts should be no closer than 2 ft (0.6 m) from the hinge point.

Exhibit 9.15 Guardrail Summary

1.E End Treatments

Crashworthy end treatments are essential for guardrail terminals within the lateral obstacle clearance distance. End treatments should not spear, vault or roll vehicles that impact them, whether head-on or at an angle. Guardrail end treatments used in Nebraska may be found in the Standard/Special Plans Book (Reference 9.3).

1.E.1 Guardrail End Treatment, Type I

Type I Guardrail End Treatments are used for design speeds of 65 mph (100 km/h) and above for parallel guardrail installations or for installations with a 25:1 taper. This end treatment is used primarily on the Interstate System and on Expressways, in medians of 64 ft. (19.5 m) and wider and on the outside of the lanes. See the Standard/Special Plans Book (Reference 9.3) for the current Type I End Treatments in use.

1.E.2 Guardrail End Treatment, Type II

Type II Guardrail End Treatments are installed on guardrail installations with a 15:1 taper and are primarily installed on two-lane, two-way roadways. See the Standard/Special Plans Book (Reference 9.3) for the current Type II End Treatments in use.

1.E.3 SRT-75 and MELT

The SRT-75 and MELT guardrail end treatments are installed on low speed (less than 45 mph (75 km/h)) two-lane, two-way roadways with guardrail installations with a 15:1 taper. See the Standard/Special Plans Book (Reference 9.3) for details.

1.E.4 Blunt Ends

Blunt ends are not permitted except on the trailing ends of guardrail installations that are not exposed to oncoming traffic and on curved beam guardrail installations (with control releasing terminal posts) terminating on driveways.

1.F Bridge Approach Sections/Special Bridge Approach Sections

The bridge approach section is a transition section normally used where semi-rigid guardrail joins a rigid bridge rail. Bridge Approach Sections connect the concrete bridge rail to W-Beam guardrail. Special Bridge Approach Sections connect the concrete bridge rail to Thrie-Beam guardrail. Transition sections are designed to produce a gradual transition between the deflection capabilities of the two types of rail. This reduces the potential of an errant vehicle pocketing, snagging or penetrating the rail in the transition area.

The connection of the approach guardrail and bridge rail should be strong enough to resist being pulled out on impact. The connection itself should be designed to avoid snagging vehicles (from both directions on two-way facilities). The transition section is usually strengthened using strong posts, strong beams, or a combination of the two. The approach section may be stiffened by decreasing the spacing between posts and/or by increasing post size. The bridge approach sections used in Nebraska may be found in the Standard/Special Plans Book (Reference 9.3).

1.G Median Barrier Treatments

Median guardrail is longitudinal barrier placed on the left side of traffic lanes of a divided highway designed to redirect vehicles striking from either side of the barrier. As with roadside guardrail, median barrier design, height and lateral placement is critical for proper performance. **EXHIBIT 9.16** presents the guidelines for median barriers on high-speed controlled access roadways that have relatively flat, unobstructed medians. These criteria may be used in the absence of cross median accident data for a specific site. Median width and ADT are the criteria used for the median barrier guidelines.

Median barriers sometimes are used on high-volume, non-access controlled facilities. Safe end treatments and sight distance at intersections should be provided. Median barrier for divided roadways at different elevations should be considered. See the Roadside Design Guide (Reference 9.2) for additional information.

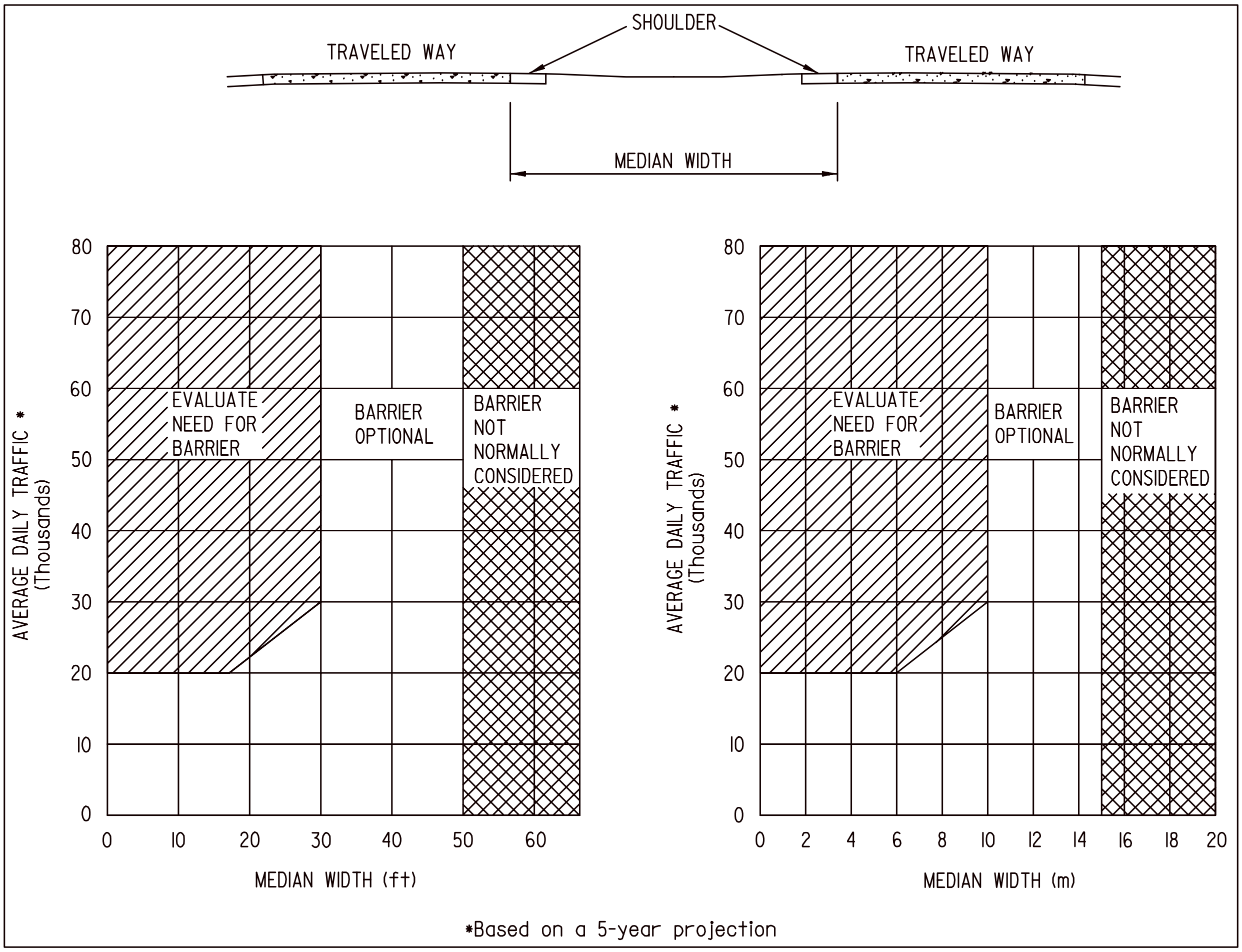


Exhibit 9.16 Guidelines for Median Barriers
Source: Roadside Design Guide (Reference 9.2)

1.G.1 Concrete Protection Barrier

The concrete protection barrier and single slope concrete barrier [32 in. or 42 in. (810 mm or 1070 mm)] should be used in narrow medians, depending upon the percentage of heavy truck traffic. Both the 32 in. and 42 in. (810 mm and 107 mm) heights provide for future 3 in. (75 mm) overlays. Concrete median barriers may be precast or cast in place. The ends should be safety treated with impact attenuators (See Section 2). See the Standard/Special Plans Book (Reference 9.3) for details.

1.G.2 Semi-Rigid Guardrail

Guardrail may be installed in the median to deflect errant vehicles from hitting specific obstacles, such as piers and at dual bridges on divided highways (See Reference 9.1). A semi-rigid guardrail installation should be designed for median widths of 64 ft. (19.5 m) or greater. A bullnose guardrail system may be utilized in medians of 16 ft. (4.9 m) and greater. When a median is wider than 40 ft. (12.2 m), it is usually better to place a bridge approach section, then W-beam guardrail and a Type I Guardrail End Treatment instead of a bullnose installation, (See Section 1.E.1, Appendix B, “Guardrail Design Examples”, and the Standard/Special Plans Book, Reference 9.3).

1.G.3 Bullnose

The Bullnose guardrail installation may be used on multilane divided highways, generally with median widths of 40 ft. (12.2 m) or less, to protect the motorist from hitting sign bases, bridge piers, or other obstacles in the median or gore areas. The bullnose guardrail consists of a thrie-beam rail with slots in the first, second and third rail pieces. These slots help capture the vehicle and bend at short intervals to prevent tearing of the rail. Cables are placed behind the top two corrugations of the first rail, transferring the forces involved to the second rail. Bullnose attenuators are designed so that the front end of vehicles hitting end-on will be wrapped by the guardrail and will be gradually decelerated. These attenuators are designed to redirect side-impacting vehicles. The approaching terrain should be unobstructed and should be graded 10:1 or flatter for 60’ (18.3m) minimum prior to and under the bullnose for proper performance, (See the Standard/Special Plans Book, Reference 9.3).

Some districts prefer to attach the bullnose from one bridge to the other parallel bridge. Other districts prefer the away side to be unattached so that maintenance can mow behind the bullnose without having to lift the mowers over it. The designer should contact the **District** to ascertain the preferred installation method, (See Appendix B, “Guardrail Design Examples”, for design examples).

1.H Guardrail at Intersections

When a minor road or driveway intersects a main roadway near a bridge, it may not be possible to shield the bridge rail end with the standard guardrail design. If it is not feasible to relocate the intersecting road, a crash cushion or an impact attenuator should be installed to protect the end of the bridge rail. If *absolutely necessary,* a curved beam guardrail installation may be used with **Roadway Design Project Manager** approval, (curved beam guardrail installations have not passed NCHRP-350 test standards). An area behind the guardrail, based on the radius of the curved beam, should be free of fixed objects. The standard bridge approach section should be used to transition to the concrete bridge rail. Controlled releasing terminal (CRT) posts shall be used through the curved section. Low-speed guardrail end treatments may be used for the terminal on the minor road, an end anchorage assembly may be used for the terminal on driveways, and Type II guardrail end treatments should be used for the terminal on state highways. See the Standard/Special Plans Book (Reference 9.3) for an example of this design and for plans of the guardrail components. Further information may be found in the Roadside Design Guide (Reference 9.2).

1.I Guardrail Over Low Fill Culverts

When full embedment of a guardrail post is not possible, such as over low fill culverts, the Standard/Special Plans Book (Reference 9.3) illustrates culvert mounted guardrail posts details to be used. Designers should graphically lay out the post location to use the minimum number of special posts.

EXHIBIT 9.17 illustrates the guardrail design to be used when posts are eliminated, such as over low fill culverts or in places where a guardrail post cannot be placed. Directly over the culvert, two nested W-beams are installed, (when using this design a minimum clearance of 2 ft. (600 mm) is required between the back face of the nested guardrail and the culvert headwall). If more than two posts should be eliminated to clear the culvert span, special posts are required. Designers should graphically lay out the post location to insure that the minimum number of eliminated posts is required. Variable post spacing (using field cut holes) may also be used for guardrail systems. The length of need may be determined using the methods described in Section 1.B.

1.J Guardrail and Curbs

If a curb is used in conjunction with a guardrail installation on a high-speed facility [greater than 45 mph (70km/h)], the curb should be either a 3” (75 mm) or 4” (100 mm) concrete lip curb, or a 3” (75 mm) asphaltic concrete mountable curb. The desirable curb installation will have the back of curb a minimum distance of 2’ (600 mm) behind the back of the guardrail post. If curb must be placed in front of a guardrail installation the back of curb should be flush with the front face of the guardrail posts. Curb will not be allowed either in front of the guardrail end treatment or for a distance in advance (upstream) of the guardrail end treatment. This curb free distance should be 25’ (7.6 m) in advance of the first post of the guardrail end treatment for low-speed roadways [45 mph or less (75 km/h)]. For high-speed roadways, a curb free distance of 50’ (15.2 m) will be provided upstream of the first post of the guardrail end treatment. For further information, see the Roadside Design Guide, (Reference 9.2), the Standard/Special Plans Book, (Reference 9.3), and Exhibit B-25 in Appendix B, “Guardrail Design Guides”.

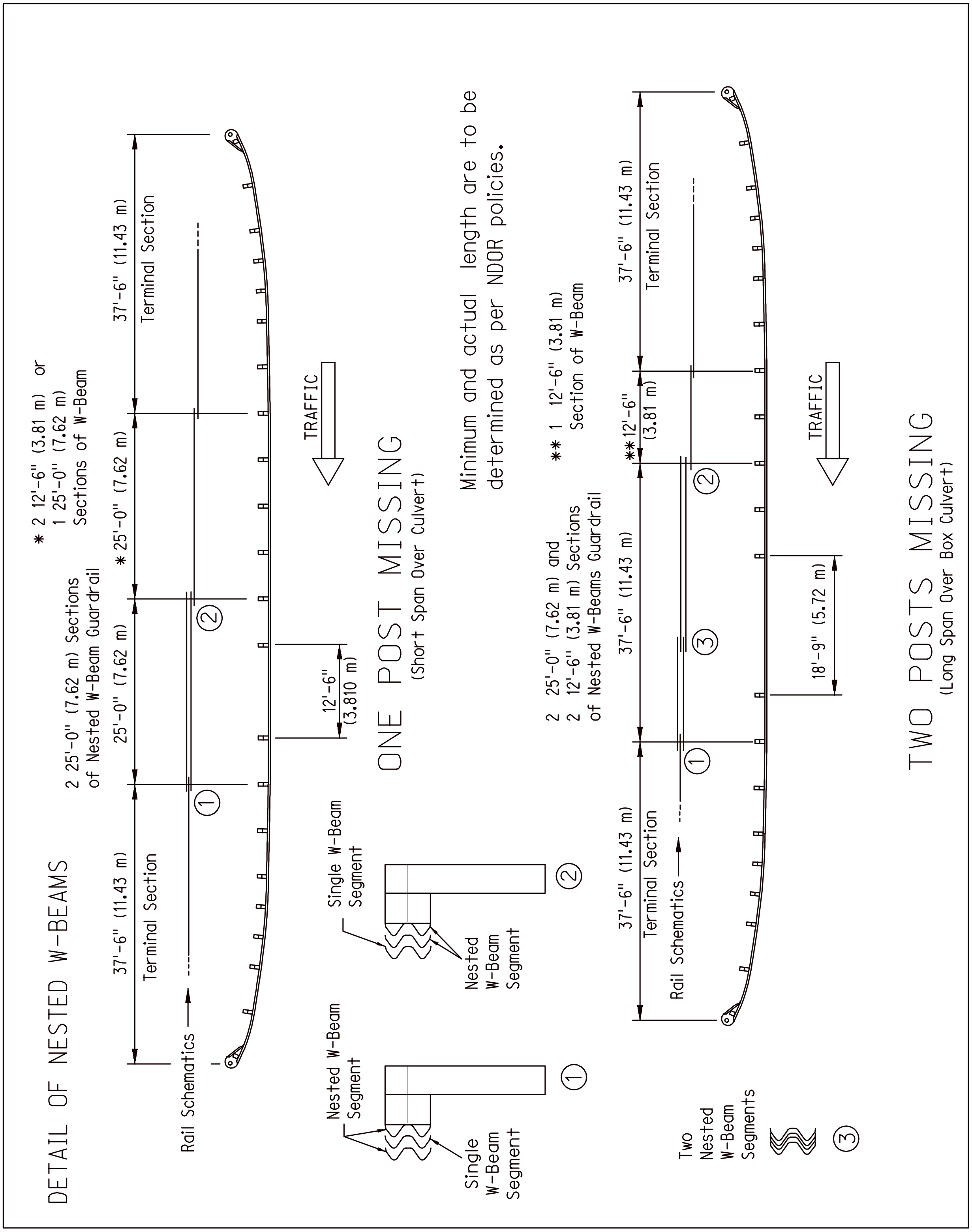


Exhibit 9.17 Guardrail Over Low Fill Culverts – Nested

1.K 3R Project Guardrail Design Criteria/Guidelines

1.K.1 Guardrail Design

- Check existing fill slopes for guardrail warrants using **EXHIBITS 9.3 & 9.4**.
- Use the posted speed limit or 60 mph (100 km/h), which ever is greater.
- Use the tables in **EXHIBIT 9.7** for L_r values. Interpolate L_r values for speeds not listed in the table.
- Use the 3R fixed obstacle clearance unless the project was graded to a safety section, and then use the appropriate DR lateral obstacle clearance, (See the Nebraska Minimum Design Standards, Reference 9.1). Use a 35' fixed obstacle clearance on the Interstate.
- Use a tangent installation of a Type I End Treatment (see Section 1.E.1) when there is minimal or no earthwork on the project.
- When designing guardrail on the outside of a curve, the L_r line should extend tangent from the curve to the fixed obstacle point. Design the inside of the curve as if it were not in a curve, (See Appendix B, "Guardrail Design Examples", and **EXHIBIT 9.10**).
- Cable guardrail should be installed instead of w-beam, when possible, at all locations that warrant w-beam guardrail, including culvert locations, (See Section 1.K.2).
- See Appendix B, "Guardrail Design Examples", and **EXHIBITS 9.7 – 9.10** for guardrail design examples.

1.K.2 Guardrail Design at Culverts

- For 6'x6' to 20'x10' span and rise box culverts or 6' to 8' diameter culvert pipes located within 3R fixed obstacle clearance: check warrants for w-beam guardrail using **EXHIBIT .2**.
- For larger than 20'x10' span and rise box culverts or larger than 8' diameter culvert pipes located within 3R fixed obstacle clearance: run a benefit/cost analysis to determine if guardrail is warranted.
- If there is existing guardrail and it is warranted: replace the guardrail.
- If there is existing guardrail and it is not warranted: remove the guardrail (Approval from **Assistant Design Engineer** required).
- If there is no existing guardrail and it is warranted: either extend the box culvert or build new guardrail.
- If there is no existing guardrail and it is not warranted: use the box culvert in place.

1.L Maintenance and PEP (Pavement Extension Plan) Project Guardrail Criteria

- Review all projects to determine if there is existing guardrail.
- On a Maintenance project, guardrail may be replaced in kind, i.e., install the same length of guardrail as was removed. If additional guardrail work is required, the project will be reclassified to a 3R project.
- Guardrail adjustments are not allowed on PEP projects and are not required for a grade raise of ½ inch or less.
- If the grade raise is greater than ½ inch the designer should ask the **Materials and Research Division** if the grade raise at the guardrail locations may be lowered and if so, by what amount.

- If the grade raise cannot be lowered, or if the **District** does not want it lowered, the designer shall request a measurement of the guardrail height by the **District** to determine if the guardrail will meet minimum height requirements after the grade raise.
- If the grade raise is greater than ½ inch, the project must meet one of the following requirements to remain a PEP project:
    1. The height of the guardrail meets the minimum height requirements after the project has been completed, (See EXHIBIT 9.18).
    2. The grade raise is lowered at the guardrail locations to no more than ½ inch or is lowered enough that the guardrail height meets minimum height requirements, (See EXHIBIT 9.18).
    3. The guardrail can be removed based on a cost-effective analysis, (**Assistant Design Engineer** approval required).

MINIMUM GUARDRAIL HEIGHT REQUIREMENTS *		
	Nominal Height	**Acceptable Range**
Cable Guardrail (Installed prior to 2003)	27 in.	27 in. – 30 in.
Cable Guardrail (Installed in 2003 or later)	30 in.	27 in. – 32 in.
W-Beam Guardrail	27 in.	27 in. – 30 in.
Thrie-Beam Guardrail	32 In.	29 in. – 35 in.

***** Guardrail height shall be measured at the face of the rail, from the existing shoulder, (when the guardrail is within 2 ft. of the shoulder), to the upper cable strand or to the top of the uppermost beam.

Exhibit 9.18 Minimum Guardrail Height Requirements

2. CRASH CUSHIONS AND IMPACT ATTENUATORS

Some form of impact attenuation should be considered in cases where fixed rigid obstacles within the lateral obstacle clearance distance are unavoidable, such as a concrete bridge rail or piers. Crash cushions are designed to gradually decelerate a vehicle to a safe stop in head-on impacts and to redirect a vehicle away from rigid objects in side impacts. Crash cushions may be used alone or in conjunction with properly designed longitudinal barriers. Crash cushions may also be used in construction and work zones. Crash cushions and impact attenuators shall be designed to the appropriate NCHRP Report 350 Test Level [Test Level 3 approved devices are for use when the design speed is 60 mph (96 km/h) and greater; Test Level 2 approved devices are to be used when the design speed is less than 60 mph (96 km/h)].

The Standard/Special Plans Book, (Reference 9.3) contains plans and examples of the crash cushions and impact attenuators used by **NDOR**. For design information on crash cushions and impact attenuators see the Roadside Design Guide, (Reference 9.2).

2.A Inertial Barriers

Inertial barriers are sand-filled barrel modules arranged with increasing amounts of sand in the barrels as they are placed closer to the obstacle. Standard module mass varies from 200 to 2100 lbs. (90 to 950 kg). They operate by dissipating the energy of an impacting vehicle, transferring the vehicle's momentum to the variable weights of sand in the barrels as they are hit. Inertial barriers may be used to shield a variety of fixed object obstacles and are used primarily for protection of pole and column bases, lighting supports and other rigid objects on the ground.

Inertial barriers should be set as far from the travel lanes as possible to avoid nuisance hits. The width of the last row of modules should be greater than the shielded object. The individual manufacturers supply design details for barrel layout. See the Roadside Design Guide (Reference 9.2) for additional design details and the Standard/Special Plans Book, (Reference 9.3) for details of inertial barriers in use by **NDOR**.

3. REFERENCES

9.1 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

9.2 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2002.

9.3 Nebraska Department of Roads, Standard/Special Plans Book, Current Edition.

9.4 Nebraska Department of Roads, Standard Specifications for Highway Construction, 1999 and supplemental updates. (http://www.nebraskatransportation.org/ref-man/).

9.5 Transportation Research Board, National Research Council, “Roadside Safety Features and Other General Design Issues”, TRR Report No. 1599, Washington, DC, 1997.

CHAPTER TEN
MISCELLANEOUS DESIGN ISSUES

LIST OF EXHIBITS

CHAPTER TEN
MISCELLANEOUS DESIGN ISSUES

Chapter Ten
Miscellaneous Design Issues

1. RAILROAD/HIGHWAY GRADE CROSSINGS

Railroad-highway crossing design must consider approach grades, sight distance, drainage, highway traffic volume and the frequency of train movements. The traffic volumes and frequency of train movements should be used as the basis for evaluating the exposure factor. If the current number of vehicles using the crossing multiplied by the number of trains per day is 50,000 or greater, grade separation should be considered. Existing railroad and site conditions will dictate whether an underpass or overpass should be used.

The ideal crossing geometry at railroad/highway grade crossings is a right angle intersection of track and highway, with slightly ascending grades on both highway approaches to reduce the flow of surface water toward the crossing. For general coordination of mainline alignment at railroad grade crossings, the following design considerations apply:

1. Horizontal Alignment. The highway should intersect the railroad at a right angle without intersections or driveways nearby. This configuration maximizes the driver's view of the tracks and minimizes conflicting vehicular movements from crossroads and driveways. Crossings should not be located on either highway or railroad curvature where practical. Highway curvature limits the driver's sight distance and may cause the driver to concentrate on negotiating the curve rather than looking for a train. Railroad curvature may inhibit a driver's view down the tracks. Superelevation also complicates a crossing on a curve and may result in maintenance and rideability problems.

   If the intersection between track and highway cannot be made at right angles, the variation from 90^{o} should be minimized. At skewed crossings, motorists must look over their shoulders to view the tracks. Because of this awkward movement, some motorists may only glance quickly and not take the necessary precaution. Elimination, consolidation, relocation, realignment and signalization of crossings are all options that should be considered. Early coordination with **Railroad Liaison Engineer** is required.

2. Vertical Alignment. Preferably, vertical alignment should be as flat as possible at railroad intersections to enhance sight distance, rideability, and braking and acceleration distances. Vertical curves should be of sufficient length to insure an adequate view of the crossing. The roadway grade shall match the railroad grade. If the roadway crosses the railroad at a superelevated track section the roadway profile shall be designed to incorporate the railroad superelevation.

   A Policy on Geometric Design of Highways and Streets, (Reference 10.2c), Chapter 9, Exhibit 9-102 recommends that the crossing surface be in the same plane as the top of rails for a distance of 2 ft. (0.6 m) outside of the rails and that the surface of the highway shall not be more than 3 inches (75 mm) higher nor 6 inches (150 mm) lower than the top of the nearest rail at a point 30 ft. (9 m) from the rail, unless track superelevation dictates otherwise.

In cases where a railroad company has a maintenance road parallel to the tracks, it may be necessary to provide access for railroad maintenance across the highway. Cases such as this, and those involving horizontal clearances, may require special consideration. The designer should contact and coordinate with the **Railroad Liaison Engineer.**

When railroads and highways parallel each other in close proximity, there is a possibility that long vehicles will not clear the railroad tracks when stopped at an access road to a state highway. The designer should provide sufficient distance along the parallel state highway for truck storage in these cases. When the highway is on new alignment, it is desirable to have 85 ft. (25 m) to 110 ft. (35 m) of storage between the railroad stop bar and the edge of the highway shoulders. This translates to about 110 ft. (35 m) to 145 ft. (45 m) from centerline of the closest railroad track to the edge of the closest through highway lane.

Where parallel railroad tracks run within 200 ft. (60 m) of the edge of the pavement and are intersected by surfaced roadways (highway, county or other), it is preferable to pave to the tracks instead of stopping at the end of the return. Work of this nature can be accomplished by a special provision only, as prepared by the **Railroad Liaison Office**. For additional information, see Chapter Four: Intersections, Driveways, and Channelization, Section 3.A and **EXHIBIT 4.20**.

Geometric design of the railroad-highway grade crossing should be done in concert with the determination of the appropriate traffic control devices (e.g., signs, pavement markings, flashing light signals and automatic gates). The **Traffic Engineering Division** should be consulted to coordinate design.

1.A Railroad/Highway Crossing Surfacing

Each rail line has specific crossing requirements. Some railroads prefer crossings with high tonnage main line tracks to have at least 10 ft. (3.05 m) of asphalt surfacing between the edge of a crossing and a concrete roadway surface (See **EXHIBIT 10.1**). This allows replacement or installation of concrete cross ties with on-track equipment without removing concrete roadway surfacing. At other locations, the concrete pavement should end at least 6 in. (150 mm) from the edge of timber or concrete crossings (See **EXHIBIT 10.2**). This 6 in. (150 mm) gap is filled with asphalt to keep the expansion of concrete from moving track out of line and allows the railroad to replace crossing and timber cross ties.

Railroad crossings may be of various types, (such as timber, concrete or rubber), and widths. The railroad company will construct the railroad crossing. The designer should contact the **Railroad Liaison Engineer** to determine the type and width of railroad crossing to be used. For further information, see Chapter Two: Roadway Design Process, Section 22.B and Chapter Thirteen: Planning and Project Development, Section 5.G.

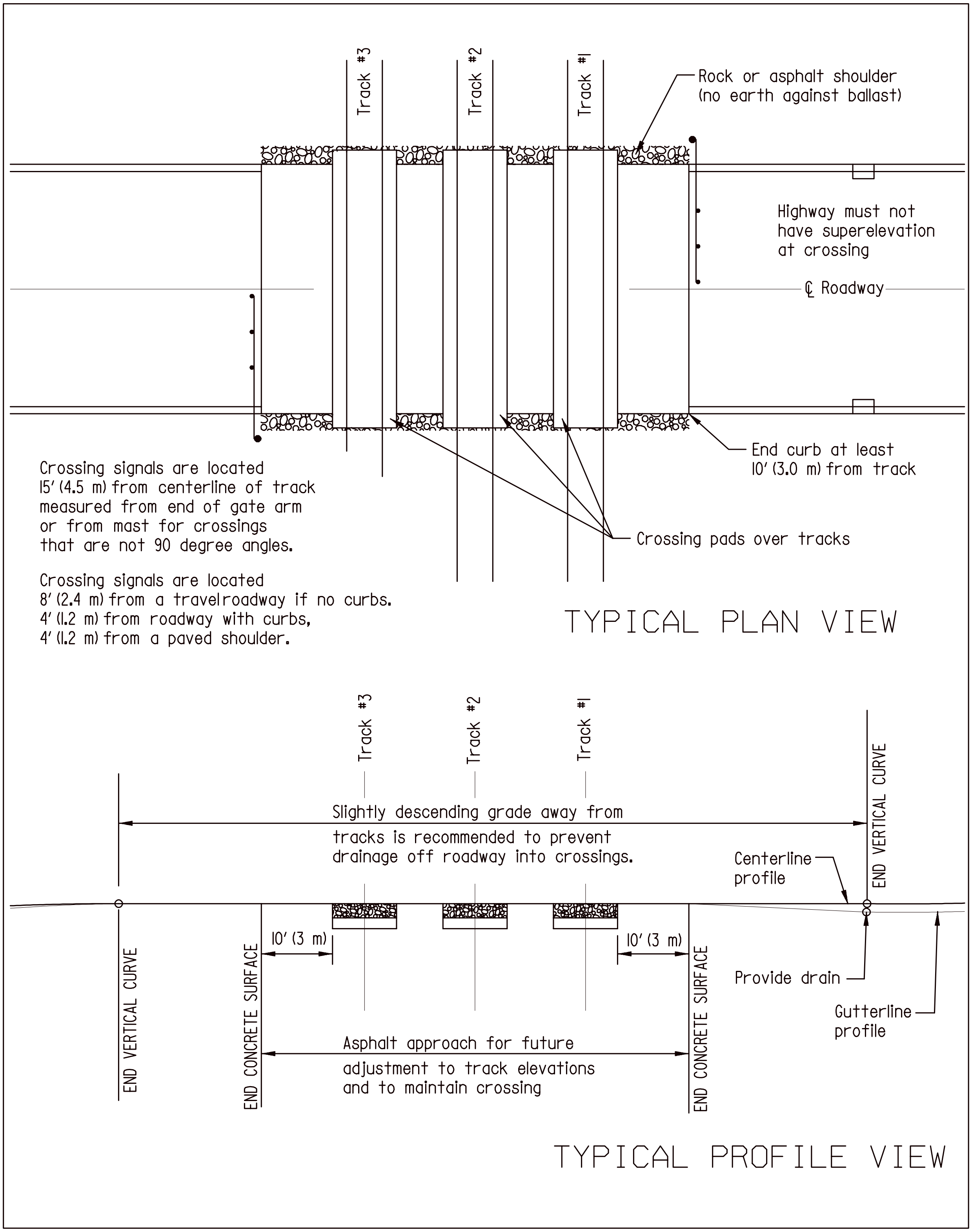


Exhibit 10.1 Railroad/Highway Grade Crossing

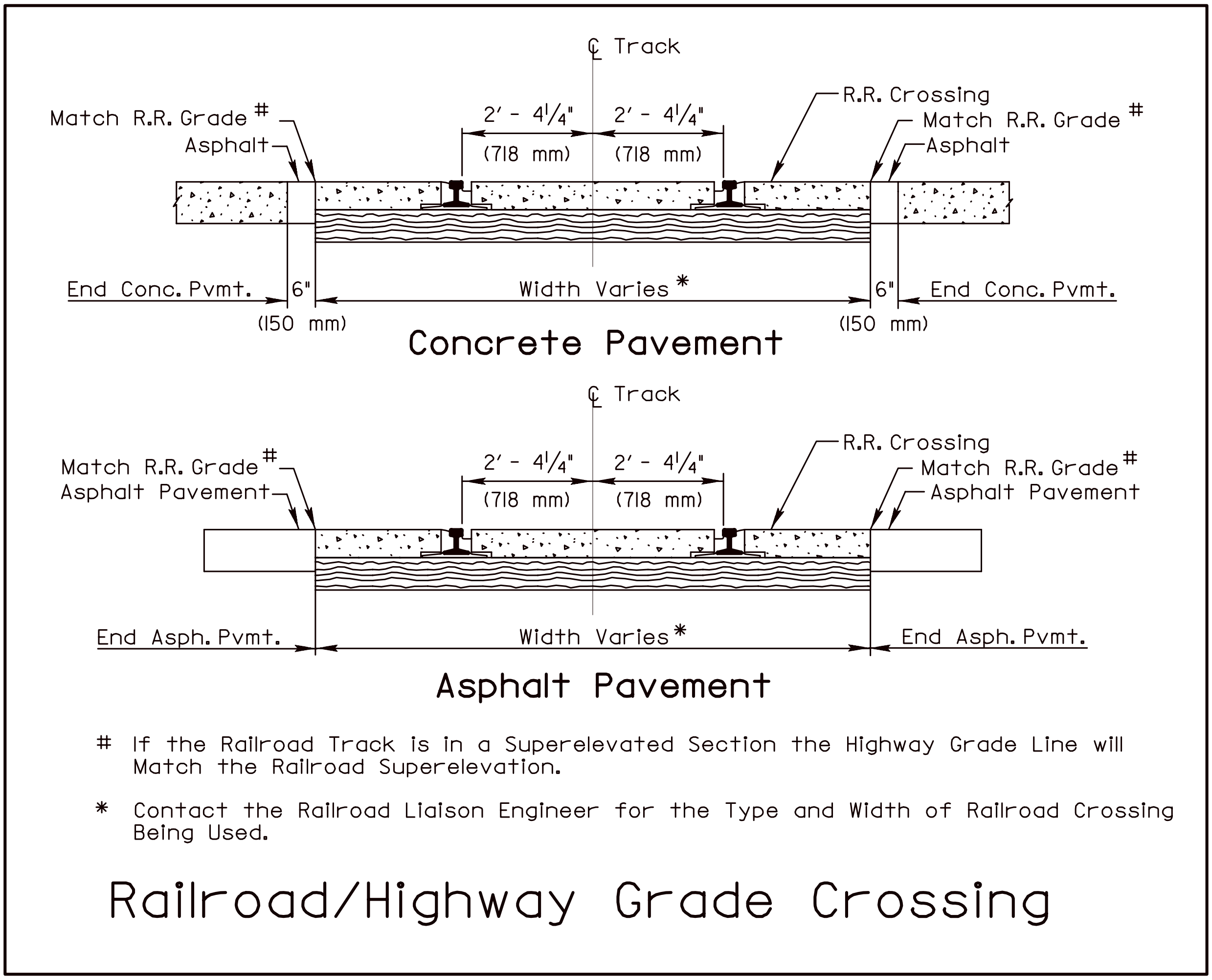


Exhibit 10.2 Railroad/Highway Grade Crossing

2. BRIDGE STRUCTURES

The **Federal Highway Administration** defines a bridge as "*A structure, including supports, erected over a depression or an obstruction, such as water, a highway, or a railway, having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 ft. between undercopings of abutments or spring lines of arches, or extreme ends of the openings for multiple boxes; it may include multiple pipes where the clear distance between openings is less than half of the smaller contiguous opening*." If a multiple span concrete box culvert, as measured from the inside surface of the outer wall to the inside surface of the outer wall, is less than 20 ft. along the centerline of the roadway, it is a culvert and shall be designed by the roadway designer, (See the Drainage Design and Erosion Control Manual, Reference 10.3). If a multiple span concrete box culvert measures more than 20 ft. along the roadway centerline, it is a bridge and its design shall be referred to the **Bridge Division Hydraulics Unit**. The designer shall pay particular attention to the effect of a skew on a box culvert as the skew may increase the length of a multiple span concrete box culvert, as measured along the roadway centerline, to bridge length.

The design of horizontal and vertical roadway alignments must be carefully coordinated with any bridges or other structures located within the project limits. Proper coordination may eliminate undesirable bridge characteristics.

2.A Horizontal Curvature

If practical, horizontal curves and superelevation transitions should be avoided on bridges. However, safety is the primary consideration and introducing sharp horizontal curvature on approaches to avoid placing a curve on a bridge is not considered practical. Where a curve is required on a bridge, developing the superelevation on the approaching roadways and carrying the fully superelevated section continuously across the structure can simplify both bridge design and bridge construction. Due to the prevailing snow and ice conditions, the maximum superelevation rate permitted by **NDOR** on bridge structures is 6%.

In some cases, superelevation transitions are unavoidable on bridges and, while less desirable, can still be properly designed and constructed. The designer should coordinate the superelevation design with the **Bridge Division** in the early stages of design (before bridge design is completed).

Superelevated roadways on bridges should not have a break in cross slope where the travel lane meets the shoulder. In other words, shoulder rollover is not permitted on bridge decks. If a break is provided between shoulder and roadway on the superelevated approach to the bridge, the section should transition to a continuous plane prior to the bridge structure.

See Chapter Three: Roadway Alignment, Section 3, for further information

2.B Skewed Structures

EXHIBIT 10.3 illustrates the method for defining the crossing angle or skew, between the mainline facility and the feature intersected (e.g., topographic anomalies, railways, waterways, etc.). When a bridge structure intersects a feature at a skew, the bridge abutments and piers are usually constructed parallel to the feature intersected to provide adequate horizontal clearances and reduce span lengths. Piers for structures over waterways are set parallel to the direction of the flood flow. Skewed intersections increase structure length, complexity and costs.

For bridge structures over roadways, railways and waterways, the maximum practical skew is 45°. Larger skews can be accommodated for facilities intersecting roadways and railways but require additional design and construction work. For culverts, the maximum desirable skew is 35°. The Standard/Special Plans Book, (Reference 10.4), provide details for concrete box culverts with skew angles ranging from 5° to 35°, in 5° increments.

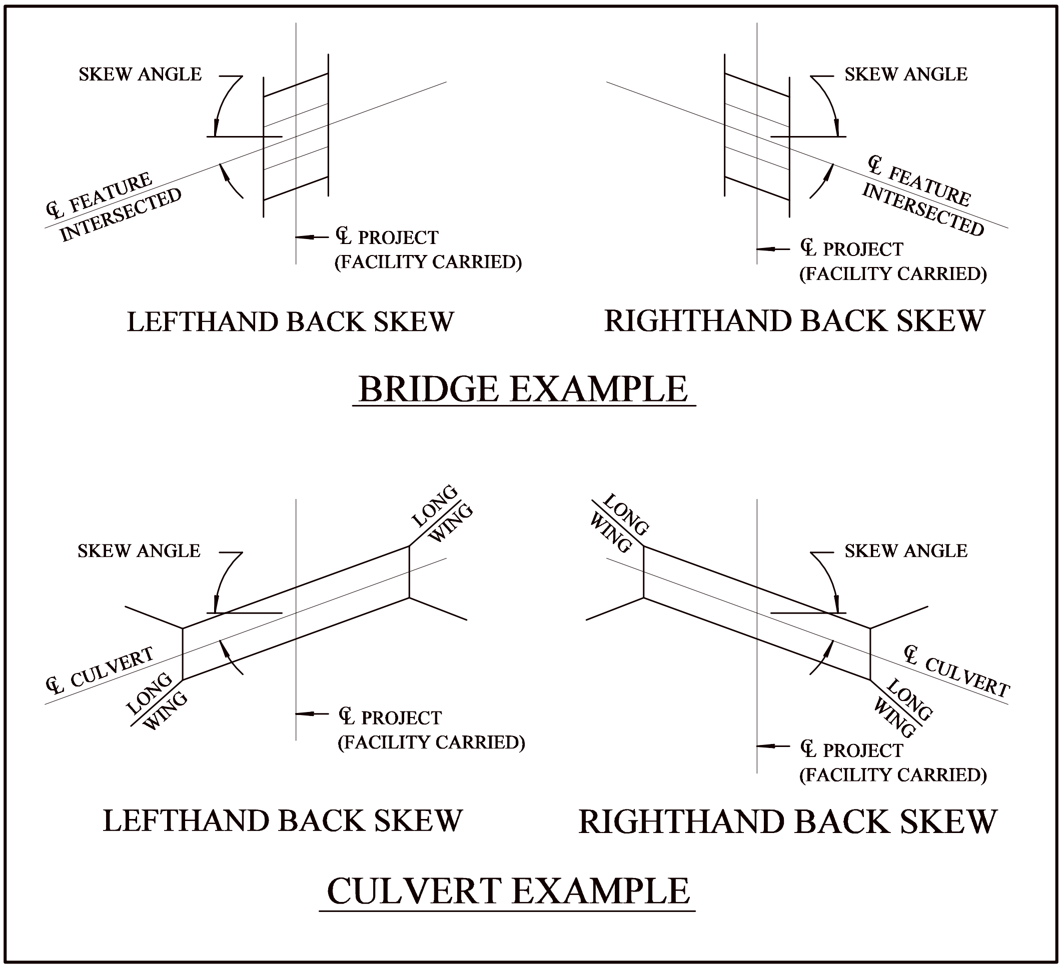


Exhibit 10.3 Skew Angle Definition

2.C Bridge Grades

Avoid vertical profile grades on bridges in excess of 5% to 6% as this can complicate the bearing design for certain types of bearing devices. Also, unanticipated movement can occur on bridges that are built to a steep grade. The grade line on bridge decks should preferably be tangent. For long bridges where drainage is confined to the bridge deck, a 0.5% grade is the desirable minimum.

2.D Vertical Curvature

Avoid placing bridges on crest and sag vertical curves with K values in excess of 143 U.S. Customary (43 Metric) as they may have an inadequate longitudinal slope to drain the bridge deck. Longitudinal drainage is not a significant concern for bridges with open, free-draining rail systems. See Chapter Three: Roadway Alignment, Section 4, for further information.

2.E Vertical Clearances

2.E.1 Grade Separations

Minimum vertical clearances for various conditions are shown in **EXHIBIT 10.4**. The values provided are intended for general guidance only. Final grade decisions should be coordinated with the **Bridge Division.**

Vertical alignment will need to be coordinated with structural requirements for superstructure depth to allow for proper clearance between grade separations. The **Bridge Division** will provide a preliminary estimate of superstructure depth for the types of structures to be used so that preliminary grades can be designed.

Where practical, the low point of a sag vertical curve for a roadway under a bridge should be located at least 100 ft. (50 m) from the limits of the bridge structure. This will help to reduce the need for drainage structures under the bridge and will reduce the ponding of water that may weaken the earth foundation beneath the bridge. Ice accumulation on the roadway would also be minimized since the low point of the sag vertical curve would not be located within the shadow of the bridge structure.

Type	Minimum Clearance
New Structures *	16.4 ft. (5.00 m) (1)
Structure to be used in place, DR1 *	16.08 ft. (4.9 m) (2)
Structure to be used in place, DR2 – DR6 & 3R *	14.44 ft. (4.40 m) (2)
Roadway or pedestrian bridge over railroad	23.5 ft. (7.16 m) (3)
Roadway under pedestrian bridge	17.0 ft. (5.20 m) (4)

1. It is desirable to include a 0.5 ft. (150 mm) allowance for future resurfacing.
2. 16.4 ft. (5.00 m) is desirable.
3. Measured above the plane of the top-of-rails. f the required vertical clearance cannot be met, a minimum vertical clearance of 23.0 ft. (7.01 m) may be used with the approval of the **Assistant Bridge Engineer** in the **Bridge Division.**
4. The pedestrian overhead structures require an additional margin of safe clearance because they are relatively light in weight and could be knocked down by vehicle impact. Such an occurrence may cause accidents as the structure could drop across traffic lanes.

Note: Minimum vertical clearances also apply to roadway shoulders.

* See the Nebraska Minimum Design Standards, (Reference 10.5), (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf), Section 001.02 "New and Reconstructed Bridges on Rural State Highways" and Section 001.13 "New and Reconstructed Bridges on Municipal State Highways".

Exhibit 10.4 Minimum Vertical Clearances for Structures

2.E.2 Stream Crossings

Bridges over meandering rivers, streams and other natural waterways preferably should not be located on a bend in the channel. This can result in less than desirable stream flow characteristics and may require excessive rock embankment to protect the structure from erosion and scour. Divided roadway facilities intersecting with a bend in a natural waterway may require construction of parallel bridges with different span configurations in lieu of the more desirable twin bridge configuration.

The vertical profile design in the vicinity of a stream crossing and the allowable overtopping frequency for the roadway dictate the required waterway opening for a bridge structure. The **Bridge Hydraulics Section** determines required waterway openings. Prior to preliminary design, the roadway designer will provide the **Bridge Hydraulics Section** with a very preliminary, "best guess" profile at bridge locations for use in hydraulic analysis. For some conditions, required waterway openings may consist of the combined bridge opening and roadway overtopping. **EXHIBITS 10.5 AND 10.6** illustrate the basic criteria used to establish bridge length and vertical profile for crest and sag or level profiles, respectively.

2.F Intersections

Avoid placing bridges close to intersections if possible, particularly where guardrail is required.

2.G High Embankments

Embankment for grade separation structures should be of sufficient height to ensure that adequate vertical clearance is provided over the facility intersected. Excessive embankment height will increase span length thus increasing costs.

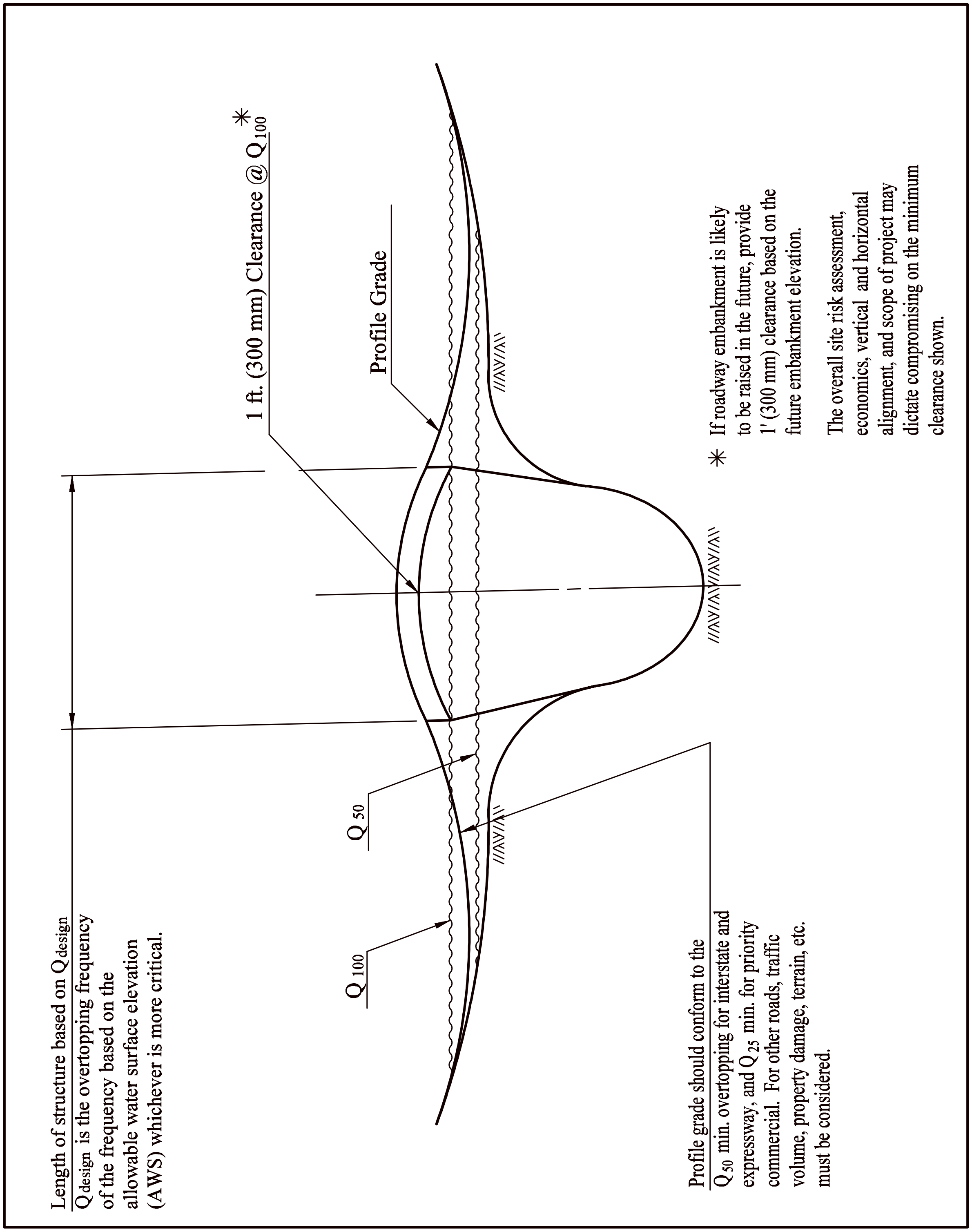


Exhibit 10.5 Vertical Stream Clearances for Crest Profile

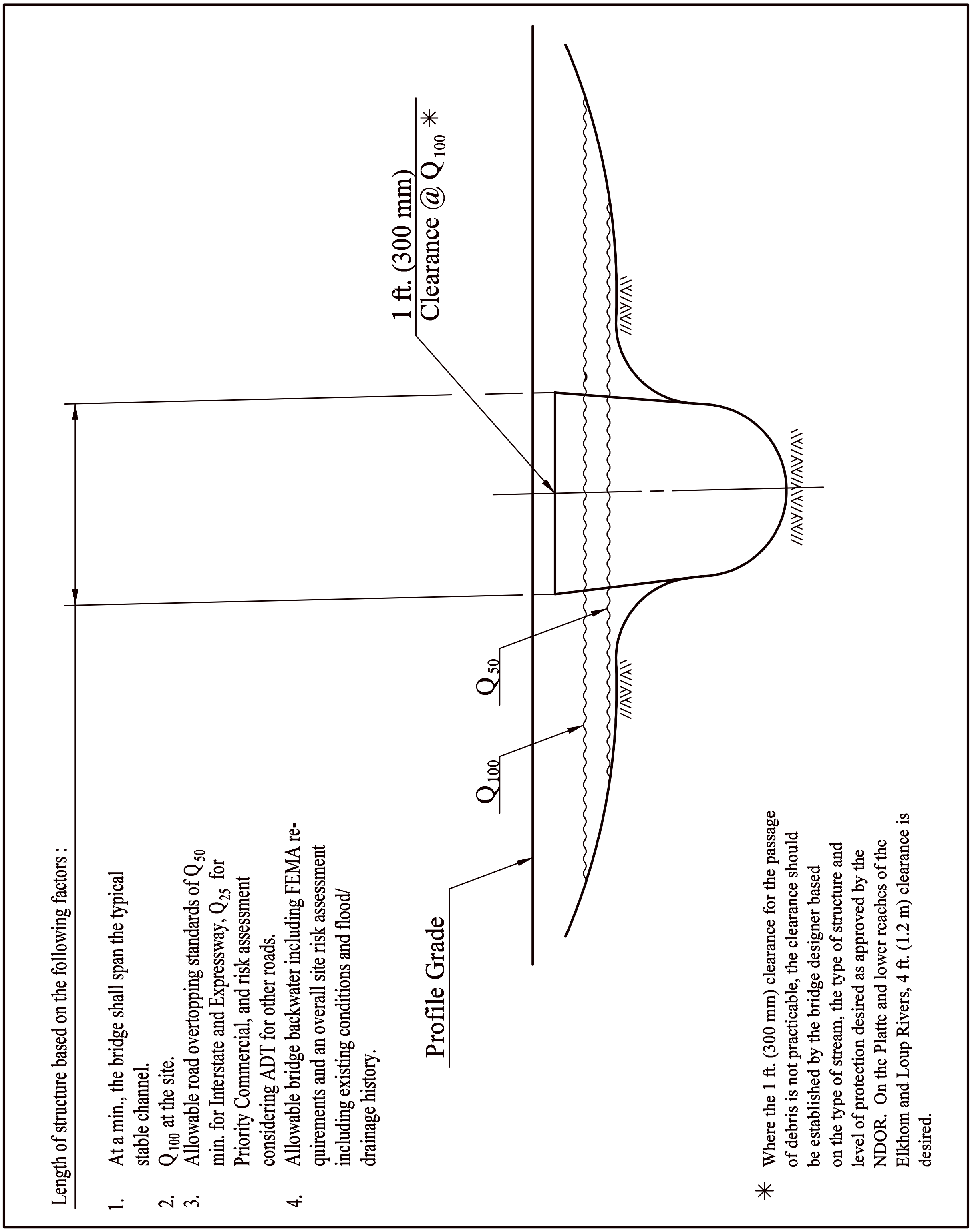


Exhibit 10.6 Vertical Stream Clearances for Sag or Level Profile

3. AIRWAY HIGHWAY CLEARANCES

Within 2 miles (3.25 km) of airports, highways must be designed to provide minimum clearances between the highways and the navigable airspace. Highway appurtenances such as overhead signs, light standards, and moving vehicles on the highway and/or over-crossing structures must not penetrate navigable airspace. Minimum clearances for civil airports are shown in **EXHIBIT 10.7**. The designer should also consider future surfacing overlays that may reduce clearance and future growth of the airport that may necessitate highway relocation.

The **Nebraska Department of Aeronautics** shall be contacted if any object, (fence, culvert end section, utility pole, road, etc.), is planned for construction within 1000 ft. of either end or within 400 ft. of the centerline of an airport runway. The **Department of Aeronautics** shall also be contacted if any object is planned within 160 ft. of any airport pavement or structure, (building, pole, weather equipment, etc.).

The regulations of the **Federal Aviation Administration** for airway highway clearances are published as "Part 77, Federal Aviation Regulations" (Reference 10.6), (http://www2.faa.gov/arp/ace/part77.htm). The **Nebraska Department of Aeronautics** should be consulted early in the design process for current regulations and notification requirements related to highway projects near civil and military airports and heliports and for information on future growth planned at the airport.

The **Federal Aviation Administration (FAA)** requires written notification prior to construction in the vicinity of an airport. This includes the use of cranes near an airport. FAA Form 7460-1, “Notice of Proposed Construction or Alteration” must be filed at least 30 days before work starts and should be filled out either during the Plan-in-Hand Report, (Activity 5315), or during the preparation of the L.O.C. Plans, (Activity 5335). This form may be found on the Internet at (http://www1.faa.gov/aso/aso500/7460-1n.doc). Contact the Department of Aeronautics for more information.

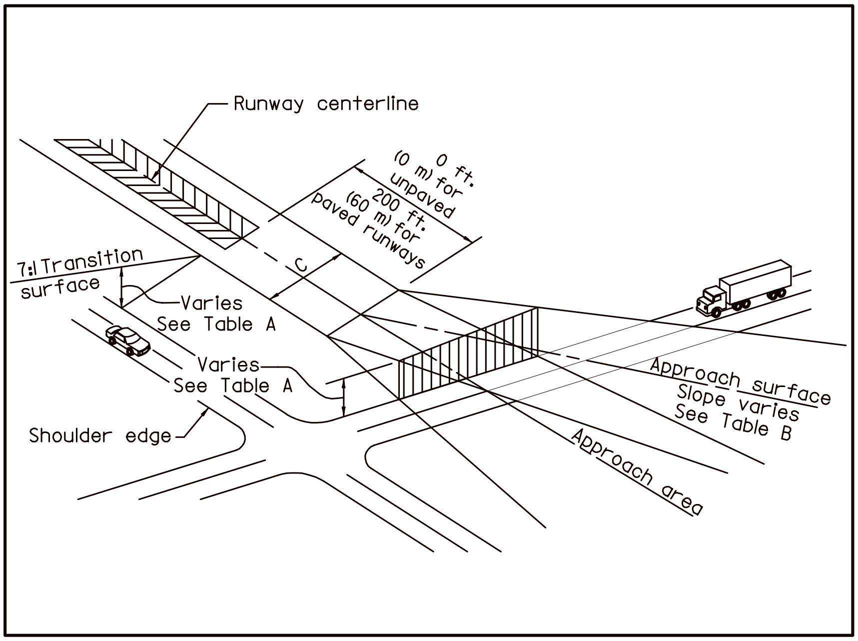


TABLE A	
Minimum vertical clearance between approach surface and:	
Interstate	17 ft. (5.2 m)
Other public roadways	15 ft. (4.6 m)
Railroad, waterway or other traverse way	23 ft. (7.0 m)

Approach surface: a surface longitudinally centered on the extended runway centerline outward and upward from each end of the primary runway surface extending horizontally from the end of the runway. The approach surface flares out as it extends from the runway end. The approach surface has the following dimensions:

TABLE B				
Type of Runway*	**Dimension C**	**Length of Approach Surface**	**Width of Approach Surface at End**	**Slope of Approach Surface**
Utility – Visual	250’	5,000’	1,250’	20:1
Utility – Nonprecision	500’	5,000’	2,000’	20:1
Larger than Utility – Visual	500’	5,000’	1,500’	20:1
Larger than Utility – Nonprecision with minimums greater than ¾ mile	500’	10,000’	3,500’	34:1
All – Nonprecision with minimums as low as ¾ mile	1,000’	10,000’	4,000’	34:1
All – Precision	1,000’	50,000’	16,000’	50:1 / 40:1**

* Check with the **Nebraska Department of Aeronautics** to determine the runway type.

** The first 10,000 ft. (3050 m) is at a 50:1 slope and the last 40,000 ft. (12200 m) is at 40:1 slope.

Transitional surfaces extend outward and upward at right angles to the runway centerline and the runway centerline extended at 7:1 slope from the sides of the primary runway surface and from the sides of the approach surfaces.

Exhibit 10.7 Airway Highway Clearance Requirements (Civil Airports)

4. LANDSCAPING

Landscaping is an ongoing and essential part of **NDOR's** Six-Year Plan and is the responsibility of the **Roadway Design Division**. Landscaping includes, but is not limited to, plantings, scenic view development, use of retaining walls, median treatments, slope rounding, berms, aesthetic treatment for noise walls, and other treatments for environmental, functional or aesthetic purposes.

Landscaping provides many functional and aesthetic benefits that are as integral to good roadway design as are geometrics. Landscaping should enhance the visual quality of the roadway environment, thus reducing the impact of the roadway on the adjacent area. The goals of landscaping include:

- Enhance the safety of the roadway by maintaining recovery areas for errant vehicles.
- Accentuating the roadway features with appropriate plantings.
- Reduce maintenance costs by the use of living snow fences, erosion control, limited mowing, and the prompt removal of tree seedlings.
- Conserve, enhance and effectively display the natural environment and beauty of the roadway landscape, providing a pleasant driving experience for the traveler.
- Encourage wildlife conservation and habitat improvement, within the roadway right-of-way, through selected plantings and limited mowing.

Implementation of the landscaping policy includes the following activities:

1. During the development of major (normally not resurfacing, lighting, etc.) roadway projects, urban or rural, the **Roadside Development Unit** will review and recommend an appropriate landscaping treatment for each project in accordance with the **AASHTO** manual A Guide for Landscape and Environmental Design, (Reference 10.7).
2. The **Roadside Development Unit** involvement will begin at the engineering review or corridor study stage of project development to promote early identification of the potential for landscaping. Landscaping recommendations will be included in the engineering review report, corridor study report and in the design public hearing engineering statement.
3. The **Roadside Development Unit** will review design plans prior to the plan-in-hand and will furnish written landscaping and erosion control recommendations to the roadway designer for evaluation during the plan-in-hand.
4. The **Roadside Development Unit** will review the plan-in-hand report to estimate specific erosion control needs and to make further landscaping recommendations, as necessary.
5. Landscaping recommendations will be included in the design public hearing engineering statement.
6. The **Roadside Development Unit** will review the limits of construction plans and forward final landscaping recommendations and specifications and final erosion control recommendations to the roadway designer.
7. Erosion control specifications will be sent to the roadway designer after a joint review of final cross-sections with the designer is completed.

4.A Tree Planting and Removal

Every effort will be made to minimize disruption to the surrounding environment. Where trees and other desirable flora can be saved, consistent with sound engineering judgment, they will be. Normally, trees and other flora located within the recovery area for out-of-control vehicles or the limits of construction will be removed, however, the retention of healthy trees and other desirable flora will be reviewed on a case-by-case basis by the **Roadside Development Unit** and the **District Engineer** to determine appropriate action. Guardrail, retaining walls, and other alternatives may be considered before healthy trees are removed. The cost of protecting trees should not be the only determining factor when considering their removal. Tree removal may be a factor in determining the need for tree planting.

When a significant amount of additional right-of-way is required for a project that would not otherwise be classified as "major," the **Roadside Development Unit** should review the project for appropriate landscaping treatment, even if the latter would require the purchase of additional right-of-way outside of the proposed construction limits. Right-of-way will not be acquired solely for tree planting, unless needed to comply with Section 404 Permit requirements, (See Chapter Thirteen: Planning and Project Development, Section 4.B.4).

A special provision is required for removing and resetting trees from the construction zone with the appropriate size tree spade. The **Roadside Development Unit** will determine the feasibility of tree removal and tree spade size.

4.B Roundabout Landscaping

Landscaping for a roundabout should be selected and strategically placed to help improve the overall operation of the roundabout when possible. Plantings in the central island can help provide recognition of the roundabout by approaching drivers and aid in reducing their approach speeds. While allowing adequate sight distance to the left, these plantings help drivers make better judgments concerning the distance to approaching vehicles in the roundabout by filtering out other distracting movements.

All guidelines for intersection sight lines and roadside safety must be followed. The central island plantings must be of sufficient volume to be visible in advance of the intersection and reduce headlight glare across the roundabout, but not infringe on necessary sight distances for motorists and pedestrians. This is accomplished by deliberate positioning of plant material to maximize the view between vegetative elements and minimize the view of opposing vehicles. Plantings also need to address snow drifting concerns and shedding deciduous vegetation on the circulatory roadway. Plant types should be selected to limit excessive maintenance when possible.

5. SNOW CONTROL

Snow drifting may be a problem when the prevailing winds are from the north or west. Snowdrifts on roadways can be minimized by several different methods, including:

- Cross-section modification.
- Structural snow fencing, both temporary and permanent.
- Living snow fencing.

The **District's** input regarding the location of existing snow fences will help to identify locations susceptible to drifting snow. If aerial photos were taken in late fall or early winter, they may show the location of existing snow fence. Designers are responsible for contacting the **District Engineer** to see if snow shots are desired for the plan-in-hand inspection. Snow shots are cut stations where the top of the backslope is less than 60 ft. (20 m) from the roadway centerline and the backslope elevation is greater than the centerline elevation.

Allowing a greater ditch area for the accumulation of snow at locations susceptible to drifting can minimize snowdrifts on roadways. Normally snowdrifts on a roadway occur at the ends of cut sections. Ditches may be widened to provide more area for snow accumulation. The backslope, especially at the ends of high cuts, should be laid back from its normal 3:1 slope.

Structural snow fencing is often used to reduce snow drifting. Annually, maintenance units will place temporary snow fence along the right-of-way in areas of known snow drifting. Along roadways with limited right-of-way, temporary snow fencing may be placed on private property. Permanent snow fencing panels may be needed where a cut section becomes a fill section. Living snow fencing may also be used to reduce snow drifting. If the right-of-way is sufficient, shrubs and trees can be planted along right-of-way or fence lines. Contact the **Roadside Development Section** for the possibility of using living snow fence at the right-of-way line.

6. FENCING

Generally, interstates and freeways should be fenced and some expressways may be fenced. Chainlink fencing is used in urban, developing urban and suburban areas. Chainlink fencing is also used for pedestrian barriers on bridges, (the **Bridge Division** will provide details). The need for fencing expressway projects should be discussed at the plan-in-hand inspection. Refer to the Standard/Special Plan Book (Reference 10.4) for fencing details.

In rural areas, depending on the function and use of the adjoining property, barbed wire or woven wire fences will be erected. The responsibility for removing, resetting or rebuilding fences and cattle guards rests with the property owner, who is compensated by **NDOR** as necessary. Fencing is generally a right-of-way item and the roadway designer should contact the **Right-of-Way Division** for assistance. For further information, see Chapter Fifteen: Right-of-Way, Section 7.D.

For additional information, see Section 8 for fencing adjacent to retaining walls and Section 10.B.1 for fencing behind sidewalks adjacent to steep slopes.

7. CATTLE PASSES

New cattle passes should be built if either of the following criteria is met:

- The appraised segregation damages equal or exceed the cost of constructing the structure.
- The property owner pays for the difference in the cost of the structure and any segregation damages.

Existing cattle passes should be perpetuated if either of the following criteria is met:

- The property owner's title or any other legal document indicates that the owner has a non-revocable right to use the existing structure as a livestock crossing.
- It is apparent that the structure was built to alleviate damage to a segregated property and is being used for a livestock crossing.

The design of cattle passes shall give the contractor the option of furnishing a precast unit, provided that the fill height is within the structural limits of the unit. It is important that cattle passes be designed without bends or grade breaks. If cattle cannot see out the other end of the passage, they will not enter it.

8. RETAINING WALLS

The need for a retaining wall may be determined during any of the following activities:

- Engineering review.
- Preliminary design.
- Plan-in-hand.
- Roadway design.

When a retaining wall with a height of 3 ft. (0.9 m) or greater is built in an urban area, a chainlink fence with a nominal height of 4 ft. (1.2 m) shall be erected adjacent to the retaining wall, (just behind it) on public right-of-way.

EXHIBIT 10.8 outlines **NDOR's** basic procedure to be followed in the design of retaining walls.

NDOR RETAINING WALL
DESIGN GUIDELINES
From Conception thru Shop Plan Review

Step 1) Identify the need for a retaining wall during Activity 5202-Engineering Review.

Step 2) **Planning and Project Development** requests Preliminary Foundation Report-Activity 5603 from **Materials & Research Division, Geotechnical Section**.

Step 3) Confirm the need during Activity 5307 - Preliminary Roadway Design and order Final Foundation Report - Activity 5604.

Step 4) The Final Foundation Report **shall** be submitted to the Roadway Designer and **Bridge Division**.

Step 5) The Roadway Designer shall schedule a meeting with the **Materials & Research Geotechnical Section** and **Bridge Divisions** in order to select the appropriate wall type (i.e., MSE Panel; MSE Block; or conventional Cast-In-Place wall). Prior to the meeting, the roadway designer should have compiled all relative information, such as wall length, height, surcharge loading and other factors relative to the wall construction.

Step 6) If an MSE Panel or Block wall was selected, the roadway designer shall design the wall's general characteristics to be incorporated into the bid plans, along with the appropriate generic Special Provisions. The approved wall vendors will be listed in the Approved Products List for Metric projects. As a minimum, the wall plan should include:

- All wall geometrics - length, height, stationing, offsets, leveling pad elevations, etc.
- Traffic data
- Construction sequencing, if applicable
- Surcharge loading (due to traffic or embankment)
- Architectural notes
- The calculated "Established Quantities":

Concrete Face Panels (SF)
or
Wall Materials (SF) (for Modular Block Walls)

Concrete Leveling Pad (LF)
or
Compacted Earth Leveling Pad (LF) (for Modular Block Walls)

Coping (LF) (if applicable)

Select Granular Backfill for Mechanically Stabilized Earth Structure (CY)

18" Corrugated Metal Pipe (LF) (if applicable)

Shoring for Mechanically (Lump Sum)
Stabilized Earth Structure

Exhibit 10.8 NDOR Retaining Wall Design Guidelines

- All the "External Site Factors" per the 'Design Requirements' section of the generic Special Provision. These factors should be found in **Materials & Research Geotechnical Section's** Final Foundation Report.
- Ensure the following note is placed on the plan near the "External Site Factors":
  The Contractor, in conjunction with the MSE Wall vendor, shall determine the wet unit weight of the select granular backfill material used in the reinforced soil zone. The unit weight shall be shown on the wall shop plans.
- Utilities
- On metric plans, list wall vendors per the "Approved Products List"

If the MSE wall is to be used at a bridge location, submit MSE Wall Special Plan to **Bridge Division** for review. If a conventional wall was selected, the **Bridge Division** shall design the wall and submit the special plan and associated Special Provisions to the roadway designer.

Step 7) Advertise Project

Step 8) Bidding Contractors send MSE Wall plans and Special Provisions to the approved wall vendors (listed in Special Provisions or the Approved Products List) in order to secure bids.

Step 9) The awarded Contractor submits six sets of shop plans and working drawings (stamped by a Nebraska P.E.) to the **Construction Division**. The **Construction Division** shall place a REVIEWED Stamp on the first sheet of all six sets (similar to the one shown below).

REVIEWED by: **Roadway Design**
Materials & Research Geotechnical Section
Bridge
Construction

Construction Division will then forward all six sets to the roadway designer.

Step 10) The roadway designer shall review the submitted plans for the wall geometrics and to ensure the plans reflect the bid plans. Corrections, deletions or concerns should be marked in red on all six sets. Sign and date the Reviewed stamp on the plans.

Step 11) The roadway designer shall then forward all six sets to **Materials & Research Geotechnical Section** to review the "External Stability" of the wall. After **Materials & Research** signs and dates the review stamp on all six sets, they will forward all six sets to **Bridge Division**.

Step 12) The **Bridge Division** shall review the structural aspects of the wall. Again marking corrections, deletions and concerns in red, on all six sets. After Bridge signs and dates the review stamp on all six sets, they will forward one set to **Roadway Design**, one set to **Materials & Research Geotechnical Section** and four sets to **Construction**.

Step 13) The **Construction Division** will then distribute one set to the **District Office**, and the remaining three sets to the Contractor.

Exhibit 10.8 NDOR Retaining Wall Design Guidelines (Continued)

9. OLD ROAD OBLITERATION

Once existing pavement on an abandoned alignment is no longer needed, (such as for phasing or property access), the pavement may be removed. The quantities of removed pavement shall be paid for by the sq. yd. (m^2). The plans for old road obliteration should be put on 2-N sheets (See Chapter Eleven: Final Plan Preparation, Section _). The Standard/Special Plans Book, (Reference 10.4) illustrates cross-sections for old road obliteration.

10. PEDESTRIAN AND BICYCLIST ACCESSIBILITY

This section introduces design concepts and considerations associated with pedestrian, bicyclist and multi-use facilities.

10.A Design Goals and Guidelines

The following are basic assumptions that underlie **NDOR's** approach in the design of facilities for pedestrian and bicycle use:

- To make the behavior of the bicyclist, pedestrian and motorist as predictable as possible. A basic goal of design is to develop a physical environment that gives all transportation modes facilities suited to their needs.
- Design to minimize risk. If you cannot construct a new facility, or retrofit an existing one to meet **AASHTO** guidelines, there are still steps that may be taken. Sometimes relatively low-cost measures such as signing, striping, traffic calming and improved maintenance can result in reduced risk.
- Decide for whom you are designing, (pedestrians, bicyclists, or both), and take a hard look at what it will take to meet their needs. If in doubt, use the more restrictive design standard or engineering approach.
- Design to minimize conflict. To the extent possible, give each transportation mode its own "turf". Provide sidewalks, bike lanes and/or bicycle-friendly roadways. Design transit stops and turn lanes to minimize conflicts and to delineate clearly expected paths of travel.
- Design according to anticipated levels of use. Current **AASHTO** guidelines call for 10 to 12 ft (3.0 to 3.6 m) trail widths where heavy use is anticipated.
- Consider the future growth of the system. Give some thought to continuity, establish linkages, and minimize inconvenience and design inconsistencies.
- Facilities should accommodate comfortable and direct travel, following a convenient route. If deviations from the route must occur, design them so that their advantages are obvious and take steps to provide clear directions either through signage or landscaping.

For further information, refer to the Guide for the Development of Bicycle Facilities (Reference 10.8), Pedestrian and Bicyclist Safety and Accommodation (Reference 10.9), Pedestrian Facilities at Interchanges (Reference 10.10), and Designing Sidewalks and Trails for Access, (Reference 10.17).

10.B ADA Accessibility Guidelines

All newly constructed and reconstructed sidewalks, curb ramps, ramps, steps, stairs and handrails shall be compatible with the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities (Reference 10.11), (http://www.access-board.gov/adaag/html/adaag.htm). Facilities for the handicapped may be made to meet local requirements if those requirements meet or exceed **NDOR** standards. Additional information about the ADA may be found at (http://www.Access-Board.gov).

10.B.1 Sidewalks

10.B.1.a Warrants - Sidewalks

Sidewalk construction should be considered during the preliminary design of a project. The final determination regarding sidewalk construction will be made at the plan-in-hand inspection, with the concurrence of the local governing authority, and verified at the public hearing. Where sidewalks currently exist along a roadway, the sidewalk will normally be reconstructed. Public input is considered when determining if sidewalks should be constructed on both sides of a roadway where a sidewalk currently exists on only one side. If an existing bridge structure with a sidewalk is to be rehabilitated or replaced, the sidewalk will normally be retained.

The need for sidewalks on a new or reconstructed rural roadway where no sidewalks currently exist is determined on a case-by-case basis. If they are approved, sidewalks should be provided between the origins and destinations of existing and future pedestrian trips within the project limits. Additional design guidance can be found in A Policy on the Geometric Design of Highways and Streets (Reference 10.2), Pedestrian and Bicyclist Safety and Accommodation (Reference 10.9), and Pedestrian Facilities at Interchanges (Reference 10.10).

10.B.1.b Design Considerations – Sidewalks

Widths – Sidewalk widths may vary from 4 to 8 ft. (1.2 to 2.4 m), (**NDOR** prefers a 5 ft. (1.5 m) width). The minimum width of sidewalk shall be 4 ft. (1.2 m) provided that every 200 ft. (60 m) or less there is a driveway or other such widened pavement area to facilitate the passing of wheelchairs. Where there are no driveways or intersections every 200 ft. (60 m), the designer should use a 5 ft. (1.5 m) minimum sidewalk. If both pedestrians and bicyclists frequently use a sidewalk, a 6 ft. (1.8 m) minimum sidewalk should be used. See **EXHIBIT 10.9** for further information.

Buffer Areas - Where there is sufficient right-of-way, a 10 ft. (3 m) or wider buffer area between the back of the curb and the sidewalk is desirable. Generally, providing a 4 ft. wide (1.2 m) buffer area between the back of curb and the edge of sidewalk is the most practical section based on available right-of-way. **EXHIBIT 10.10** illustrates the typical sidewalk section. Where right-of-way is limited, a minimum 2 ft. (600 mm) buffer should be provided to allow adequate space for hydrants, parking meters and other roadside appurtenances. If no buffer is provided, a minimum 6 ft. (1.8 m) sidewalk width should be used to accommodate these appurtenances.

Cross Slope - The maximum allowable cross slope is 2%.

Curb Ramps - Curb ramps shall be constructed at all sidewalk-curb intersections. See Section 10.B.3 and the Standard/Special Plans Book, (Reference 10.4).

SIDEWALK & BIKEWAY MINIMUM WIDTHS (ON & OFF BRIDGES)		
	MINIMUM WIDTHS	**ON BRIDGES**
*** SIDEWALK**	4 feet (1.2 m) without providing for passing 5 feet (1.5 m) providing for passing	6 feet (1.8 m) without providing for passing 7 feet (2.1 m) providing for passing
**** ONE - WAY BIKEWAY**	5 feet (1.5 m)	7 feet (2.1 m)
**** TWO - WAY BIKEWAY**	8 feet (2.4 m)	10 feet (3.0 m)
**** SHARED USE PATH**	6 feet (1.8 m)	8 feet (2.4 m)

* ADA minimum requirement
** AASHTO Guide for the Development of Bicycle Facilities (Reference 10.8)
See the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities, (Reference 10.11), for further information.

NOTE: Designers need to check city ordinances in regard to sidewalk and bikeway width requirements.

Exhibit 10.9 Sidewalk and Bikeway Minimum Widths

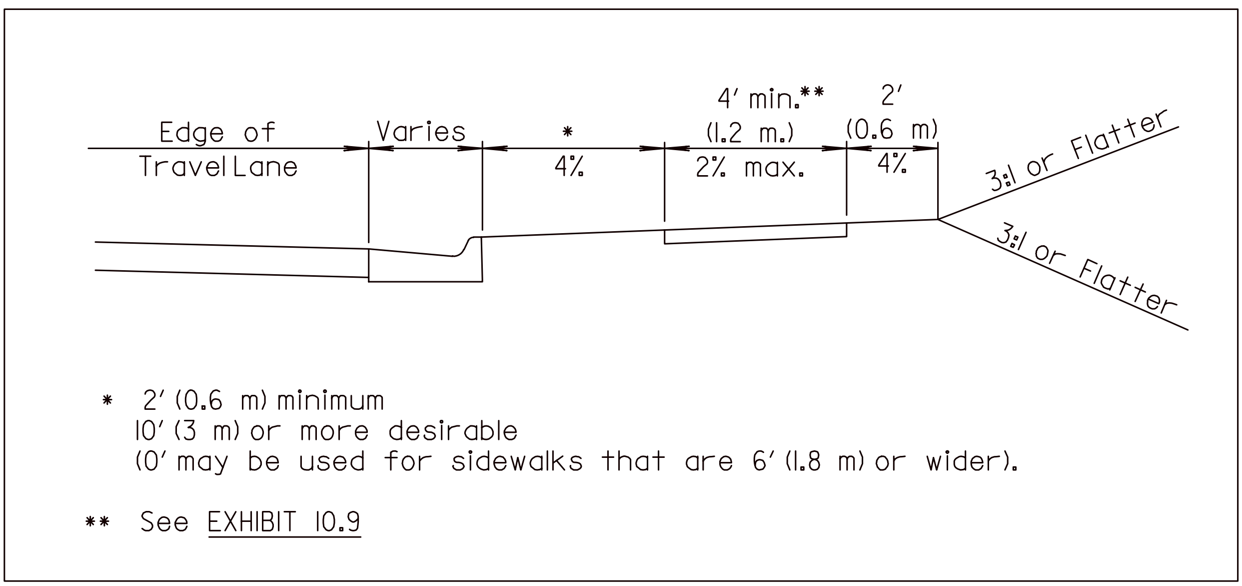


Exhibit 10.10 Typical Sidewalk Section

Fencing – To provide safety when there are sidewalks adjacent to steep slopes (greater than 3:1) and where no safety barrier or guardrail is present, a chainlink fence may be considered at a typical distance of 2 ft. (0.6 m) behind the sidewalk. The fence should have a minimum height of 4 ft. (1.2 m) with the chainlink fabric facing the sidewalk (See **EXHIBIT 10.11**). If the sidewalk and the steep slope are on the approach to a viaduct or overpass, the concrete bridge railing should be extended onto the approach slab and, where possible, the sidewalk flared away from the traffic.

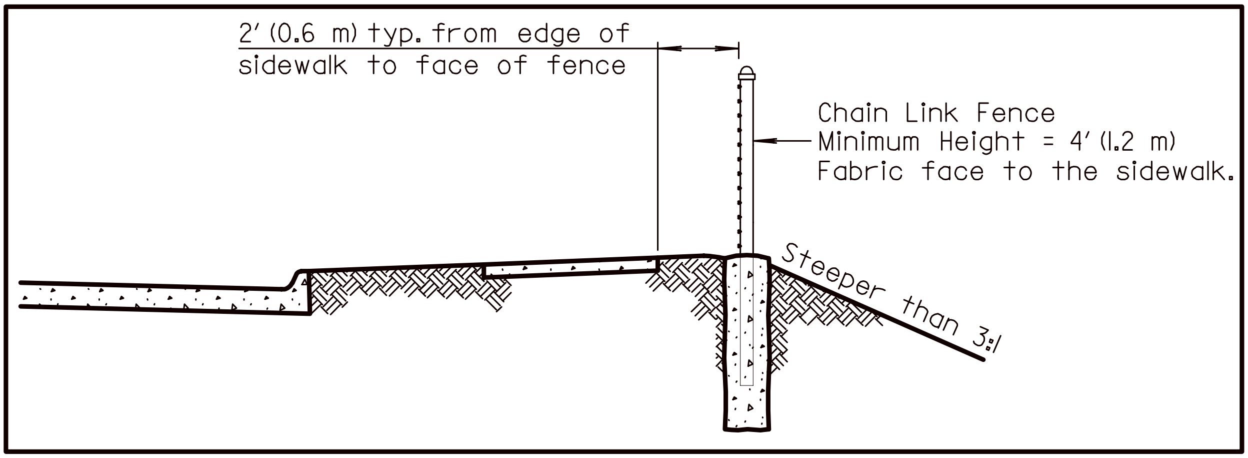


Exhibit 10.11 Fencing on Steep Slopes Adjacent to a Sidewalk

Underpasses - When a culvert is to be used as a bicycle and pedestrian underpass, the minimum reinforced concrete box size shall be 10 ft by 10 ft (12 ft by 12 ft if equestrian use is expected). The designer shall consider the safety of the underpass users, (including location, sight distance, and lighting), and the drainage of the facility while designing the underpass. Bicycle/pedestrian underpass design shall be coordinated with the **Bicycle/Pedestrian Coordinator** in **Planning and Project Development**.

10.B.2 Bikeways

Most bicyclists use public roads with no dedicated bicycle space. Bicycle traffic can be expected on almost all roadways. The **State of Nebraska** permits bicycles on all roadways and roadway shoulders except for the freeway and the interstate systems. Therefore, the bicycle has become an element for consideration in the highway design process.

Measures that can enhance a shared roadway's safety and capacity for bicycle traffic include:

- Paved shoulders.
- Bicycle-safe drainage grates.
- Adjusting manhole covers to grade.
- 2 ft. (600 mm) wide shoulder rumble strips permitting bicycle traffic on the remaining width of shoulder.

Where high volumes of vehicular and bicycle traffic share the same roadway, bikeways may be warranted. A bikeway may be a bicycle lane or a bicycle path, (**EXHIBIT 10.9** gives the allowable minimum widths for bikeways). A bicycle lane is a portion of a roadway that has been designated by signing and pavement markings for the preferential or exclusive use of bicycles. A bicycle path is physically separated from vehicular traffic by an open space or barrier, either within the highway right-of-way or within an independent right-of-way. In many instances, design features of separate bicycle facilities are controlled by the adjoining roadway and are an element of the design of the roadway itself. For further information on bicycle facilities, see **AASHTO's** Guide for Development of Bicycle Facilities (Reference 10.8).

10.B.3 Curb Ramps

Curb ramps will be maintained, constructed, or reconstructed to meet the American with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities, (Reference 10.11), on all “New and Reconstructed” projects and on all “3R” and “Maintenance” projects in municipalities, residential developments, and sanitary and improvement districts beyond the zoning jurisdictions of municipalities where there are existing sidewalks and/or where sidewalk construction is a part of the project. Curb ramps for the handicapped may be constructed to meet local requirements if those requirements meet or exceed **NDOR** standards (See the Standard/Special Plans Book, Reference 10.4).

Design details for these intersection elements may vary according to the following factors:

- Sidewalk width.
- Sidewalk location with respect to back of curb.
- Height and width of curb cross section.
- Design turning radius.
- Angle of street intersections.
- Location of signs and signal control devices.
- Stormwater inlets and above ground utilities.
- Possible sight obstructions.
- Street width.
- Border width behind the sidewalk.
- Roadway grade.
- Suitable location for stop bar.
- Location of the marked crosswalk.

Consideration should be given to the relative locations of inlets and sidewalks or crosswalks to ensure that there is sufficient room for the 5 ft. (1.5 m) blockout required for a curb inlet and that neither grates nor ponded water are hazardous to pedestrians, (See the Drainage Design and Erosion Control Manual, Reference 10.3).

The ADA guidelines (Reference 10.11) require that a curb ramp and level landing area shall be provided wherever a public sidewalk crosses a curb, at each street crossing and where otherwise required (See **EXHIBIT 10.12**). Curb ramps shall be a minimum of 4 ft. (1.2 m) wide (exclusive of flared sides) and should be perpendicular to the direction of crossing vehicular traffic. Placement of ramps at 45º to the vehicular traffic, directing pedestrians to the center of the intersection, is not acceptable.

The maximum allowable running slope of any curb ramp is 8.3%. The maximum allowable cross slope of any public sidewalk shall be 2%. Where a side of a perpendicular curb ramp abuts a public sidewalk, the sides of the ramp shall be flared with a maximum 10% slope. Each sidewalk curb ramp shall have a 4 ft. (1.2 m) minimum long level landing at the top to allow wheelchair operators to turn. The cross slope of the landing shall not exceed 2% (See the Standard/Special Plans Book, Reference 10.4).

Where the right-of-way will not accommodate a perpendicular sidewalk curb ramp (See **EXHIBIT 10.12**, Detail a), a parallel ramp with a level landing at the bottom shall be provided (See **EXHIBIT 10.12**, Detail b). Where parallel and perpendicular curb ramps are combined, the landing may be coincident with that provided for the parallel curb ramp (See **EXHIBIT 10.12**, Detail c).

The surface of a curb ramp shall be stable, firm and slip-resistant. Gratings and similar access covers shall not be located on curb ramps or landings. A detectable warning area for the visually impaired, consisting of truncated domes, shall be provided at each pedestrian curb ramp as detailed in the Standard/Special Plans Book (Reference 10.4).

Transitions shall be flush and free of abrupt changes. Counter slopes of adjoining gutters and road surfaces connecting to the full width of a curb ramp shall be 5% maximum for a distance of 2 ft. (600 mm) as measured from the base of the curb ramp or landing edge at the street. See the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities, (Reference 10.11), for additional details.

Warrant analysis for mid-block pedestrian crosswalks and overpasses will be developed by the **Traffic Engineering Division** at the same time as signalization is being considered during the plan-in-hand or public hearing processes. Where a pedestrian structure is required, the **Bridge Division** will design such structures. For further information, see Chapter Fourteen: Traffic Engineering, Sections 1.G and 4.A.

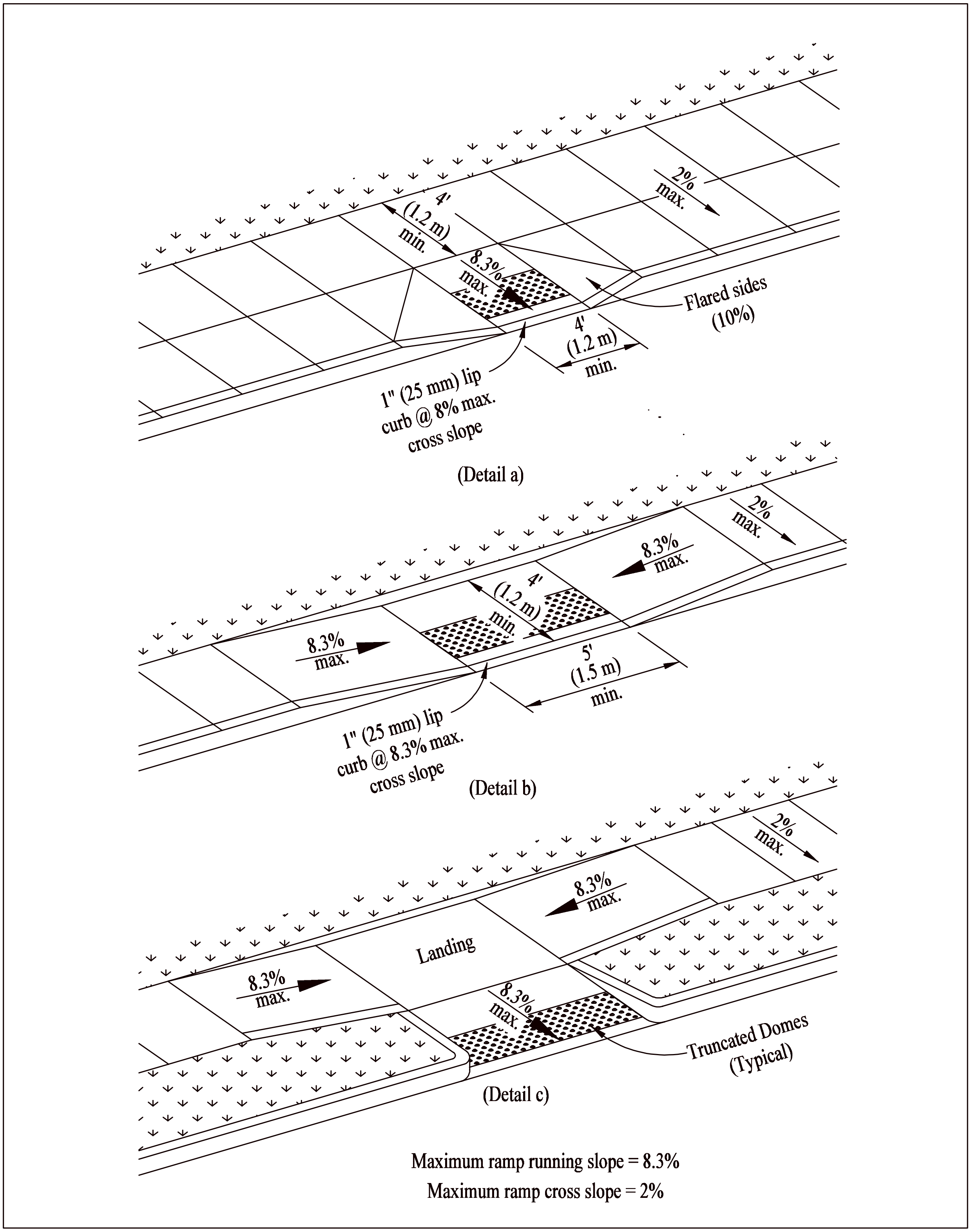


Exhibit 10.12 Public Sidewalk Curb Ramps (Source: Adapted from Reference 10.11)

10.B.4 Pedestrian Ramps

Any part of an accessible route that has a slope greater than 5% in the direction of travel shall be considered a ramp and shall comply with Section 4.8 of the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities, (Reference 10.11). The maximum allowable slope of a ramp in new construction shall be 8.3% in the direction of travel and the maximum allowable cross slope shall be no greater than 2%. The maximum allowable rise for any length of run shall be 30 in. (750 mm). Ramps shall have a minimum clear width of 4 ft. (1.2 m) and shall have level landings at the top and bottom of each ramp. Ramp landings shall be at least as wide as the ramp and the length of the landing shall be at least 5 ft. (1.5 m). If the ramp changes direction at the landing the landing shall have a minimum size of 5 ft. by 5 ft. (1.5 m by 1.5 m). Pedestrian ramps with a rise of more than 6 in. (150 mm) or with a horizontal projection of 6 ft. (1.8 m) or greater shall have handrails on both sides of the ramp, (curb ramps are not required to have handrails). The ramps and their approaches shall be designed so that water will not pond on walking surfaces.

10.B.5 Steps and Stairs

Exterior stairs that connect levels that are not connected by an elevator, ramp or other accessible means of vertical access must comply with the following guidelines:

- All steps on a given flight of stairs shall have uniform riser heights and uniform tread widths of not less than 11 in. (275 mm) wide as measured from riser to riser.
- The undersides of nosings shall not be abrupt. The radius of curvature at the leading edge of the tread shall be no greater than 0.5 in. (13 mm).
- Risers shall be sloped or the underside of the nosing shall have an angle of not less than 60° from the horizontal. Nosings shall project not more than 1.5 in. (38 mm).
- Stairways shall have handrails on both sides of all stairs (See Section 10.B.6).
- Exterior stairs and their approaches shall be designed so that water will not pond on the walking surface.

The **Bridge Division** will provide site-specific plans upon request from the roadway designer.

10.B.6 Handrails For Pedestrian Ramps and Stairs

For pedestrian ramps that require handrails (see Section 10.B.4) and for other locations where handrails are to be provided, the following guidelines should be used. Handrails shall comply with the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities, (Reference 10.11), and shall have the following features:

- Handrails shall be provided along both sides of ramp segments, and the inside rail shall be continuous.
- If handrails are not continuous, they shall extend at least 1 ft. (300 mm) beyond the top and bottom of the ramp segment and shall be parallel to the ground.
- The clear space between handrails and a wall shall be 1.5 in. (40 mm).
- Gripping surfaces shall be continuous.
- The top of handrails shall be between 34 and 38 in. (850 mm and 950 mm) above the ramp surface.
- Ends of handrails shall be rounded or smoothly turned to the wall, floor or post.
- Handrails shall not rotate within their fittings.

Refer to Reference 10.11 for examples of edge protection and handrails. The **Bridge Division** will provide site-specific plans upon request from the roadway designer.

10.B.7 ADA Upgrades - Cost Sharing

10.B.7.a Municipal Share – Municipalities With a Population of 5000 or Less:

- **"New and Reconstructed" Projects:** The municipality will not be required to share in the costs of constructing or reconstructing sidewalks and curb ramps when included in the normal scope of a "New and Reconstructed" project.
- **"3R" or "Maintenance" Projects:** Sidewalks will not ordinarily be reconstructed as a part of a "3R" or "Maintenance" project, unless the municipality requests that sidewalks be reconstructed, at its sole cost, as a part of the project. Curb ramps will be constructed or reconstructed to meet ADA accessibility guidelines under "3R" and "Maintenance" projects at no cost to the municipality. The cost of constructing or reconstructing any sidewalk required to blend these curb ramps into the adjoining sidewalk will also be at no cost to the municipality.
- **All Projects:** The municipality will be responsible for 100 percent of the costs for upgrading existing sidewalks and curb ramps to meet ADA accessibility guidelines, which are outside the normal scope of the project and are at the request of the municipality.

For further information, see the Nebraska Dept. of Roads Operating Instruction 60-11, "Municipal Cost Sharing", (Appendix F, "Selected NDOR Operating Instructions).

10.B.7.b Municipal Share – Municipalities With a Population Over 5000:

- **"New and Reconstructed" Projects:** The municipality will share in the costs of constructing or reconstructing sidewalks and curb ramps when included in any "New and Reconstructed" project.
- **"3R" or "Maintenance" Projects:** Sidewalks will not ordinarily be reconstructed as a part of a "3R" or "Maintenance" project, unless the municipality requests that sidewalks be reconstructed, at its sole cost, as a part of the project. Curb ramps will be constructed or reconstructed to meet ADA accessibility guidelines under "3R" and "Maintenance" projects. The municipality may be required to share in the cost of constructing or reconstructing these curb ramps and any sidewalk required to blend these curb ramps into the adjoining sidewalk.
- **All Projects:** The municipality will be responsible for 100 percent of the costs for upgrading existing sidewalks and curb ramps to meet ADA accessibility guidelines, which are outside the normal scope of the project and are at the request of the municipality.

For further information, see the Nebraska Dept. of Roads Operating Instruction 60-11, "Municipal Cost Sharing", (Appendix F, "Selected NDOR Operating Instructions).

11. MAINTAINING TRAFFIC DURING CONSTRUCTION

During construction of some projects, it may be necessary to detour traffic around the construction site on an existing roadway network. On other projects, the construction phasing may require construction of temporary facilities that route traffic around or through construction work zones. This section discusses the various methods of maintaining the traffic flow while a project is under construction.

11.A Detours

On many projects, detours are used to maintain traffic during construction. A detour guides traffic around a construction zone on an existing road network. The **District** makes recommendations for possible detour routes during the plan-in-hand. An existing state highway, county road, or city street will be used as a detour route. The **District Engineer**, prior to the time that the detour route is announced to the public, will approve the route in writing.

When detours are routed on non-state system roadways, agreements must be made with the appropriate governmental entity regarding the anticipated effects increased traffic will have on the roadway surface of the detour route. The **City/County** should be contacted early in the design process, informing them about the proposed detour route(s) and requesting information regarding any local construction projects or special events (i.e. parades, local festivals, etc.) that will affect the choice and/or allowable timeframe of a detour route. Often the selected route requires temporary geometric and surfacing improvements to handle the intended detour traffic. Pavement needed for detour improvements is paid for under a separate pay item group. The designer should be aware of the improvements to be made and will need to compute quantities of surfacing and other construction necessary to make the proposed detour suitable for traffic.

The agreement will outline the surface, geometric and/or safety improvements necessary. When at-grade railroad crossings are encountered on non-state system detour routes, the designer shall contact the **Railroad Liaison Engineer** regarding any necessary upgrading of the crossing, the crossing signals, and any necessary agreements with the railroad company. For additional information regarding detours, refer to Chapter Fourteen: Traffic Engineering, Section 5.

11.B Temporary Roads

When there is no viable detour route (or the project includes the construction of culverts, bridges, etc.), it may be more practical to construct a temporary road around the work zone than to build the project under traffic, (See **EXHIBIT 10.13**). There are several considerations in the design of a temporary road that the roadway designer should be aware of:

Right-of-Way - Right-of-way should be adequate, or an easement shall be acquired, to construct the temporary road.

Design Vehicle – The temporary road should be designed using the same design vehicle as the project, (See Chapter Four: Intersections, Driveways and Channelization, Section 1.C.5).

Design Speed – As a rule-of-thumb, the design speed for the temporary road is 10 mph (16 km/h) less than the existing posted speed.

Sight Distance – Stopping sight distance and intersection sight distance shall be based on the design speed of the temporary road. The designer shall pay particular attention to sight distance where there is a combination of horizontal and vertical curves.

Typical Section - Typical temporary road sections are shown in **EXHIBIT 10.14**.

Grades – Grades shall be designed based on the temporary road design speed. The maximum allowable grade is 10%.

Transitions – Traffic may be moved between the main roadway and the temporary road by the use of tapers, curves, or, preferably, a combination of the two.

Curves – Horizontal curves should be designed according to the design speed of the temporary road. High-speed temporary roads [V > 45 mph (70 km/h)] should be designed according to the e_{max} = 4% superelevation table found in Chapter Three: Roadway Alignment, (**EXHIBIT 3.9**). Low-speed temporary roads [V ≤ 45 mph (70 km/h)] should be designed in accordance with Exhibit 3-40 of A Policy on Geometric Design of Highways and Streets, (Reference 10.2c), using a relative gradient of 185:1.

(See Chapter Three: Roadway Alignment, Section 3.A for information on the design of horizontal curvature).

Tapers – Taper rates between 29:1 (2°) and 11:1 (5°) are allowed. A 20:1 taper rate is recommended.

Lateral Clearance to the Work Zone (Buffer Space) - The distance required between the centerline of a temporary road section and the project centerline is determined on a case-by-case basis. Factors affecting the required width of this space include construction clearances, side slope geometry, and temporary drainage requirements. For further information, see Chapter Fourteen: Traffic Engineering, Section 5.B.

When a temporary road is required adjacent to bridge construction/reconstruction, the highway designer shall coordinate with the **Bridge Division** regarding the lateral offset of the temporary road to the bridge (See **EXHIBIT 10.14**) and the required size of the drainage structure(s) needed to handle the water flow or the use of a temporary bridge structure.

Drainage - Existing drainage patterns shall remain intact to prevent flooding of the existing roadway and surrounding properties. The designer shall pay particular attention to the drainage of the temporary road surface where there is a combination of horizontal and vertical curves. Drainage structures needed to construct the temporary road shall be included in the cost estimate and any necessary connection bands shall be added to the build notes and cost estimates. If temporary drainage pipe is to be retained by the **District,** they should be consulted regarding the pipe lengths and diameters that can be used when the pipe is salvaged.

Earthwork - Earthwork quantities for temporary roads shall be included in the project earthwork calculations. Temporary road material is put in as embankment and removed as excavation specified for the temporary road.

Surfacing - The **District** will determine the type of surfacing for each temporary road at the plan-in-hand inspection. The following considerations should be kept in mind:

- Pavement used to construct the temporary road shall be structurally adequate to handle expected traffic.
- Pavement used to construct the temporary road shall be estimated for the same quantity items as for the main roadway (See Chapter Twelve: Cost Estimating, Section _) and shall be included in the pavement quantities.
- If gravel surfacing is used, gravel embedment is required.

The roadway designer will do all preliminary calculations. The following individuals will calculate the final quantities, depending on the type of temporary road surfacing to be used:

Temporary Road Surfacing Type	**Final Quantity Calculations by:**
Concrete	Roadway Designer
Asphaltic Concrete	Materials and Research Division
Gravel & Gravel for Embedment	Roadway Designer
Embedment of Gravel	Materials and Research Division
Calcium Chloride	Materials and Research Division

Traffic – The designer shall submit the temporary road design, including geometrics and design speed, to the **Traffic Engineering Division**. Pavement markings and signals needed to construct the temporary road shall be determined by the **Traffic Engineering Division** and included in the cost estimate.

Erosion Control – Temporary erosion control measures will be required for temporary road construction. Temporary erosion control methods may be found in Chapter Two, Section 5 of the Drainage Design and Erosion Control Manual, (Reference 10.3). The designer shall review the temporary road design with the **Roadside Development Unit**.

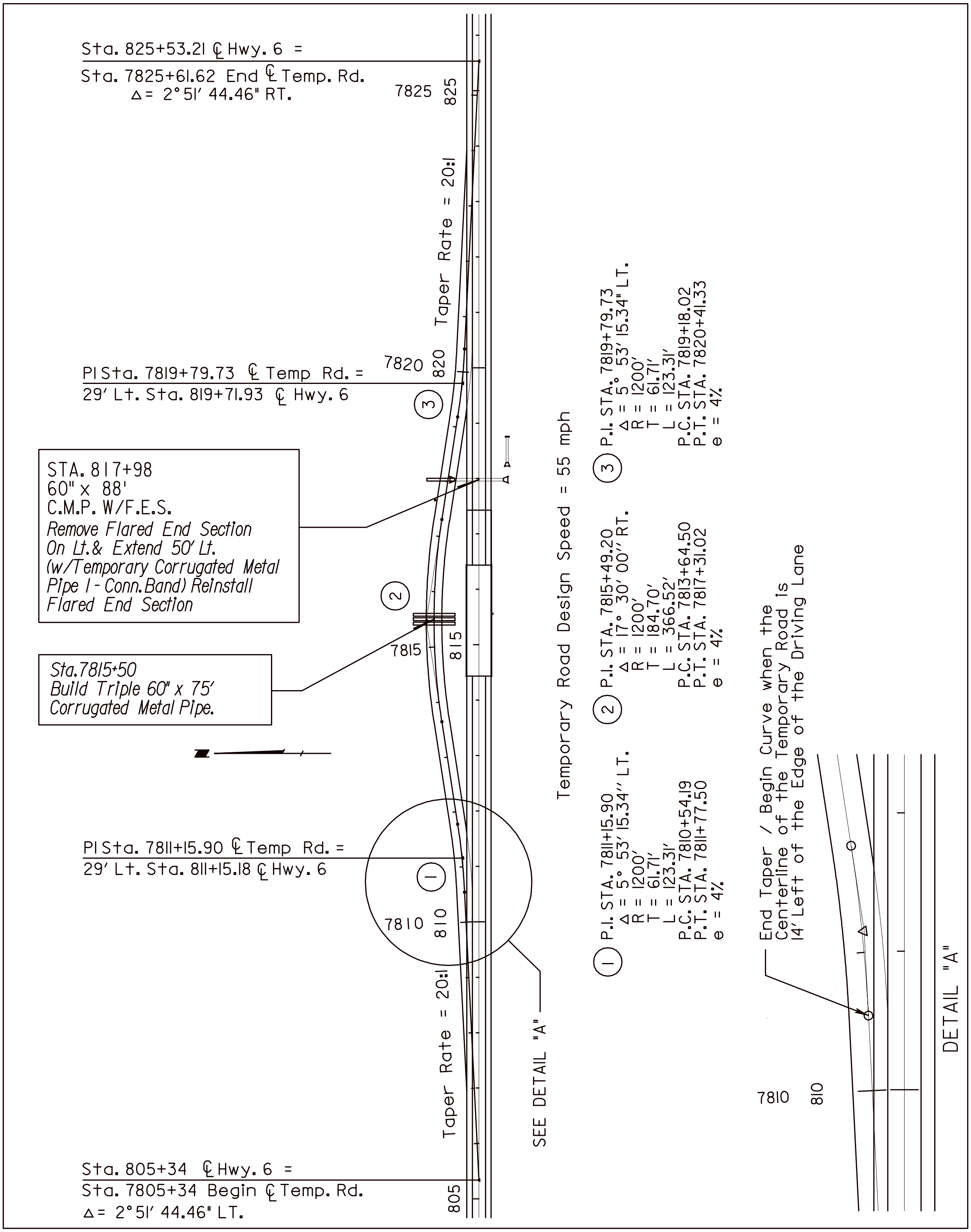
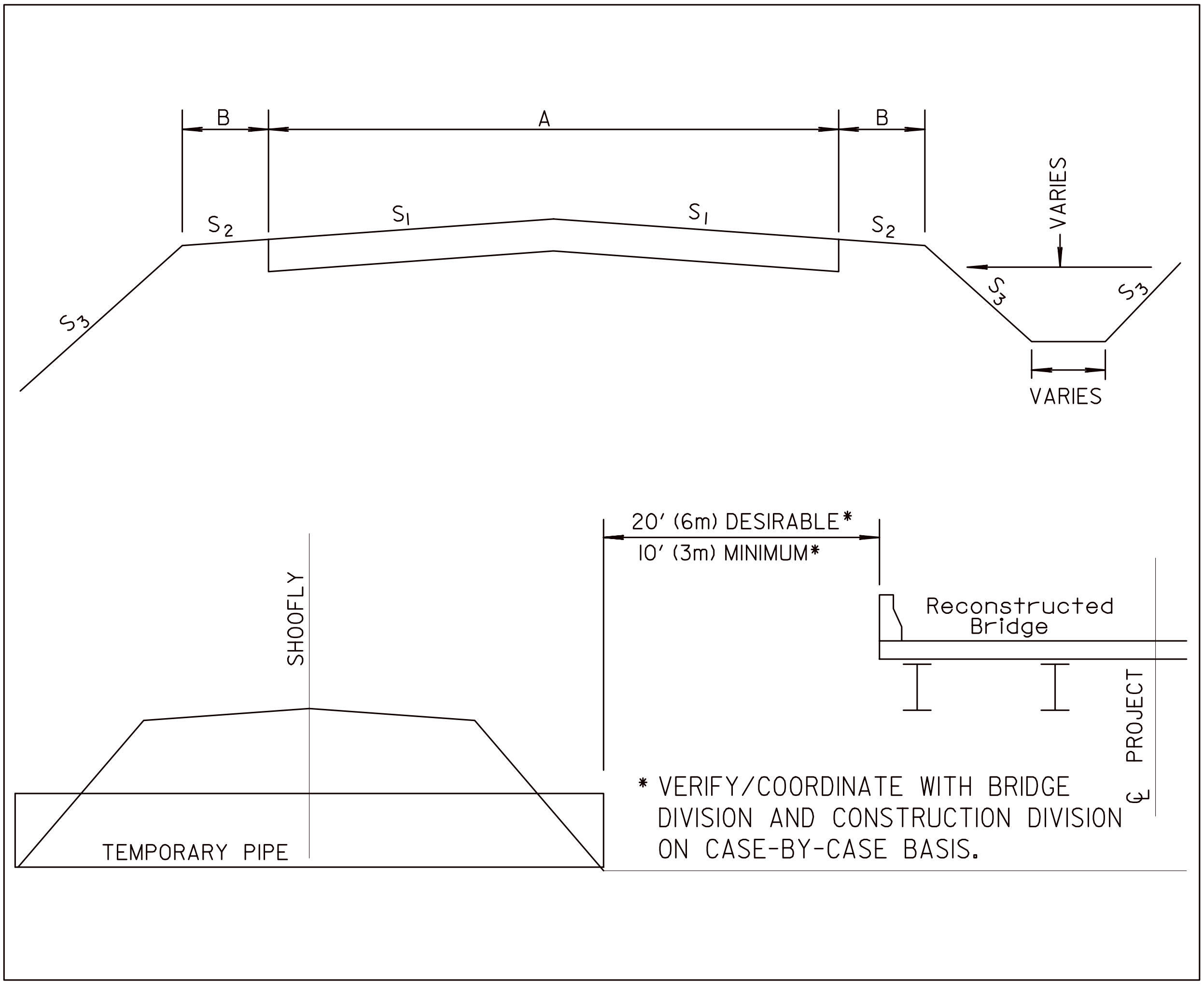


Exhibit 10.13 Example Temporary Road



Paved	**Location/Type**	**A****	**B**	**S_1**	**S_2**	**S_3**
	Sandhills	28 ft. (8.6 m) Desirable	2 ft. (600 mm) Minimum	2%	2%	3:1
	Normal Rural	28 ft. (8.6 m) Desirable	2 ft. (600 mm) Minimum	2%	2%	3:1***
Unpaved	Gravel Embedded	28 ft. (8.6 m) Desirable	2 ft. (600 mm) Minimum	2%	2%	3:1***

** Check A Policy on Geometric Design of Highways and Streets, (Reference 10.2c), Chapter 3 for width vs. radius of curve.
*** 2:1 slope may be used with concrete barriers (**Roadway Design Project Manager** approval required) .

Exhibit 10.14 Typical Temporary Road Section

11.C Crossovers

Crossovers are used on four-lane divided highways to temporarily route traffic across the median to the opposite lanes so that construction can progress on the vacated side. Additional earthwork needed to construct the crossovers shall be included in the earthwork quantities (See Chapter Seven: Earthwork, Section 2). Single lane crossovers should be designed with 16 ft. (4.9 m) lane widths. The crossover pavement quantities shall be included in the cost estimate and paid for separately (See Chapter Twelve: Cost Estimating, Section _).

11.D Temporary Surfacing

Additional temporary surfacing may be needed during different phases of construction for lane or shoulder widening, property entrances, etc. These surfacing quantities shall be included in the cost estimate and paid for separately (See Chapter Twelve: Cost Estimating, Section _).

On New and Reconstructed Projects with major grading involving disrupted accesses, the designer should discuss the use of gravel, crushed rock, or millings with the **District** on the plan-in-hand field inspection. These materials may be used to provide temporary access to adjacent properties during construction.

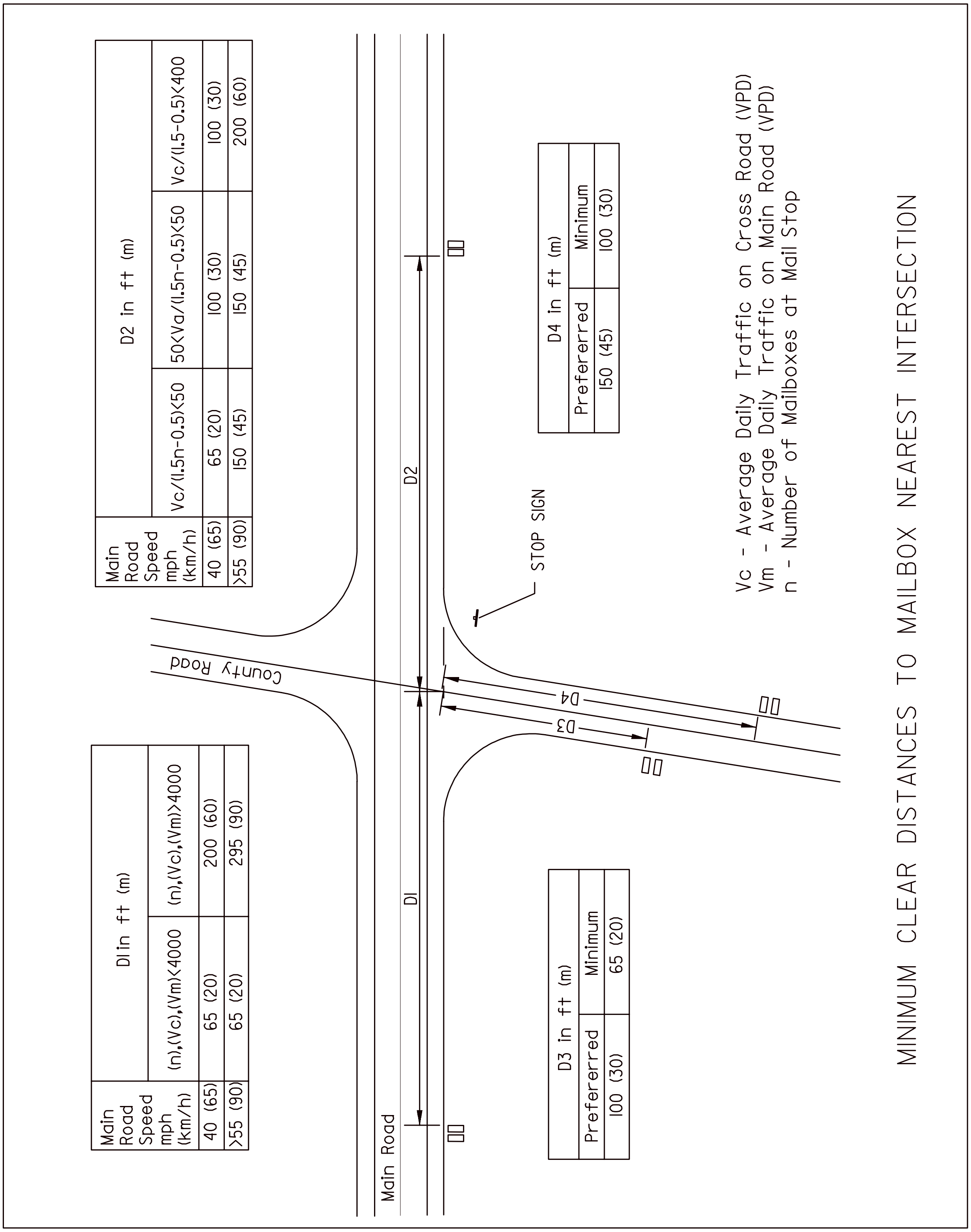
12. MAILBOX TURNOUTS AND SUPPORTS

On one-way streets, mailboxes may be on the left side if designated by the local postmaster. Where a mailbox is located at a driveway, it shall normally be placed 17 ft. (5.2 m) beyond the driveway surfacing on the right hand side of the road in the direction of travel as designated by the local postmaster for each delivery route. A mailbox should not be located on urban roadways where through driving lanes are adjacent to the curb. **EXHIBIT 10.15** shows minimum clearance distances for mailboxes near intersections with county roads.

Asphalt surfacing shall be used for mailbox turnouts, if available. New and Reconstructed projects shall have a minimum 8 ft. (2.4 m) wide mailbox turnout [or a total of 20 ft. (6.0 m) of surfacing width from the centerline)]. A turnout width of 8 ft. (2.4 m) should be considered as desirable on 3R projects and other types of work. The Standard/Special Plans Book, (Reference 10.4), illustrates mailbox turnouts for various roadway types, (these plans provide surfacing quantities for typical mailbox turnouts, but additional surfacing will be needed for turnouts that have more than one mailbox support post).

No more than two mailboxes may be mounted on a single support structure (See the Standard/Special Plans Book, Reference 10.4). **NDOR** provides mailbox supports to the contractor, so the roadway designer needs to have a mailbox support count. The plan build note shall include the number of supports, the mailbox location(s), and the required area of special mailbox surfacing.

For additional information, see a Guide for Erecting Mailboxes on Highways (Reference 10.12) and the Roadside Design Guide (Reference 10.16).



Main Road Speed mph (km/h)	D1 in ft (m)	
	(n),(Vc),(Vm)<4000	(n),(Vc),(Vm)>4000
40 (65)	65 (20)	200 (60)
>55 (90)	65 (20)	295 (90)

Main Road Speed mph (km/h)	D2 in ft (m)		
	Vc/(1.5n-0.5)<50	50<Va/(1.5n-0.5)<50	Vc/(1.5-0.5)<400
40 (65)	65 (20)	100 (30)	100 (30)
>55 (90)	150 (45)	150 (45)	200 (60)

D3 in ft (m)	
Preferered	Minimum
100 (30)	65 (20)

D4 in ft (m)	
Preferered	Minimum
150 (45)	100 (30)

Exhibit 10.15 Clearance Distances for Mailboxes Near Rural Intersections

13. ROADWAY LIGHTING

The **Roadway Design Lighting Unit** is responsible for ascertaining the need for roadway lighting for each project, and for the design of the lighting systems. Lighting will be considered at the plan-in-hand inspection. The **Lighting Engineer** shall be notified if the **District Engineer** determines that a project will include lighting in order to avoid right-of-way problems and utility, driveway and drainage conflicts.

13.A Guidelines for the Installation Of Roadway Lighting

Highway projects that have existing roadway lighting will continue to have roadway lighting. City agreements will need to include the operational and maintenance costs of the system. Requests for new lighting should be transmitted to the **Lighting Engineer**, who will conduct a study for each request. If the results of the study satisfy the conditions of one of the warrants in the following sections, **NDOR** may add lighting to a programmed project or schedule a lighting project to design and build a lighting system at the requested location (subject to the availability of funds). The **Lighting Engineer** will determine the type and style of the system. Even though a lighting request meets the appropriate warrants. the state is not obligated to provide lighting. **NDOR** will own all lighting systems within state highway right-of-way.

13.A.1 Urban Lighting

13.A.1.a Warrants

- **Warrant I - Accident History (Continuous or Intersection):** The number of nighttime accidents (N) per year is greater than 2 times the number of daytime (D) accidents in a three year accident history study with more than 4 nighttime accidents per year per intersection or per mile (N > 2 x D, & N > 4).
- **Warrant II - Traffic Signals:** All intersections warranting traffic signals will also warrant roadway lighting.
- **Warrant III - Two Way Left Turn Lane (TWLTL):** Continuous lighting may be warranted with a two-way left turn lane when there is 80% or more of commercial lighting along the state highway and more than 15 driveways per mile. Consideration will be given to continuous lighting when the mainline curves have a radius of less than 573 ft. (175 m) with a two-way left turn lane.
- **Warrant IV - Local Responsibility:** If none of the previous warrants are met, the local governing authority (city, town, village, or S.I.D.) can choose to install lighting if sufficient benefits are found in the form of convenience, safety, policing, community promotion, or public relations. The local governing authority will pay 50% of the installation cost and 100% of the operation and maintenance cost of the lighting system.

13.A.1.b Festoon Outlets

Festoon outlets (electrical outlets for holiday decorations) will be installed on urban projects as a project cost with a prior written request from the **City/Village**. Festoon outlets will only be installed in the core business area. If additional festoon outlets are requested, their cost will be the sole responsibility off the **City/Village**.

13.A.1.c Costs

When specifying lighting for an urban project, be sure that local government officials are aware that the cost of maintaining and operating the system is a **City/Village** responsibility. Lighting cost estimates should be obtained from the **Roadway Lighting Section** and given to local officials, prior to the agreement signing, so that the **City/Village** may plan and budget for the expense. They should also be informed that the lighting system might include poles that are outside of corporate limits. A signed city covenant agreement is required before a public hearing can be scheduled.

Lighting Projects INSIDE the corporate limits meeting warrant I, II, or III and <u>not</u> installed as part of a “New and Reconstructed”, “3R”, or “Maintenance” project: The local governing authority will pay for 50% of the installation cost and 100% of the operation and maintenance costs of the lighting system.

Lighting Projects INSIDE the corporate limits meeting warrant I, II, or III and installed as part of a “New and Reconstructed”, “3R”, or “Maintenance” project: Installation will be a project cost. 100% of the operation and maintenance costs of the lighting system will be the responsibility of the local governing authority.

13.A.2 Rural Intersection Lighting

13.A.2.a Warrants

- **Warrant A - Accident History:** The number of nighttime accidents per year is greater than one-third the number of daytime accidents per year and the average number of nighttime accidents per year is greater than three in a three year accident history study, or since the intersection was last modified (N > D/3, & N > 3).
- **Warrant B - ADT/Topography/Geometrics:** A current ADT greater than 2500 vehicles/day at the intersection (combine all traffic ADT’s from all legs and divide by two, with a minimum 250 ADT at each leg) combined with two or more of the following conditions would be sufficient to warrant lighting:
    1. There are complex or unusual geometrics.
    2. The intersection sight distance is less than 660 ft.
    3. There is frequent pedestrian traffic (more than 200 per day).
    4. Adjacent development creates confusing background lighting.
    5. There are raised medians on the mainline highway.
- **Warrant C - Traffic Signals:** All locations meeting warrants for traffic signals will warrant roadway lighting.
- **Warrant D - Local Responsibility:** If none of the warrants A, B, or C are met, the local governing authority (city, town, village, or S.I.D.) can choose to install lighting if sufficient benefit is found in the form of convenience, safety, policing, community promotion, or public relations. The local governing authority will pay for 50% of the installation cost and 100% of the operation and maintenance costs of the lighting system.
- **Warrant E - 4-Lane Bypass:** Whenever a 4-lane highway bypasses a city, town, or village, access roads which intersect the bypass but do not meet lighting warrants may have lighting installed as a project cost if the local governing authority feels that such lighting is necessary. The local governing authority is responsible for 100% of the operation and maintenance costs of the lighting system.

13.A.2.b Costs

Lighting projects OUTSIDE of the corporate limits meeting warrant A, B, or C: The state will assume responsibility for the cost of installation, operation, and maintenance of lighting system.

13.A.3 Rural Continuous Lighting

Rural continuous lighting is only warranted when it is an extension of a continuous urban lighting system being installed as part of an urban project, and the lighting extension meets an urban lighting warrant. The installation of warranted lighting extensions will be a project cost and 100% of the operation and maintenance costs will be the responsibility of the state. If the extended lighting is at the request of the local governing authority, 100% of the operation and maintenance costs of the lighting system will be the responsibility of the local governing agency. **NDOR** will not pay for unwarranted rural continuous lighting located outside of the corporate limits and which was built at the request of the local governing authority.

13.A.4 Interchange Lighting

Warrants for interchange lighting on Interstates or Expressways will be determined using the warrants in An Informational Guide for Roadway Lighting (Reference 10.13). If the lighting is located in an urban area, the local political subdivision will have the responsibility for 100% of the operation and maintenance costs of the lighting system.

14. PARKING

EXHIBITS 10.16 & 10.17 provide parking stall dimensions for curb/street parking and for parking lot/parking garage designs for passenger cars. The designer should check local standards before designing parking facilities. Parking modifications should be discussed with local city officials, especially if existing parking is eliminated on the proposed facility. This should be done as early as possible in the design process. The designer should check with the **Traffic Engineering Division** if there is a need to provide for longer or wider vehicles. For further information, see Sections 60-6, 164 and 60-6, 168 of Nebraska Bridge Law (Reference 10.14), (http://statutes.unicam.state.ne.us/).

14.A Accessible Parking

When the **Department of Roads** constructs or re-stripes parking spaces, it must provide accessible parking spaces as required by the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities (Reference 10.11). Accessible parking spaces must be located to provide the shortest possible accessible route of travel to an accessible facility. Accessible parking spaces for automobiles must have a minimum 5 ft. (1.5 m) wide access aisle located next to the designated parking space and accessible parking spaces for vans require a minimum 8 ft. (2.4 m) access aisle. The access aisle must be level (2% maximum slope in all directions) and the same length as the parking stall(s) it serves. Access aisles may serve two parking stalls. Ramps will not extend into the access aisle. **EXHIBIT 10.18** shows a typical access aisle layout and the required minimum number of accessible stalls for a given number of parking spaces. The designer should check local standards and consult with the local city officials regarding the number of accessible parking spaces. Further information may be found at (http://www.Access-Board.gov).

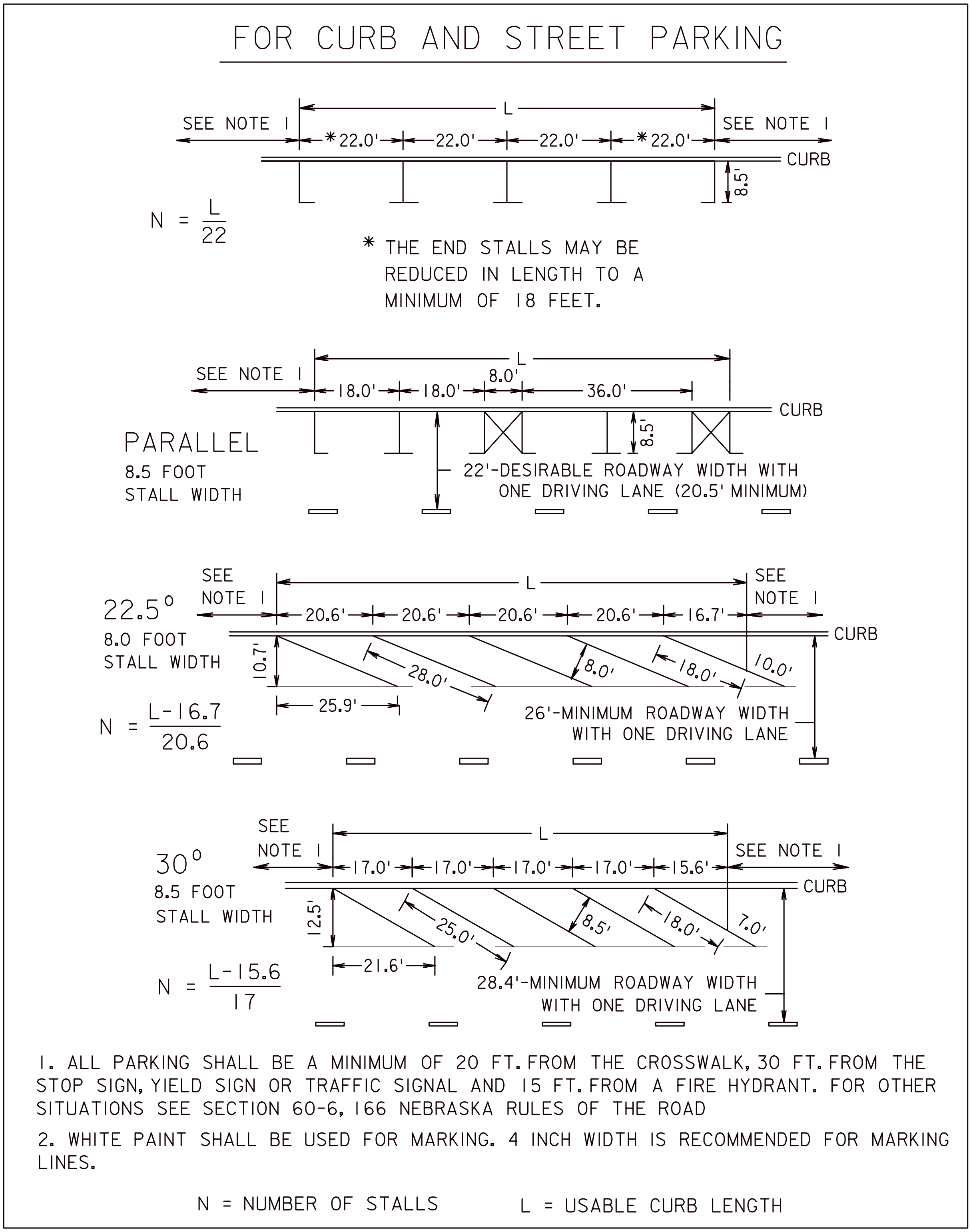
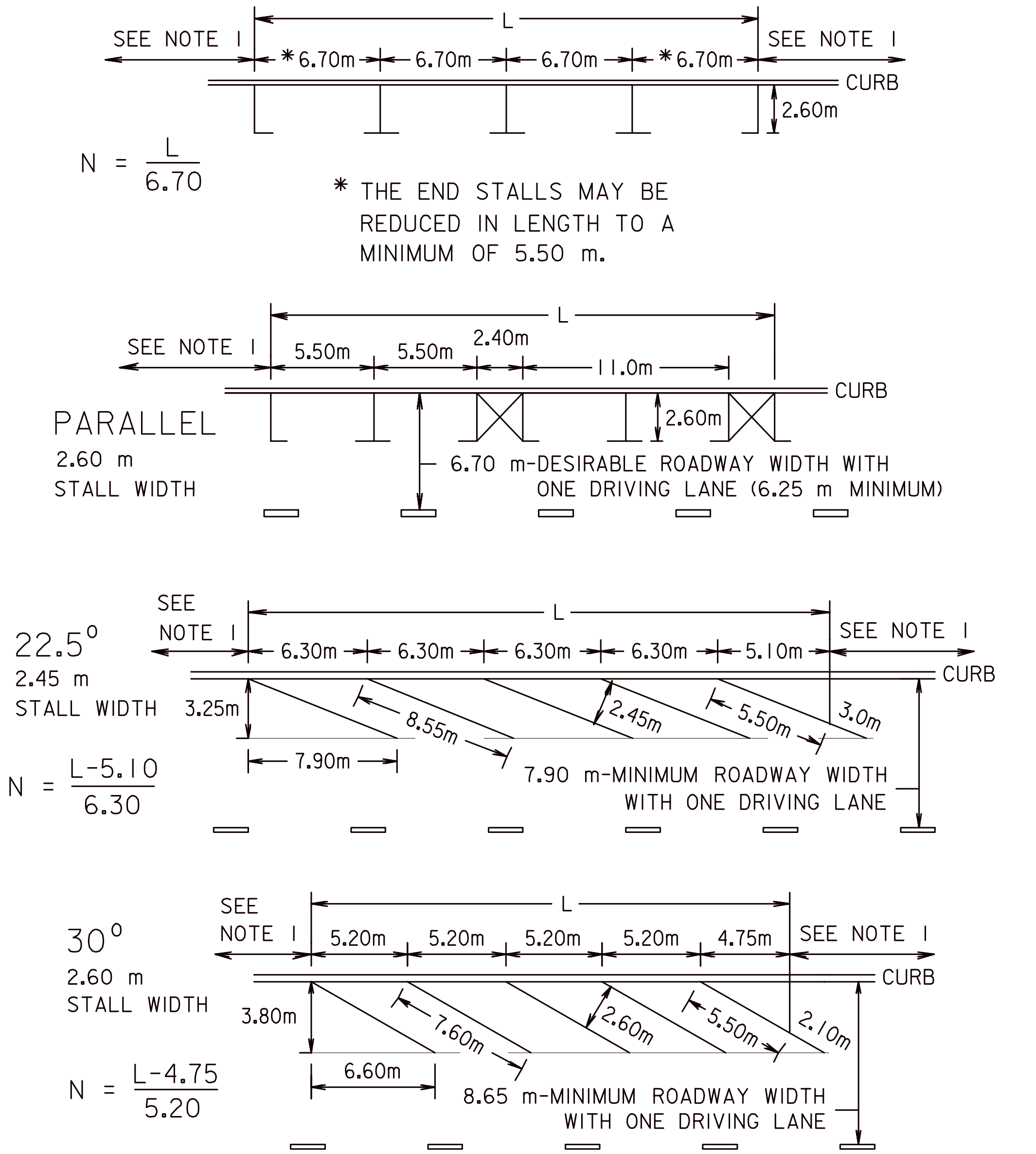


Exhibit 10.16a Parking Stall Dimensions for Curb and Street Parking (English)

FOR CURB AND STREET PARKING



1. ALL PARKING SHALL BE A MINIMUM OF 6.10 m FROM THE CROSSWALK, 9.15m FROM A STOP SIGN, YIELD SIGN OR TRAFFIC SIGNAL AND 4.55 m FROM A FIRE HYDRANT. FOR OTHER SITUATIONS SEE SECTION 60-6, 166 NEBRASKA RULES OF THE ROAD.

2. WHITE PAINT SHALL BE USED FOR MARKING. 100 mm WIDTH IS RECOMMENDED FOR MARKING LINES

N = NUMBER OF STALLS L = USABLE CURB LENGTH

Exhibit 10.16b Parking Stall Dimensions for Curb and Street Parking (Metric)

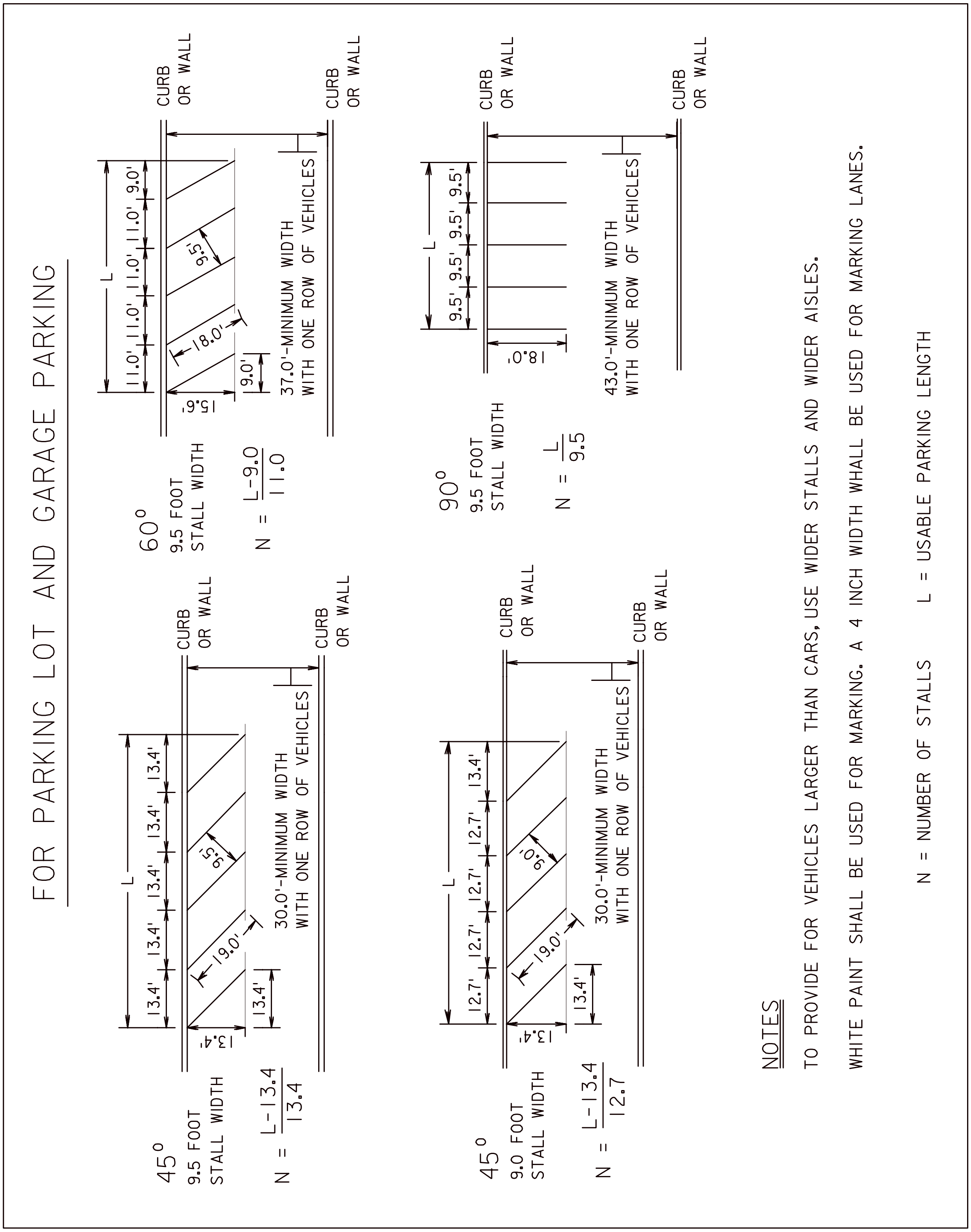


Exhibit 10.17a Parking Stall Dimensions for Parking Lots and Garages (English)

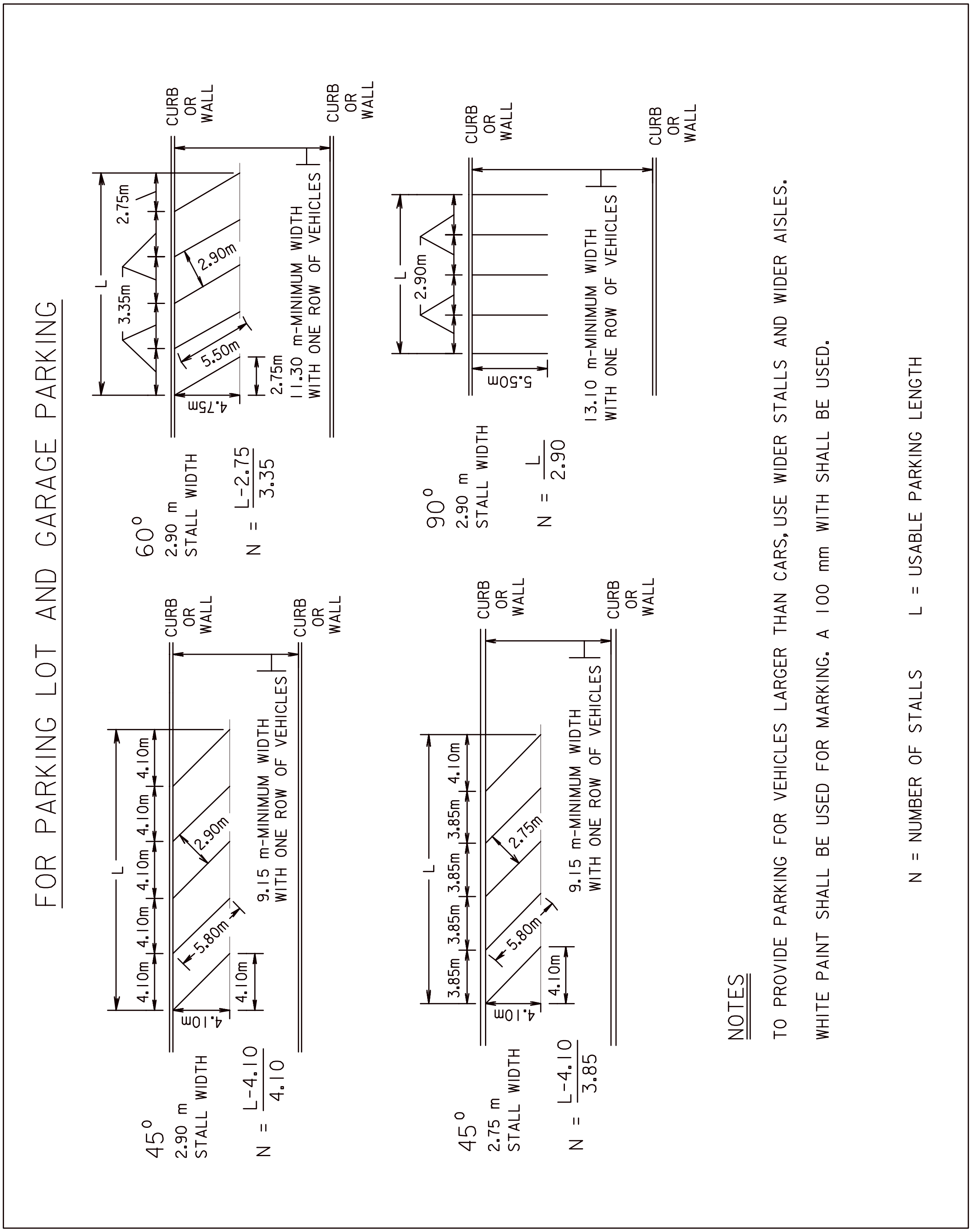


Exhibit 10.17b Parking Stall Dimensions for Parking Lots and Garages (Metric)

Total spaces in parking area	Required minimum number of accessible spaces	Van accessible spaces (8' min. aisle width)	Car accessible spaces (5' min. aisle width)
1 to 25	1	1	0
26 to 50	2	1	1
51 to 75	3	1	2
76 to 100	4	1	3
101 to 150	5	1	4
151 to 200	6	1	5
201 to 300	7	1	6
301 to 400	8	1	7
401 to 500	9	2	7
501 to 1000	2% of total	❶	❷
1001 and up	20 plus 1 for each 100 over 1000	❶	❷

❶ One of every 8 accessible spaces
❷ 7 of every 8 accessible spaces
Source*:* ADA Design Guide 1 – Restriping Parking Lots, (Reference 10.15), (http://www.usdoj.gov/crt/ada/restripe.htm)

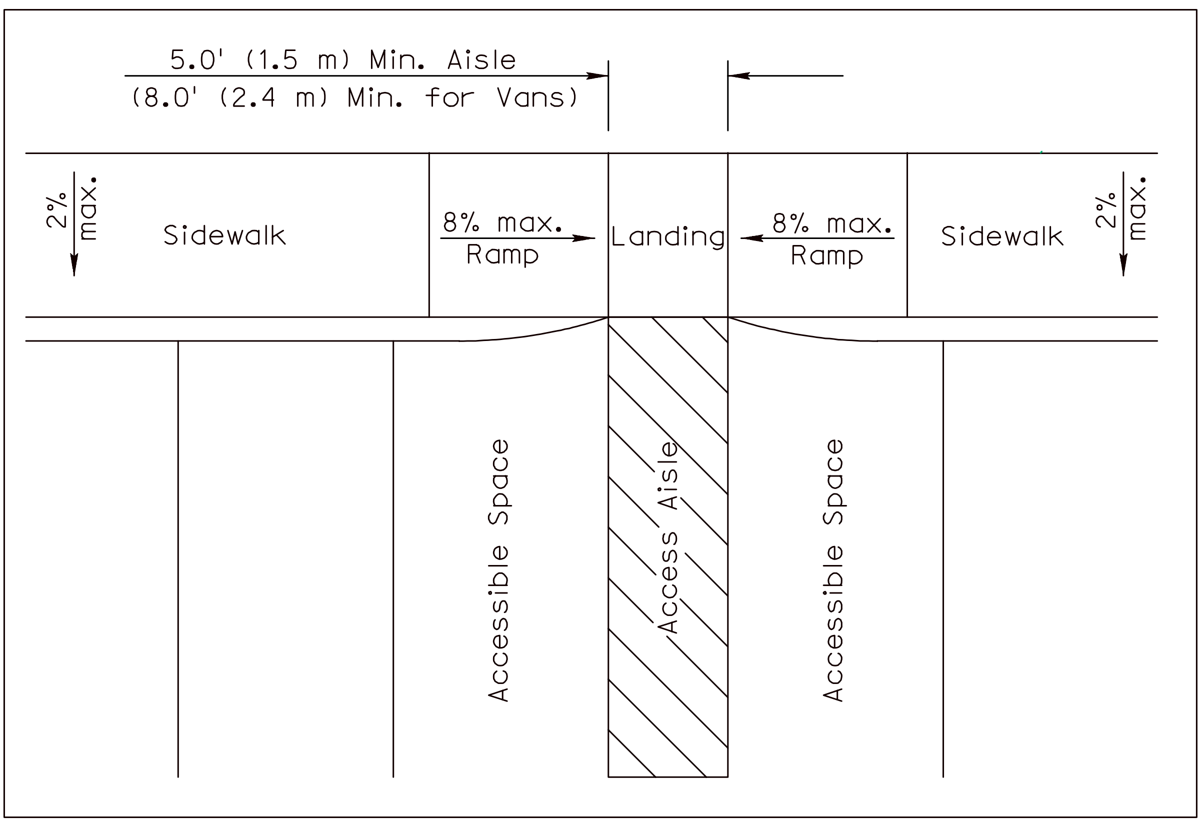


Exhibit 10.18 ADA Accessible Parking Guide

15. REFERENCES

10.1 Nebraska Department of Roads, Design Process Outline, Current Edition. (www.dor.state.ne.us/roadway-design/#DESIGN)

10.2a American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 1990. (English units)

10.2b American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 1994. (Metric units)

10.2c American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2001.

10.3 Nebraska Department of Roads, Drainage Design and Erosion Control Manual, Current Edition.

10.4 Nebraska Department of Roads, Standard/Special Plans Book, Current Edition.

10.5 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

10.6 14 Code of Federal Regulation Part 77, “Objects Affecting Navigable Airspace”, Federal Aviation Regulations. (http://www2.faa.gov/arp/ace/part77.htm)

10.7 American Association of State Highway and Transportation Officials, A Guide for Landscape and Environmental Design, 1991, Washington D.C.

10.8 American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities, Washington, D.C., 1991.

10.9 Federal Highway Administration, Pedestrian and Bicyclist Safety and Accommodation, HI-96-028, Washington, D.C., 1996.

10.10 NDOR Research Project SPR-PL-1(33)P493, Pedestrian Facilities at Interchanges.

10.11 U.S. Architectural and Transportation Barriers Compliance Board (Access Board), "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities,", Washington, D.C., 2002. (http://www.access-board.gov/adaag/html/adaag.htm)

10.12 American Association of State Highway and Transportation Officials, Guide for Erecting Mailboxes on Highways, Washington, D.C., 1985.

10.13 American Association of State Highway and Transportation Officials, An Informational Guide for Roadway Lighting, Washington, D.C., 1985.

10.14 Nebraska. Laws, Statutes, Etc., Nebraska Highway and Bridge Law; Consisting Of Chapter 39, Highways And Bridges; Sections 49-801 And 49-802, Definitions And Rules of Construction; Article 6 Of Chapter 60, Nebraska Rules Of The Road. Revised Reissued Statutes of Nebraska, Current edition. (http://statutes.unicam.state.ne.us/)

10.15 U.S. Department of Justice, ADA Design Guide 1 – Restriping Parking Lots, Jan. 2002, Washington D.C. (http://www.usdoj.gov/crt/ada/restripe.htm)

10.16 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2002.

10.17 Federal Highway Administration, Designing Sidewalks and Trails for Access, Parts 1 and 2, Washington D.C., 2003.
(http://www.fhwa.dot.gov/environment/bikeped/access-1.htm) and
(http://www.fhwa.dot.gov/environment/bikeped/errata.htm).

CHAPTER UNDER CONSTRUCTION

CHAPTER UNDER CONSTRUCTION

CHAPTER THIRTEEN
PLANNING AND PROJECT DEVELOPMENT

LIST OF EXHIBITS

CHAPTER THIRTEEN
PLANNING AND PROJECT DEVELOPMENT

Chapter Thirteen
Planning and Project Development

1. INTRODUCTION AND GENERAL CONSIDERATIONS

Prior to the preliminary design stage, a roadway project goes through extensive planning, analysis, and evaluation to assure that **NDOR** provides improvements when and where they are most needed. Among the many factors that are considered during the planning and project development stages are:

- Traffic counts and forecast evaluation.
- Needs study criteria evaluation.
- Environmental effects of the project.
- Public participation and input into the project.
- Social and economic effects of the project.
- Alternative courses of action.

The **Materials and Research Division**, the **Planning and Project Development Division** and the **Project Scheduling and Program Management Section** are responsible for the planning and project development processes and for liaison with other agencies and organizations that are involved in a project. The **Communication Division** coordinates the public meetings and hearings that are part of the process.

2. PLANNING AND SCHEDULING

- The **Materials and Research Division Classification, Needs, and Pavement Management Unit** performs ongoing data collection, analysis, prioritization and evaluation involving roadway inventories, pavement condition, traffic forecasts, demographic and economic information.
- The **Project Scheduling and Program Management Section** plans and programs highway improvements and then manages the Project Scheduling System (PSS), which programs, schedules and monitors projects through preconstruction stages.
- The **Project Scheduling and Program Management Section** develops One Year Programs and Five Year and Beyond Programs.

The factors noted in Section 1 are used to develop the highway plan for non-metropolitan areas. In metropolitan areas such as Omaha, Lincoln, and South Sioux City, transportation planning is part of the continuing, cooperative and comprehensive (3C) planning process performed by metropolitan planning organizations (MPOs) consisting of state and local government officials and citizen representatives. Transportation modeling in urban areas consists of trip generation, distribution, assignment and modal split models that forecast system needs.

The Needs Study Segment Evaluation (See Chapter One: Design Standards, Section 3.A) is an annual review of the condition of the existing roadways throughout the state conducted by the **Materials and Research Division Classification, Needs, and Pavement Management Unit**. The results of the review are summarized in the State Highway Plan and Highway Need Report and the State Highway Inventory and Priorities Report. Transportation plans, traffic forecast maps, functional classification maps, priority commercial maps, etc. are products of the planning process.

3. ENGINEERING REVIEW AND LOCATION STUDIES

3.A Engineering Review

Once a project has been initiated with a "Highway Improvement Programming Request", DR Form 73, but before it has been approved, the scope of the project and the initial cost estimate (Status 10) are determined (See Chapter Twelve: Cost Estimating, Section _).

After the DR Form 73 has been approved, the **Planning and Project Development Division Location Studies Section** conducts an engineering review. Engineering review is a process performed very early in the development of a project to establish the concept of work to be performed and the initial itemized cost estimate for the project (Status 20) (See Chapter Twelve: Cost Estimating, Section _). Engineering reviews are generally performed for major, non-interstate projects such as resurfacing, major bridge work, reconstruction, relocation, etc. Usually an engineering review is not performed for safety projects, traffic signal projects or other minor engineering projects.

The engineering review summarizes the existing highway condition, pavement condition, traffic volumes, and highway classification and includes a description of the existing typical roadway section and of adjacent roadway sections. It outlines or describes the horizontal and vertical alignment geometrics. The engineering review includes a listing of any structures within the proposed project limits and their condition. It also includes a listing of historical bridges, wetland involvement, underground fuel tanks, hazardous waste locations, safety history, railroad involvement, utilities, etc.

The **Planning and Project Development Division** then reviews the existing conditions, confers with the **District Engineer** and other engineers, reviews the photolog or visits the site, if necessary, and decides upon a recommendation for the type of project to be undertaken. The engineering review and its recommendations then are circulated to the **Roadway Design Engineer**, the **District Engineer** and the **Deputy Director-Engineering** for their approval.

The engineering review provides a starting point and direction for the roadway designer. The designer must use it as a guideline but has the option of making significant scope modifications, with proper documentation and approval, as more information becomes available.

From the engineering review, the **Project Scheduling and Program Management Section** prepares a DR Form 333, "Initial Project Data", containing project data, a brief description of the proposed work and a recommendation as to the environmental classification of the proposed project, (See Section 4). This form is submitted to the **Federal Highway Administration (FHWA)** for review, comments, and concurrence in the environmental classification. Once **FHWA** environmental classification concurrence is obtained, preliminary design may proceed.

3.B Location Studies

Location studies are conducted to address social, economic, environmental and other issues associated with alternative project locations. Location studies may be conducted for specific "spot" locations, such as new bridge crossings of the Missouri River, or for longer corridors.

Corridor study projects often involve some relocation and some community bypasses. Corridor study results are published in report form. Contents of a corridor report include information similar to that in an engineering review, e.g., alignment location factors, cost estimates, etc. They may include plan and profile sheets developed from as built plans or **U.S. Geological Survey (USGS)** contour maps.

Location studies usually take from eighteen months to two years to complete. Public information meetings and a location public hearing are usually part of the study (See Chapter Two: Roadway Design Process, Section 12). Location studies are also circulated among various **NDOR** divisions for comment and input. Projects on new location are normally taken to the **State Highway Commission** and the **Governor** for location approval shortly after the location hearing.

4. ENVIRONMENTAL STUDIES

4.A. Environmental Classification and Documentation

The National Environmental Policy Act (NEPA) (Reference 13.1), (http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm), specifies that all federal agencies, including the **Federal Highway Administration (FHWA)**, must protect the environment through their policies, goals and actions. The **Planning and Project Development Division** is responsible for the required research, documentation and applications for approvals and permits.

Roadway design should be coordinated with environmental impact mitigation measures. If the designer encounters potential problems during design, e.g., learns of the possible presence of an endangered species, underground fuel tank, electrical substation, wetland, channel relocation, etc., he/she should contact the **Environmental Section Manager** of the **Planning and Project Development Division**.

4.A.1 Environmental Classification

Federal regulations divide all projects into three classes, depending on their potential for impacting the environment. The three classes are:

A. Class I Projects may significantly affect the environment and require preparation of an environmental impact statement (EIS), and the issuance of a Record of Decision (ROD) by **FHWA.** Basically, new four-lane construction on new location or projects with a significant environmental impact will be Class I projects.

   When **FHWA** concurs that a project is a Class I project, the **Planning and Project Development Division** conducts a social, economic and environmental review (SEE). Issues of significant impact and possible alternatives are identified. Appropriate federal, state and local agencies are contacted for coordination and comments throughout the development of the project.

B. Class II Projects, based on past experience, do not have a significant effect on the environment. These will include projects such as overlays, bridge replacement, lighting and various other projects with no significant impact. Class II projects, identified as categorical exclusions (CE), are divided into two groups:

- Group 1 CE - normally do not require NEPA documentation or **FHWA** approval as a CE.
- Group 2 CE - normally do require minimal environmental documentation and **FHWA** approval of the proposed CE.

C. Class III Projects are projects on which the significance of the effect on the environment must be determined. Class III projects require the preparation of an environmental assessment (EA) and result in a finding of no significant impact (FONSI). Class III projects that find possible significant impact are reclassified as Class I.

Design provides functional design plans (Activity #5316) for use in evaluating impacts of the project and in the preparation of an environmental assessment or an environmental impact statement, as noted in **EXHIBIT F** of the Design Process Outline, (Reference 13.2), (http://www.nebraskatransportation.org/roadway-design/#designprocess), (See Chapter Two: Roadway Design Process, Section 9). Preparation and submittal of the necessary documents for review and approval may take extended periods of time. Signed draft environmental documents and a noise study, if needed, are required before a Public Design Hearing can be advertised. The roadway designer may continue to work on the project under the signed draft environmental documents but right-of-way appraisal and final design activities, (Activity #5355), cannot begin until **all** signed final environmental documents have been received from the **Federal Highway Administration (FHWA).** **EXHIBIT 13.1** lists the meetings associated with each class of project. See Chapter Two: Roadway Design Process, Section 12, and **EXHIBIT 2.2** for additional information regarding hearings.

Meeting	Class I Project	Class II Project	Class III Project
Information Meeting	Meeting required	Meeting not required	Meeting may be held if input is needed
Location Hearing	Meeting required only if location of project is to be determined	Meeting not required	Meeting required only if location of project is to be determined
Design Hearing (A signed Draft Environmental Document, and Noise Study (if needed), is required before a Design Hearing can be advertised if federal funds are involved)	Meeting required; if appropriate, a combined location/ design hearing may be held	Meeting may be held if a review of the project (e.g., scope, amount of new right-of-way required, and/or other factors) indicate	Meeting required

Exhibit 13.1 Meetings Required for Environmental Class of Project

4.A.2 4(f) Evaluation (Publicly Owned Lands/Historic Places)

Section 4(f) of the 1966 Transportation Act (Reference 13.3), (http://www2.faa.gov/programs/en/impact/impactheaders/dot.cfm), applies to **U.S. Department of Transportation** agencies and projects. It limits use of the following publicly owned lands:

- public parks.
- recreation areas.
- wildlife/waterfowl refuges.
- lands having historic sites of national, state or local significance.

These lands are known as 4(f) lands.

FHWA may not approve use of 4(f) lands for roadway improvements unless *"no feasible and prudent alternative is possible and all possible planning has been done to minimize harm".* Among the impacts that are considered in 4(f) evaluations are: amount of land to be used for the project, facilities and functions affected, noise/air pollution, visual impact, etc. The designer must contact the **Environmental Documents Unit** if any of the above listed facilities may be impacted by the project.

4.A.3 6(f) Lands (Land Water Conservation Funds Used For Park Improvements)

In addition to 4(f) documentation, the **Planning and Project Development Division** must also determine if any improvements to the public park lands were funded with monies from Section 6(f) of the Land Water Conservation Fund Act (Reference 13.4), (http://www.house.gov/resources/105cong/reports/105_a/lwcf65_.pdf), administered by the **National Park Service**. Use of areas improved with 6(f) funds for roadway projects will require coordination with the **National Park Service** and possible replacement of any lands used for the roadway project. Contact the **Environmental Documents Unit** to determine if 6(f) lands are present on the project. If 6(f) lands are present, the designer should attempt to avoid impacting them, minimize the impact if avoidance is not possible, and/or mitigate the impact.

4.B Wetlands and Section 404 Permits

Under Section 404 of the Clean Water Act, (Reference 13.5), (http://www.epa.gov/region5/water/cwa.htm), and under Title 117 of the Nebraska Surface Water Quality Standards, (http://www.deq.state.ne.us), impacts to wetlands are to be avoided if possible, minimized if avoidance is not possible, and/or mitigated.

4.B.1 Wetlands Definitions

The **U.S. Army Corps of Engineers** and the **U.S. Environmental Protection Agency** define wetlands as follows:

> *"Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."*

Wetlands generally include swamps, marshes, bogs and similar areas.

Wetland determination is based upon an evaluation of soil type, hydrology and plants that live in the area. Situations that suggest that a wetland determination should be made include:

- Area is in a floodplain or otherwise has low spots in which water stands at or above the soil surface during the growing season (however, most wetlands lack both standing water and waterlogged soils during at least part of the growing season).
- Area has plant communities that commonly occur in areas having standing water for part of the growing season.
- Area has soils that are peats or mucks.
- Area is designated on a National Wetlands Inventory Map as being a wetland.

4.B.2 Wetlands Procedures

A primary goal of roadway design is to avoid wetlands as much as practicable. If this is not possible, then wetlands encroachment should be minimized. Mitigation for wetland encroachment may be required. Wetlands are replaced at a minimum rate of 1:1 or more. If any work is planned in or near a river, stream, pond or wetland, contact the **Environmental Permits Unit** in the **Planning and Project Development Division** as early as possible during project planning. The following procedures should be followed to coordinate roadway design, wetland delineation and wetland mitigation design.

1. During engineering review, the **Wetlands Biologists** will inspect the project site and delineate the wetlands on air photos (2-W sheets).
2. The **Environmental Permits Unit** drafts the wetland delineation on CADD and sends the CADD file and Waterway Permit Data Sheet to the roadway designer (**EXHIBIT 13.2**). This permit data sheet covers waterway permit information, historic bridges and other environmental issues.
3. The designer will use the 2-W sheets and his/her cross-sections to calculate the areas in acres (hectares) of impacted wetland for each type of wetland as delineated on the 2-W sheets (See DR Form 290, **EXHIBIT 13.2**).
4. At the plan-in-hand, the impact on wetlands will be discussed and alternative designs may be considered.
5. After the plan-in-hand changes, if any, have been incorporated into the project the designer completes the Waterway Permit Data Sheet using the limits of construction. The completed 2-W sheets, with the limits of construction, and Waterway Permit Data Sheet will be returned to the **Environmental Permits Unit** for preparation of the waterway permit applications.
6. If mitigation is required for a project, the roadway designer and the **Environmental Permits Unit Manager** will study alternate mitigation sites and select the proper mitigation site prior to the public hearing dry run.
7. The **Environmental Permits Unit** will review the information and will send mitigation requirements, suggested mitigation sites, reconstruction sites, etc. to the designer. The designer will make final site decisions based on this information, present land use and other engineering considerations.
   - When possible, only one mitigation site should be shown on the public hearing plans.
   - When no apparent suitable mitigation site is available, public hearing plans should not show any wetland mitigation sites.

- If mitigation will be accomplished at a wetland mitigation bank site, the bank's name and legal description should be stated at the public hearing, (See **EXHIBIT 'M'** of the Design Process Outline, Reference 13.2).

8. If mitigation is required along the project, the roadway designer designs the mitigation site area with wetland design parameters from the **Environmental Permits Unit** before the public hearing.
9. After considering public hearing inputs, the final mitigation site design is incorporated into the project plans.
10. Once the mitigation area is designed the **Roadway Design Division** sends the plan and profile sheets and the cross-sections to the **Environmental Permits Unit** for further processing.
    - Mitigation areas should be noted on the profile and on the cross-sections to assure that areas specifically designed not to drain are not changed during construction.
11. The **Environmental Permits Unit** then develops and sends to the designer an environmental summary sheet (**EXHIBIT 13.3**) that includes threatened and endangered species, specifications, special provisions, conditions, copies of the applicable permits and instructions on additional plans needed and aerials to be included in the final plans. The **Environmental Permits Unit** will also send this package to other concerned parties.
12. The roadway designer will provide the necessary pay item quantities, plans, cross-sections and other relevant information for the plans, specifications and estimates (PS&E) package.
13. The **Environmental Permits Unit Manager** will provide the 2-W sheets delineating wetlands both on and off the project, special provisions and the permit documents with conditions for the PS&E package.

Deeds for land acquired for wetlands mitigation shall be written specifying the reason for the acquisition to forestall selling this land in the future. It is the responsibility of the roadway designer to inform the **Right-of-Way Division** when, and what, land is being acquired for wetlands mitigation.

Nebraska Department of Roads

WATERWAY PERMIT DATA SHEET

FIGURES ARE TO BE COMPLETED IN ACRES

DATE:

FROM:

TO: Jason Jurgens, Environmental Permits Unit Manager

Project Name: **Letting Date:**

Project Number: **Delineation Date:**

Control Number: **Biologist:**

County:

IS THE PROJECT LOCATED IN A MAPPED FLOODPLAIN/FLOODWAY AREA: ☐ **Yes** ☐ **No**

If YES, please attach Certification and Compliance with Floodplain and Floodway Regulations

Please provide the following:

- ☐ Location Map.
- ☐ 2 – ½ size copies of 2W plans *(turn on wetland feature file levels 54, 61, 62, 63 for 2W sheets submitted to EPU for Section 404 permitting)*.
- ☐ Report wetland impacts *(attached)*.
- ☐ Report all roadway structure crossings that will be replaced or modified *(attached)*.
- ☐ Report all channel change information with applicable cross sections *(attached)*.
- ☐ Provide applicable bridge/structures data sheets and/or TS&L *(Type, Span & Length)* plans provided by Bridge Division.
- ☐ Provide plans for specific features (weirs, jetties, drop structures, etc.)

Project Description: *(include existing facility, proposed improvements, design standard, etc. Please describe special features affecting delineated waterways such as weirs, jetties, drop structures, etc.)*

WETLANDS DRAFTING INFORMATION:
Wetland delineation information available in Falcon by:
Project Control No./division/wetlands/_____wf.dgn

Exhibit 13.2a Waterway Permit Data Sheet

Nebraska Dept. of Roads

IMPACTED WETLANDS (ACRES)

Return to:
Planning & Project Development
Environmental Permits Unit

Project Name:			**Control No.:**					
Project No.:			**Date Submitted:**					
							Stream Channel	
Station to Station	**PEMA**	**PEMC**	**PEMF**	**PSSA**	**PFOA1**	**Other**	**Area**	**Length (Ft.)**
Totals	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Exhibit 13.2b Waterway Permit Data Sheet (continued)

Nebraska Department of Roads

CHANNEL CHANGES

Project Name:
Project No.:
Control No.:

Structure No.:

Project Station:

Stream Name:
Location:
County:

Date Submitted:

EXISTING CHANNEL:

Depth:
Width:
Side Slopes:
Length:

NEW CHANNEL:

Depth:
Width:
Side Slopes:
Length:

RIP-RAP REQUIRED:

Type:
Length:
Cubic Yards Below Ordinary High Water:
Purpose:

Describe Channel Shaping/Grading Activities: *(Please attach cross sections)*

Reason for Channel Change:

Attach Structure Data Sheet/TSL Plans, if applicable

Return to:
Planning and Project Development Division
Environmental Permits Unit

Exhibit 13.2c Waterway Permit Data Sheet (continued)

Nebraska Department of Roads

STRUCTURES

(Road Crossings)

Project Name: **Project Station:**
Project No.: **Date Submitted:**
Control No.:

Project Station/Structure No. and Feature Crossed	Existing Structure Size And Type	Proposed Improvement

If shoo-flys are built, enclose Plan & Profile and typical section of shoo-fly.

Return to:
Planning and Project Development Division
Environmental Permits Unit

Exhibit 13.2d Waterway Permit Data Sheet (continued)

Project No.:
Control No.:
Location:

SPECIAL ENVIRONMENTAL CONDITIONS
PROJECT DEVELOPMENT SUMMARY SHEET

WATERWAY PERMITS

	Type of Permit	Location	Permit Number
Sample	Nationwide #14	between Section 13+24, T2N-R23W	NE 99-11158
	Floodplain Permit	Section 13+24 T2N-R23W	

Special Plans (to be included in final plan package):

2WA Sheets	☐ Yes	☐ No
Mitigation Plan	☐ Yes	☐ No
Special Cross-Sections	☐ Yes	☐ No
Others	☐ Yes	☐ No

Special notes on plans:

None

Special provisions (see attached):

See Attachment A: Fact sheet for a Nationwide #14 permit.

Special conditions (see attached):

See Attachment B: The Corps of Engineers Authorization.

Additional comments:

See Attachment C: Floodplain permit from _______________ City/County.

This project was delineated for the presence of wetlands on _________________. Mandatory criteria, as defined in the 1987 Corps of Engineers Wetlands Delineation Manual, were used for wetland determinations. These findings were based on hydric soil, wetland plant, and wetland hydrology information gathered during this on-site evaluation.

____
Environmental Permits Unit Manager *(Signature & Date)*

Exhibit 13.3a Sample Environmental Summary Sheet

Project No.:
Control No.:
Location:

HISTORIC SITES

Historic bridges ☐ Yes ☐ No

Special provisions (See Attached):

Additional comments:

____
Environmental Section Manager *(Signature & Date)*

OTHER ENVIRONMENT ISSUES

Special conditions:

Special notes on plans:

Additional comments:

____
Environmental Section Manager *(Signature & Date)*

Exhibit 13.3b Sample Environmental Summary Sheet (continued)

4.B.3 Public Notification of Wetland Mitigation

It is **NDOR's** intent to make the public aware of wetland issues as early in the life of a project as is feasible. To that end, **NDOR** has adopted the following policy regarding public notification of wetland mitigation:

A. Public information meetings held for Engineering Reviews or Location Studies.
   1. A preliminary determination of wetlands will be done on aerial photos for use in the development of alternative concepts.
   2. Information about the anticipated impact to wetlands will be made available to the public, either on handout material or on the displays. The wetland impact will be described as either major (more than 3 acres (1.2 hectares)) or minor (less than 3 acres (1.2 hectares)).

B. Major projects on new alignments that have a corridor study and hearing.
   1. Location Hearing
      a. The Location Studies Engineer provides avoidance analysis and preliminary estimate of wetland impacts to the Environmental Permits Unit.
      b. The Environmental Permits Unit biologist returns the required mitigation area and potential mitigation sites.
      c. At the location hearing, existing wetlands and potential mitigation sites that are truly feasible are shown.
   2. Before Plan-In-Hand
      a. The designer sends updated wetland impacts, based on limits of construction, to the Environmental Permits Unit (4 weeks prior to plan-in-hand). Include revised avoidance analysis if impacted wetlands are different from corridor study.
      b. The Environmental Permits Unit biologist sends the designer updated mitigation areas and prioritized mitigation sites.
   3. During Plan-In-Hand
      a. The preferred mitigation site is decided upon.
   4. After Plan-In-Hand
      a. The designer notifies the Environmental Permits Unit of the preferred mitigation site and continues design. (Include in plan-in-hand report.)
   5. Design Hearing
      a. The preferred mitigation site is shown.
      b. Show existing wetlands and other alternate mitigation sites, if they are truly feasible.
      c. The public hearing notice will include a location map with preferred site and other potential sites shown.

C. Design Hearing Held and Corridor Hearing Not Held
   1. Before Plan-In-Hand
      a. For a project with proposed new alignments, the designer sends avoidance analysis and estimated wetland impact based on limits of construction, to the Environmental Permits Unit. (Four weeks prior to plan-in- hand.)
      b. The Environmental Permits Unit biologist sends the designer required mitigation areas and prioritized mitigation sites.
   2. During Plan-In-Hand
      a. The preferred mitigation site is decided upon.

3. After Plan-In-Hand
   b. The designer notifies the Environmental Permits Unit of the preferred mitigation site and continues design. (Include in plan-in-hand.)
4. Design Hearing
   a. The preferred mitigation site is shown.
   b. Show existing wetlands and other alternate mitigation sites, if they were truly feasible.
   c. The public hearing notice will include a location map with preferred site and other potential sites shown.

D. Design Hearing Not Held and Three Acres (1.2 Hectares) or More Mitigation Required
1. Before Plan-In-Hand
   a. The designer sends avoidance analysis and estimated wetland impacts, based on limits of construction, to the Environmental Permits Unit. (Four weeks prior to plan-in- hand.)
2. During Plan-In-Hand
   a. The preferred mitigation site is decided upon.
3. After Plan-In-Hand
   a. The designer notifies the Environmental Permits Unit of the preferred mitigation site and continues design. (Include in plan-in-hand report.)
4. Hold Wetlands Information Meeting
   a. The preferred mitigation site is shown.
   b. Show existing wetlands and other alternate mitigation sites, if they were truly feasible.
   c. The public information meeting notice will include a location map with preferred site and other potential sites shown.

E. Design Hearing Not Held and Less Than Three Acres of Mitigation Required
1. Before Plan-In-Hand
   a. The designer sends avoidance analysis and estimated wetland impacts, based on limits of construction, to the Environmental Permits Unit. (Four weeks prior to plan-in-hand.)
   b. The Environmental Permits Unit biologist sends the designer the required mitigation area and prioritized mitigation sites.
2. During Plan-In-Hand
   a. The preferred mitigation site is decided upon.
3. After Plan-In-Hand
   a. The designer notifies the Environmental Permits Unit of the preferred mitigation site and continues designing. (Include in plan-in-hand report.)
   b. A location map with the preferred site and other potential sites will be sent to local newspapers with a note that **NDOR** will be mitigating the loss of wetlands due to the construction of pending project no. ________________.
      For more information, contact ________________.

F. If wetland mitigation is handled by taking credit from a wetland bank, specific wetland information meetings are not necessary.

4.B.4 Section 404 Permits

Section 404 of the Clean Water Act (Reference 13.5) requires that anyone interested in depositing dredged or fill material into waters of the United States, including wetlands, must receive authorization for such activities through permitting from the **U.S. Army Corps of Engineers**. Activities in wetlands for which permits may be required include: placement of fill material, ditching activities, levee and dike construction, mechanized land clearing, land leveling, most road construction and dam construction.

The **Corps of Engineers** issues three types of permits: individual, regional and nationwide (NWP) general permits. An individual permit is required when a project is not exempted from regulation and is of a scope and magnitude that it does not fall under the other two categories. Regional and nationwide permits are issued for projects that have minimal environmental impacts. In evaluating a permit application, the **Corps of Engineers** analyzes the following factors:

- Conservation
- Economics
- Aesthetics
- General environmental concerns
- Historic values
- Fish and wildlife values
- Flood damage prevention
- Land use, navigation
- Recreation
- Water supply and water quality
- The needs and welfare of the people.

For an individual permit on new alignments, the **Corps of Engineers** will require alternatives analysis. Impacts for alternate alignments must be calculated and retained in the project file by the designer. Required alternatives analysis includes:

- What was done to avoid wetlands impacts?
- What was done to minimize wetlands impacts?

Erosion control is a condition of the Section 404 permit, (See Chapter 2 of the Drainage Design and Erosion Control Manual, Reference 13.6). Plans must include control of water (and siltation due to runoff) into any water body including wetlands. The **Planning and Project Development Division** will identify any location where roadway runoff or other non-point source pollution may adversely impact sensitive water resources such as water supply reservoirs, ground water recharge areas, high quality streams and threatened and endangered aquatic species.

The **Planning and Project Development Division** submits the necessary applications for Section 404 permits.

4.B.5 Section 10 of the Rivers and Harbors Act

Structures or work affecting navigable waters of the U.S. are regulated under Section 10 of the Rivers and Harbors Act of 1899 as amended (Reference 13.7), (http://www.usace.army.mil/inet/functions/cw/cecwo/reg/rhsec10.htm). In Nebraska, only the Missouri River is considered a navigable river. If required, the **Environmental Permits Unit** will obtain a Section 10 permit from the **U.S. Army Corps of Engineers.**

4.B.6 Channel Changes

When a channel change is required to meet project objectives, site conditions should be evaluated early in the design process. Channel width and length, vegetation, ponding, existing erosion control measures, etc. should be noted and the new channel should be designed so as to equal or better these conditions. The **Environmental Permits Unit** of the **Planning and Project Development Division** should be notified of the proposed channel change as soon as possible in order to determine mitigation, special conditions, and to get the necessary outside agencies involved at the beginning of the project. This will benefit **NDOR** in the permitting process.

The **Nebraska Department of Environmental Quality** and the **United States Army Corps of Engineers** typically requires the following conditions for channel changes for Nationwide (404) Permits:

1. A 30' (9.1 m) minimum width buffer strip of native vegetation on each side of the channel, starting at the top of the bank and measuring outward.
2. In some cases, 2:1 tree and shrub replacement, planted in the buffer strip.
3. Construction of a channel wide enough so that the new stream bottom area is equal to or greater than that of the channel to be filled and the cross-sectional area of the new channel is equal to or greater than that of the old channel.
4. New channel banks should be sloped no steeper than 3:1, (2:1 if certified by an engineer).
5. Channel length shall be equal to or greater than that of the channel to be filled if the total channel length is less than 100' (net loss).
6. No more than 300' of channel can be impacted.

If these conditions cannot be met, meet with the **Environmental Permits Unit Manager** as soon as possible because an individual 404 permit will be required, increasing the time required for the permit process.

The **United States Army Corps of Engineers** also requires that any channel change designed without a grade control structure must have a registered engineer verify, in writing, that a grade control structure is not required. The following example statement has been accepted by **Planning and Project Development** and by the **Army Corps of Engineers** as fulfilling this requirement:

"I have determined that the channel change from Station 252 +/- 50 Rt. to Station 253 +/- Rt. does not require a grade control structure."

A copy of this transmittal shall be kept in the project file.

Deeds for land acquired for channel changes shall be written specifying the reason for the acquisition to forestall selling this land in the future. It is the responsibility of the roadway designer to inform the **Right-Of-Way Design Division** when, and what, land is being acquired for channel changes.

4.B.6.a Bridge Channel Work

The pay limits provided for channel work as a **Bridge Division** pay item will be from ROW to ROW (or as specified on the Bridge Data Sheet) and from centerline of abutment to centerline of abutment, (See EXHIBIT 13.4). Payment for channel work (and riprap) beyond the Bridge Plan quantity limits may be paid for as either Excavation (Established Quantity) or Earthwork Measured in Embankment. Excavation (Established Quantity) will be provided if the greatest earthwork net volume is excavation while Earthwork Measured in Embankment will be used if the greatest net volume is in fill. The Roadway Designer will coordinate with the **Bridge Designer** to decide how the work will be shown in the plans and how the limits of payment will apply.

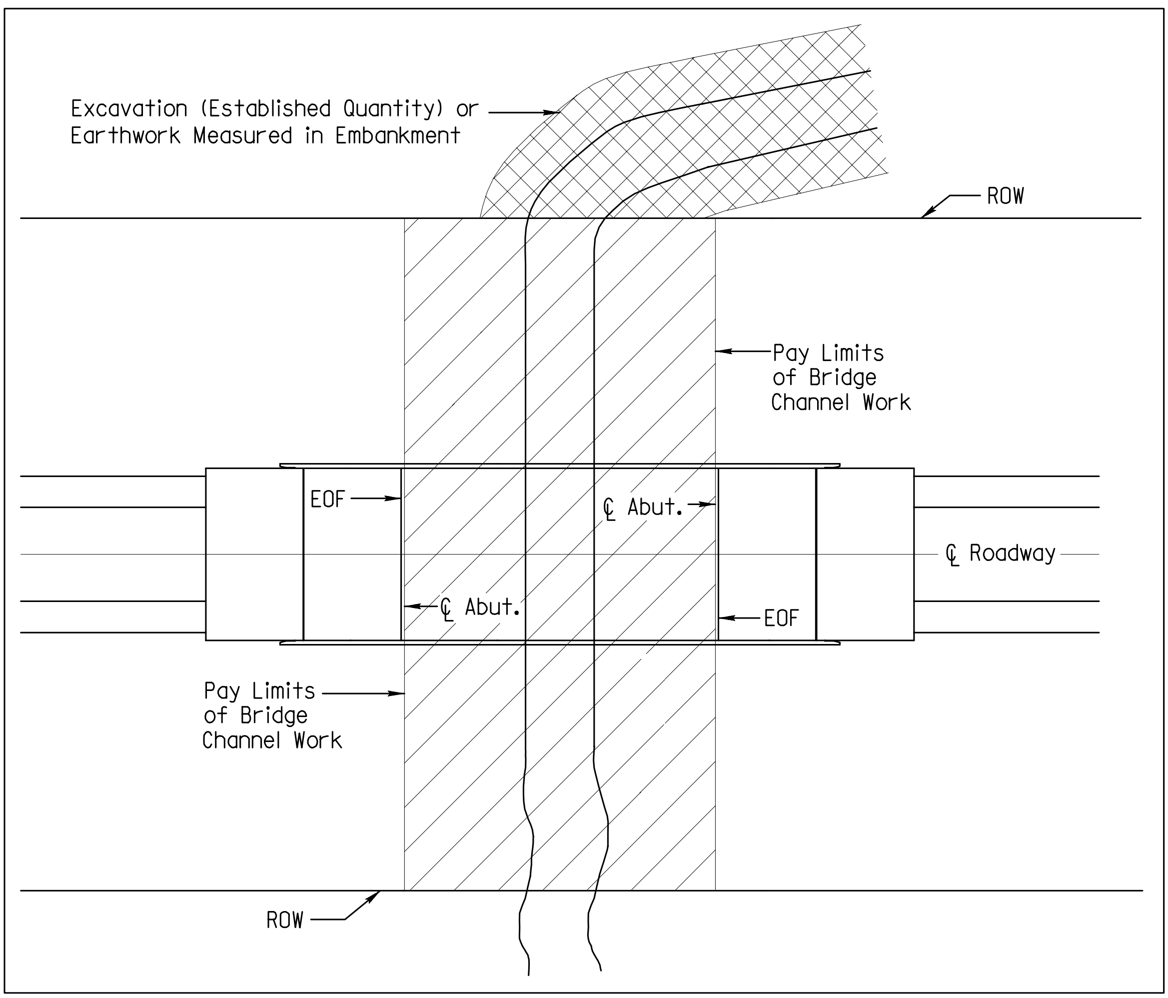


Exhibit 13.4 Pay Limits for Bridge Channel Work

4.B.7 Floodplains

The **Federal Emergency Management Agency (FEMA**) administers the National Flood Insurance Program (NFIP). **FEMA** has established regulations for the modification of floodways and floodplains.

There can be no surcharge or increase of the 100-year flood profile resulting from highway construction in floodway (See the Drainage Design and Erosion Control Manual, (Reference 13.6), Chapter 1, Section 6.6). If an area is mapped **FEMA** zone A or a flood fringe area on a Flood Insurance Rate Map (FIRM) and there is a local (**Town, City or County**) designated regulating authority, **NDOR** must obtain a Floodplain/Floodway permit if construction activities occur in the mapped area. To apply for the permit, a “No-Rise” certificate is required along with the application. For bridge construction activities in the mapped area, the **Bridge Division** provides a “No-Rise” certificate and a bridge data sheet. For roadway construction activities in the mapped area, **Roadway Design** provides a “No-Rise” certificate and a memo explaining the construction activities. Refer to References 13.8 through 13.12 for further guidance.

4.B.8 Water Quality

NDOR must comply with federal regulations related to water quality including the Clean Water Act (Reference 13.5) and the Safe Drinking Water Act (Reference 13.13), (http://www.epa.gov/safewater/sdwa/sdwa.html). A Water Quality Certificate must be obtained from the **NDEQ**.

The **Planning and Project Development Division** will also research impacts of the project on any areas designed as principal or sole-source aquifers under Section 1424(e) of the Land Water Conservation Fund Act, (Reference 13.4). If a rest area with a point source discharge is proposed as part of the project, the **Planning and Project Development Division** will also obtain a Section 402 permit (Procedures for Coordinating Highway Encroachments on Floodplains with Federal Emergency Management Agency, Reference 13.8), (http://environment.fhwa.dot.gov/guidebook/vol1/doc6d.pdf).

4.C Air Quality

The Clean Air Act (Reference 13.14), (http://www.epa.gov/oar/caa/contents.html), was passed to protect and enhance the quality of the nation's air resources. The **Environmental Protection Agency** has established air quality standards that must be followed. The **Noise and Air Section** of the **Planning and Project Development Division** will make all necessary air quality evaluations. Air analysis will be made for projects where the traffic exceeds 15,000 vehicles in the year of construction or 30,000 vehicles in the design year.

4.D Noise

Noise is defined as unwanted sound. Vehicles generate noise, and designers should work with the noise analyst to evaluate expected noise levels and measures to reduce traffic noise levels through location and design features. Sometimes embankment design and design features may serve to reduce noise levels. Criteria have been developed to analyze anticipated noise levels to determine if additional noise abatement measures should be incorporated into design. Noise sensitive areas, e.g., residences, businesses, schools, parks, etc., should be noted in the early project stages for both developed and undeveloped lands for which development is planned, designed and programmed. The designer should work with the **Noise and Air Section** of the **Planning and Project Development Division** if noise levels are expected to be a problem.

Noise levels should be considered during design of alignment, cross-section, earthwork balance and right-of-way. Sometimes natural barriers from the terrain may be effective noise barriers. Noise barrier structures should be located outside of the lateral obstacle clearance zone if practicable. Stopping sight distance should be maintained. Some noise barrier designs incorporate concrete safety shapes. Barriers should begin or terminate at least 200 ft. (60.0 m) from the nose of gore areas. Refer to **American Association of State Highway and Transportation Officials' (AASHTO)** A Policy on Geometric Design of Highways and Streets (Reference 13.15), Chapter 4, for further information.

4.E Wildlife Issues

Transportation agencies are responsible for recognizing potential conflicts between wildlife and transportation facilities and for minimizing those conflicts during all phases of roadway development. The **Planning and Project Development Division** coordinates wildlife and habitat studies and will notify the **Roadway Design Division** of project-related concerns. The designer should consider the effects of roadway design on wildlife habitat and incorporate appropriate measures in project design.

Direct impacts on wildlife by roadway development stem from the disturbance of essential habitat components such as key forage areas, nesting sites, breeding grounds and essential escape cover. The Migratory Bird Act (http://www4.law.cornell.edu/uscode/16/ch7.html) protects nesting bird habitat. Tree removal cannot be done during primary nesting season, (from April 1 through July 15), without a survey to check for nesting activity. If the tree removal activity will disrupt nesting, a permit must be obtained. The contractor shall be responsible for the nesting survey and for obtaining the permit. Wildlife also may be disturbed by interruptions of migration paths and highway mortality. The placement of fencing should take into consideration any restrictions it will have on animal movement. Any use of or modification to water bodies that may impact wildlife will also be included in any environmental documentation, (See Section 4.A).

The **Planning and Project Development Division** provides early project coordination with the **Nebraska Game and Parks Commission** to identify endangered species concerns for use in design, copies of the determination will be provided to the designer. An endangered species is defined as any species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. If endangered or threatened species are concerns on a project, the **Environmental Permits Unit** will work with the designer to avoid or minimize impacts. If, at a public meeting/hearing or during other design activities, concerns are raised regarding the presence of endangered species, contact the **Environmental Permits Unit** of the **Planning and Project Development Division.**

AASHTO's A Design Guide for Wildlife Protection and Conservation for Transportation Facilities (Reference 13.16) provides additional information, terms and concerns of the biological community.

4.F Social, Economic, and Environmental Impacts

As part of the social, economic and environmental review (SEE) for Class I and Class III projects, (See Section 4) the following social impacts are considered:

1. Changes in community or neighborhood identity, such as splitting neighborhoods, isolating ethnic groups, separating residents from community facilities such as police and fire protection, school districts, churches, businesses, etc.
2. Travel patterns, accessibility, transit captives such as elderly, handicapped, non-drivers, pedestrian, bicyclists, etc.
3. Relocation impacts (See Chapter Twelve: Cost Estimating, Section _).
4. Impacts on the handicapped and minorities.
5. Economic impacts both for the region as well as adjacent highway-related and other businesses, etc.

Executive Order 12898 covers Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations (2/11/94), (http://www.hud.gov/offices/fheo/FHLaws/EXO12898.cfm). **FHWA** has developed policies and procedures to use in complying with this Executive Order. Any project with Federal funding will require **NDOR**, through the NEPA process, to identify and address disproportionately high and adverse effects on minority and low-income populations. In design, avoidance, minimization, and/or mitigation must be considered for disproportionately high and adverse effects. Public involvement opportunities must be provided to the affected populations for proper alternative consideration. The **Planning and Project Development Division** will notify the **Roadway Design Division** when Environmental Justice issues must be addressed.

4.G Archeological and Historical Features

Section 106 of the National Historic Preservation Act of 1966 (Reference 13.17), (http://www2.cr.nps.gov/laws/NHPA1966.htm), requires an investigation be made for possible impacts of transportation projects on historic or archeological resources. A determination is necessary if any historic or archeological resources that are on or may be eligible to be on the National Register of Historic Places will be adversely impacted.

NDOR works with the **State Historic Preservation Officer (SHPO)** to evaluate sites to determine if they should be preserved or if they may be researched only, without the need for preservation. Historic sites may be bridges, buildings, neighborhoods, farmsteads, sites where significant events occurred, etc. If historic sites are present, the designer should coordinate with the **Environmental Documents Unit Supervisor.**

4.H Hazardous Materials

4.H.1 Materials Prohibited or Restricted as Fill Materials

The **U.S. Army Corps of Engineers** has issued generic prohibitions of use of certain materials as fill in waters of the **United States** as defined by the Clean Water Act (33 U.S.C. 1344) (Reference 13.5). The following materials are prohibited or restricted as fill materials in waters of the United States within the regulatory boundaries of the **Omaha District of the Corps of Engineers:**

1. Vehicle bodies, farm machinery and metal junk including appliances, containers and barrels (including plastic barrels).
2. The use of small aggregate, in the form of streambed material, for bank stabilization and erosion control below the ordinary high water mark of a waterbody or wetland when the material to be discharged is removed from a stream or river for such purpose. Small aggregate, from any source, placed below the ordinary high water mark of a waterbody or wetland when the proposed project will be unstable and subject to frequent failure.
3. The use of old or used asphalt as a fill material and the use of asphalt in general for bank stabilization or erosion control.
4. The use of organic debris (properly anchored trees and treetops are excluded).
5. Biodegradable building materials including wood debris, sheetrock, roofing materials, and chemically treated materials subject to leaching when placed in an aquatic environment. The use of clean brick and broken concrete will continue to be allowed on a case-by-case basis. Broken concrete should be free of exposed rebar and old asphalt.
6. Tires shall be prohibited unless placed in the form of a mat or other design and anchored to preclude entering the waterway.

The **Location Studies Unit** of the **Planning and Project Development Division** will obtain proper authorization from the **U.S. Army Corps of Engineers** for any discharge of dredged or fill material into a water of the **United States.**

4.H.2 Guidelines for Handling Petroleum Tanks/Leaks on Construction Projects

The Resource Conservation and Recovery Act (RCRA) (Reference 13.18), (http://www4.law.cornell.edu/uscode/42/ch82.html), and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (Reference 13.19), (http://www4.law.cornell.edu/uscode/42/ch103.html), regulate hazardous waste sites. The locations of permitted and non-regulated hazardous waste sites should be identified.

On federal-aid highway projects, **FHWA** expects early investigation of all potential hazardous waste/petroleum sites to preclude costly delays. An initial site assessment should be done, as early as possible in the project development stages, to identify any known or potential waste site within the project limits.

For projects where no significant excavation is involved and a paper review of the tank sites reveals no problems, **NDOR** will not perform on-site drilling and testing. For projects with major excavation in the vicinity of fuel tanks, site drilling and testing may be required with the results incorporated into the EIS, (See Section 4.A.1).

During the on-site engineering review of projects, the locations of active and inactive fuel stations should be noted. Any stations converted to other uses should be flagged for follow-up. Once preliminary design is begun and the design is roughed out, the designer can request that the **Location Studies Unit** of the **Planning and Project Development Division** make a paper review of any fuel tank locations. The following activities will be included in the paper review:

1. Plans will be checked to see that the tank fill pipes/gas pumps are shown. A fill pipe is usually but not always directly over the tank. Vent pipes are almost always remotely located.
2. Cross-sections will be checked for cuts and fills, presence of storm sewer pipe, longitudinal or cross pipes. Even if the old grade line is matched, excavation may be needed for pavement widening, storm sewer pipes, or modern ditch sections.
3. The amount of right-of-way and its impact on existing tanks will be reviewed.
4. The **Fire Marshall's Office** will be contacted to find out tank registrations, approximate ages and sizes, when the sites were last inspected, and the results of any precision (tightness) testing.
5. The **NDEQ** will be contacted for sites on the active spill/leak list.
6. City Hall and long time residents may be contacted for history.
7. The CERCLA map will also be checked.

Upon completion of this review, the **Location Studies Unit** will write a memo to the **Roadway Design Division** (and **FHWA**, as appropriate, for the EIS) summarizing their findings.

In some cases, contaminated soil is not anticipated. In other cases, where questions remain, on-site drilling and testing may be needed. In those cases, the **Location Studies Unit** of the **Planning and Project Development Division** will request that the **Materials and Research Division** arrange testing. The **Materials and Research Division** will send a report to the **Planning and Project Development Division** which is then forwarded to the **Roadway Design Division** and, if necessary, to **FHWA**.

4.H.3 Guidelines for Handling Contaminated Soils on Highway Right-of-Way

Sometimes unanticipated contaminated soils are encountered during construction activities. **Nebraska Department of Environmental Quality** has issued guidelines for handling petroleum-contaminated soils from an excavation or construction activity (e.g., during a trenching operation). The soils may be temporarily removed within the area of contamination and subsequently redeposited back into the excavation and contaminated area under the following conditions:

1. The placement of underground equipment, such as a storm sewer line, cannot be allowed to act as a conduit for further migration of the contamination.
2. Impervious geological features, such as clay silt, cannot be punctured so as to open a path for contamination to migrate into an aquifer.
3. Cross-contamination of stacked fill material that expands the area of contamination cannot be allowed, i.e., the soil should not be stirred.
4. Migration of contamination from storm runoff due to the stockpiling of consolidated excavated soil cannot be allowed. The material shall be redeposited at the end of the day or be covered with plastic cover until it is redeposited.
5. Inversion of the layers of contamination in the replaced soil is not allowed. The contaminated soil needs to be placed back in the trench at the same layer from which it came.

These **NDEQ** guidelines do not apply to mass grading operations (e.g., cut and fill) in which contaminated soils are encountered. If contaminated soils are found during a mass grading operation, these soils need to be kept separate from the "clean" soils as recommended by **NDEQ**. Special handling will be needed.

5. LIAISON WITH OTHER AGENCIES AND ORGANIZATIONS

5.A Agreements

Intergovernmental agreements outlining the scope and participation of all parties will be executed for projects involving other units of government. The **Agreements Unit** in the **Planning and Project Development Division** prepares all agreements, except relinquishment agreements. Prior to the public hearing, covenant relinquishment agreements are prepared by the **Materials and Research Division** (See Chapter Two: Roadway Design Process, Section 10). Final relinquishment agreements are prepared prior to plans submittal to the **Plans, Specifications and Estimates Section (PS&E)**. **Roadway Design** may provide input for exhibits and/or displays which may be needed for the agreements (See Chapter Eleven: Final Plan Preparation, Section _).

5.B Federal Agencies

Ordinarily, **FHWA** is the lead federal agency for **NDOR** contact. However, **NDOR** may also work with the **U.S. Environmental Protection Agency**, **U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Park Service, Federal Emergency Management Agency, U.S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs, the Architectural and Transportation Barriers Compliance Board (Access Board)** and other federal agencies. The **Planning and Project Development Division** serves as liaison with these agencies.

5.C Other State Agencies

NDOR works with many state agencies including the **Nebraska State Historical Society**, the **Natural Resource Commission**, the **Game and Parks Commission**, etc. In addition, the **Department of Environmental Quality** issues water quality certification, the **Advisory Council on Historic Preservation** works with **NDOR** on historic site issues, and the **Paleontological and Archaeological Highway Salvage Program** addresses archeological issues.

5.D Local and Regional Agencies

The **Planning and Project Development Division** coordinates with **MPOs** (Metropolitan Planning Organizations) in metropolitan areas, and the **Government Affairs Division** coordinates with city and county governments, natural resource districts, et al.

5.E Public Participation and Input

Federal Policy requires public involvement in the development of transportation plans. The public participates in the planning process through the **State Highway Commission**, the **Board of Public Roads Classifications and Standards** and through other committees, meetings and hearings. In addition, information about transportation plans, projects and programs is disseminated through the public media and through mailings to interested organizations and individuals such as the **Nebraska Highway Coalition,** the **American Automobile Association,** the **Nebraska Motor Carriers Association**, etc.

Types of public meetings that are held by the **Roadway Design Division** are: public information meetings, city officials meetings, pre-hearings, location public hearings, and design public hearings. (See Chapter Two: Roadway Design Process, Section 12, and the Design Process Outline, Reference 13.2, **EXHIBIT 'M'**).

Communication between **NDOR** and the public is an important ongoing activity coordinated by the **Public Hearings Officer** in the **Communication Division**. Depending upon the nature of the project, several types of contact may be made during the course of a project.

The **Public Hearings Officer** publishes notices of opportunity for hearings in general circulation newspapers in project areas to provide general information about the proposed projects to the general public and also to provide them the opportunity to submit a written request to **NDOR** to hold a public hearing. If no requests are submitted, **NDOR** may notify **FHWA** that no requests were received and that hearing requirements were thus satisfied.

5.F Consultants

Consultants are hired to assist **NDOR** on various projects. The **Agreements and Consultant Services Section** of the **Planning and Project Development Division** provides liaison with consultants, including:

- Participating in the selection of and negotiation with consultants.
- Maintaining certification records of consultants.
- Reviewing consultant billings.

Engineers who work in the **Consultant Design Units** in the **Roadway Design Division** will be responsible for day-to-day business contacts with consultants including transmittal of data, progress inspections and meetings as set out in the scope of work. This does not include authorization to change the scope of work for the project, to exceed the agreed upon project cost or to extend the completion date. These authorizations come from the **Agreements Engineer**. If a change in scope of work is necessary, it should be discussed with the **Agreements Engineer** and that office will prepare a supplemental agreement for the additional cost. If a time extension is necessary, the **Agreements Engineer** will ask the consultant to provide a written extension request and will discuss this with the appropriate division for approval of the time extension.

The **Agreements Engineer** should be informed of design public hearings so he/she can be prepared to have the consultant ready to go on final design. The **Agreements Engineer** will set up the scope of work and be in charge of the negotiations. Following a design public hearing, the negotiations will be completed so the consultant will be ready for final design as soon as approval is received from the **State Highway Commission** and **Governor.**

5.G Railroads

(Map at http://www.nebraskatransportation.org/maps/misc-maps/railroad.pdf)

Many roadways in Nebraska are in close proximity to railroads. The roadway designer for any roadway project that is near a railroad (within 300 ft. (100 meters) from the centerline of the nearest track) should inform the **Railroad Liaison Office** in the **Rail and Public Transportation Division** as early as possible. The designer should complete the DR Form 95 and forward it with plans to the **Railroad Liaison Office**.

The applicable railroad company will review design issues such as earthwork and drainage near the railroad. Railroad insurance, purchased by the contractor, will be required for work within 50 ft. (15 m) of the centerline of the outside tracks. The roadway designer needs to estimate the percentage of work done in each group of work within the 50 ft. (15 m) limit for insurance purposes. The roadway designer will provide cost estimates for all of these items. If the project is a major project which will involve a viaduct or overpass, the railroad will need to be involved in discussions in the early planning stages. Roadway designers may also initiate safety improvements with improved crossing design and may expand the project by possible consolidation of nearby crossings. See Chapter Two: Roadway Design Process, Section 22.B, and Chapter Ten: Miscellaneous Design Issues, Section 1, for further information.

Any changes in design, such as adding a safety section, may change the level of involvement with the railroad. The **Railroad Liaison Office** should be informed of changes of this nature immediately.

6. UTILITIES

6.A Utility Liaison

Highway construction projects frequently require the revision and relocation of utilities. The **Utilities Unit** of the **Planning and Project Development Division** is responsible for providing liaison with public and privately owned utilities. This includes:

- Reviewing plans and performing field inspections to determine utility ownership and identify potential conflicts.
- Providing utility input to help determine the most satisfactory and economical location or design adjustments versus utility adjustments.
- Requesting input from utility companies and reviewing and approving their plans, specifications and estimates.
- Coordinating with municipalities for the rehabilitation of their owned and operated utilities on highway projects.
- Reviewing utility billings and submitting them for payment and subsequent audit review.

It is the responsibility of the roadway designer to work with the **Utilities Unit** in identifying and resolving utility conflicts. As soon as the designer identifies a possible conflict, he/she should meet with the **Utilities Unit** to determine the best rehabilitation procedure. If utility relocation is required, the **Utilities Unit** will notify the utility owner.

The **Utilities Unit** submits preliminary design plans, received from the roadway designer, to the utility owners at the time of plan-in-hand, for the identification of any utilities not shown on the plans. When the **Utilities Unit** sends plans to the utility owners on a project, they will furnish the

Roadway Design Division with a memo indicating when and to whom the plans were sent. At the plan-in-hand, it is important that the roadway designer notes any utilities not located on the plans and identifies any potential conflicts. As right-of-way appraisal plans are nearing completion, the **Utilities Unit** sends right-of-way and limits of construction plans to the utility owners for preparing utility rehabilitation plans and cost estimates. Throughout the development of the project, it is very important that the roadway designer notifies the **Utility Coordinator** whenever design changes occur. This will enable proper coordination with the affected utility owners (See "Utility Rehabilitation Negotiations", Reference 13.20). Failure to inform the **Utilities Unit** of design changes may result in a utility relocating their facility and then being informed they will have to move again because they are still in conflict with the proposed construction. This could result in a delay to the contractor and additional expense to the state.

6.B Utility Rehabilitation Plan Review

The **Utilities Unit** will submit utility rehabilitation plans, as the utility owners return them, to the **Roadway Design Project Manager** for review unless the utility work is minor. The **Utilities Coordinator** will have previously reviewed the plans and will indicate any comments from his/her review. The **Roadway Design Project Manager** and/or designer will review the plans and return them to the **Utilities Coordinator** with any comments regarding the plans on the transmittal letter received from utilities.

6.C City/County Utility Cost Reimbursement

Responsibility for determining cost sharing to relocate city utilities is also a joint effort by both the **Utilities Unit** and the **Roadway Design Division**. However, any financial commitment to a city for a utility relocation shall be submitted by the **Utilities Unit** in agreement form. Reimbursable costs represent the eligible non-betterment expenditures of the utility required to install, revise, and/or relocate utilities. Municipally owned utility facility non-betterment relocation costs are 100% reimbursable whether they are on public or private right-of-way inside the corporate limits. Outside the corporate limits, the eligible reimbursement is based on the right-of-way/private easement criteria.

Not all utility relocation costs are reimbursable. Utilities located within existing state right-of-way that must be moved for a project are not eligible for reimbursement and the utility owner must bear the cost of the relocation expense. If a utility line is outside of existing state right-of-way and additional right-of-way is to be acquired, necessitating relocation of the utility, the relocation expense is reimbursable. The utility may stay within the new right-of-way but must obtain a permit to occupy state right-of-way. The **Right-of-Way Division** maintains a computerized listing of all utility permits by utility type. Designers may consult this listing to assist in determining utility locations (See Chapter Two: Roadway Design Process, Section 5.D).

On all projects, especially federal-aid projects not on the state highway system, the project manager shall notify the **Roadway Design Division** or **Secondary Roads Unit** and the proper city or county officials (if necessary) if utility work, not originally anticipated, is required during construction. If the utility work is eligible for reimbursement and the **City/County** wants federal aid, the **City/County** should contact the **Urban Design Engineer** or the **Government Affairs Manager**. The project manager will coordinate with the utility involved to expedite the utility work to minimize delays to the construction contractor.

6.D Utility Accommodation on State Highway Right-of-Way

Utilities are permitted to occupy public highway right-of-way at the discretion of **NDOR**. On state highways, **NDOR** is responsible for regulating utility right-of-way occupancy. All requests to place utilities within state right-of-way are submitted to the **Utilities Unit**. See a Policy for Accommodating Utilities on State Highway Right-of-Way, (Reference 13.21), (http://www.nebraskatransportation.org/projdev/docs/utilaccom.pdf) for additional information.

Any underground utility facility that crosses a drainage course within the right-of-way must be installed a minimum of 4 ft. (1.2 m) below the flow line of the drainage structure or drainage course, whichever is lower. Underground utility lines that cannot be installed with minimum cover due to natural conditions or conflict with other utilities may be required to protect the lines with suitable bridging, concrete slab, casing or other appropriate means. Utility route and line markers shall be placed on the right-of-way line identifying the name, address and telephone number of the utility owner in case of emergency.

6.D.1 Aerial Lines

Aerial electrical power and communication lines constructed within the public right-of-way must be constructed in accordance with the current National Electric Safety Code (Reference 13.22). The alignment of the overhead lines shall be as near the right-of-way line and parallel to the highway centerline as is practicable, ignoring minor irregularities in the right-of-way line. Joint use of utility poles is encouraged to avoid placing additional poles within the right-of-way. All poles and anchors shall conform to the following horizontal clearances:

1. In rural areas, all rigid poles and anchors must be located beyond lateral obstacle clearance, right-of-way permitting, (See Nebraska Minimum Design Standards, Reference 13.23), (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf). If sufficient right-of-way is not available, **NDOR** may require the use of breakaway design or a regrading of the right-of-way.
2. On urban or suburban highways with 45 mph (70 km/h) or lower speed limits and rural cross-sections, all rigid poles and anchors shall be located at least 15 ft. (4.5 m) from the edge of the traveled way, preferably near the right-of-way line.
3. On city, town and urban highways with curbed sections, rigid poles and anchors may be located at the back of the sidewalk or at a minimum of 6 ft. (1.8 m) back of the curb where feasible.
4. Exceptions to these clearances may be made where curbside parking is permitted or where poles and anchors can be placed at locations behind guardrails, beyond deep ditches or on top of high banks, or at other similar locations that would not present additional hazards to the traveling public.

Poles located closer than the limits shown above should contain breakaway bases or other breakaway characteristics to permit the pole to collapse upon sharp impact or should be shielded. If poles are in urban conditions with high pedestrian traffic, breakaway bases should not be used (See the Roadside Design Guide, Reference 13.24).

The following vertical clearances for utilities above the traveled way are required:

1. Aerial lines with 750 volts or less shall have a minimum clearance of 18 ft. (4.5 m) above the traveled way.

2. Installation of aerial lines within and crossing public highway right-of-way and having 750 or more volts of electrical power shall comply with the regulations in Reference 12.6 for vertical clearances and conductor sizes.

Longitudinal utility occupancy inside the fenced right-of-way of an interstate or freeway is considered only as a "last resort" when no other feasible route can be followed by the utility facility or when such utility facility exclusively serves a highway facility. Specific details for each installation will be determined at the time the utility occupancy is authorized.

New aerial installations should be avoided at scenic locations and will be considered only if installation in alternative locations is unusually difficult and unreasonably costly, where installing the line underground is not technically or economically feasible, or if the installation can be made in such a manner that adequate attention to the visual qualities of the area will be addressed.

6.D.2 Underground Electrical Power and Communication Lines

Underground electrical power and communication lines constructed within highway right-of-way shall conform to the current electrical safety regulations (National Electric Safety Code, Reference 13.22) and the current Nebraska Standard Specifications for Highway Construction (Reference 13.25), (http://www.nebraskatransportation.org/ref-man/).

- In villages and cities, the preferred location of parallel underground electrical power and communication lines installation is near the right-of-way line. They may be installed under the shoulder, however, this may cause possible conflicts with future construction.
- On highways in villages and cities without sufficient right-of-way or a suitable location for underground lines outside of the traveled way, lines may be placed under the surfacing if it is determined to be in the best interest of the traveling public.
- Installations of underground electrical power and communication lines may occupy a position near the toe of the fill slope or the top of back slope if insufficient right-of-way exists or if topography prohibits placement near the right-of-way line. **NDOR** shall designate the specific location of such facilities and any additional conditions concerning the right-of-way occupancy.
- All manholes shall be placed outside of the traveled way where possible, and shall not protrude more than 4” above the surrounding ground or shall comply with the horizontal clearances listed in Section 6.D.1.
- Underground electrical power and communication lines within right-of-way with large cut and fill sections shall be placed at or near the toe of the fill or top of back slope.
- Installation of underground electrical power and communication lines under the traveled portion of an existing highway must be performed by jacking, tunneling or dry boring from the toe of the fill slope to the toe of the opposite fill slope.
- The utility shall be placed at a minimum depth of 4 ft. (1.2 m) below the bottom elevation of the parallel road ditch or, in the absence of ditches, the minimum depth of cover of 3 ft. (0.9 m) below the elevation of the natural ground. Additional cover may be required to protect the traveling public.
- In areas with scenic designation, new underground utility installations may be permitted where they do not require extensive removal or alteration of trees or other natural features visible to the highway user or do not impair the visual quality of the lands being traversed.

6.D.3 Pipelines

Pipelines include sewer, water, gas, petroleum products, chemicals and irrigation lines. Approved materials for the construction of pipelines shall include cast iron, ductile iron, steel pipe with protective coating, vitrified clay, concrete, specially treated concrete, composite pipe (truss pipe), copper pipe and flexible pipe with some restrictions. Pipeline and casing construction within highway right-of-way shall conform to current appropriate standards.

- The preferred location of pipeline installation parallel to the highway is near the right-of-way line.
- Installations within villages and cities may require the use of shoulders or driving lanes and should take into consideration the provisions discussed for underground electrical and communication lines in Section 6.D.2.
- Where insufficient right-of-way or topographic features prevent pipeline installation near the right-of-way line, pipelines may be installed near the toe of the fill or top of back slope at locations designated by **NDOR**.
- Pipelines located within right-of-way with large cut or fill sections shall be placed at or near the toe of the fill or top of back slope.
- All manholes and shutoffs shall be placed outside of the traveled way where possible, and shall not protrude more than 4” above the surrounding ground or shall comply with the horizontal clearances listed in Section 6.D.1.
- The minimum depth of earth cover over pipelines shall be 3 ft. (0.9 m) unless polyvinyl chloride (PVC) pipe is used. PVC pipelines carrying liquids shall be installed a minimum depth of 5 ft. (1.5 m). PVC pipelines carrying natural gas shall be installed a minimum depth of 3 ft. (0.9 m), however, additional cover may be required.
- Backfill of pipeline trenches shall conform to the standard specifications (Nebraska Specifications for Highway Construction, Reference 13.25).
- All pipelines attached to structures shall be placed in a neat manner beneath the structure's floor and inside of the outer girders or beams or in cells specifically designed for the installation.

6.D.4 Water Mains

Water mains shall be laid at least 10 ft. (3 m) horizontally from any existing or proposed storm sewer, sanitary sewer, or sanitary sewer force main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 ft. (3 m) separation, the **Nebr. Dept. of Health** may allow deviation on a case-by-case basis, if supported by data from the designer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer or at such an elevation that the bottom of the water main is at least 18 in. (0.45 m) above the top of the sewer.

Water mains crossing storm sewers, sanitary sewers, or sanitary sewer force mains shall be laid to provide a minimum vertical distance of 18 in. (0.45 m) between the outside of the water main and the outside of the sewer. This shall be the case whether the water main is above or below the sewer. At crossings, one full length of water pipe shall be located so that both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

The **Nebr. Dept. of Health** must specifically approve any variance from the requirements of these instructions when it is impossible to obtain the specified separation distances. Where sewers are being installed and these instructions cannot be met, the sewer materials shall be water main pipe or equivalent and shall be pressure tested to ensure water tightness.

Water pipe shall not pass through or come into contact with any part of a sewer manhole. For additional information, see Recommended Standards for Water Works, (Reference 13.26), (http://www.leafocean.com/test/10statepreface.html).

7. REFERENCES

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13.2 Nebraska Department of Roads, Design Process Outline, Current Edition. (http://www.nebraskatransportation.org/roadway-design/#designprocess)

13.3 Section 4(f), U.S. Department of Transportation Act of 1966. (http://www2.faa.gov/programs/en/impact/impactheaders/dot.cfm)

13.4 Section 6(f), Land Water Conservation Fund Act. (http://www.house.gov/resources/105cong/reports/105_a/lwcf65_.pdf)

13.5 Clean Water Act of 1977, 33 U.S.C. 1251 et seq. (http://www.epa.gov/region5/water/cwa.htm)

13.6 Nebraska Department of Roads, Drainage Design and Erosion Control Manual, Current Edition.

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13.9 "The Floodway: A Guide for Community Permit Officials," Federal Emergency Management Agency.

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13.11 Executive Order No. 11990: Federal Wetlands. (http://hydra.gsa.gov/pbs/pt/call-in/eo11990.htm)

13.12 U.S. Department of Transportation, Federal Highway Administration, "Location and Hydraulic Design of Encroachments on Flood Plains, "Federal Aid Policy Guide, Volume 6, Chapter 7, Section 3, Subsection 2. (http://www.fhwa.dot.gov/legsregs/directives/cfr23toc.htm)

13.13 Safe Drinking Water Act: 42 U.S.C. 300f, 300h and 300j-6, 23 CFR 650, Subpart E. (http://www.epa.gov/safewater/sdwa/sdwa.html)

13.14 The Clean Air Act: 23 U.S.C. 109(1) as amended, 42 U.S.C. 7401-7428. (http://www.epa.gov/oar/caa/contents.html)

13.15 American Association of State Highway and Transportation Officials, A Policy on the Geometric Design of Highways and Streets, Washington, DC, 2001

13.16 American Association of State Highway and Transportation Officials, A Design Guide for Wildlife Protection and Conservation for Transportation Facilities, 1976, Washington, DC.

13.17 Section 106, National Historic Preservation Act as amended: 16 U.S.C. 470f. (http://www2.cr.nps.gov/laws/NHPA1966.htm)

13.18 Resource Conservation and Recovery Act of 1976 (RCRA) as amended: 42 U.S.C. 6901, 40 CFR 260-271. (http://www4.law.cornell.edu/uscode/42/ch82.html)

13.19 Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended: 42 U.S.C. 9601-9657 (http://www4.law.cornell.edu/uscode/42/ch103.html)

13.20 Nebraska Department of Roads, "Utility Rehabilitation Negotiations," Operating Instruction 45-1, December 17, 1993.

13.21 Nebraska Department of Roads, Policy for Accommodating Utilities on State Highway Right-of-Way, Current Edition. (http://www.nebraskatransportation.org/projdev/docs/utilaccom.pdf)

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13.23 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

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CHAPTER FOURTEEN
TRAFFIC ENGINEERING

Chapter Fourteen
Traffic Engineering

1. TRAFFIC ENGINEERING STUDIES

The **Traffic Engineering Division** is responsible for conducting a variety of studies. These studies are summarized in the following sections. The roadway designer is responsible for requesting necessary traffic information from the **Traffic Engineering Division**.

1.A Capacity Analysis

The principal objective of capacity analysis is to estimate the amount of traffic that can be accommodated by a given facility while maintaining a predetermined level of service. Capacity analysis provides the necessary information to evaluate improvement alternatives. The designer should confirm with the **Traffic Engineering Division** that the design typical section and alignment, contained in the Engineering Review, provides the intended capacity and level of service for the project. See Chapter One: Design Standards, Section 9.A; Chapter Four: Intersections, Driveways and Channelization, Section1.C.1; and Chapter Five: Interchanges and Grade Separations, Section 3.E.

1.B Volume Studies

Traffic volume studies are conducted to determine the levels of traffic during specified time periods, e.g., annual average daily traffic (ADT), peak hour traffic, etc. Traffic study results are used for choosing the appropriate design standard and for planning, capacity analysis, accident rate analysis, etc.

1.C At-Grade vs. Interchange Recommendations

The **Traffic Engineering Division** develops recommendations for consideration of interchange type and design alternatives, e.g., at-grade intersection or interchange, where two or more roadways intersect. See Chapter Five: Interchanges and Grade Separations, Section 1.

1.D Weaving Section Analysis

The **Traffic Engineering Division** analyzes weaving sections where traffic entering and exiting a roadway facility will cross paths. The length and number of lanes necessary in a weaving section are determined using capacity analysis techniques.

1.E Lane Configuration

Auxiliary lanes may be provided for left turn lanes, right turn lanes or free flow right turn lanes as recommended by the **Traffic Engineering Division**. The length of the turn lanes should be verified with the **Traffic Engineering Division**. See Chapter Four: Intersections, Driveways and Channelization, Section1.D.

1.F Traffic Control Studies

Traffic control determination is the responsibility of the **Traffic Engineering Division**. Warrants for traffic control devices at intersections (See the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), Reference 14.1), (http://mutcd.fhwa.dot.gov/kno-millennium.htm), are addressed and recommendations are made with regard to the type of traffic control necessary, i.e., stop or yield sign, traffic signal. If traffic signalization is recommended, the **Traffic Engineering Division** will also develop the signal timing design. See Section 4 and Chapter Four: Intersections, Driveways and Channelization, Section 1.E.

1.G Pedestrian Crossings

Pedestrian crossings are used to facilitate the movement of the walking public and/or bicycles across highways, railroad tracks, and rivers or streams. Warrant analysis for mid-block pedestrian crossings, pedestrian crossings at railroad tracks, and for pedestrian overpasses and underpasses are the responsibility of the **Traffic Engineering Division.** The roadway designer should coordinate the geometric design of the pedestrian crossing with the geometric design of the highway, sidewalk/bikeway, railroad crossing, or bridge. When a pedestrian overpass/underpass is required, the roadway designer will coordinate with the **Bridge Division**, which will be responsible for the design of the structure. For additional information, see Section 4.A, Chapter Four: Intersections, Driveways and Channelization, Section 1.C.10, and Chapter Ten: Miscellaneous Design Issues, Section 10.

2. ROADWAY SIGNS

Roadway signs are used to regulate traffic and to advise and inform motorists in order to provide for safe and efficient vehicle operation on highways. Signing should be considered an integral part of design and should be designed concurrently with geometrics. The designer should submit a preliminary alignment design to the **Traffic Engineering Division** at Preliminary Roadway Design, Activity 5307, (See Chapter Two: Roadway Design Process, Section 5).

Because supports for highway signs are potential obstacles to motorists, they should be located outside the clear zone or behind traffic barriers to shield motorists from the obstacle. If these measures are not possible, supports for signs should be the "breakaway" type. Exceptions to the “breakaway” requirement may occur in urban areas with significant pedestrian traffic and/or restricted right-of-way.

The **Traffic Engineering Division** determines the need for overhead signs. Although the roadway designer does not design the signs, he/she should confirm that any overhead signs are included in the cost estimate for the project and should ensure that the locations of overhead signs meet lateral and vertical clearances as defined in Chapter Three: Roadway Alignment, Section 4.G.

3. MARKINGS

Markings should be an integral part of roadway design and should be designed concurrently with roadway geometrics. There are three general classifications of markings: pavement markings, object markings, and delineators.

Pavement markings usually consist of line markings such as centerlines, edge lines, lane lines, parking lines, cross walk lines, etc. The roadway designer should submit a preliminary lane configuration to the **Traffic Engineering Division** for review of pavement joints with respect to the location of pavement markings as soon as the alignment and geometrics are designed during Functional Design, Activity 5316, (See Chapter Two: Roadway Design Process, Section 9). In addition, roadway designers should run a passing sight distance computer program that provides station-to-station no passing zone locations. The information from this program is given to the **Traffic Engineering Division** during Roadway Design, Activity 5325, (See Chapter Two: Roadway Design Process, Section 13).

Object markers warn of physical obstructions within or adjacent to the roadway that pose as an obstacle to motorists such as piers, bridge abutments, handrails and culvert headwalls. Object markers may warn of roadside conditions such as abrupt changes in alignment or the end of a roadway. Object markers are considered maintenance items and are not included in the roadway quantities and cost estimate.

Delineators are retroreflective devices mounted at the side of the roadway. They are used to guide traffic, especially at night. The units are installed at specified heights and spacing to delineate changes in the roadway. Designers are responsible for determining the locations and quantity of the delineators for a project and should refer to the Standard/Special Plans Book, (Reference 14.2) for information concerning location and spacing of delineators.

4. TRAFFIC SIGNALS

Traffic signals are used to direct conflicting movements of vehicles and/or pedestrians by assigning the right-of-way to various movements at different times. The design of traffic signals and signal timing should be coordinated with the geometric design of the intersection. Refer to Chapter Four: Intersections, Driveways and Channelization, Section 1.E.2, for additional information concerning the coordination of signal design with intersection design.

4.A Pedestrian Crossing Signals

Warrant analysis for pedestrian crossing signals, as outlined in the Manual on Uniform Traffic Control Devices, (Reference 14.1), is the responsibility of the **Traffic Engineering Division**. For further information, see Section 1.G.

5. DETOURS AND TRAFFIC THROUGH CONSTRUCTION

Traveling through a construction work zone or through a detour can be confusing to drivers. To alleviate the confusion, a well-designed traffic control plan (TCP) of warning signs, markings, channelization devices, etc. should be developed. The **Traffic Engineering Division** is responsible for developing the traffic control plan, and the roadway designer should address construction-sequencing issues and coordinate the development of the traffic control plan with the **Traffic Engineering Division** early in the design process. For additional information, see Chapter Ten: Miscellaneous Design Issues, Section 11.

The roadway designer should consider the following when preparing roadway and construction phasing plans:

- Capacity of a detour or temporary road should be adequate to handle expected traffic around or through the construction zone.
- Geometrics should meet minimum guidelines so the driver can travel safely through the work zone.
- Roadside safety and clear zone requirements should be addressed.
- Traffic control devices should be selected appropriately.
- Construction sequencing should be constructable.
- Economic costs to users and adjacent property owners and businesses should be considered.
- Community and social impacts should be considered.
- Traffic control plans should have some flexibility to accommodate changes in work schedule and traffic patterns.

The use of a detour versus construction under traffic should be addressed.

5.A Detours

Detours guide traffic around construction zones outside the project right-of-way instead of through the construction. A detour is a signed alternate route within an existing roadway system that is adequate or appropriate for the intended traffic and the intended duration.

At the plan-in-hand, the following items should be considered in determining if a detour is practical:

- The speed of the proposed detour should be relatively close to the speed of the facility being improved.
- The existing roads should be able to adequately and safely handle the expected volumes of traffic generated by the proposed detour. Geometric improvements along the proposed detour route may be required.
- The existing pavements should be structurally adequate to handle the expected traffic volumes. Surfacing improvements along the proposed detour route may be necessary.
- The detour route should be a reasonable length and should not require the motorist to travel too far from the normal route.
- The detour should not significantly affect the operation of businesses along the proposed improvement.
- Local access should be provided to residents and businesses.
- The detour should not adversely affect emergency vehicle operations.
- Approvals should be obtained from applicable governing agencies.
- Detours around railroad tracks should be coordinated.

The **District Operations & Maintenance Manager** should be consulted at the plan-in-hand about the feasibility of maintaining the detour during construction.

The roadway designer provides the detour route to the **Traffic Engineering Division** and designs any geometric and surfacing improvements that may be required. Pavement for detour improvement is a separate pay item group.

The **Traffic Engineering Division** will review the proposed detour route. If roads other than state roads are proposed for use as a detour, approval should be obtained from the appropriate governing agencies. Covenant agreements should reflect the detour route. It is also important to discuss proposed detour routes at the public hearing. Refer to Chapter Two: Roadway Design Process, Section 9.B, and to Chapter Thirteen: Planning and Project Development, Section 5.A, for additional information concerning coordination with other political entities.

5.B Traffic Through Construction

Although it is often better to provide detours around construction, there are times when this is not practical and it is necessary to maintain traffic through construction. It may be necessary to encroach upon travel lanes, shift lanes or even close lanes during construction. When this is needed, the frequency and length of time traffic must be routed through the construction zone should be kept to a minimum. Adequate warning should be provided to motorists.

Throughout the entire design process, the roadway designer should consider construction sequencing and the maintenance of traffic during construction. The following items should be considered and provided for in the design of a project that is to be built under traffic:

- A clear zone and/or a positive barrier should be provided where construction is to take place adjacent to traffic. The desirable distance from the driving lane to the edge of the new pavement should be a minimum of 10 ft (3 m), 2 ft (0.6 m) for barrier width and a 2 ft (0.6 m) empty space behind the barrier, leaving a 6 ft width (1.8 m) for working area.
- Taper lengths for lateral lane transitions and lane drops should meet minimums set by the MUTCD (Reference 14.1).
- Day and night sight distances should meet minimums set by **AASHTO's** A Policy on Geometric Design of Highways and Streets (Reference 14.3).

Often road improvements such as milling, armor coat and asphalt surfacing, and shoulder work will require the closing or partial closing of travel lanes on highways during construction. On highways of four lanes or more, this may simply involve reducing the number of lanes in each direction so construction work can be completed. On two-lane highways, this may involve the actual closing of an entire lane and the use of a flagger to direct traffic through the construction. The **Traffic Engineering Division** will recommend what type of traffic control is needed.

5.C Temporary Roads

The construction of culverts, bridges, etc. may require a temporary road to allow traffic to bypass the construction site. For these situations, it may be more practical to construct a short route around the work zone than to build the project under traffic (See Chapter Ten: Miscellaneous Design Issues, Section 11.B).

6. REFERENCES

14.1 United States Department of Transportation Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, Washington, D.C., 2000. (http://mutcd.fhwa.dot.gov/kno-millennium.htm)

14.2 Nebraska Department of Roads, Standard/Special Plans Book, Current Edition.

14.3 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2001.

CHAPTER FIFTEEN
RIGHT-OF-WAY

LIST OF EXHIBITS

CHAPTER FIFTEEN
RIGHT-OF-WAY

Chapter Fifteen
Right-of-Way

This chapter provides guidance to the roadway designer regarding issues associated with the design and acquisition of right-of-way. Refer to the Right-of-Way Manual (Reference 15.1), (http://www.nebraskatransportation.org/roway/pdfs/row-manual/index.pdf), for additional right-of-way information.

1. RIGHT-OF-WAY (R.O.W.) SURVEY

Whenever a proposed highway improvement requires the acquisition of easement rights and/or the purchase of additional land for construction purposes, a right-of-way survey will be required. The **Survey Coordinator** in the **Geodetic Surveys Section** of the **Roadway Design Division** determines which projects need to have a right-of-way survey. Information used to determine whether or not a right-of-way survey is required include:

- The Highway Improvement Programming Request DR Form 73, provided by the **Project Scheduling and Program Management Section**.
- The Initial Project Data DR Form 333 and the Project Data Revision DR Form 334, which are initiated by a request from the **District Engineer**.
- The Engineering Review Report, which is provided by either **Project Development** or **Roadway Design**.
- Additional input from the **Right-of-Way Design Engineer**.
- Additional input from the **District Engineer**.

Preliminary survey parties assigned to the project, assisted by the **Deputy State Surveyor**, make a right-of-way survey in conjunction with the roadway design survey. The two surveys then are combined into a single set of preliminary survey notes. The ultimate goal for all projects is the accurate completion of right-of-way surveys in a timely manner to allow for completion of the right-of-way Ownership Plans for the public hearing.

2. RIGHT-OF-WAY DESIGN PLANS

The **Right-of-Way Design Section** is responsible for the coordination and preparation of the following right-of-way design plans:

1. **Corridor protection plans** - Corridor protection plans generally are prepared in advance of other design activity for projects in areas of potential development. These plans are often aerial sheets from corridor study reports. Ownerships and the protected corridor are shown on the plan. Plans are filed with the **County**, and **NDOR** is notified before any preliminary subdivision plat or building permit is approved.
2. **Ownership Plans** – Ownership plans are prepared prior to the plan-in-hand activity. Preliminary survey, topography, land lines, previous right of way, previous controlled access, property lines and ownership data are shown on the Ownership Plans.

3. **Preliminary ROW Design** – Proposed limits of construction (LOC's) are added to the Ownership Plans and right-of-way is designed, along with any permanent or temporary easements, and permanent or temporary railroad easements and rights of entry or occupation areas as needed. These plans are used in the Preliminary ROW Plan Review, (See Chapter Two: Roadway Design Process, Section 17).
4. **Appraisal Plans** – The changes made during the Preliminary ROW Plan Review are shown, areas of taking(s) are computed, legal descriptions are written and summarized on the right-of-way plans summary of areas sheet. The Appraisal Section and others use the resulting Appraisal Plans. The appraiser may request a plan review with the roadway designer using the appraisal plans.
5. **Negotiation Plans** – Following preparation of the right-of-way contracts, the Appraisal Plans are updated to reflect any changes made during appraisal. The negotiators use the resulting Negotiation Plans when dealing with property owners.
6. **Finalized Half-Size Plans** - After the right-of-way property deeds are recorded in the county **Register of Deeds Office**, the plans are checked and modified to reflect the properties which were acquired. Plans are then half-sized and filed in the **Right-of-Way Division**.

A more detailed description of these plans is presented in the following sections.

2.A Corridor Protection Plans

Highways in areas that have the potential for development prior to a planned highway improvement will be reviewed for corridor protection. Corridor protection is a procedure whereby **NDOR** notifies the appropriate local government agencies and the general public of the intent to acquire right-of-way along a highway corridor. Corridor protection is designed to allow **NDOR** to review proposed development that may occur adjacent to the selected highway corridor, minimizing acquisition costs and reducing or eliminating development impacts to the highway project.

The **Right-of-Way Division** has the responsibility for establishing corridor protection on state highways and notifying the public that corridor protection has been filed. If there is a need for corridor protection, a recommendation will be made by the **Planning and Project Development Division, Roadway Design Division, Right-of-Way Division**, or the **District**. If a corridor hearing is held and a relinquishment is involved, the relinquishment agreement must be signed before project corridor approval is presented to the **Highway Commission**, (See Section 7.E).

For projects on existing alignment for which it is deemed necessary to file corridor protection, a strip 300 ft. (100 m) wide will be designated on both sides of the existing right-of-way. In the case of projects on a new alignment, a strip 400 ft. (120 m) wide on both sides of the proposed centerline will be designated for corridor protection. These widths are guidelines only and may vary depending on the terrain and roadway design standard. Applicable projects will have corridor protection procedures initiated after the project concept and alignment have been defined.

When a property owner files a preliminary subdivision plat or a request for a building permit in an area with corridor protection, the local zoning authority informs the owner that **NDOR** has filed corridor protection and that the preliminary plat cannot be approved or that the permit cannot be issued unless **NDOR** releases the corridor protection. **NDOR** has two months to approve or disapprove the request after notification by the local authority. If **NDOR** disapproves the request, it has six months to negotiate and acquire the necessary right-of-way. If **NDOR** has not acquired the right-of-way within six months, the local authority can issue an approval of the preliminary subdivision plat or the building permit. See Legislative Bill 187, Section 39-1311 (http://www.unicam.state.ne.us/pdf/FINAL_LB187_1.pdf) and the Nebraska Dept. of Roads Operating Instruction 60-9, "Corridor Protection", (Appendix F, "Selected NDOR Operating Instructions), for additional information about corridor protection.

2.B Ownership Plans

The **Right-of-Way Design Section** begins the right-of-way design process with the production of a set of plans that depict preliminary survey, topography, current ownerships, property lines, and previous right-of-way in the area of the project. The plans are reproduced and forwarded to **Roadway Design** for use in public hearings.

The following items are used in the creation of Ownership Right-of-Way Plans:

- The sheet files from **Roadway Design** provide the base plan layout, (coordinate the base plan layout with the **Right-of-Way Design Section** at Meeting "A", see Appendix G, "CADD Coordination Policy").
- The right-of-way survey provides section corners, quarter-section corners and lot corners.
- Title research provides a five-year record of ownership.
- Previous right-of-way and controlled access is researched by reviewing old plans, deeds, railroad maps, railroad leases and city plats.

Ownership Plans can be completed before Preliminary Roadway Design, Activity 5307, (See Chapter Two: Roadway Design Process, Section 5). It is desirable that the ownership plans be available for the project plan-in-hand inspection.

2.C Preliminary Right-of-Way Design

The roadway designer should submit the following items to **Right-of-Way Design** for their use in designing right-of-way for the project:

- Typical sections.
- 2-A sheets with alignment drafted.
- Roadway Design plans (Activity 5325) with limits of construction, (See Chapter Two: Roadway Design Process, Section 13).
- Cross-sections.
- Culvert cross-sections.
- Access Control letter, if applicable (See Section 3).
- Identify the locations where the **Roadway Design Division** has identified and promised the extent of right-of–way to be purchased (i.e., from information meetings, meetings with property owners, in the release of corridor protection, etc.)

Possible conflicts with pivot irrigation systems should be investigated during Roadway Design (Activity 5325). A review of the design and pivot damages will be made at the Preliminary ROW Plan Review.

2.C.1 New Right-of-Way Design

Right-of-way will be designed using the following guidelines:

1. Design urban right-of-way about 2 ft. (600 mm) behind the sidewalk to allow space for utilities.
2. Design rural right-of-way about 10 ft. (3 m) behind limits of construction in low cuts.
3. Design rural right-of-way about 20 ft. (6 m) behind limits of construction in high fills and high cuts.
4. Designers should try to minimize the impact of damages to irrigation pivots, wells, homes, yards, windbreaks and utilities.
5. Easements will be used where appropriate
6. Design widths along reconstructed county roads should be tighter (0-10 ft. (0-3 m) behind limits of construction) than design width along state highways. On long county road relocations, right-of-way should be designed parallel and at a uniform offset from the centerline.
7. A standard break in controlled access is 40 ft. (12 m) wide. For intersections and anywhere else where it is desirable to have an access break opening wider than 40 ft. (12 m), access control should have an end station and a begin station (See Section 3).
8. Right-of-way shall be acquired to or beyond the lateral obstacle clearance.
9. When right-of-way is designed at the beginning and ending of a project, and either of those points are within the limits of an individual ownership, consideration should be given to acquiring right-of-way through the ownership for future connecting projects so that the owner will not have to be contacted again.

Normal right-of-way widths have been established by the **Board of Public Roads Classifications and Standards** and approved by **FHWA** (See the Nebraska Minimum Design Standards, Reference 15.2), (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf). Sound engineering judgment should be used to obtain a balance between right-of-way costs and widths.

2.C.2 Permanent Easements

It is generally desirable to purchase land for the highway. However, sometimes a permanent easement should be considered. In the case of a permanent easement **NDOR** has rights to a parcel of land for a specific purpose while the land remains in private ownership and will be taxed. The owner may fence the land or do with it whatever he/she chooses as long as it does not conflict with the purpose of the permanent easement. A permanent easement usually damages the land because it restricts the land use. Some examples of permanent easement uses are to:

- Build and maintain embankments, dikes, retaining walls, drainage structures, etc.
- Channel relocations and required buffer strips, (See Chapter Thirteen: Planning and Project Development, Section 4.B.6).
- Provide access to two or more adjacent properties.
- Minimize impact on adjacent property.
- Maintain a uniform right-of-way width.

2.C.3 Temporary Easements

Temporary easements permit the use of private property for a time period not to exceed the duration of the project. Temporary easements typically will be used when construction activities must take place outside of the area that is needed for the highway. Temporary easements are requested for:

- Site clearing (e.g., removal of a structure, such as a granary, that is bisected by the right-of-way line. Please note that a special provision should be written to provide that the contractor will remove both the structure and the foundation.)
- Culvert, channel, ditch cleanout.
- Borrow pit or excess material disposal.
- Replacement of existing driveways or building new driveways.
- Build, maintain and remove temporary roads.
- Build sewers or inlets that drain water from private property (e.g., an inlet in a private parking lot.)
- Shaping (e.g., to blend in fill or cut in urban areas where the slope is 4:1 or flatter.)

2.C.4 Railroad Easements, Rights or Leases

NDOR normally does not acquire land from railroads in fee. All land required at crossings or which is parallel to the highway will normally be acquired in the form of an easement, right of entry, right of occupation, or lease.

2.C.5 Preliminary ROW Design Review

When the preliminary right-of-way design is completed, it is sent to the **Roadway Design Project Manager** for review and coordination. The roadway designer then schedules a Preliminary ROW Plan Review to coordinate the right-of-way design and to identify potential right-of-way impacts (See Chapter Two: Design Process, Section 17). After this meeting, the Appraisal Plans are prepared.

2.D Appraisal Plans

The preparation of Appraisal Plans involves the actual design of the project right-of-way. These plans should be representative of the proposed right-of-way takings needed for construction. Two inputs are necessary for Appraisal plans: Ownership Plans and the limits of construction. The major steps undertaken by **Right-of-Way Design** at this stage are:

1. Receive (reference) the project design and limits of construction.
2. Design the right-of-way, referenced to the project centerline.
3. Design control of access.
4. Review the design and coordinate with **Roadway Design**.

Following approval of the right-of-way design, areas of all takings are computed and the metes and bounds legal descriptions are written. Appraisal Plans show the right-of-way design and stations/offsets. The **Utility Section**, **Railroad Liaison**, and appraisers use the Appraisal Plans.

Station and offset to utilities will not be shown on right-of-way plans until the Appraisal Plan stage. The roadway designer should not change DTM Alignment after the Appraisal Plan stage.

2.E Negotiation Plans

Negotiation Plans reflect any changes made to the Appraisal Plans as a result of the appraisal process. Right-of-way negotiators use Negotiation Plans to explain the offers to purchase right-of-way to landowners. If agreement cannot be reached with a landowner on an amount to settle, the **State of Nebraska** will file a condemnation to acquire the right-of-way. On all projects, all right-of-way required for the project should either be acquired and paid for or condemned and paid for prior to advertising a project for bid letting.

2.F PS&E Plans

When the roadway designer is ready to take plans to the **Plans, Specifications and Estimates Unit (PS&E)** for review, he/she should request a reproducible set of right-of-way design plans and a right-of-way certificate (See Section 6). Right-of-way plan revisions following submittal to **PS&E** will be coordinated with the **District, Roadway Design, PS&E, Utilities** and others involved.

2.G Revisions

Right of way plan revisions may be made during any stage of development, but most often occur during the Appraisal and Negotiation stages. As per revision process documented July 2, 1997, the requesting individual will notify the **Right of Way Design Engineer** and/or **Roadway Design Division** of possible conflict and concerns. The appraiser or negotiator will also report back specific suggestions or questions from the landowner and will ask the designer to review (and change if possible or necessary) the design related to the questions. Some change requests and/or revisions may also be brought to the **Roadway Design Division** through the **District Engineer**. Requests for right-of-way plan revisions must be formal and should include a transmittal letter and plan sheets showing the changes. A recommended right-of-way design offset or easements should be shown if applicable. Requests for plan revisions should be sent to the **Right-of-Way Design Engineer**. The following design or plan changes should be coordinated with **Right-of-Way Design**:

- Updated topography.
- Revised culvert design.
- Revised driveway design or location.
- Revised alignments.
- Revised limits of construction.

Final right-of-way plans are completed only after all land is purchased.

3. ACCESS CONTROL

Access control is a restriction of the number and location of access points, (intersections, driveways and field entrances), along a highway. Access control along a highway reduces interruptions in the traffic flow, increasing the efficiency and safety of the facility. Typically, access rights will be acquired on all:

- Interstates.
- Freeways.
- Expressways and other multi-lane divided highways.

Access control will be considered on all other highways when:

- The 20 year forecast traffic (ADT) is 3,001 or greater, as shown on the current 20 Year Forecast Traffic Map (See Chapter One: Design Standards, Section 8.A).
- The route is within the present or projected two mile (3.0 km) zoning limits of cities of the first class (population 5,000 to 99,999) and within the present or projected three mile (5.0 km) zoning limits of primary (population 100,000 to 299,999) and metropolitan class cities (population more than 300,000).
- There are 3 miles (5.0 km) or less between the interstate and the connecting or parallel highway.
- The development of any major highway, particularly where mobility is important.

The degree of access control should be balanced between three essential public functions: access to property, travel mobility and motorist safety.

By statute, (Revised Statutes of Nebraska, Section 39-1302, Paragraph (9), Reference 15.3), (http://statutes.unicam.state.ne.us/Corpus/statutes/chap39/R3913002.html), **NDOR** may acquire, in public or private property, such rights of access as are deemed necessary, including but not necessarily limited to air, light, view, egress and ingress. The **State of Nebraska** cannot condemn property from one owner to provide access to property for another owner if the owner to be served by the access already has another access to his/her property. This is the case no matter how inconvenient the existing access may be or if the existing access is only a right-in, right-out situation because of median restrictions.

For additional information on access control and on the access control project review procedure, refer to the Access Control Policy to the State Highway System, (Reference 15.4), (http://www.nebraskatransportation.org/roway/pdfs/accesscontrol.pdf).

3.A Access Control Design

There are currently two types of driveway classification: access and future access. Access locations identified, but not built as part of the highway project, shall be designated as future access. Access should be provided for each property along a project to provide for possible future development.

At the time that the access points are designed, existing entrances may be removed or relocated to connect to the designed access locations as a part of the highway project. **NDOR** shall be responsible for constructing the entrances at the designed access locations as a part of the project. **NDOR** will not construct the access locations referred to as future access. Driveways at the quarter-section line will typically be "joint drives" and will provide access to two or more properties. **EXHIBIT 15.1** is an example of the typical permanent easement acquired for a joint access.

The roadway designer shall designate access locations for a project during Preliminary Design, (See Chapter Two: Roadway Design Process, Section 5). This may be accomplished by:

1. Obtaining relevant information from the **District Engineer** and others.
2. Reviewing the zoning, existing and future land use.
3. Conducting a field examination.
4. Giving consideration to intersection sight distance, natural barriers, property lines, the development of future frontage roads and traffic signal spacing.

All property adjacent to the highway project must be permitted access to a public road, unless the project results in the abutment of property that previously did not have direct egress and ingress to the highway. If a parcel is "landlocked" and access cannot be provided economically, the parcel may be purchased as part of the right-of-way taking.

If a roadway has previous controlled access, and access is being revised as part of a current project, some items to consider are:

- When providing an access (unrestricted) to a property that previously had restricted access, the property may be considered enhanced. The potential for enhancement will be considered during appraisal. Typically, **NDOR** has no obligation to provide access rights other than what presently exists. A decision to provide enhanced access shall be justified.
- When access is restricted to a property that previously had unrestricted access, it is likely the property value has been damaged. **NDOR** appraisers will consider these damages before acquisition.

Once the roadway designer is prepared to make recommendations about acquiring access control, he/she should contact the **Highway Right-of-Way Associate** in the **Property Management Section** of the **Right-of-Way Division** and request to be put on the agenda for the next available access control meeting. The designer should present to the **Control Access and Permit Review Committee** his/her recommendations for or against acquiring access rights and should be able to support the recommendations. The roadway designer should provide an aerial photo with property lines and locations of access sites that meet the policy for the **Committee's** review and approval.

The **Committee** reviews the project as part of the functional design review to determine access control. The **Committee's** decision is based on the following considerations:

- Traffic count.
- Highway classification.
- Safety of persons using the highway.
- Preservation of the public's investment in the existing highway.
- Effect of vehicles using the access point on the traffic-carrying capability of the highway.
- Existing sight distance.

- Highway alignment and configuration.
- Volume and speed of traffic on the highway at the proposed access point.
- Traffic volumes generated by the development served by the access and extent to which improvement to the highway facilities by persons requesting access will mitigate adverse effects caused by the access point to the highway.
- Closure or relocation of existing access points.
- Moving the new access to a property line for a joint-use drive.
- Conformance of proposed development to zoning regulations.
- Dedication of right-of-way for future public streets to provide for the orderly development of the property abutting the highway.

The roadway designer shall be responsible for preparing the CA (control access) Letter, which indicates the decisions made by the **Control Access and Permit Review Committee.**

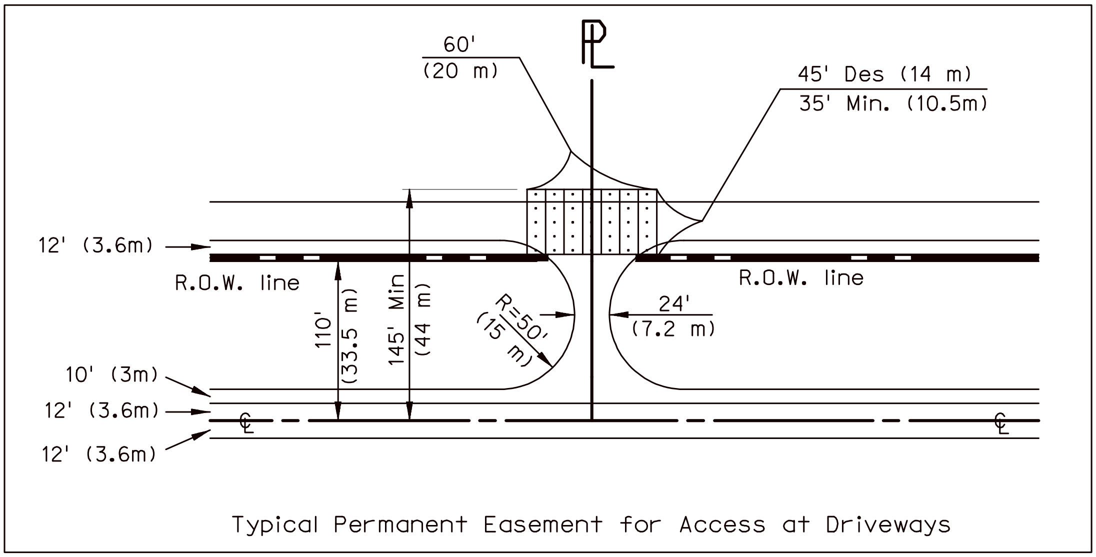


Exhibit 15.1 Typical Access Control at Joint Driveways

3.B Access Control on the Interstate and Freeways

The interstate and freeway systems are divided highways for through traffic with full control of access and no at-grade intersections. Access to the facility is allowed only at interchange locations. Access control should be acquired a minimum of 660 ft. (200 m) beyond the interchange terminal (See **EXHIBIT 15.4**).

3.C Access Control on Expressways and Other Four-Lane Divided Highways

An expressway is a divided highway for through traffic with full or partial control of access, generally with grade separations at intersections. An expressway highway is, or will ultimately be, a four-lane divided highway with interchanges at major intersections and at-grade intersections at designated minor public road intersections.

Selected public road intersections will be permitted at-grade. At-grade access from abutting property to the expressway at approved points will also be considered and allowed as noted in the Access Control Policy to the State Highway System, (Reference 15.4). In rural areas and in undeveloped urban areas, desirable spacing is no more than one access per mile (1.6 km) with 2,000 ft. (610 m) as the minimum distance between access locations (See **EXHIBIT 15.2**). Maximum allowable spacing is no more than three access locations per mile (1.6 km) with 1,000 ft. (305 m) between access locations. The maximum allowable spacing should be used only for access to landlocked parcels or farmsteads.

Desirable spacing for expressways in developed urban areas will consolidate access locations. Access locations should be no closer than two blocks. Maximum allowable spacing should also consider consolidating access locations and may match the existing street system and/or development. If possible, an access location on one side of the highway should be located opposite access on the other side of the highway.

3.D Access Control on All Other Highways

In rural areas, spacing of access locations on all other access controlled highways shall take into consideration all access of the property involved, including that from adjacent county roads or streets. Access locations required to provide reasonable access shall be provided by **NDOR** (See **EXHIBIT 15.2**).

An effort should be made to consolidate access locations. When consolidating access locations, driveways on one side of the highway should be located opposite the driveways on the other side of the highway. Future access openings should be provided for each property, where warranted, to provide for possible future development.

In undeveloped urban areas, rural rules apply. In developed areas, an effort will be made to consolidate access locations. Future access openings should be provided for each property, where warranted, to provide for possible future development.

Table I				
Expressway and Other Multi-lane Divided Highways **Including Non Multi-lane Highways with future ADT over 6000**				
Area Type	**Desirable Access**		**Maximum Allowable Access***	
	Number of Access Locations per Mile (1.6 km)	**Spacing Between Access Pts.**	**Number of Access Locations per Mile (1.6 km)**	**Minimum Spacing Between Access Points**
Rural and Undeveloped Urban	1	2,000 ft. (610 m)	3	1,000 ft. (305 m)
Developed Urban	Consider consolidation of drives	2 blocks	Consider consolidation of drives	Consider street system and/or development

* Maximum allowable access is no more than three access locations per mile with 1000 ft. (305 m) as the minimum distance between access locations. Minimum spacing should only be used for access to developed properties such as occupied farmsteads, residences, businesses, and land-locked parcels.

Table II				
All Other Controlled Highways				
Area Type	**Desirable Access**		**Maximum Allowable Access**	
	Number of Access Locations per Mile (1.6 km)	**Spacing Between Access Points**	**Number of Access Locations per Mile (1.6 km)**	**Minimum Spacing Between Access Points**
Rural and Undeveloped Urban	3**	1,000 ft. (305 m)	Provide access to all properties **	Consider consolidation of drives
Undeveloped Urban	7**	600 ft. (183 m)	Provide access to ll properties **	Consider consolidation of drives
Urban	Provide access to all properties **	Consider consolidation of drives	Provide access to all properties **	Consider consolidation of drives

****** Future access openings should provide for each property, where warranted, to provide for possible future development.

Exhibit 15.2 Desirable and Minimum Access Locations

3.E Access Control on Side Streets and Roads

On projects that include the purchase of access control, access points along intercepting public roads and highways shall be located a sufficient distance from the intersection to avoid conflicts and to improve the efficiency of the highway intersection. Access control shall be extended along these intercepting roads to ensure the proper distance from the intersection remains clear of all intersections, driveways and field entrances.

Access control shall be purchased for a minimum distance of 220 ft. (67 m) along intercepting public roads and for 660 ft. (200 m) along intercepting highways (See **EXHIBIT 15.3**). To account for multiple through lanes, turning lanes, and variable median widths, this distance shall be measured from the closest edge of the nearest through lane of the mainline (See **EXHIBIT 15.4**). **Roadway Design** will calculate these distances in relation to the project centerline and provide the necessary information to **Right-of-Way Design** for the design of the access control.

Skewed intersections will have the access control measured along the centerline of the intersecting roadway from the closest edge of the nearest through lane of the mainline (See **EXHIBIT 15.5**). The access control limits will be offset to left and/or right of the intercepting road at this station. Intersections of greater than 15º skew should be evaluated on a case by case basis to determine if the minimum distances should be increased to maintain the integrity of the intersection.

Drives and field entrances along the intercepting roadway shall be placed so that the driveway throat is beyond the access control limits. Exceptions to this policy must have approval of the **Control Access and Permit Review Committee**.

Specific or unusual intersections shall be evaluated on a case-by-case basis, with recommendations brought before the **Control Access and Permit Review Committee** for approval.

3.F Public Notification

The normal public notification and public hearing process should be followed when access is to be affected (See Chapter Two: Roadway Design Process, Section 12). There are instances when, even though access control is not changed, access to individual properties may be affected, such as when islands are installed. A public hearing is considered adequate notification if these situations arise. However, if a public hearing is not held, an information meeting should be conducted when four or more properties are affected. If no public hearing is held and if there are fewer than four properties involved, final plans shall be sent to the **District Engineer** who will be asked to contact the property owners and show them the proposed design and its effect on their property.

A Highway Commission Statement shall be prepared for all projects that include new access control (See Chapter Two: Roadway Design Process, Section 12.B for additional information).

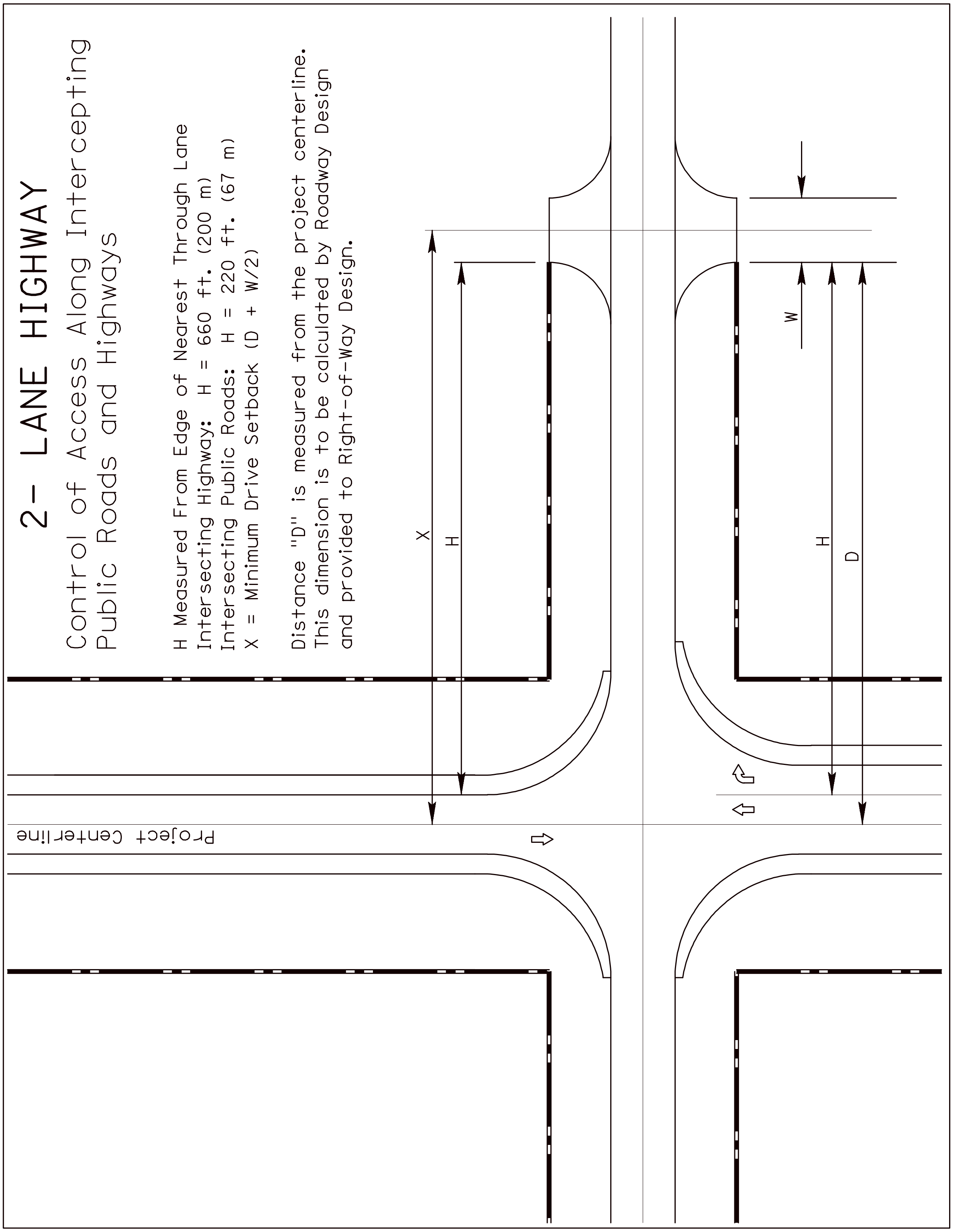


Exhibit 15.3 Control of Access Along Intercepting Public Roads and Highways
2-Lane Highway

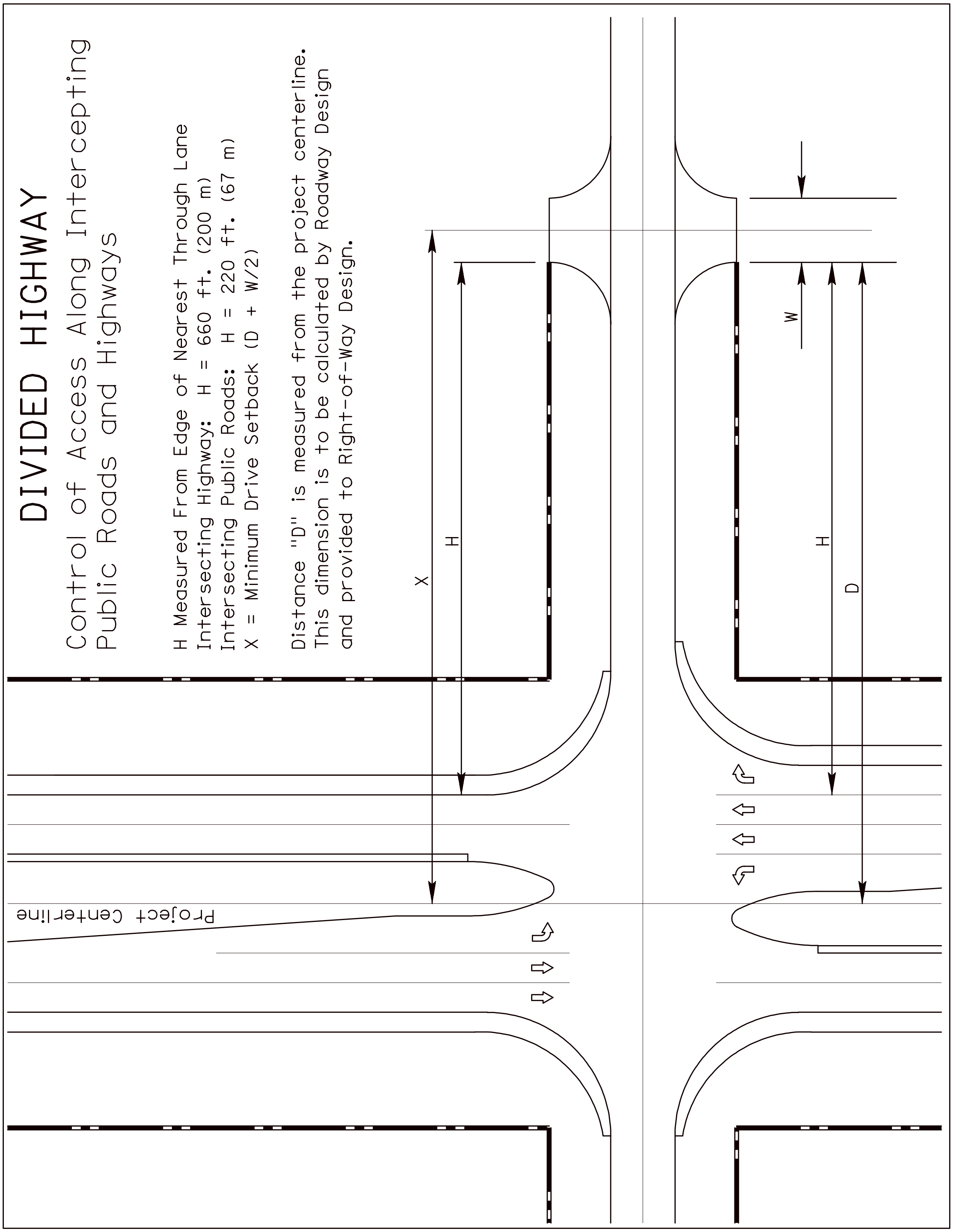


Exhibit 15.4 Control of Access Along Intercepting Public Roads and Highways
Divided Highway

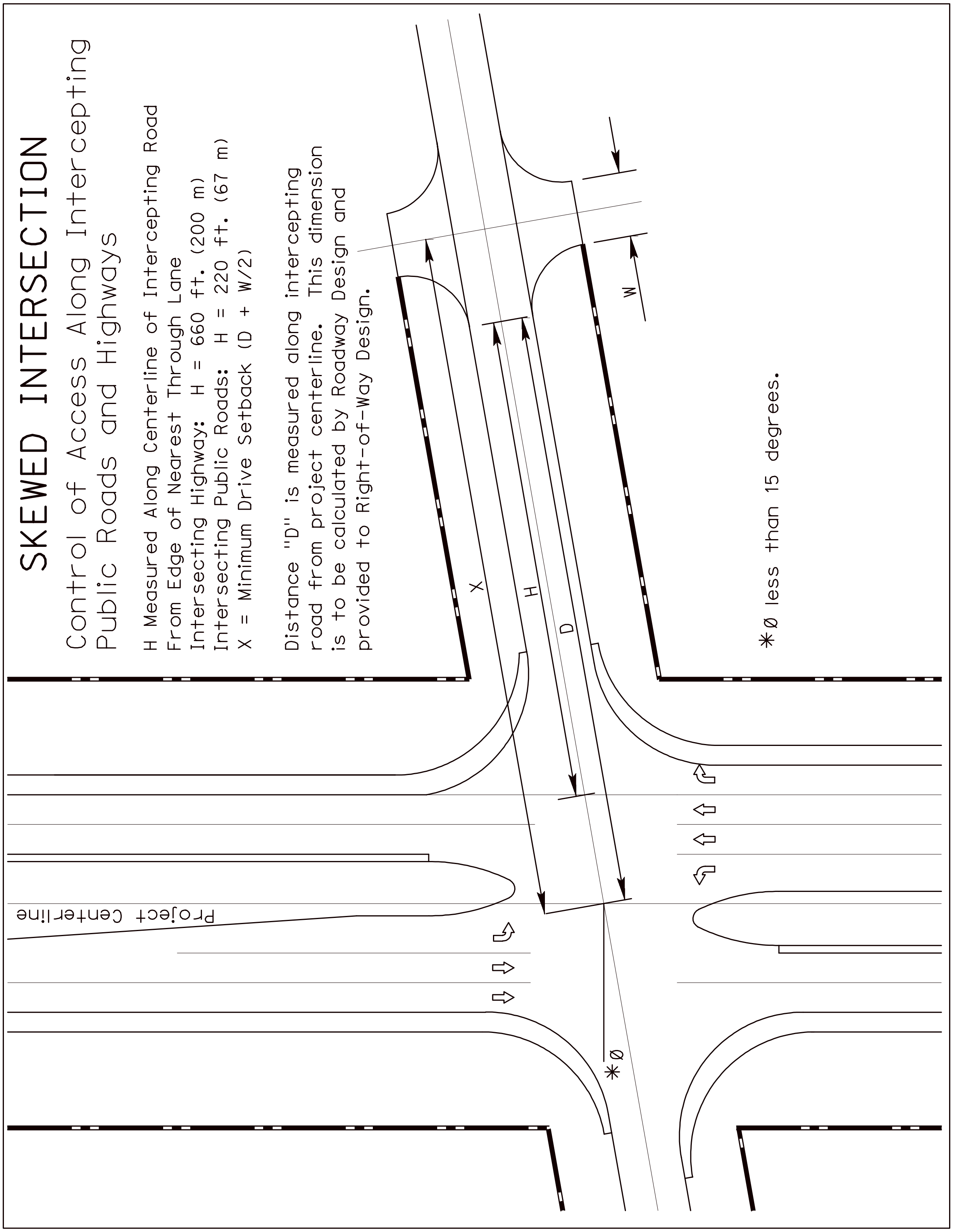


Exhibit 15.5 Control of Access Along Intercepting Public Roads and Highways
Skewed Intersection

4. APPRAISAL

Right-of-way appraisal begins with the Appraisal Plan distribution. On some projects, the **Roadway Design Division** will hold an information meeting prior to appraisal and acquisition, which may be attended by appraisers from the **Right-of-Way Division** (See Chapter Two: Roadway Design Process, Sections 12.C and 19). This is a meeting to present plans, right-of-way needs and the appraisal and negotiation process to the public. Public input and suggestions should be reviewed for consideration.

Following this public information meeting, if held, the appraisal process begins. Appraisers are required to meet with landowners where the taking and property damages are estimated to be more than a set dollar amount. Appraisers will notify the roadway designer and/or the right-of-way designer of questions, concerns or suggestions from the landowners concerning the plans.

5. ACQUISITION

The right-of-way agent will contact property owners in person or by mail when property is to be acquired.

5.A Contract Preparation

After appraisals are prepared and reviewed, they are sent to the **Right-of-Way Division Negotiation Section**. Contracts are prepared showing itemized descriptions of the property to be acquired and the dollar value associated with each item. When the contracts to purchase and legal instruments to file are prepared, the **Negotiation Section** notifies the **Right-of-Way Design Section**. The **Right-of-Way Design Section** makes any necessary changes and sends out "tentative final" Negotiation Plans.

5.B Condemnation

If the **State** and the landowner cannot agree on a settlement amount, the negotiator will notify the **Chief Negotiator**. The **Chief Negotiator** will request a condemnation plat from the **Right-of-Way Design Section**. The plat will be prepared and sent to the **Roadway Design Division** for review and coordination.

The roadway designer should review the plat for errors, omissions, or design revisions in the condemnation area. Check the alignment information, the North arrow, the situation sketch, and the county. If there is a possible change on the tract, an error or omission on the plat or a question concerning the plat, the roadway designer shall notify the **Right-of-Way Design Section**. If the plat needs to be corrected, the **Right-of-Way Design Section** will make the required changes.

6. RIGHT-OF-WAY CERTIFICATION

The **Right-of-Way Division**, prior to the advertising letting date of a project, shall furnish a certificate stating either that all of the right-of-way is available to the contractor and clear of improvements, or stating the estimated date when non-complying tracts will be clear and available. The **Property Management Supervisor** shall furnish the factual information for the right-of-way certificate, which shall be signed by the **Right-of-Way Manager**. This certificate is sent to the **Roadway Design Division** and, on federal-aid projects, to **FHWA.**

6.A Public Interest Letters

All right-of-way should be acquired prior to the project letting date. Sometimes, however, right-of-way acquisition is delayed, e.g., through condemnation proceedings, etc. To maintain project construction schedules, it is sometimes necessary to request special exception from **FHWA** on federally funded projects to proceed with the scheduled letting dates. This request should be in the form of a public interest letter (See **EXHIBIT 15.6**) that includes:

- Information about the project.
- The status of all right-of-way acquisitions.

This public interest letter shall conform to the requirements of Title 23 CFR 635.309 (b) (http://a257.g.akamaitech.net/7/257/2422/04nov20031500/edocket.access.gpo.gov/cfr_2001/aprqtr/23cfr635.309.htm) and a "Memorandum of Understanding" with the **Federal Highway Administration** (See Appendix H, "Public Interest Letters"). It is very important that all pertinent information be included in this request to avoid additional delay.

The **R.O.W. Division** provides a right-of-way status report to the **Roadway Design Project Managers** monthly. Roadway designers should use this report when developing a public interest letter. Upon completion of the public interest letter:

1. The **Assistant Design Engineer** will send the public interest letter, through the **Roadway Design Engineer**, to the **Deputy-Director of Engineering** (with a cc to the **Project Scheduling and Program Management Engineer**).
2. When the letter has been approved, the **Deputy-Director of Engineering** will notify the **Roadway Design Engineer**, with a cc to:
   - **FHWA**.
   - The **Contracts Manager**.
   - The **Roadway Design Office Supervisor** (vault/file copy).
   - The **Assistant Design Engineer**.
   - The **P.S. & E. Engineer**.
   - The **Project Scheduling and Program Management Engineer**.
   - The **District Engineer**.
   - The **District Construction Engineer**.
   - The **Right-of-Way Manager**.

On some projects, right-of-way certificates and utility statements are not required because the project does not require additional right-of-way and will not have utility conflicts. The types of projects that do not normally require right-of-way certificates include:

- Armor coat
- Fog seal
- Slurry seal
- Bridge painting
- Aggregate surfacing
- Crack sealing
- Concrete pavement repair
- Joint repair, seeding
- Mill resurfacing

A statement, however, will need to be included in the project proposal that no additional right-of-way is needed and no utility conflicts are anticipated.

Nebraska Department of Roads

Memorandum

DATE October 10, 2002

TO Monty W. Fredrickson, Deputy Director-Engineering

FROM Eldon D. Poppe-Roadway Design Engineer

SUBJECT Project EACSTPD-BR-S40D(102), Prosser North, CN 41987.

I request your authorization under the provisions of Title 23 CFR 635.309(c) and per the Memorandum of Understanding with the Federal Highway Administration dated December 7, 1998, to proceed with the contract letting of Project EACSTPD-BR-S40D(102) on November 14, 2002.

All of the right-of-way required to build this project has not been acquired at this time. The total number of tracts is 7. Tracts 1, 3, 5 and 7 have been paid. Tract 6 has been signed, but not paid. The remaining tract 4 is being negotiated. This taking is for 0.38 acre for $690.00, temporary easement for $660.00 and fence for $1555.00, for a total of $2,905.00.

It is expected that all of the right-of-way will be acquired and physical possession held by the State prior to the project's November 14, 2002 letting date, well in advance of the project's tentative starting date of June 3, 2003. If not, the bid proposal does specify that the contractor will not be allowed to perform work on any tract until legal and physical possession has been acquired by the State. If necessary, the contractor will be granted an extension of time if a delay has been caused because of a tract not being acquired.

The project has been scheduled for 90 working days, with a completion date of Nov. 29, 2003. It is feasible to move this project to a later letting and still begin work on June 3, 2003. However, per our Standard Specifications, the contractor could request an earlier starting date, which gives flexibility to the contractor's schedule of work and potential cost savings. Moving the letting to a later date would eliminate this flexibility and potential cost savings, which is not in the public's interest. Also, moving this project to later lettings, which are already large, necessitates the risk of accepting higher bids, which is not in the public's interest.

I believe it is in the public's interest that this project remain in the November 14, 2002 letting as scheduled, because of the potential cost benefits as described above. I do not believe the significance of the remaining tract necessitates moving the project to a later letting date.

I request your concurrence in this determination.

cc: Randy Needham
Chuck McCann
Claude Oie
Liz Wunderlich
Roger Winkelhake
Eldon Poppe
Barb Engel

Exhibit 15.6 Sample Letter of Public Interest

7. MISCELLANEOUS

7.A Liaison with Local Public Agencies

The **Right-of-Way Design Division** will coordinate with the **Local Public Agency Right-of-Way Coordinator** for right-of-way concerns for off-system projects.

7.B Right-of-Way Markers

Right-of-way markers will be required on most projects. One marker should be set at each of the following points:

- At each point where the right-of-way width changes.
- At each PC and PT.
- At each PI without a curve.
- At such other points required to accurately delineate the right-of-way, but not less than 20 per mile (1 per StaM average).

Where it is undesirable to set concrete right-of-way markers, such as on lot or block lines in an urban area, the concrete markers will be omitted and authorized **NDOR** personnel will place iron pipes or pins.

On projects where the existing right-of-way will be altered, the existing markers should be reset. The summary of quantities should separately identify the quantities of new markers and markers to be reset, (See Chapter Twelve: Cost Estimating, Section _). Markers should be located so that it is possible for a person standing at one marker to see either adjacent marker.

7.C Re-establishing Land Monuments and Property Corners

When construction disturbs or threatens to disturb existing land monuments or lot corners, and when requested by the landowner or **District Engineer**, the new lot corners and the new right-of-way breaks shall be re-established under the construction contract by a licensed land surveyor hired by the contractor. This work shall consist of establishing new right-of-way breaks where **NDOR** has purchased additional right-of-way and re-establishing property corners on the new right-of-way line where, through work that occurred in the area, the monuments were destroyed.

7.D Access Control Fencing

When access control fencing is specified (as it is on all interstate and freeway projects), the fencing is run along the right-of-way line according to the policy set by the Standard Specifications for Highway Construction, Section 910 (Reference 15.5), (http://www.nebraskatransportation.org/ref-man/). The following exceptions and criteria should be kept in mind:

- Where there is a frontage road, the fence is placed between the frontage road and the mainline.
- Access fences should tie into the ends of box culverts or cattle passes.
- Fences should tie into the ends of existing fences and grade separation structures. Where the crossroad runs underneath, fences may run underneath the structure.

- If a portion of a utility line within the right-of-way may be left undisturbed, the access fence may be run inside the utility line so that it can be serviced.
- At all rural interchanges, access fencing should extend 500 ft. (150 m) along the cross road from the ramp termini.

For further information, see Chapter Ten: Miscellaneous Design Issues, Section 6.

7.E Relinquishment and Abandonment

When a segment of highway is relocated, the functional classification of the old highway will be changed. **NDOR** will offer to relinquish to the political or governmental subdivision(s) or public corporation(s), any portion of the old state highway that has been relocated. If an offer to relinquish a highway segment is not accepted by the local jurisdiction(s), the **State** may abandon it as provided by law. **NDOR** will relinquish the highway to the local agency after following the approved policy for relinquishment of highways. See Reference 15.6, (http://statutes.unicam.state.ne.us/Corpus/statutes/chap39/R3913013.html), Reference 15.7 (http://statutes.unicam.state.ne.us/corpus/chapall/chap39.html), and Nebraska Dept. of Roads' Operating Instruction 60-13, "Relinquishment of Roads from the Highway System", (Appendix F, "Selected NDOR Operating Instructions"), for additional information.

Before the highway is relinquished, the surfacing shall be brought up to the minimum standards of its new functional classification, (city street, county road, etc.), if necessary. The roadway designer has the responsibility of producing the necessary plans and estimates for any upgrades required before relinquishment, and has the responsibility for the preparation of the exhibits for the public hearing and of the agreements with the local government(s) regarding the relinquishments.

Early acceptance by the local government is important. A signed Covenant Relinquishment Agreement is required before the public hearing. If a public hearing is not held, the signed agreement and petition are needed before presenting the project to the **Highway Commission** for location approval (See Chapter Two: Roadway Design Process, Sections 10 and 21).

8. REFERENCES

15.1 Nebraska Department of Roads, Right-of-Way Manual, Current Edition. (http://www.nebraskatransportation.org/roway/pdfs/row-manual/index.pdf)

15.2 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf)

15.3 Revised Statutes of Nebraska, Section 39-1302, Paragraph (9), Reissue of 1993. (http://statutes.unicam.state.ne.us/Corpus/statutes/chap39/R3913002.html)

15.4 Nebraska Department of Roads, Access Control Policy to the State Highway System, Current Edition. (http://www.nebraskatransportation.org/roway/pdfs/accesscontrol.pdf)

15.5 State of Nebraska Department of Roads, Standard Specifications for Highway Construction, 1996 and current updates. (http://www.nebraskatransportation.org/ref-man/)

15.6 Statutes of Nebraska, Section 39-1313 (http://statutes.unicam.state.ne.us/Corpus/statutes/chap39/R3913013.html)

15.7 Statutes of Nebraska, Section 39-1314 (http://statutes.unicam.state.ne.us/corpus/chapall/chap39.html)

Nebraska Department of Roads
Operating Instruction 60-4
April 12, 2000

PROJECT NUMBERING

1. **Purpose:** To provide policy for numbering highway construction projects. The office of primary responsibility is the Project Scheduling and Program Management Section. This DOR-OI supersedes DOR-OI 60-4 dated February 26, 1993.

2. All project numbers assigned since 1972 consist of three major parts:

A. In part one, the **Prefix** indicates the appropriation type or the highway system. See attachment #1.

B. The second part is the **Route Number/Zone** field, consisting of not more than four digits. For projects on the state highway system, the first three digits are the state highway **route number**. The final digit is the **zone** of the route in which the project begins. Zones are established for the state from west to east and from south to north. Each state highway is assigned a direction for zoning purposes. Zones for the interstate system differ from those on the rest of the highway system. See attachments #3 and #4. Projects off the highway system, but on a federal-aid route, use the four digit federal-aid route number as the second part of the project number. For projects off the state highway system, all four digits are in a single entity and have no relationship to highway route numbers or zones. They instead reference the county or indicate that the project is statewide.

C. Part three is the **Unit** number consisting of not more than four digits. Numbering is sequential within each zone by highway route number. Projects not on the highway system and federal-aid interstate projects begin their sequential series with number 1. Other federal-aid projects on the highway system begin their series with number 101. Highway system projects not using federal funds (including interstate) begin their series with 1001. Projects that contain four digits in part three of their project number ***do not*** involve federal funds.

When inputting project numbers into the various computer systems (PPM, PSS), an eight character standard is used, consisting of the 4 digit Route/Zone field and the 4 digit Unit field. Prefixes, dashes and parenthesis are omitted and preceding zeros are used as placeholders, e.g.: EACIM-80-4(110) is coded as 08040110.

Prefix	Route Number	Zone	Unit	Written On Plans and Other Documents	Input into PPM, PSS, Etc.
STPD	26	1	102	STPD-26-1(102)	02610102
BRO	7084		5	BRO-7084(5)	70840005
STPP	STWD*		25	STPP-STWD(25)	STWD0025

*Note that STWD references the location of the project (statewide) and is not part of the prefix.

3. The general types of project numbers include:

A. Projects on the state highway system are numbered using the highway number, zone and sequential number (in parenthesis), e.g.: NH-2-3(112). Projects on links and spurs use the state spur/link number and a sequential number, e.g.: STPD-S55G(101).

B. Urban system projects in cities of 5,000 or more population use the urban system (5000-6000 series) and the sequential number, e.g.: STPD-5044(3).

C. Federal-aid secondary system projects off the state highway system (major and minor collectors) use the system number and a sequential number, e.g.: STPE-2755(2). Major collectors are numbered from 2000-3000, and minor collectors have a 7000 series number.

D. Projects not on a federal-aid system use the county number and a sequential number, e.g.: STPB-55(110). Off-system county bridge projects use the county number preceded by “70” and a sequential number, e.g.: BRO-7055(125).

E. There are other miscellaneous projects, particularly those with federal-aid special funding, which use project numbers not included in these general guidelines. These numbers are assigned by FHWA and have no correlation to our numbering system.

Attachments:
#1 - Project Prefix Letters
#2 - Zone Map
#3 - Interstate Zones
#4 - Highway Numbers by Direction

Monty W. Fredrickson
Deputy Director-Engineering

Project Prefixes

Project Prefixes Federal-Aid Project Prefixes

Regular appropriation codes are shown for both the current (TEA-21) and previous (ISTEA) highway acts for reference.

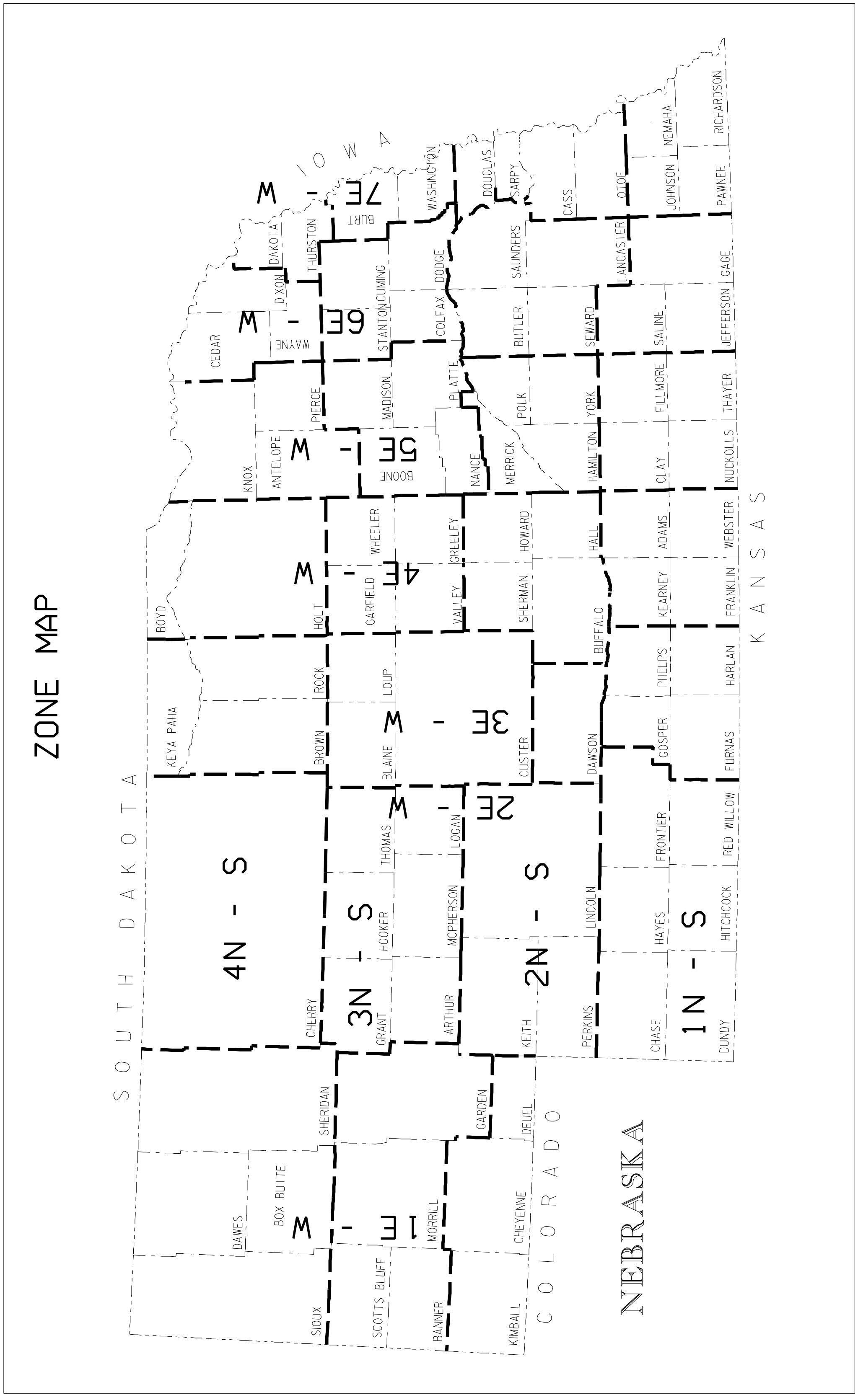
		Appropriation Code			
Prefix	**Description**	**TEA-21 FY-98**	**ISTEA (FY92-97)**	**Advance Const. (EAC)**	**Federal Participation Rate**
IM	*Interstate Maintenance:* Resurfacing, rehabilitation or reconstruction of the interstate system. May *not* be used to add capacity.	Q01	04M	0AB	90%
NH	*National Highway System:* Used only on highways designated as part of the National Highway System, including the Interstate.	Q05	315	0AC	80% (90% on the interstate if not used to add capacity)
BR BH	*Federal-Aid Bridge – On System:* Replacement (BR) or rehabilitation (BH) of bridges on the federal-aid highway system.	Q10 Q12	118 114	00F	80%
BRO BHO	*Federal-Aid Bridge – Off System:* Replacement (BRO) or rehabilitation (BHO) of off-system bridges.	Q11 Q12	117 114	00E	80%
Surface Transportation Program – Suballocations					
STPD	*Any area:* Generally used on federal-aid highways not on the NHS or interstate. (However, it can be used on those systems and any other systems for any of the purposes described in the following STP Suballocations.)	Q24	33D	0AW	80% (90% on the interstate if not used to add capacity)
STPP	*Safety – Hazard Elimination:* Safety Improvements on any public road.	Q28	33P	0BC	80%
STPM	*Safety – Rail-Highway Crossings, Protective Devices:* Signals, gates, etc.	Q26	33M	0BA	80%
STPN	*Safety – Rail-Highway Crossings, Hazard Elimination:* Replacement of at-grade crossings with grade separation structures.	Q27	33N	0BB	80%
STPA	*Safety – Optional:* May be used for work described in any of the above three safety categories.	Q21	33A	0AR	80%
STPE	*Non-Urban Areas:* Allocated to counties for work on rural major and minor collector routes.	Q25	33E	0AX	80%
STPAA	*Urban Areas:* Allocated to first class cities (5,000 – 200,000 population.)	Q20	3AA	0BD	80%
STPC	*Urbanized Areas:* Allocated to cities with 200,000+ population.	Q23	33C	0AV	80%
STPB	*Transportation Enhancement:* Used for various enhancement activities, such as: --Providing pedestrian/bicycle/equestrian facilities --Acquisition of scenic/historic sites --Landscaping and other scenic beautification --Rehabilitation and operation of historic transportation buildings/structures --Preservation of abandoned railroad corridors --Archeological planning and research	Q22	33B	0AU	80%

Project Prefixes

		Appropriation Code			
Prefix	**Description**	**TEA-21 FY-98**	**ISTEA (FY92-97)**	**Advance Const. (EAC)**	**Federal Participation Rate**
Other Miscellaneous Categories					
CM	*Congestion Mitigation and Air Quality:* Intended for use on projects to improve air quality and reduce congestion. Nebraska has no "non-attainment" areas, so it may be used for any STP or CM eligible project.	Q40	320	0AD	80%
IMD	*Interstate Maintenance Discretionary:* Special funds that may be allocated to states on a year-by-year basis. May be used for resurfacing, rehabilitating or reconstructing the interstate, including work that adds capacity.	Q02	31B		90%
B1A	*Bureau of Indian Affairs:* Projects on federal Indian reservations (Funds administrated by BIA)				80%
SPR	*State Planning and Research:* State planning and/or development and technology transfer (RD&T) activities.	Q55 Q56	081 086	0B5 0AP	80%
PL	*Metropolitan Planning:* Allocated to metropolitan planning areas to carry out the transportation planning process required by federal law.	Q45	085	0BE	80%
PLH FL	*Public Land Highways – Discretionary and Forest Highways:* Projects within, adjacent to or providing access to areas served by public lands or forest highway.	413 414	19A		100%
DPS	*High Priority Projects:* Specific projects identified in the TEA-21.	Q90 Q92		0AG	80%
OM-AD	*Defense Access Roads:* Roads identified as needed for defense activities (missile roads.)	72__	72__		100%
ER	*Emergency Relief:* Emergency repairs and restoration of federal aid highways damaged by natural disasters.	098 099			80-100%
NCPD	*National Corridor Planning and Development Program:* Discretionary funds granted for planning, design and construction of corridors of national significance.				80%
SB	*Scenic Byways:* Planning, design and development of scenic byways programs.	Q97			80%

Project Prefixes

Federal-aid project prefixes used with previous highway acts		
Prefix	**Description**	**Appropriation Code**
TBCG	Timber Bridge Construction Grant	11P
DE, DPU	Demonstration Funds	362,363,366,367
F	Consolidated Primary	010
I	Interstate	042
IR	Interstate 4R	050
M	Urban System	W-32, W-36
RS	Rural Secondary	075
RRS	Rail-Highway Crossing – Hazard Elimination	138
RRP	Rail-Highway Crossing – Protective Devices	139
HES	Highway – Hazard Elimination	141
BWD	Bikeway Demonstration	633
RR	Railroad-Highway Crossing Demonstration	697
DP	Economic Growth Center	106
State Funded Project Prefixes		
Prefix	**Description**	**Comments**
5	Resurfacing, rehabilitation or reconstruction of state highways.	100% State Highway Cash Fund
SRR	Resurfacing, rehabilitation or reconstruction of roads into or within state parks and recreational areas.	100% SRR funds for roads within parks; 90% SRR, 10% county funds for exterior roads
NFG	State grade crossing funds used for crossing protective devices and closures.	100% NFG funds
TMT	*Train Mile Tax:* State tax on rail traffic used for constructing, rehabilitating, relocating or modifying railroad grade separation facilities.	Maximum 95% TMT funds to be used on any project
RD	Small projects of one or more of the following types: road profiling, armor coat, fog seal, maintaining municipal connecting links, joint and crack filling, asphalt and concrete patching.	100% State Highway Cash Fund
STR	Small projects involving structure work such as concrete box culvert construction, bridge deck repair and/or overlay, bridge structure repair and bridge deck preservation.	100% State Highway Cash Fund
MISC	Small projects involving such things as concrete slope protection, culvert repair, landscaping, intersection modification, channel structures, pedestrian walkways, scenic overlooks and minor grading.	100% State Highway Cash Fund
ELEC	Small electrical projects such as lighting, pedestrian signals and traffic signals.	100% State Highway Cash Fund


ZONE MAP
NEBRASKA
SOUTH DAKOTA
IOWA
KANSAS
COLORADO
1E - W
2E - W
3E - W
4E - W
5E - W
6E - W
7E - W
1N - S
2N - S
3N - S
4N - S
SIOUX
DAWES
BOX BUTTE
SHERIDAN
SCOTTS BLUFF
MORRILL
BANNER
GARDEN
DEUEL
CHEYENNE
KIMBALL
CHERRY
GRANT
HOOKER
THOMAS
ARTHUR
MCPHERSON
LOGAN
KEITH
PERKINS
LINCOLN
CHASE
HAYES
FRONTIER
DUNDY
HITCHCOCK
RED WILLOW
KEYA PAHA
BROWN
BLAINE
CUSTER
DAWSON
GOSPER
FURNAS
BOYD
ROCK
LOUP
HOLT
GARFIELD
WHEELER
VALLEY
GREELEY
SHERMAN
HOWARD
BUFFALO
HALL
KEARNEY
ADAMS
PHELPS
HARLAN
FRANKLIN
WEBSTER
KNOX
ANTELOPE
PIERCE
BOONE
MADISON
NANCE
MERRICK
PLATTE
POLK
HAMILTON
YORK
CLAY
NUCKOLLS
FILLMORE
THAYER
CEDAR
WAYNE
DIXON
DAKOTA
THURSTON
STANTON
CUMING
BURT
COLFAX
DODGE
WASHINGTON
DOUGLAS
SARPY
BUTLER
SAUNDERS
SEWARD
SALINE
JEFFERSON
GAGE
LANCASTER
CASS
OTOE
JOHNSON
NEMAHA
PAWNEE
RICHARDSON

INTERSTATE ZONES

Zone No.	Location	Interstate Route No.
1	Wyoming State Line – Sidney	80
2	Sidney – I-76	80
3	I-76 – North Platte	80,76
4	North Platte – Lexington	80
5	Lexington – Kearney	80
6	Kearney – Grand Island	80
7	Grand Island – York	80
8	York – West Lincoln	80
9	West Lincoln – Iowa State Line	80, 180, 480, 680
1	South Sioux City – Iowa State Line	129

Attachment #3

HIGHWAY NUMBERS BY DIRECTION

Highway No.	Highway Direction	Highway No.	Highway Direction	Highway No.	Highway Direction
1	West-East	39	South-North	84	West-East
2	West-East	40	West-East	85	South-North
4	West-East	41	West-East	87	South-North
5	South-North	43	South-North	88	West-East
6	West-East	44	South-North	89	West-East
7	South-North	45	South-North	91	West-East
8	West-East	46	South-North	92	West-East
9	South-North	47	South-North	94	West-East
10	South-North	50	South-North	95	West-East
11	South-North	51	West-East	97	South-North
12	West-East	52	South-North	98	West-East
13	South-North	53	South-North	99	South-North
14	South-North	56	West-East	103	South-North
15	South-North	57	South-North	105	South-North
16	South-North	58	South-North	109	South-North
17	South-North	59	West-East	110	South-North
18	West-East	61	South-North	112	South-North
19	South-North	62	West-East	116	South-North
20	West-East	63	South-North	121	South-North
21	South-North	64	West-East	128	West-East
22	West-East	65	South-North	131	South-North
23	West-East	66	West-East	133	South-North
24	West-East	67	South-North	136	West-East
25	South-North	68	South-North	137	South-North
* 25A	South-North	69	South-North	138	South-North
26	West-East	70	West-East	159	West-East
27	South-North	71	South-North	183	South-North
29	South-North	73	South-North	250	South-North
30	West-East	74	West-East	275	West-East
31	South-North	75	South-North	275B	West-East
32	West-East	77	South-North	281	South-North
33	West-East	78	South-North	283	South-North
34	West-East	79	South-North	370	West-East
35	South-North	81	South-North	385	South-North
36	West-East	83	South-North		
38	West-East				

* Highway 25A will be considered as Highway 259 for programming purposes.

APPENDIX B
GUARDRAIL DESIGN EXAMPLES

4 LANE DIVIDED HIGHWAY / 40' MEDIAN

OPTION ONE:	12.5 Bullnose, 15: Taper Traffic Side, Parallel Offside Bridges not Connected
OPTION TWO:	12.5 Bullnose, Parallel Installation Bridges not Connected
OPTION THREE:	Parallel W-Beam Guardrail Installation
OPTION FOUR A:	12.5 Bullnose, 15:1 Taper Traffic Side, 7.4:1 Taper Offside Connect Parallel Bridges
OPTION FOUR B:	12.5 Bullnose, 15:1 Taper Traffic Side, 7.4:1 Taper Offside Connect Bridges, R.H.B. Skew
OPTION FOUR C:	12.5 Bullnose, 15:1 Taper Traffic Side, 7.4:1 Taper Offside Connect Bridges, L.H.B. Skew
DO NO USE:	15:1 Taper Both Sides Bridges not Connected

PIER PROTECTION IN A MEDIAN

4 LANE DIVIDED HIGHWAY / 64' MEDIAN OR WIDER

IMPACT ATTENUATOR INSTALLATION

TYPICAL IMPACT ATTENUATOR INSTALLATIONS

BRIDGE CONNECTION DESIGN: 2 LANE TANGENT ROADWAYS

BRIDGE CONNECTION DESIGN: 2 LANE TANGENT ROADWAYS, NARROW BRIDGE

BRIDGE CONNECTION DESIGN: 2 LANE CURVED ROADWAYS; R > 2860' (900 m)

BRIDGE CONNECTION DESIGN: 2 LANE CURVED ROADWAYS; R ≤ 2860' (900 m)

SEMI-RIGID GUARDRAIL INSTALLATION AT CULVERTS: 2-LANE TANGENT ROADWAYS

CABLE GUARDRAIL INSTALLATION AT CULVERTS: 2-LANE TANGENT ROADWAYS

SEMI-RIGID GUARDRAIL DESIGN, 3R DESIGN STANDARD: 2-LANE TANGENT ROADWAYS

CABLE GUARDRAIL DESIGN, 3R DESIGN STANDARD: 2-LANE TANGENT ROADWAYS

SEMI-RIGID GUARDRAIL DESIGN, 3R DESIGN STANDARD: CURVED ROADWAYS; R > 2860' (900 m)

SEMI-RIGID GUARDRAIL DESIGN, 3R DESIGN STANDARD: CURVED ROADWAYS; R ≤ 2860' (900 m)

MINIMUM GUARDRAIL FOR LOW SPEED BRIDGE CONNECTION

MINIMUM GUARDRAIL OFFSETS WHEN ADJACENT TO A FIXED OBSTACLE

CABLE GUARDRAIL TRANSITION TO W-BEAM GUARDRAIL

DROPPING THE CURB IN ADVANCE OF THE GUARDRAIL

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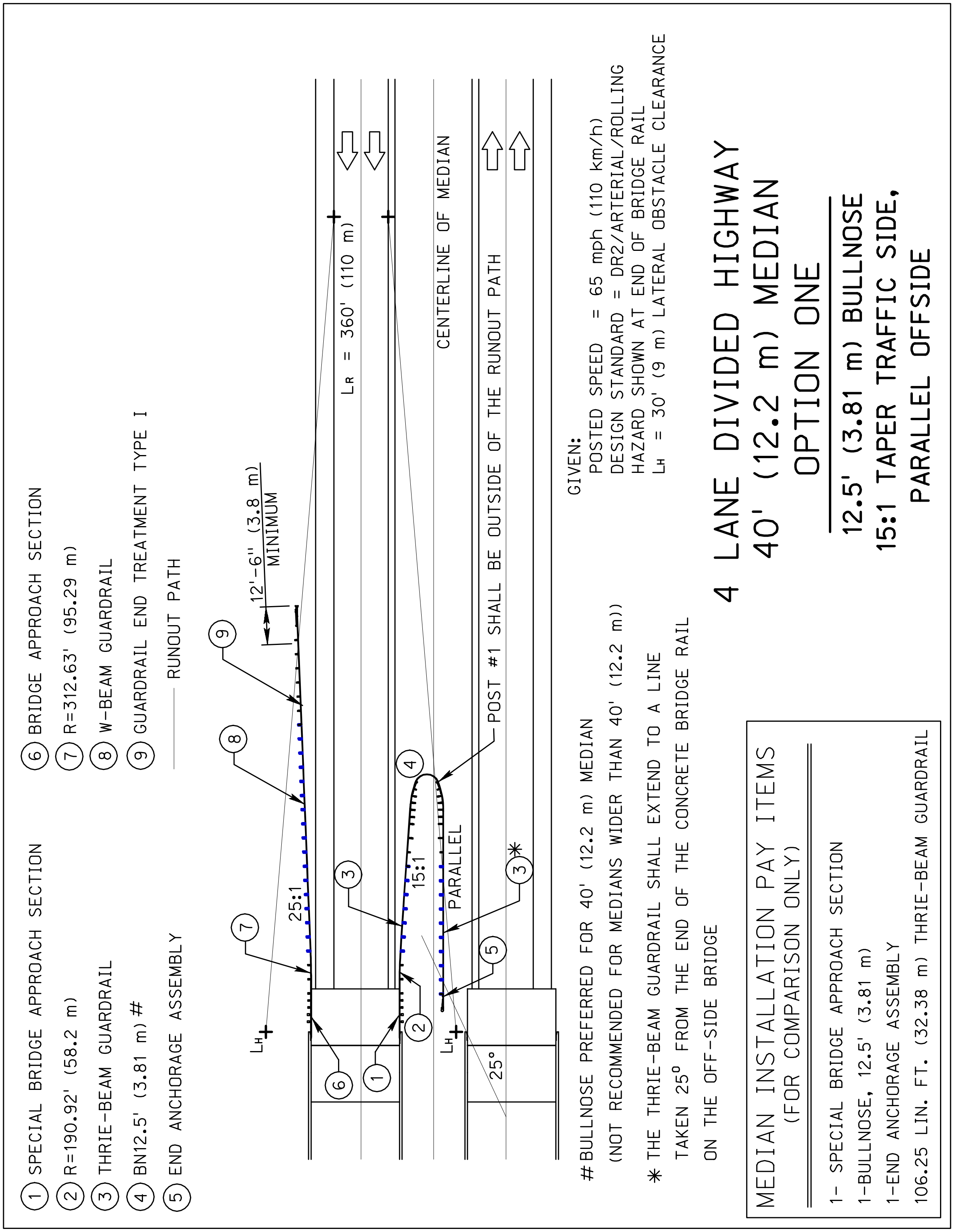


Exhibit B.1
Guardrail for Bridge Connection in a 40' (12.2 m) Median: Option One
Tapered Bullnose, Bridges not Connected

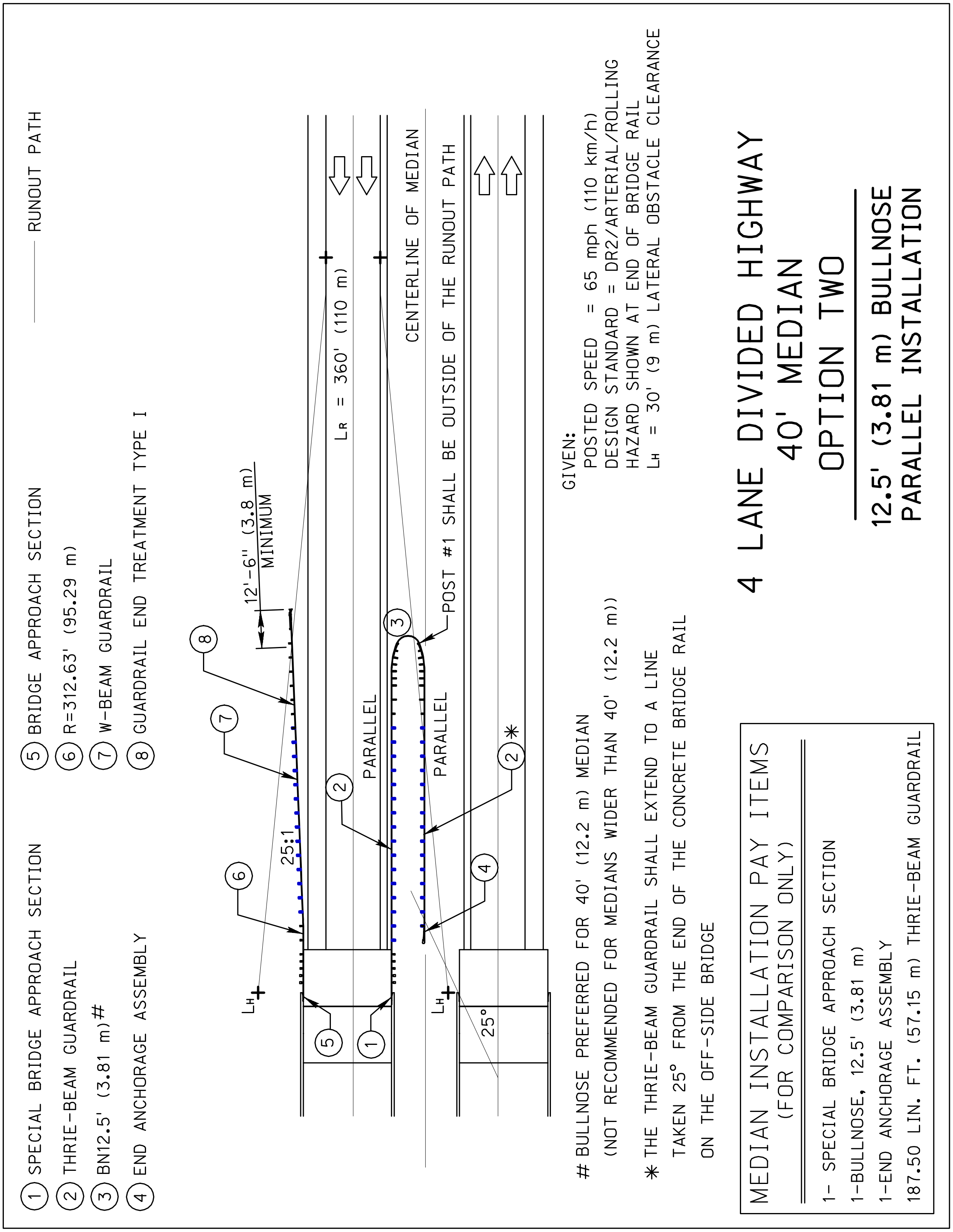


Exhibit B.2
Guardrail for Bridge Connection in a 40' (12.2 m) Median: Option Two
Parallel Bullnose, Bridges not Connected

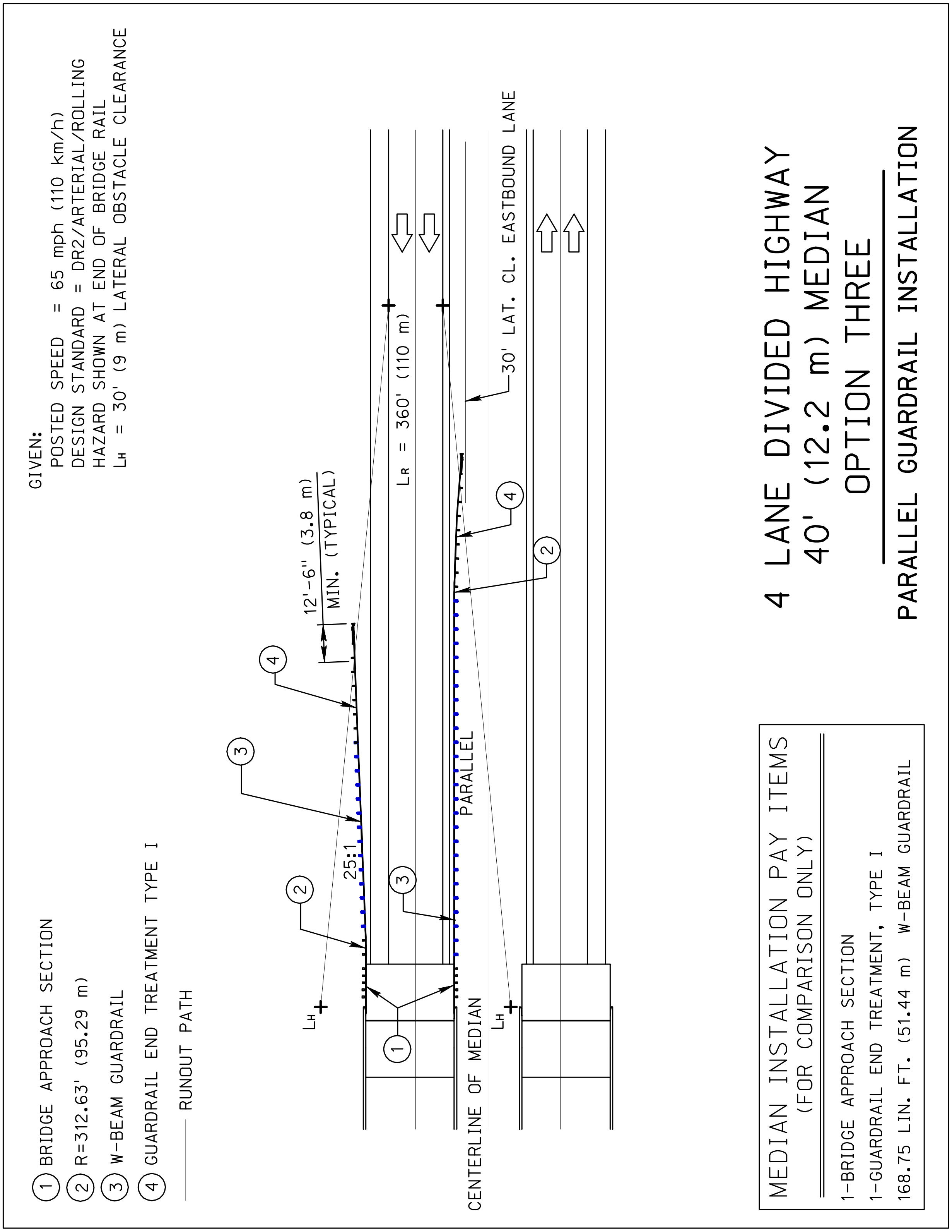


Exhibit B.3
Guardrail for Bridge Connection in a 40' (12.2 m) Median: Option Three
Parallel W-Beam Guardrail Installation

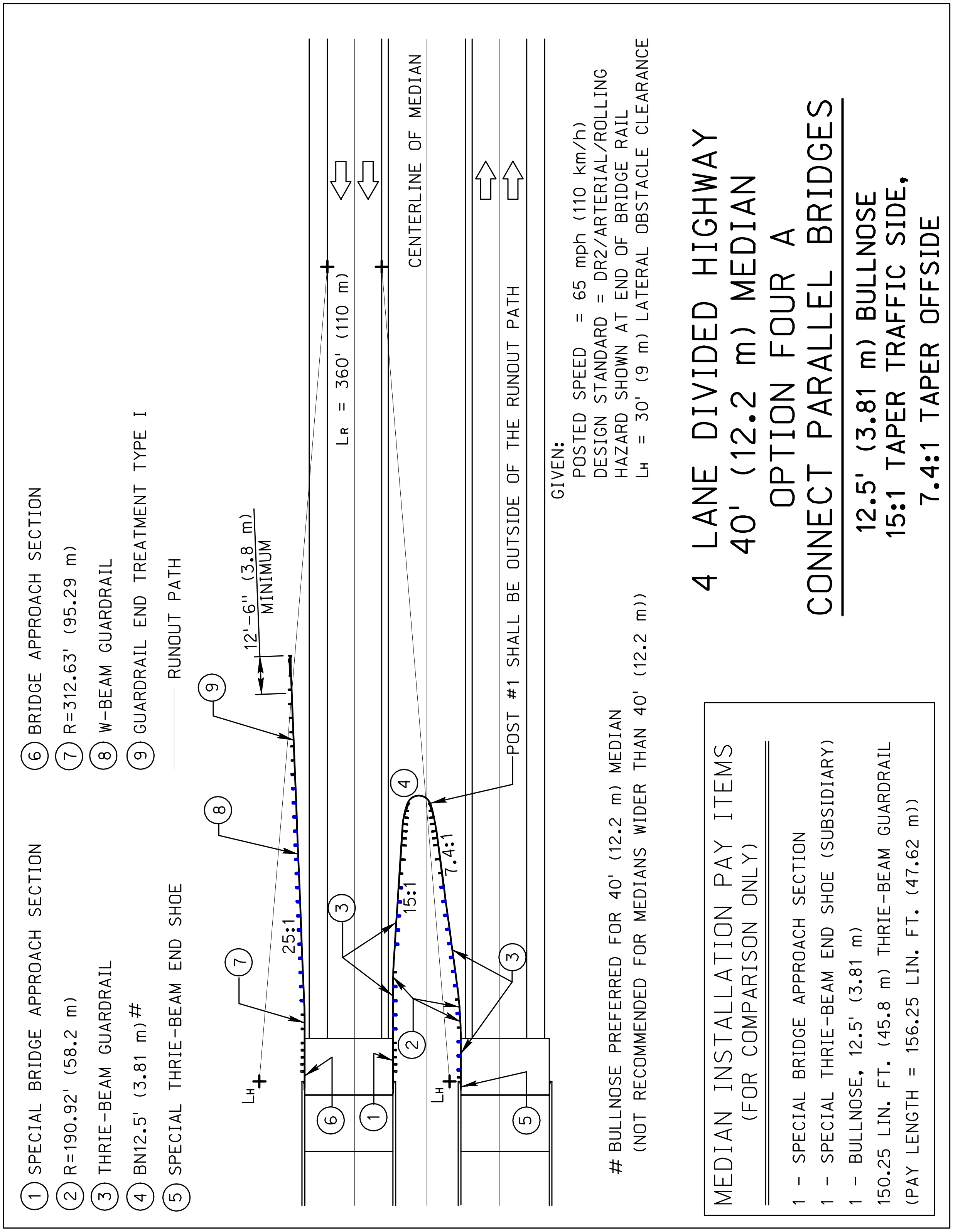


Exhibit B.4
Guardrail for Bridge Connection in a 40' (12.2 m) Median: Option Four A
Tapered Bullnose, Bridges Connected

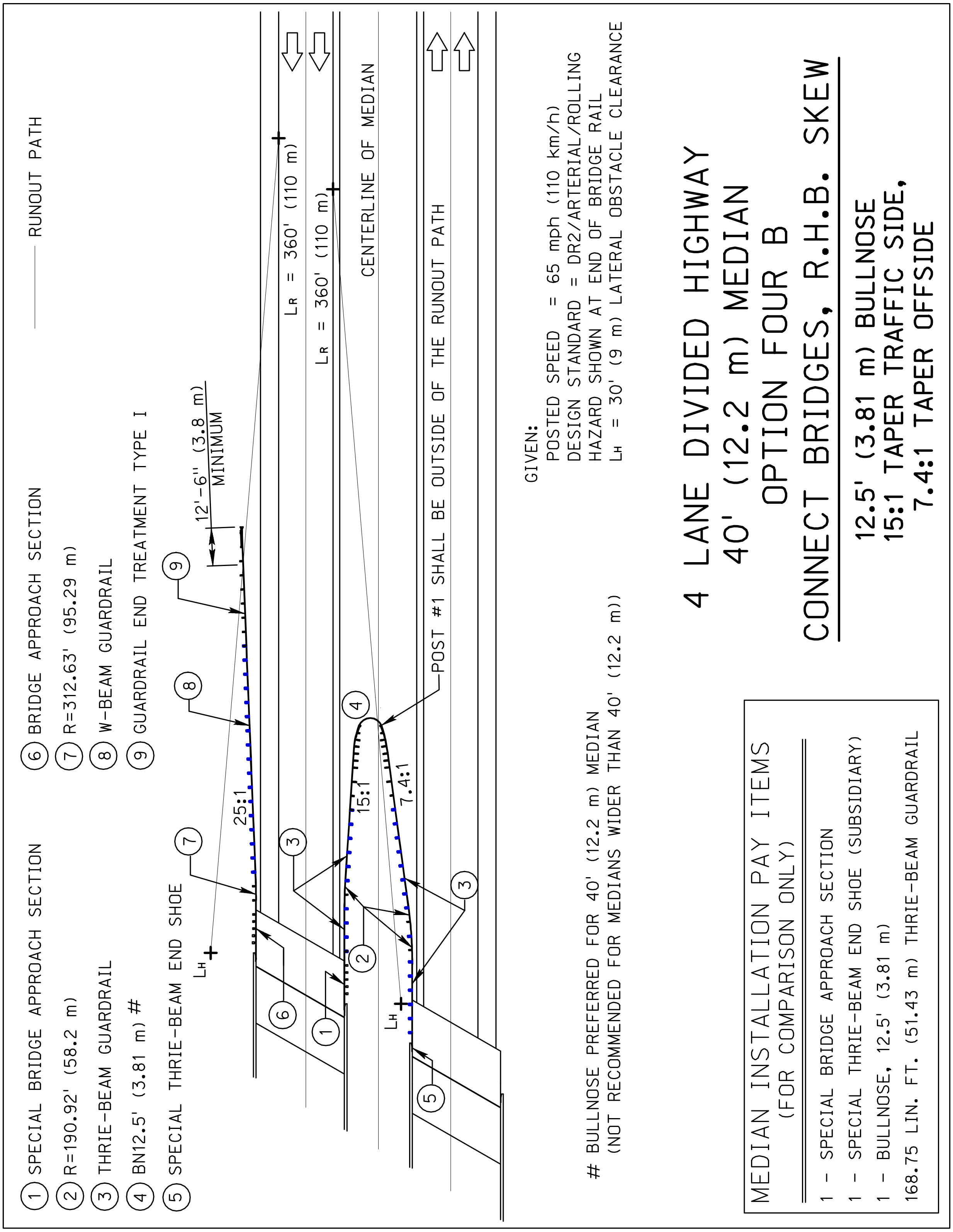


Exhibit B.5
Guardrail for Bridge Connection in a 40' (12.2 m) Median: Option Four B
Right-Hand-Back Skew, Tapered Bullnose, Bridges Connected

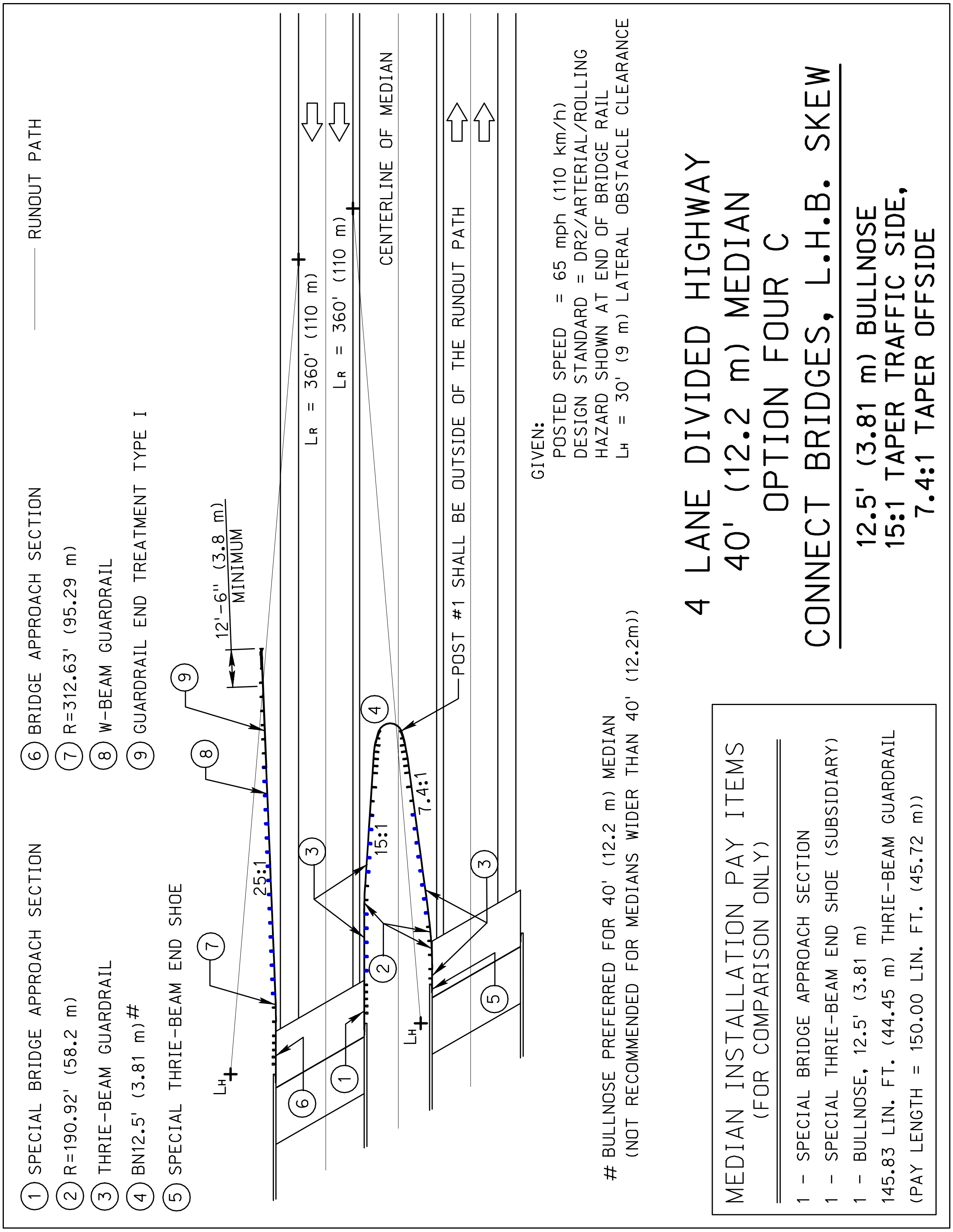


Exhibit B.6
Guardrail for Bridge Connection in a 40' (12.2 m) Median: Option Four C
Left-Hand-Back Skew, Tapered Bullnose, Bridges Connected

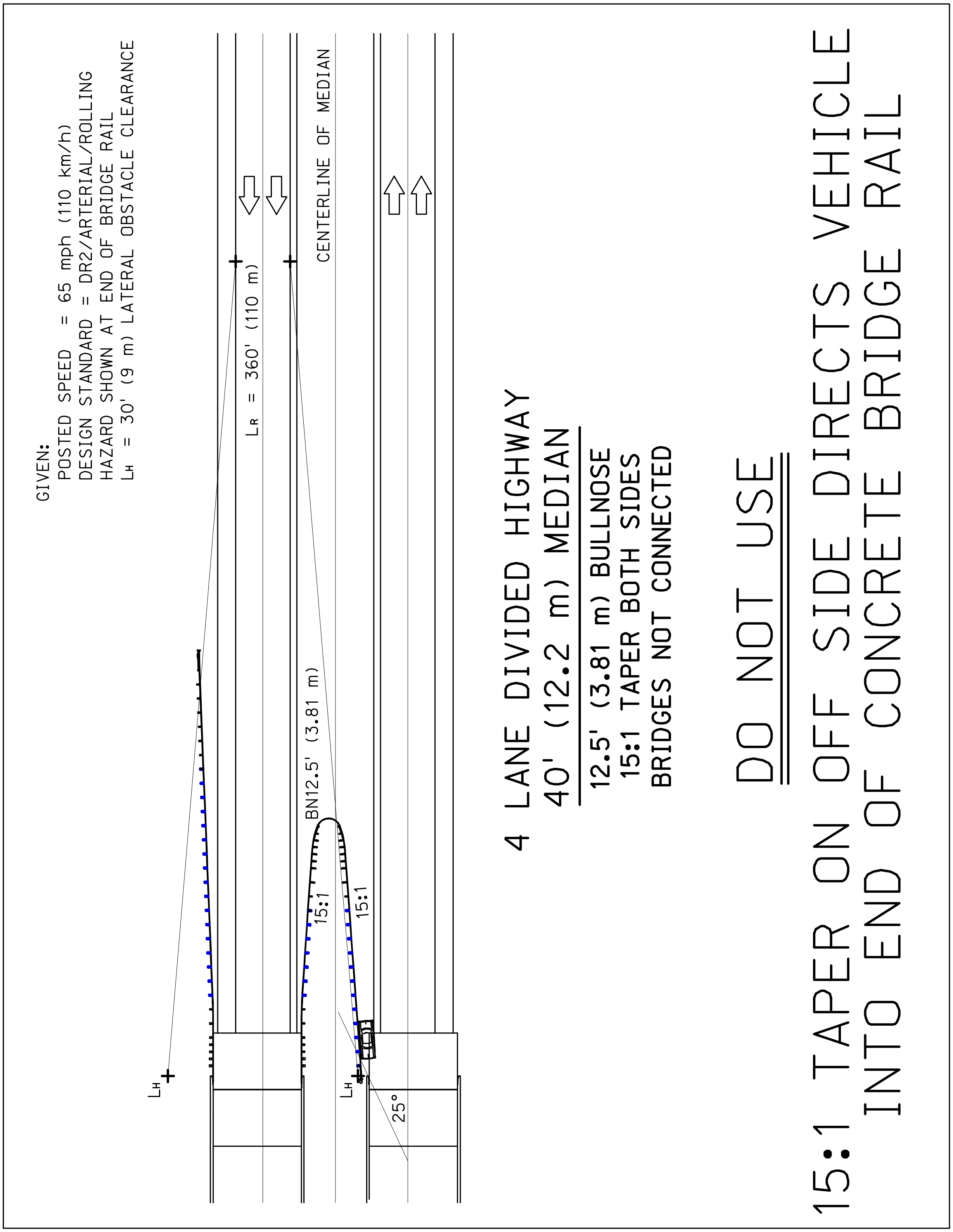


Exhibit B.7
Guardrail for Bridge Connection in a 40’ (12.2 m) Median
Do Not Use

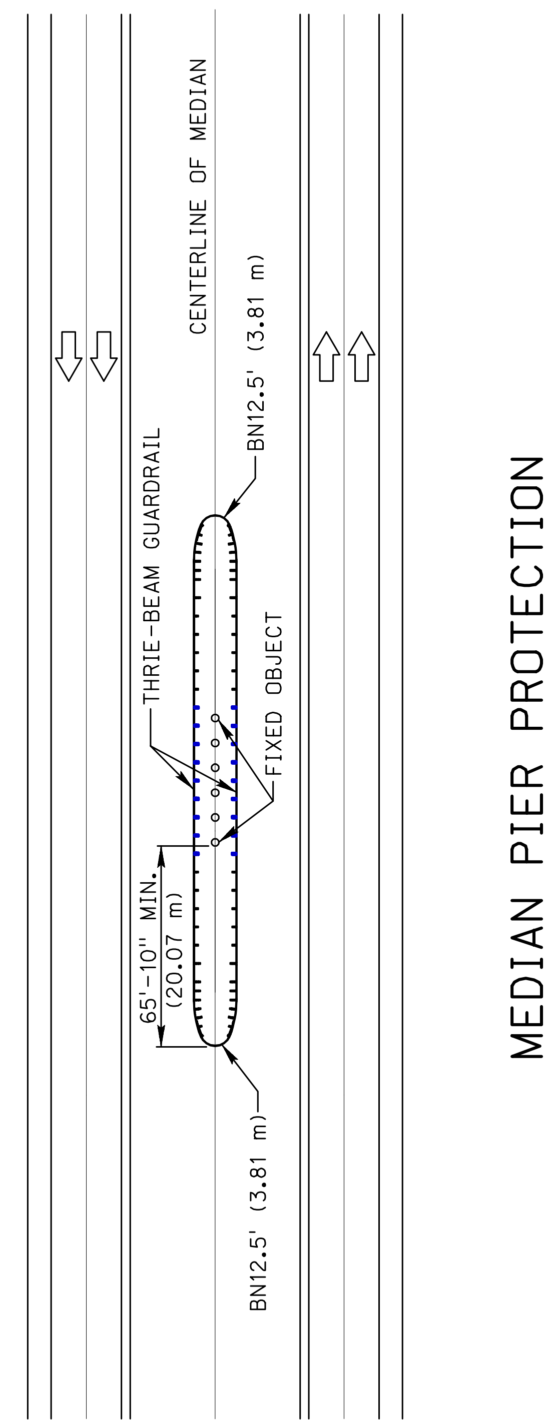


Exhibit B.8
Guardrail Design for Pier Protection in a Median

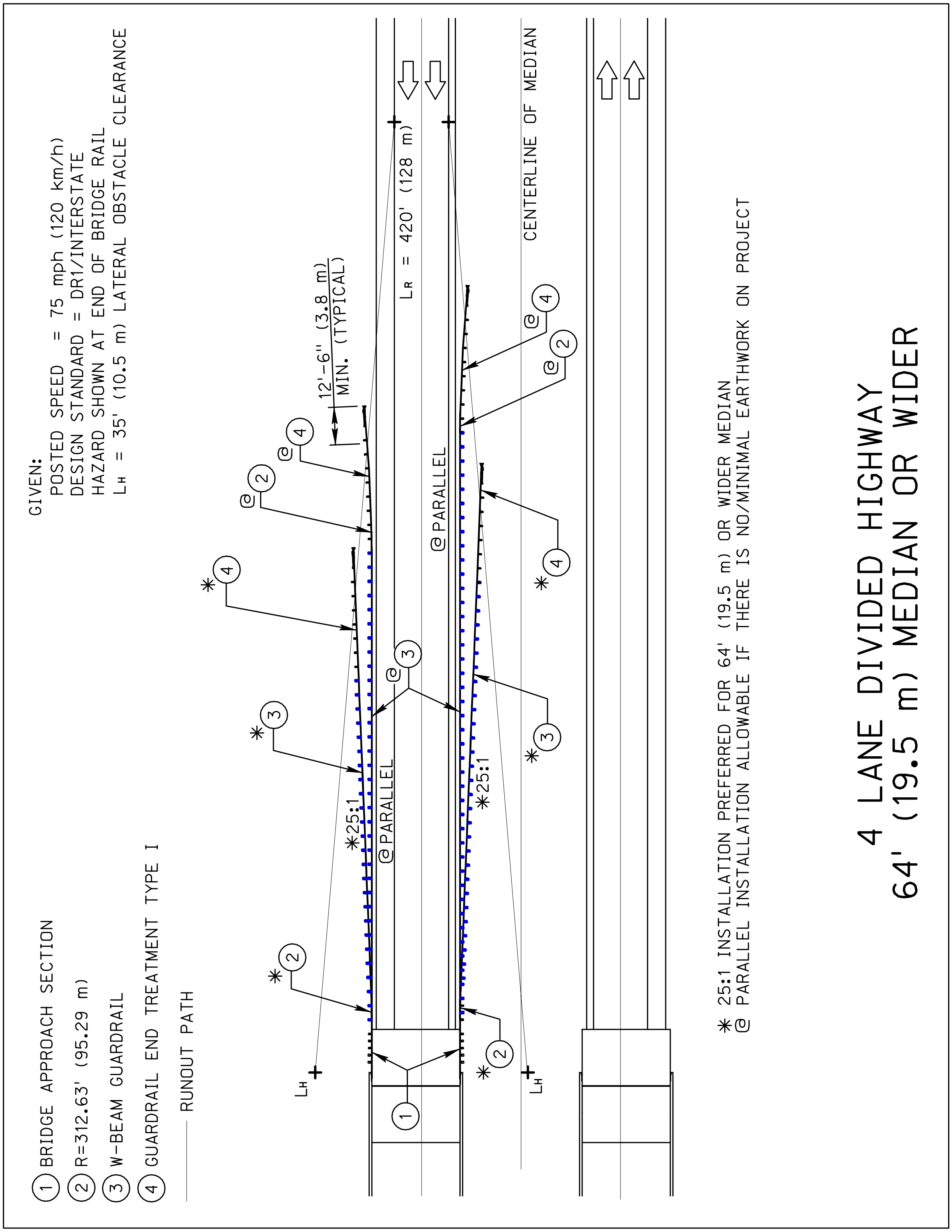


Exhibit B.9
Guardrail for Bridge Connection in a 64' (19.5 m) Median

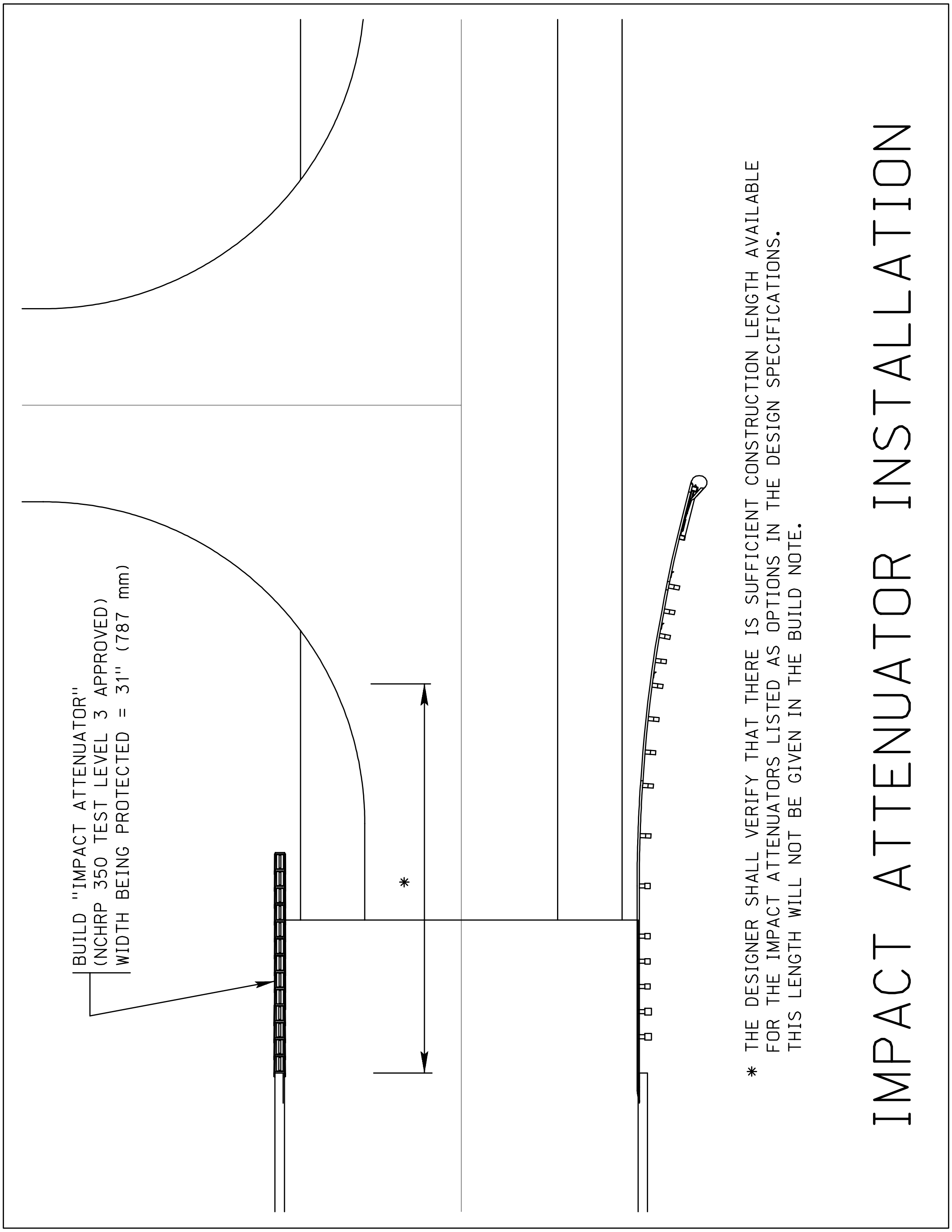


Exhibit B.10
Impact Attenuator Installation

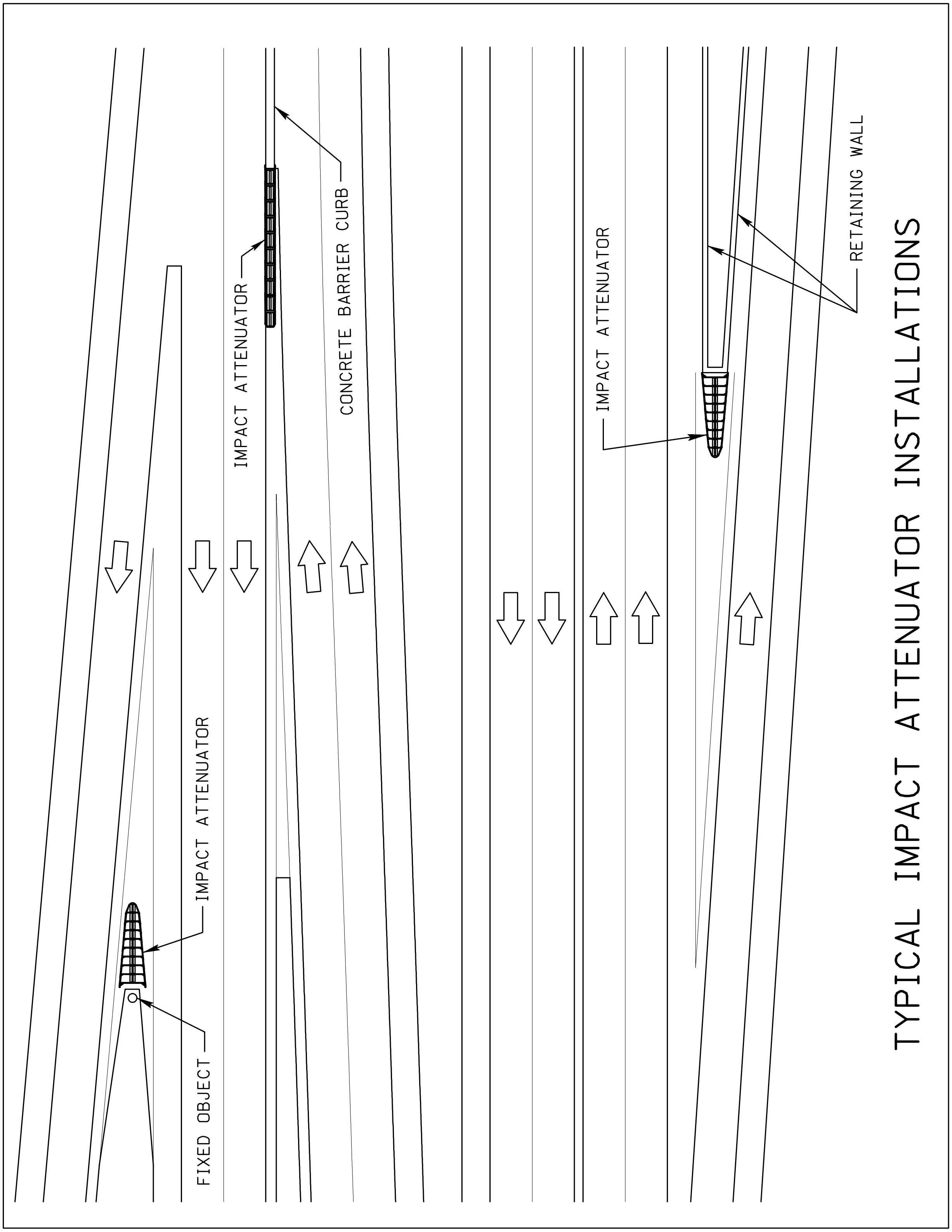


Exhibit B.11
Example of Impact Attenuator Installations

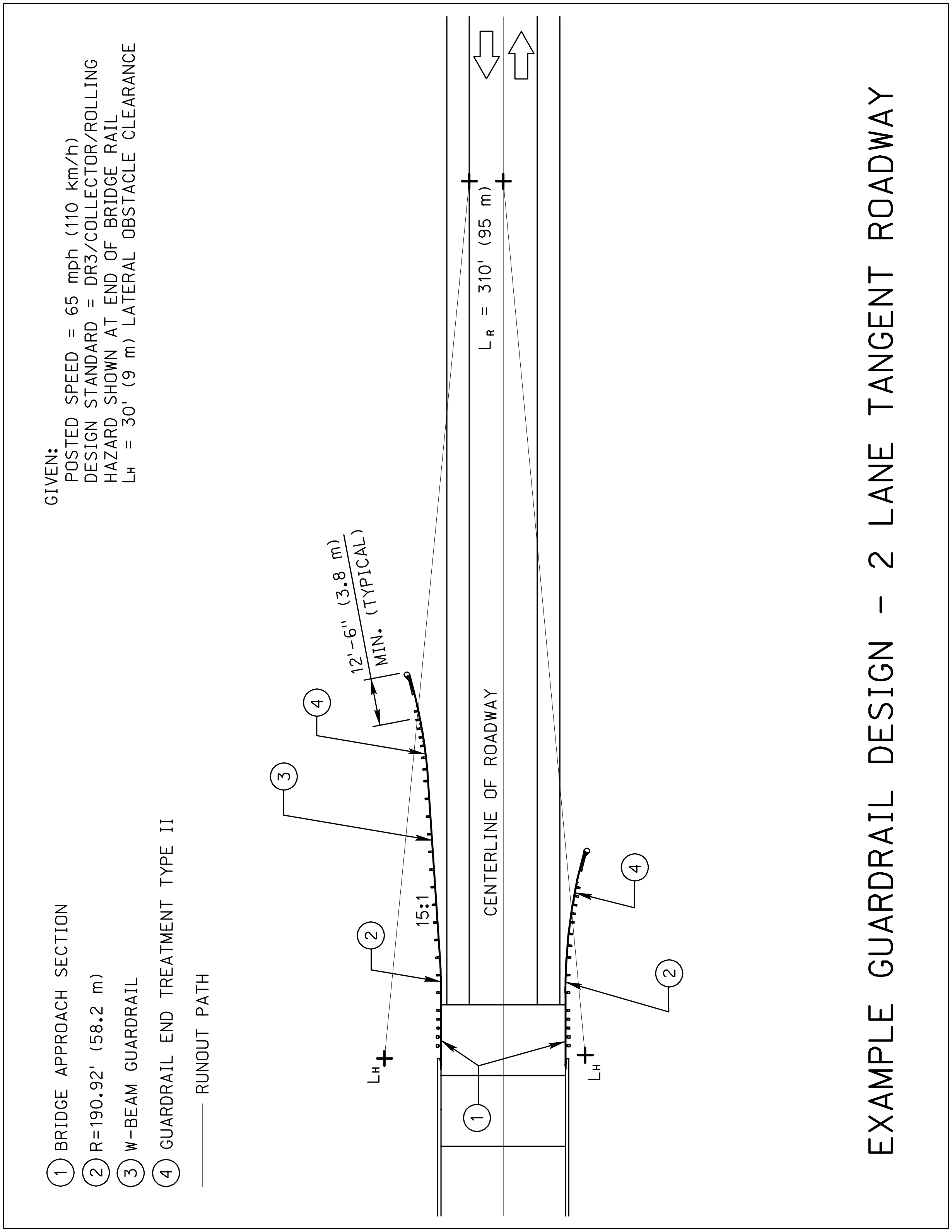


Exhibit B.12
Example Guardrail Bridge Connection Design:
2-Lane Tangent Roadways

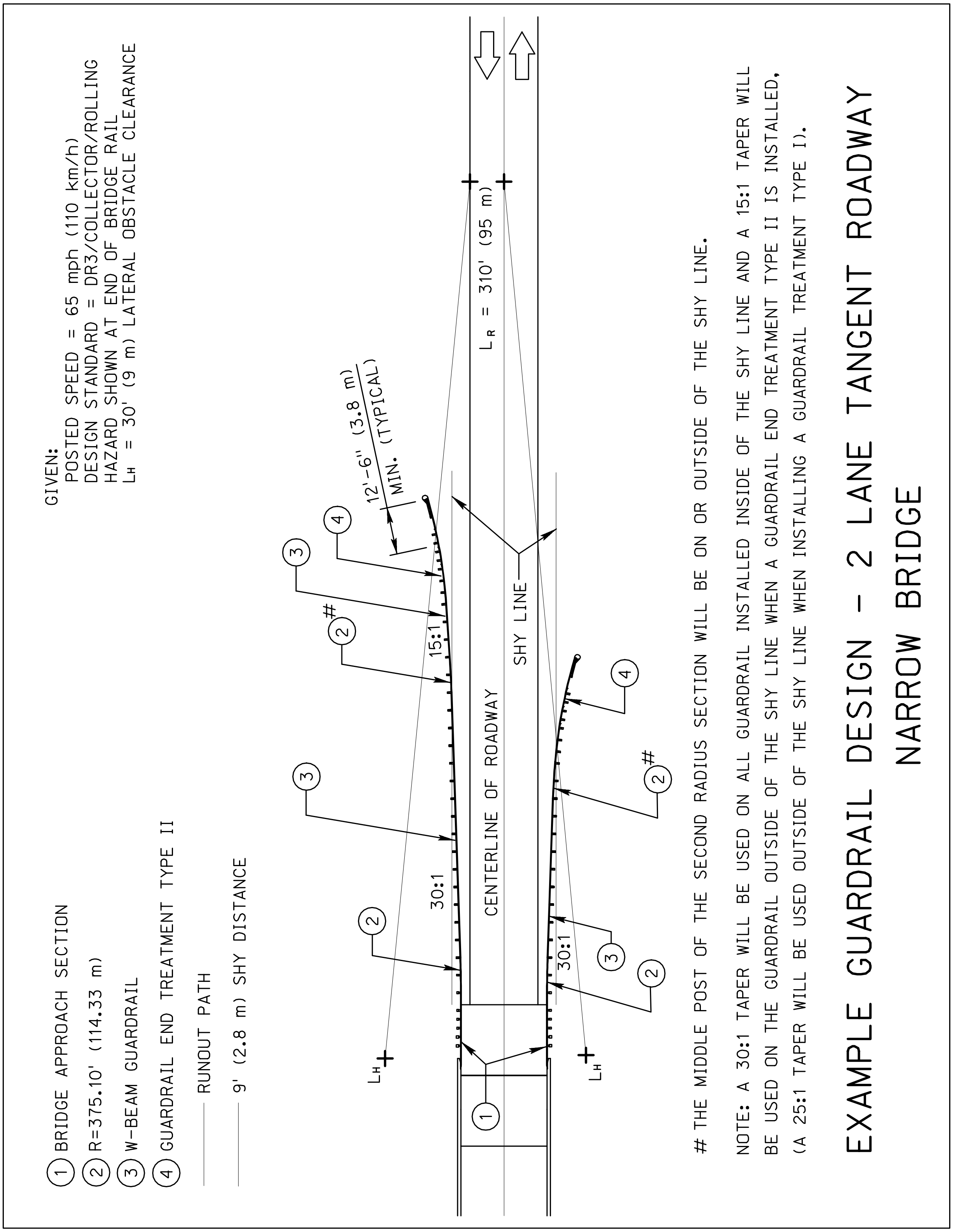


Exhibit B.13
Example Guardrail Bridge Connection Design:
2-Lane Tangent Roadways, Narrow Bridge

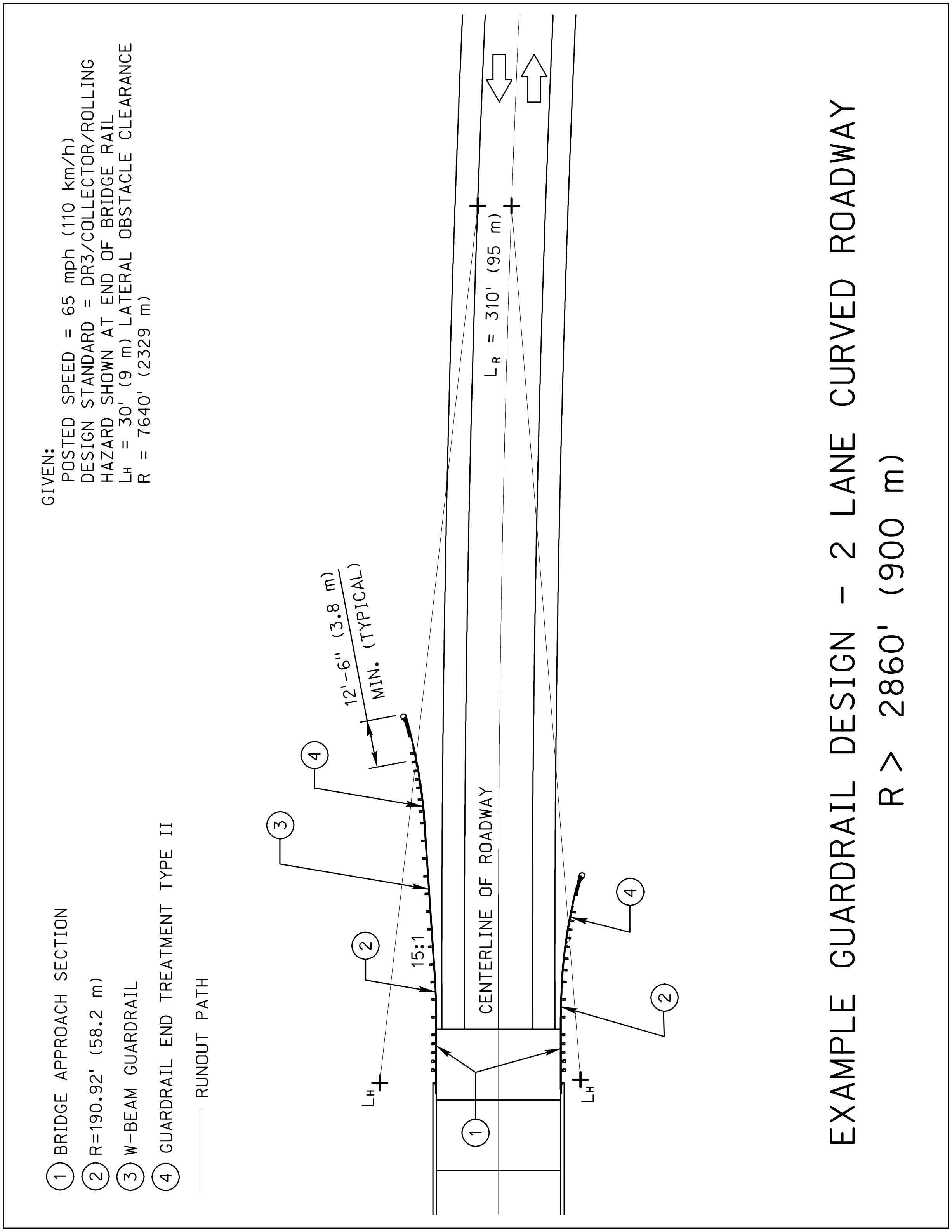


Exhibit B.14
Example Guardrail Bridge Connection Design:
2-Lane Curved Roadways; R > 2860' (900 m)

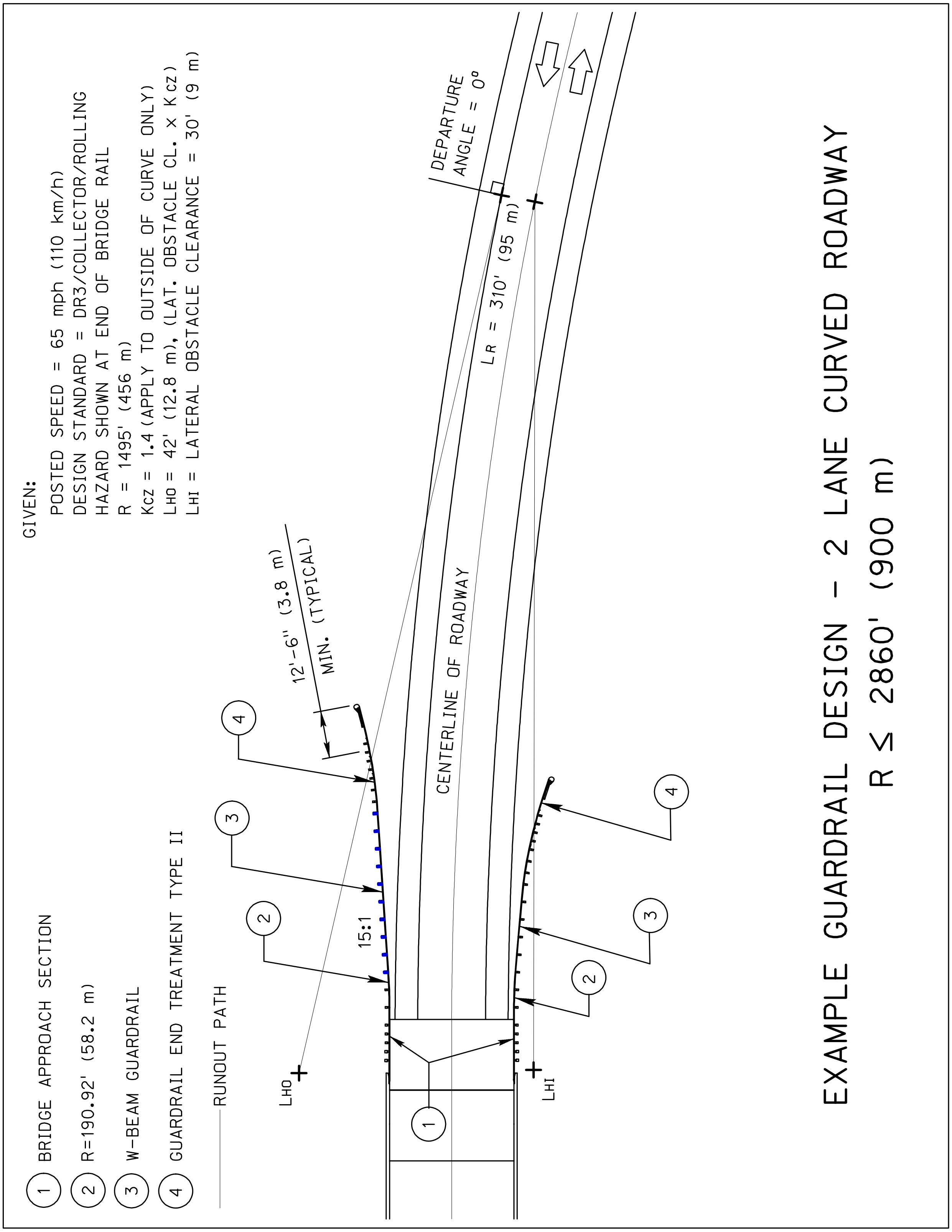


Exhibit B.15
Example Guardrail Bridge Connection Design:
2-Lane Curved Roadways; R ≤ 2860' (900 m)

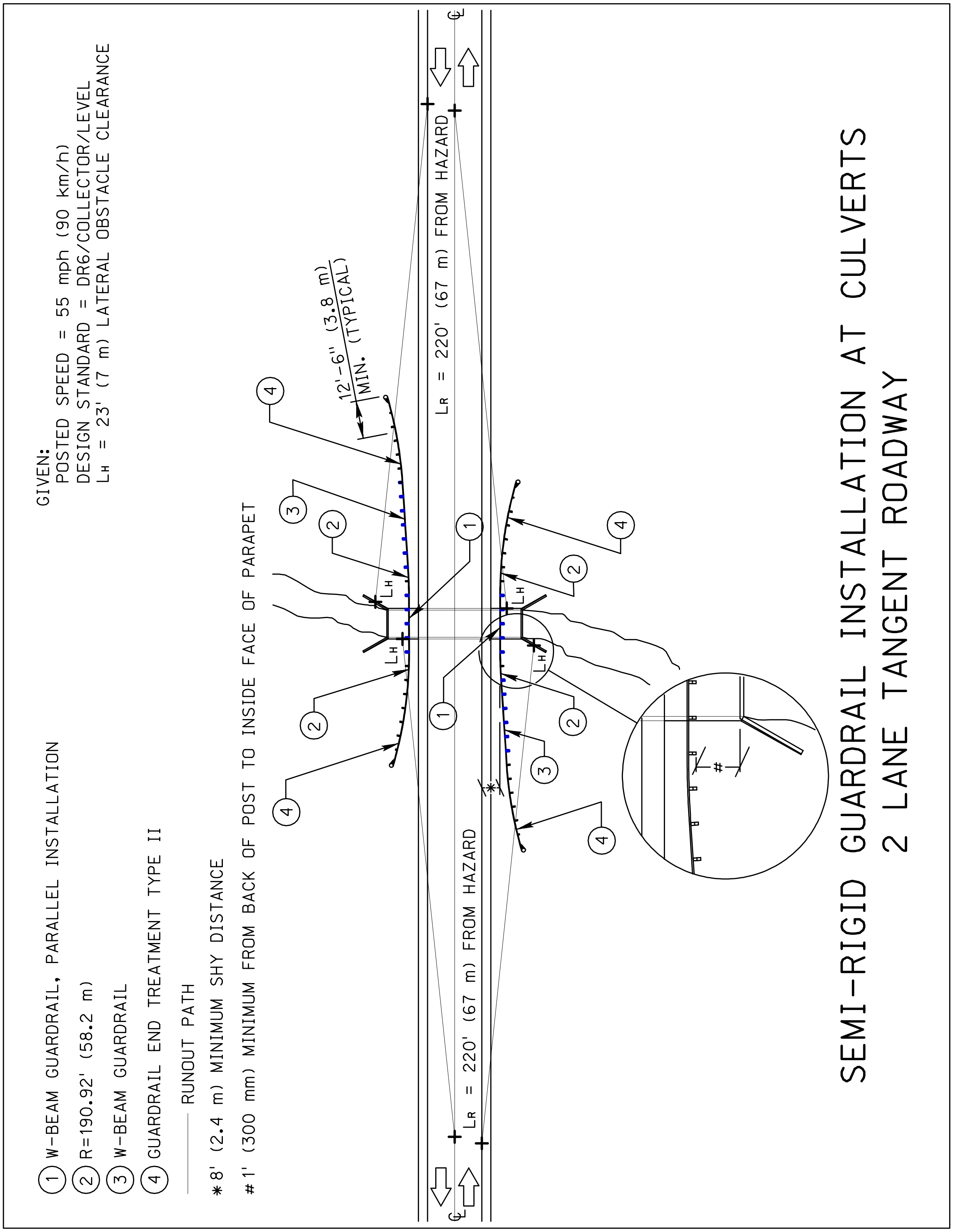


Exhibit B.16
Example Culvert Installation: Semi-Rigid Guardrail Design: 2-Lane Tangent Roadways

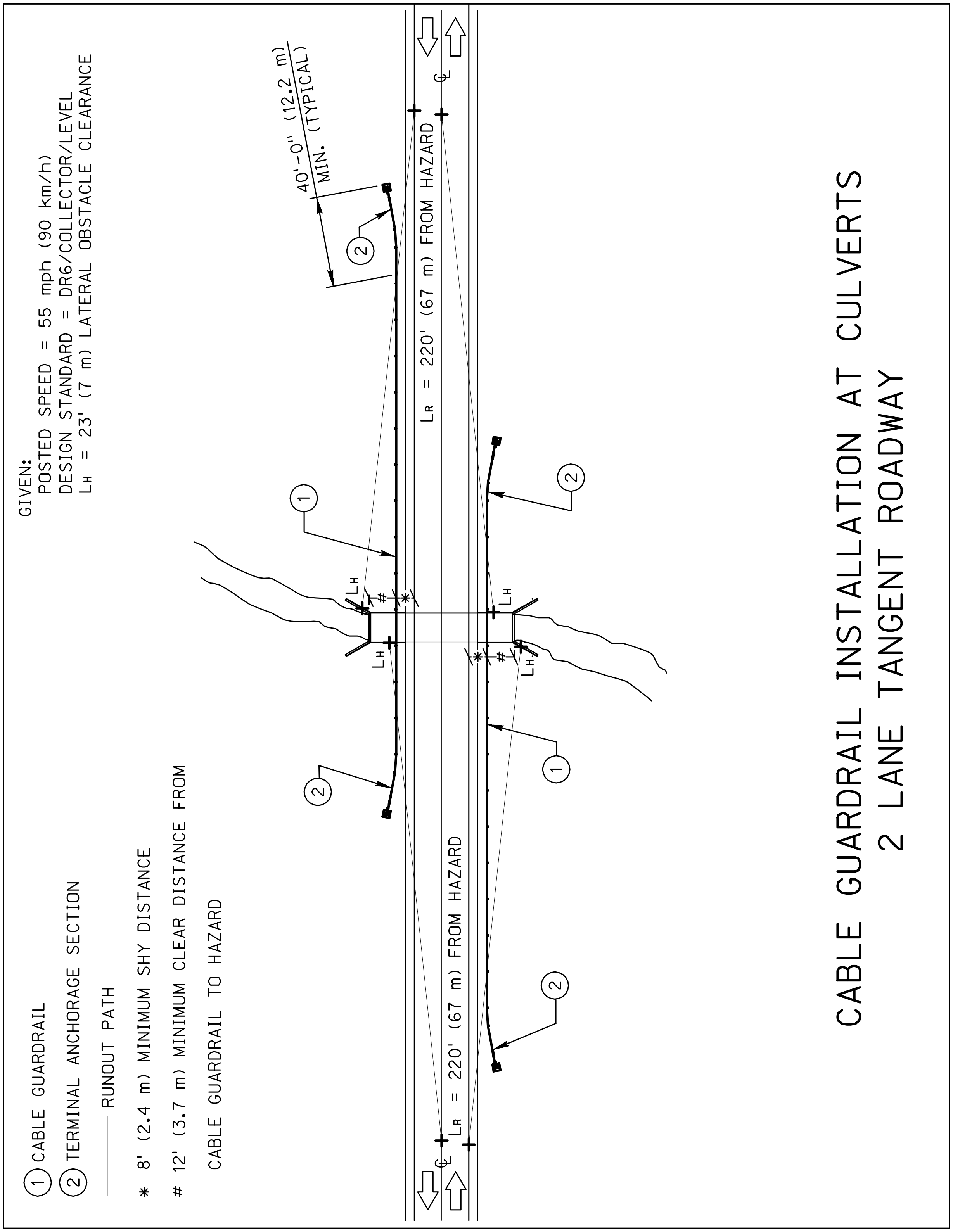


Exhibit B.17
Example Culvert Installation: Cable Guardrail Design
2-Lane Tangent Roadway

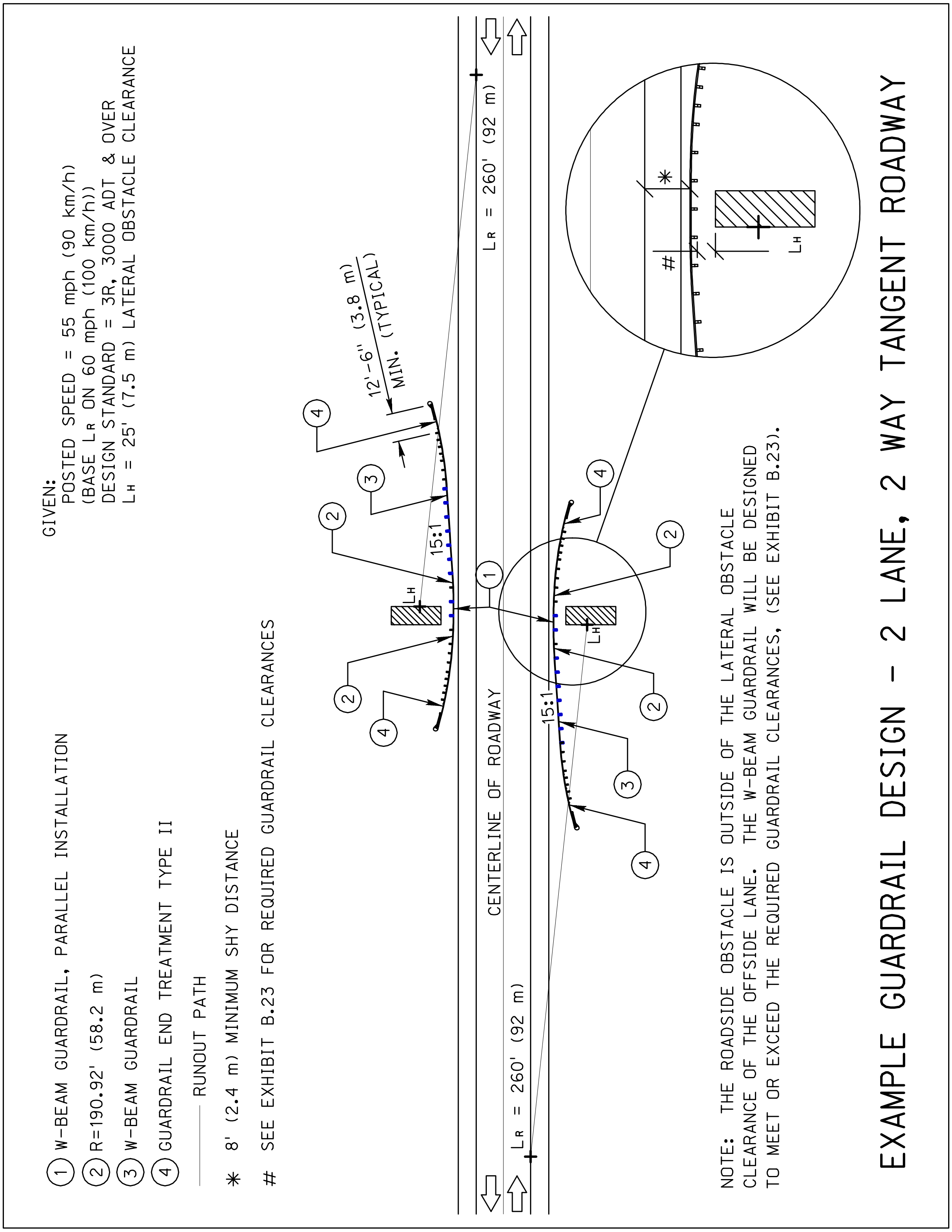


Exhibit B.18
Semi-rigid Guardrail Design, 3R Design Standard
2-Lane Tangent Roadway

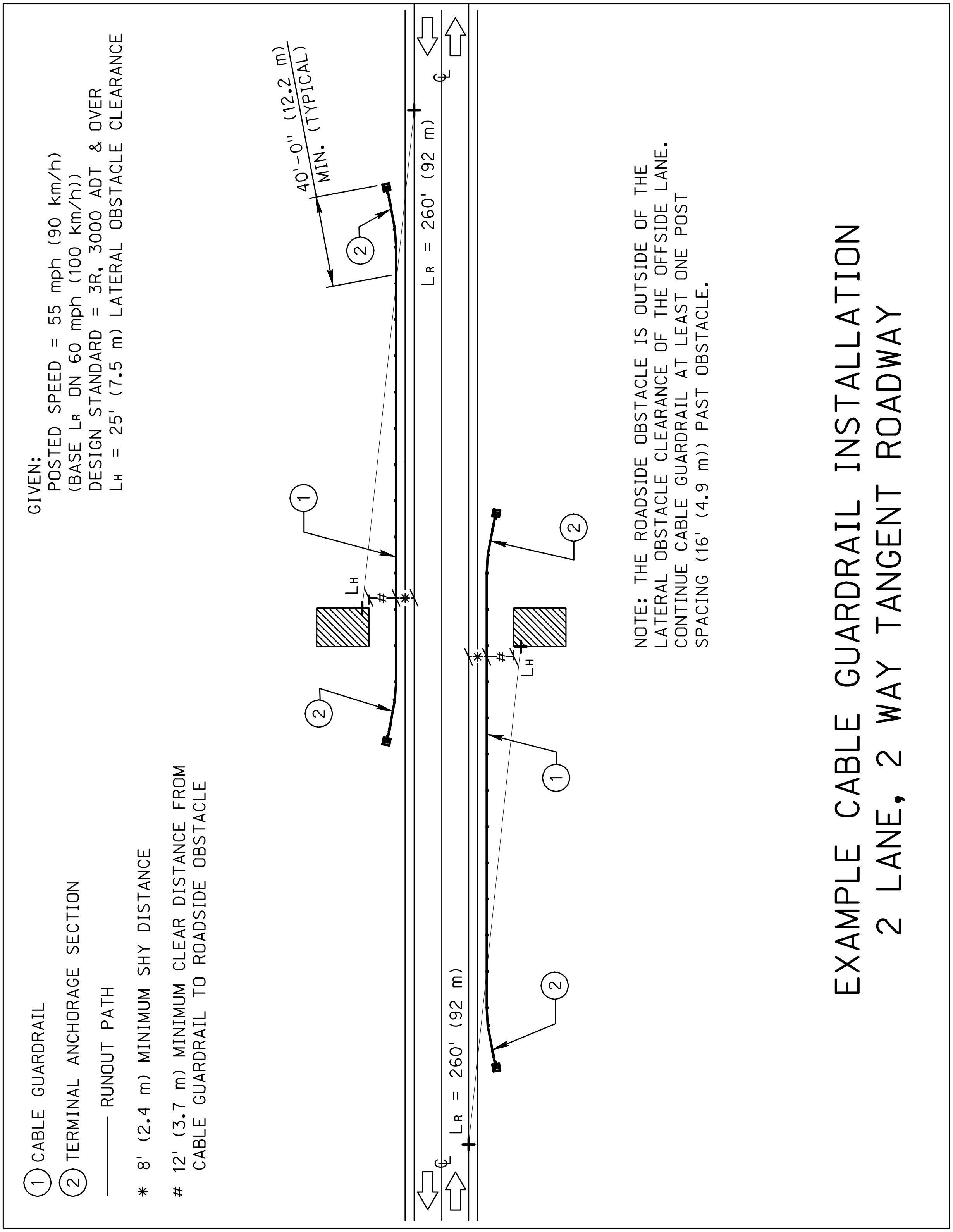


Exhibit B.19
Cable Guardrail Design, 3R Design Standard
2-Lane Tangent Roadway

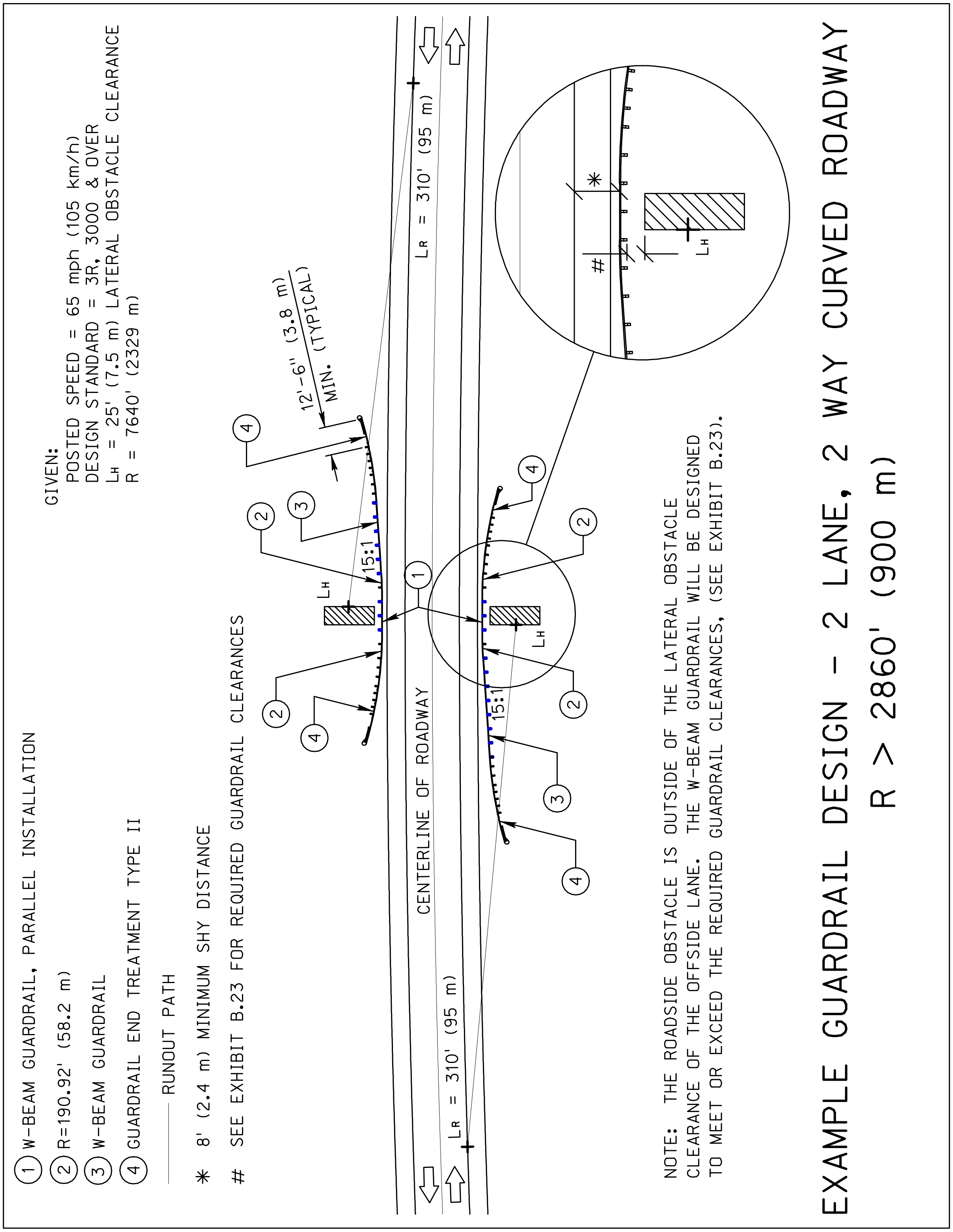


Exhibit B.20
Semi-rigid Guardrail Design, 3R Design Standard
2-Lane Curved Roadway; R > 2860' (900 m)

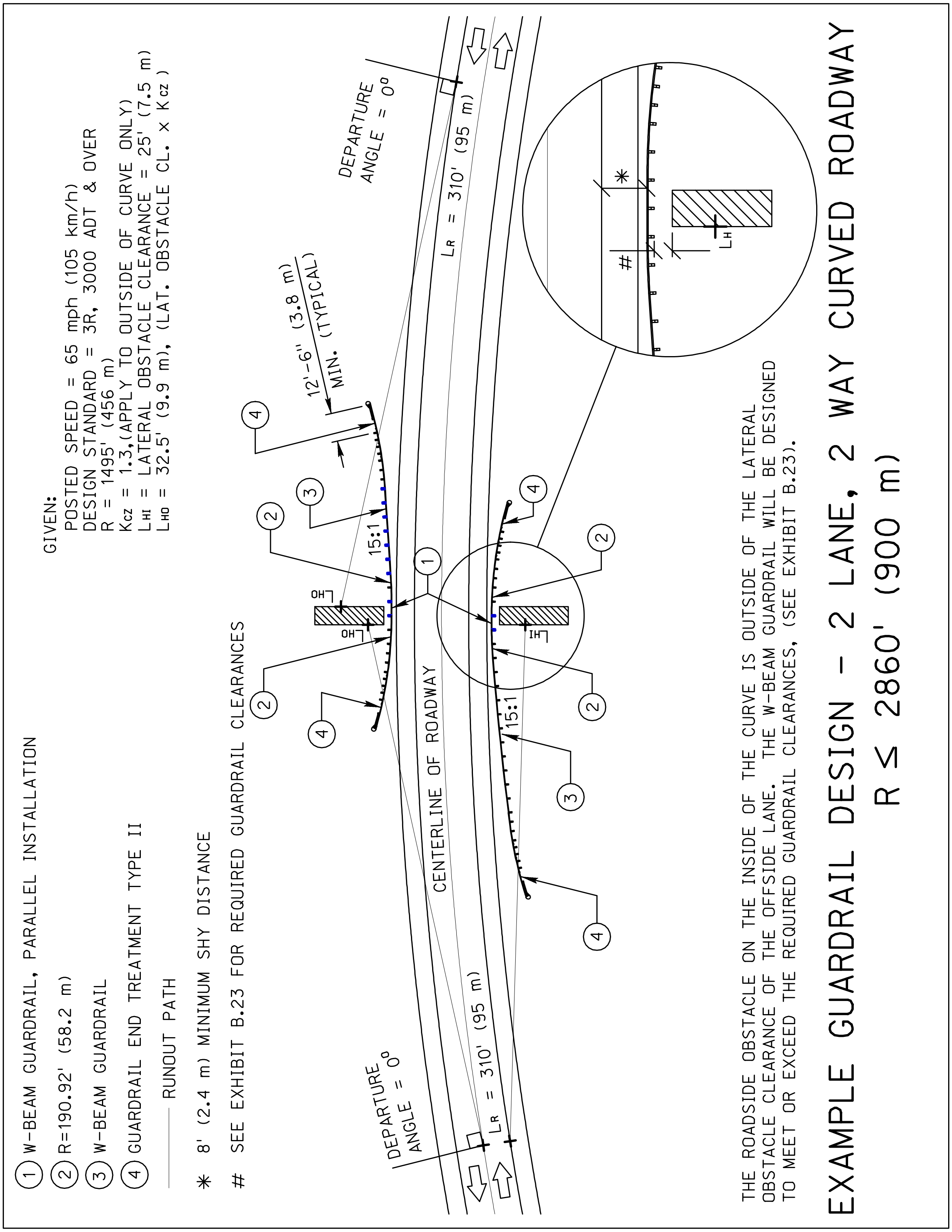


Exhibit B.21
Semi-rigid Guardrail Design, 3R Design Standard
2-Lane Curved Roadway; R ≤ 2860' (900 m)

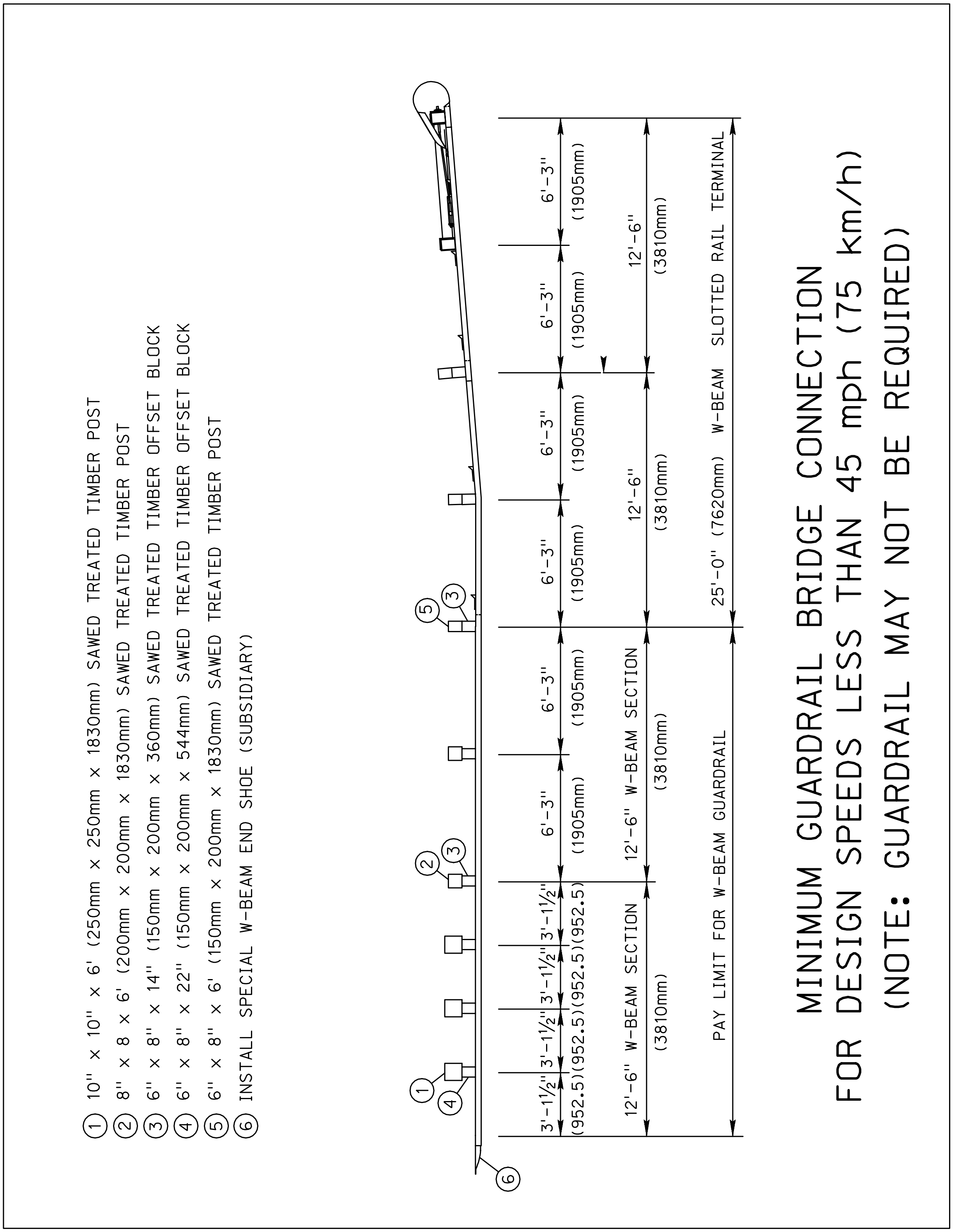
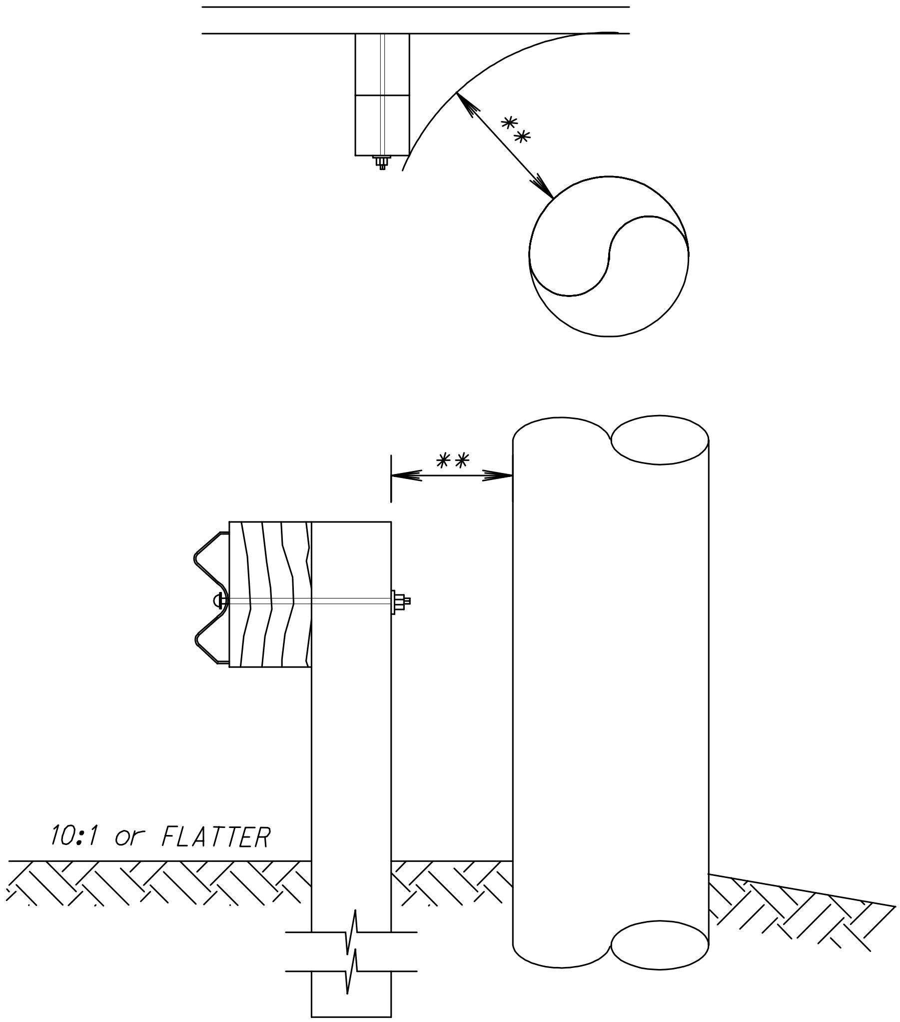


Exhibit B.22
Minimum Guardrail for Low Speed Bridge Connection



** ADJUST THE POSTS LONGITUDINALLY SO THAT THEY WILL NOT BE PLACED DIRECTLY OPPOSITE A PIER COLUMN. THE MINIMUM OFFSET BETWEEN THE BACK OF THE POST AND A PIER OR A SOLID MASS MAY BE FOUND IN THE FOLLOWING TABLE.

MINIMUM REQUIRED GUARDRAIL OFFSET FROM BACK OF POST TO FACE OF FIXED OBSTACLE	
GUARDRAIL INSTALLATION TYPE	**MINIMUM OFFSET ***
Three Strand Cable Guardrail	12.0 ft. (3.66 m)
W-Beam Guardrail	3.5 ft. (1.07 m)
Thrie Beam Guardrail	2.25 ft. (0.70 m)

* Based on the dynamic deflections from the NCHRP Report 350 standard strength test for the 4,400 lb (2000 kg) pickup truck impacting a barrier at an angle of 25º at a velocity of 60 mph (100 km/hr).

Exhibit B.23
Minimum Guardrail Offsets When Adjacent to a Fixed Obstacle

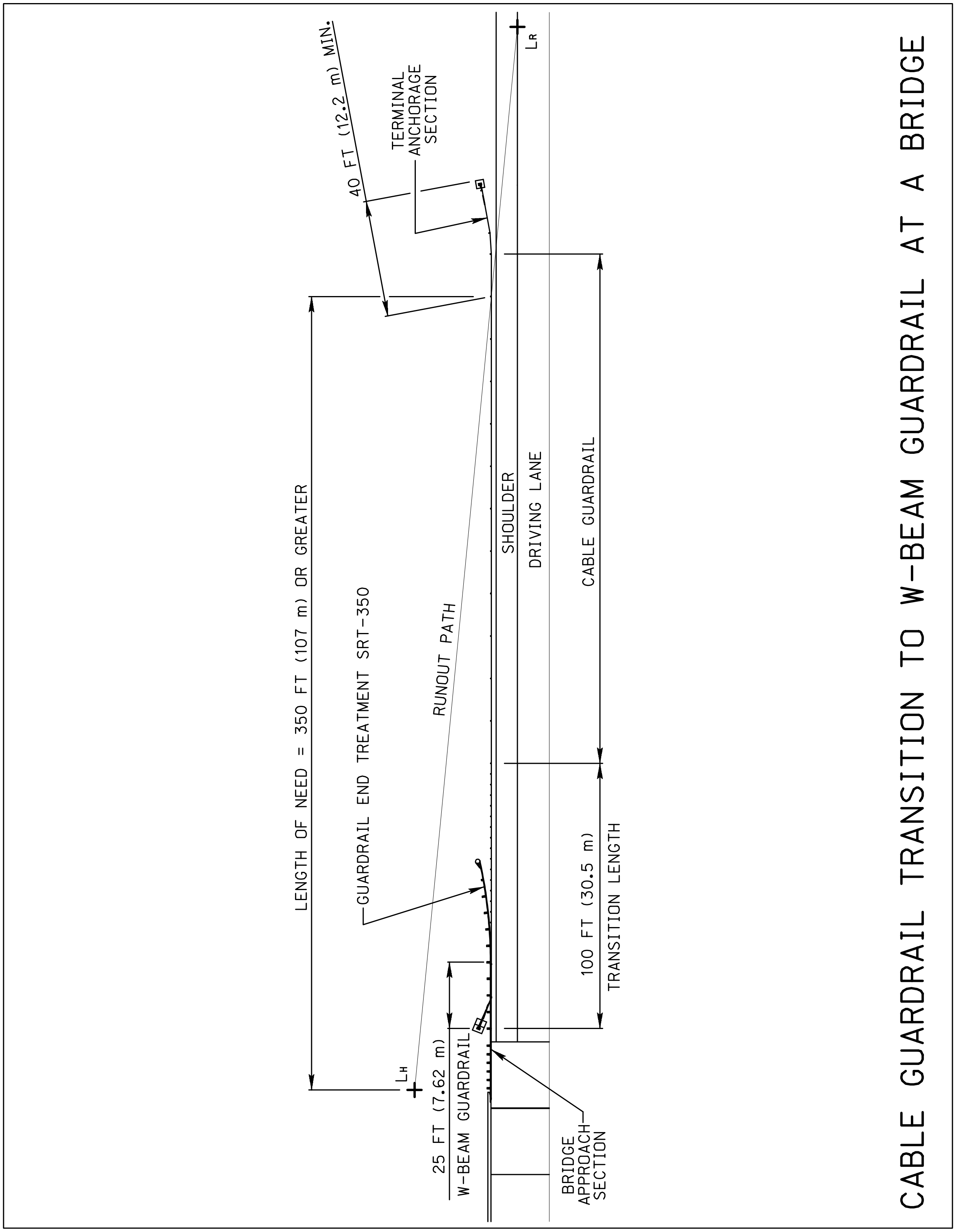


Exhibit B.24
Cable Guardrail to W-Beam Guardrail Transition

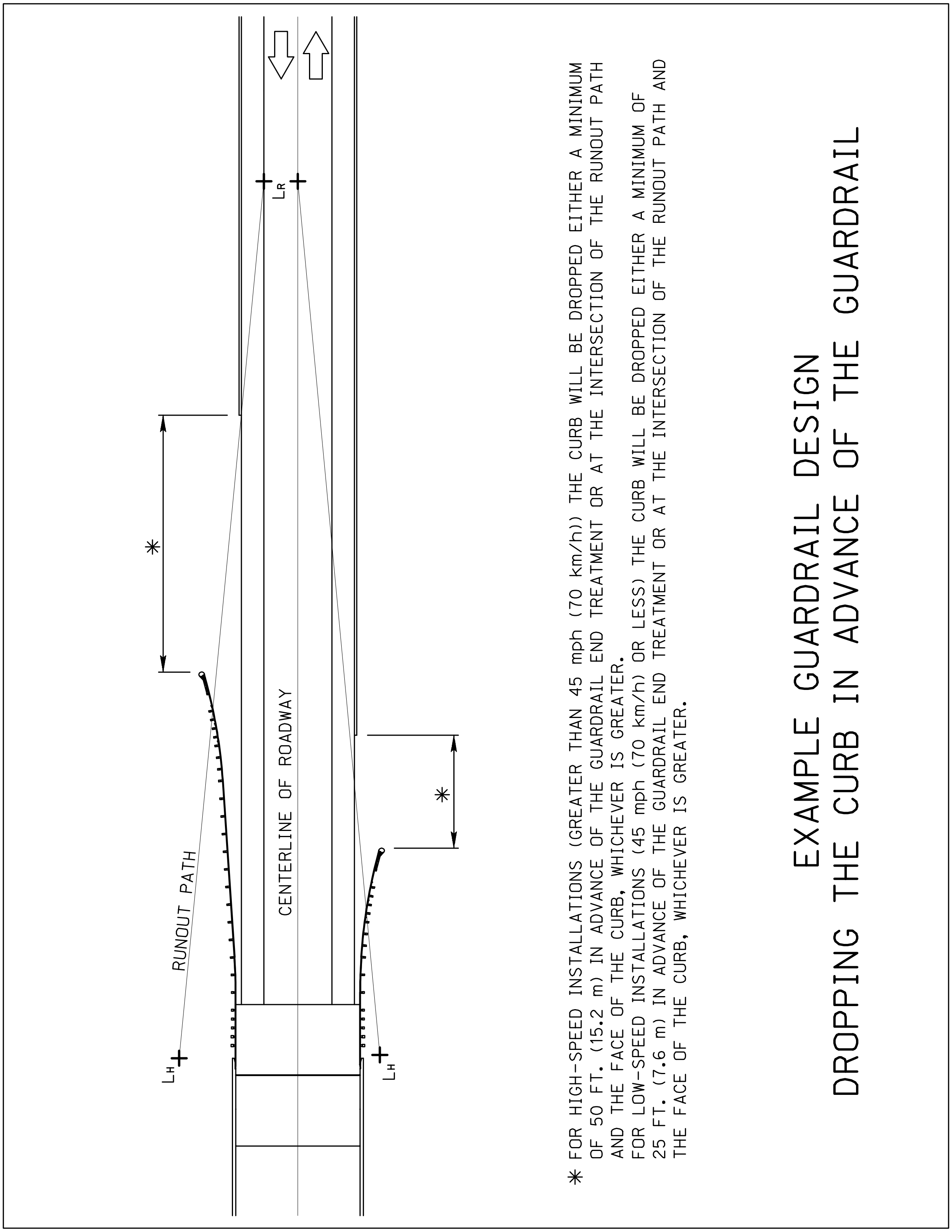


Exhibit B.25
Dropping the Curb in Advance of the Guardrail

DESIGN EXCEPTIONS FOR NATIONAL HIGHWAY SYSTEM PROJECTS

General:

1. **National Highway System (NHS) Projects:** The National Highway System (NHS) consists of the Interstate System and other selected routes, primarily principal arterials. All new construction or reconstruction projects on the NHS, including the interstate system, shall be designed in accordance with the standards listed in the Federal-Aid Policy Guide, Part 625 – "Design Standards for Highways", (23 CFR 625), (http://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0625.htm). These standards will apply to all projects on the NHS, regardless of funding source or **FHWA** oversight level. These standards are for the NHS, rather than for Federal-aid projects on the system. Deviations from the standards must have approved design exceptions.

   FHWA has defined thirteen specific elements, which must have formal design exception approvals when the standards cannot be met. The thirteen design elements are:

   a. Design Speed.
   b. Lane Width.
   c. Shoulder Width.
   d. Bridge Width.
   e. Structural Capacity.
   f. Horizontal Alignment.
   g. Vertical Alignment.
   h. Vertical Grade.
   i. Stopping Sight Distance.
   j. Cross Slope.
   k. Superelevation.
   l. Horizontal Clearance.
   m. Vertical Clearance.

   The controlling criteria for these thirteen elements are detailed in the functional chapters pertaining to freeway and arterial design in the current edition of the **American Association of State Highway and Transportation Officials'** (**AASHTO**) A Policy on Geometric Design of Highways and Streets (Green Book). Interstate design criteria are detailed in the current edition of the **AASHTO** A Policy on Design Standards – Interstate System. Generally, information in the local and collector road chapters does not apply to the NHS due to the functional classification of the routes.

   The *design speed* and *horizontal clearance* elements require some additional explanation.

   Design speed is the concept that ties together various physical design elements of the project. Selection of design speed has a significant effect on the operation and safety of a highway because its selection determines several other individual design criteria, such as stopping sight distance and horizontal curvature. Since a "design speed" exception results in exceptions for other individual physical design elements, the design speed exception will not be approved without considering its effects on *all* other elements.

Horizontal clearance is currently defined as the offset established for specific vertical objects (i.e., retaining walls, barriers, utility poles, curbs, trees, etc). Horizontal clearance is *not* equivalent to the "clear zone" defined by the **AASHTO** Roadside Design Guide (RDG). "Clear zone" is a recovery area clear of fixed objects along the borders of a highway, (the "clear zone" or "lateral obstacle clearance" for **NDOR** design standards may be found in the Nebraska Minimum Design Standards, http://www.nebraskatransportation.org/localiaison/pdfs-docs/MinDesignStds-02.pdf). In no case should the horizontal clearance be less than the established shoulder width for the project.

2. **Non-NHS Design Standards:** Non-NHS Federal-aid projects are to be "designed, constructed, operated, and maintained in accordance with state laws, regulations, directives, safety standards, design standards, and construction standards." Although **FHWA** will provide state highway agencies with technical assistance upon request, ***FHWA** review or approval of these standards is not required.* Exceptions to the state-approved design standards should follow state procedures (See Chapter One: Design Standards, Section 6).

3. **Preventive Maintenance:** This covers any rehabilitation or restoration activity shown to be cost-effective in extending the facility's service life. Activities such as joint seals; crack seals; underdrain restoration; bituminous pavement rut removal and thin (1 in. (25 mm) or less) overlay; and bridge painting may fall within this definition.

   For preventive maintenance projects retaining *existing* substandard features, no design exceptions are required. However, when the project will create a *newly* substandard feature, or aggravate an existing feature, these features must be covered by an approved design exception. The test is whether the intended work maintains the facility as it was constructed under past project agreements with **FHWA**.

Review and Approval:

Changes in the relative roles of **FHWA** and **NDOR** in project oversight have shifted considerably more responsibility for proper processing of design exceptions onto **NDOR**. A flow chart is attached that may help clarify the situation, (See Page C-6).

1. If **FHWA** has full oversight of a project's design and construction, **FHWA** must approve any design exceptions.
2. Regardless of funding source, design exceptions for Interstate System projects over $1 million must be approved by **FHWA**.
3. For NHS projects processed through the exemption or certification acceptance programs, **NDOR** will approve design exceptions internally, but must document and evaluate the design exceptions in place of **FHWA**. **FHWA** staff will conduct periodic reviews of the process.
4. For all non-NHS exempt projects, **NDOR** will process design exceptions according to its internal policy (See Chapter One: Design Standards, Section 6).

Documentation:

A design exception request to **FHWA** should contain the following items:

1. **Project design** – Basic design parameters for the project (e.g., design number, current and design year traffic volumes, design speed, posted speed, percent trucks, etc.)
2. **Degree of reduction in the standard** – Both the required standard value and the proposed reduced value of the design feature should be clearly stated.
3. **Design exception effect on other standards** – There should be clear discussion of the design exception's anticipated effect on the safety and operations of the facility, and its compatibility with adjacent sections of the roadway. Since safety enhancement is an essential element of any project design, exceptions should not degrade the overall relative safety of the highway.
4. **Accident history analysis** – A statement comparing the project's accident history to the statewide average for comparable routes is not sufficient analysis of the design exception's effect on project safety. "Sufficient analysis" should include more than the accident rate and/or history of the project. The discussion should include locating or identifying hazardous locations, accident clusters or accident trends within the project limits.
5. **Cost of attaining full standards** – The cost of obtaining the full project standards must be quantified, rather than relying upon statements that the work required to meet the full standards would be "too Costly" or beyond the project's scope. The costs should be realistically based on historical cost data.
6. **Mitigating features** – When features are added to the project to mitigate the effects of a design exception, they should be documented in the files.
7. **Future improvements** – Future work that will correct the substandard design feature should be documented in the files. This information should include the project number(s) and anticipated construction dates.
8. **Resultant environmental impacts** – Although avoidance or minimalization of environmental impacts has not typically been used to justify or approve design exceptions, there have been cases where full standards were not achieved due to their environmental implications. For these situations, the environmental effects of the design exception should be noted, even when the design exception justification will actually be based upon some other factor.
9. **Other factors that could affect the decision** – for example, proposed development in the project area or local concerns.

Special Considerations:

1. **Vertical Clearance on the interstate system** – **NDOR** must coordinate any proposed design exceptions for bridge vertical clearances on the "26,000 Mile Priority Network" (an Interstate System subset meeting the most urgent national defense needs) with the **Military Traffic Management Command** (**MTMC**). This network is also referred to as the Defense Priority Network (DPN). DPN routes within Nebraska are I-80 and I-76. This coordination is required for both the reduction of existing vertical clearance to less than 16 ft. (4.9 m) (including design exceptions for resurfacing work), and to designs that do not correct existing substandard vertical clearances.

a. For non-exempt Interstate System projects, coordination must take place before **FHWA** may take approval action of the exception request. Copies of the coordination correspondence should be included in the design exception request.
b. For exempt Interstate System projects, coordination with **MTMC** is still required; however, **NDOR** will coordinate directly with **MTMC**, sending information copies of all correspondence to **FHWA**. **NDOR** will take responsibility for the approval action on the design exceptions for these projects.
c. **MTMC** has requested information copies of approved vertical clearance exceptions for Interstate System projects off of the DPN.

MTMC may be contacted at:

Special Assistant for Transportation Engineering
Military Traffic Management Command
Transportation Engineering Agency
P.O. Box 6276
Newport News, VA 23606-2119

2. **Accessibility requirements for handicapped individuals** – The Americans with Disabilities Act (ADA), (http://www.dol.gov/esa/regs/statutes/ofccp/ada.htm) provides comprehensive civil rights protection to individuals with disabilities in the areas of employment, transportation, public accommodations, state and local government services and telecommunications. The **Architectural and Transportation Barriers Compliance Board** (**Access Board**), (http://www.Access-Board.gov) initially issued the Americans with Disabilities Act Accessibility Guidelines (ADAAG), (http://www.access-board.gov/adaag/html/adaag.htm) in July 1991. The Uniform Federal Accessibility Standards (UFAS), (http://www.access-board.gov/ufas/ufas-html/ufas.htm) were initially issued in August 1984. State and local governments (public entities) have the option of using either UFAS or ADAAG standards (**NDOR** uses ADAAG standards). ADAAG and UFAS apply to the design, construction, and alteration of public facilities. These requirements apply to all Federally funded projects, including those exempt from **FHWA** oversight. Compliance with ADA is a non-Title 23 activity and is subject to **FHWA** oversight for all Projects. Specifically:

a. All new or 3R rest area facility design must comply with UFAS or ADAAG.
b. All new or altered parking facility design must comply with UFAS or ADAAG.
c. The design of all facilities such as sidewalks and curb cuts not located on a site will comply with UFAS or ADAAG unless compelling reasons, such as steep terrain, prevent compliance. When associated with a site, these facilities shall conform to UFAS or ADAAG.
d. Design of pedestrian overpasses and underpasses must use ramps with maximum 12:1 grade. Using a 12:1 grade, resting platforms must be provided every 30 ft. (9.1 m). For grades greater than 20:1 but less than 12:1, platforms are required at each 30 in. (750 mm) rise in elevation. For grades less than 20:1, platforms are not required. Other features should comply with UFAS of ADAAG.

e. A waiver to these accessibility requirements may be obtained on a case-by-case basis. Waiver requests with appropriate justification must be submitted through the **FHWA Division** to **FHWA Headquarters** for approval or submission to the **General Services Administration** (**GSA**). Waiver requests must clearly show why it is impractical to comply with the ADA requirements. Background information should be sufficient enough that **GSA** can readily make their decision without needing any additional information

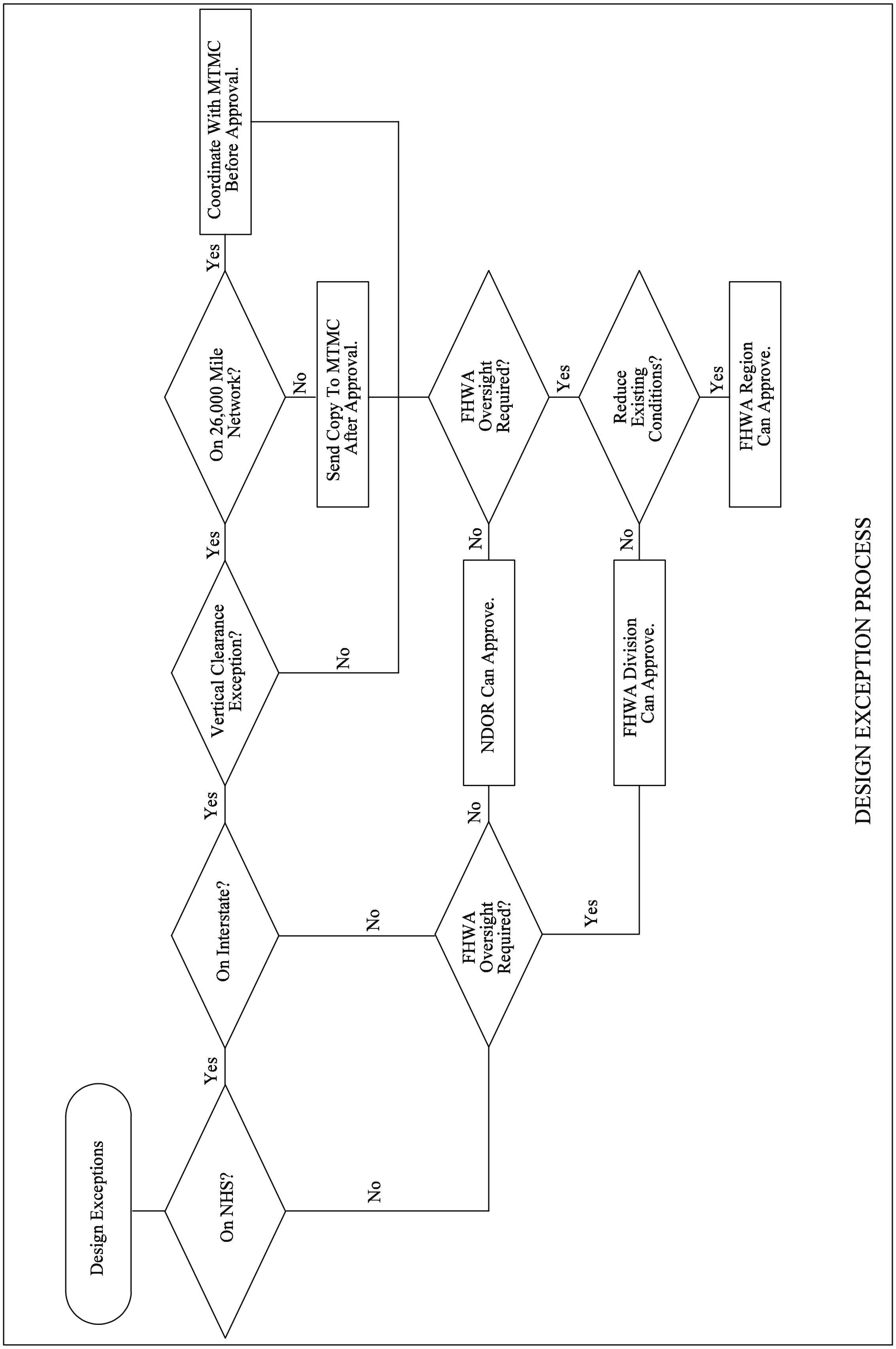
For example, if the 2% sidewalk cross slope cannot be maintained across several driveways on a project, the waiver request should include the following information:

1. Plan and profile sheets for the roadway showing the driveway locations, and a profile for each driveway.
2. The proposed sidewalk cross slope for each driveway.
3. What work would be required to achieve the 2% cross slope.
4. The cost of achieving the 2% cross slope for each drive.
5. The impact of the 2% cross slope on the remainder of the project (constructability, safety, aesthetics, etc.).

f. For projects that are not located on a site and are constructed without using federal funds, new facilities should still meet UFAS or ADAAG, unless there is a compelling reason not to do so.

3. **Bridges** – The criteria contained in 23 CFR 625 applies when determining the width of all NHS bridges that are to be constructed, reconstructed or rehabilitated. Additional information on **FHWA** design policy for bridges may be found in the Federal-Aid Policy Guide; however, the general guidelines are:

a. Rehabilitated bridges should be designed to meet or exceed the minimum **AASHTO** standards for new and reconstructed bridges.
b. For an existing bridge, the bridge width should be based on the **AASHTO** minimum clear roadway widths for existing bridges to remain in place. Exceptions to these standards should consider the accident history, future traffic volumes, and the general physical features and condition of the bridge.
c. Bridge replacement projects should meet or exceed the **AASHTO** standards for new bridges with *very* few exceptions. In the case of bridges on low volume roads and streets, exceptions may be appropriate if the existing road will not be reconstructed within the next 10 years.
d. Existing bridges, which are being retained because of an approved design exception, will be reclassified as non-deficient in the bridge inventory since **NDOR** has determined that the bridge is adequate for the type and volume of traffic expected over its remaining design life. If the exception was approved as a temporary measure because of an already scheduled future replacement project, the bridge may remain classified as deficient.



DESIGN EXCEPTION PROCESS

Federal Highway Administration
Federal Lands Highway Divisions

Design Standards Information

Project Number: ______________________________

Project Name: ______________________________

Description/Termini: ______________________________

____

[ ] New Construction [ ] Reconstruction [ ] RRR

Highway System: ______________________________

Owner Agency: ______________________________

Functional Classification: ______________________________

Traffic Data:

	ADT			Percent Trucks		
Year	Average	Seasonal	DHV	DHV	ADT	D

Current
Future

Design Speed: ______ Terrain: [ ] Level [ ] Rolling [ ] Mountainous

Applicable Standards: ______________________________

____

Design Criteria:	Standard	As Designed	Exception
Horizontal Curvature			
Superelevation			
Superelevation Runoff			
Crown			
Gradient			
Travel Way Width			
Shoulder Width			
Vertical Curvature			
Stopping Sight Distance			
Bridge Width			
Bridge Railing			
Clear Zones			

Description of and reasons for exceptions to standards:___________

____
____
____
____
____

Analysis of risks and design considerations proposed to mitigate exceptions:

____
____
____

EXHIBIT 9.1
Sample Documentation of Highway Design Standards

Sheet 1 of 2

Approval

There are no exceptions to applicable standards.

The exceptions noted have been reviewed with client or cooperating agencies and are considered acceptable.

Date	Design Engineer
Date	Design Project Manager

Approval is recommended

Date	Project Development Engineer

Approved for final PS&E

Date	Division Engineer

EXHIBIT 9.1
Sample Documentation of Highway Design Standards

Sheet 2 of 2

APPENDIX UNDER CONSTRUCTION

APPENDIX E
INTERNET LINKS TO DESIGN MANUALS OF OTHER STATES

ALASKA:
http://www.dot.state.ak.us/stwddes/dcsprecon/assets/pdf/preconstmanual/chapters/ch11.pdf

CALIFORNIA:
http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm

CONNECTICUT:
http://www.dot.state.ct.us/bureau/eh/ehen/desserv/hdm/page2.htm

FLORIDA:
http://www.dot.state.fl.us/rddesign/Florida%20Greenbook/2002%20FLORIDA%20GREENBOOK.pdf

IDAHO:
http://www.itd.idaho.gov/manuals/Design/index.htm

ILLINOIS:
http://dot.state.il.us/desenv/bdemanual.html

INDIANA:
http://www.in.gov/dot/div/contracts/standards/dm/

IOWA:
http://www.dot.state.ia.us/design/desman.htm

KENTUCKY:
http://transportation.ky.gov/design/designmanual/index.htm

LOUISIANA:
http://www.dotd.state.la.us/highways/project_devel/design/road_design/Manual/RD_Manual_Disc.asp

MASSACHUSETTS:
http://www.state.ma.us/mhd/publications/downloads/design.pdf

MICHIGAN:
http://www.michigan.gov/mdot/0,1607,7-151-9622_11044_11367---,00.html

MINNESOTA:
http://www.dot.state.mn.us/tecsup/rdm/index.html

MISSISSIPPI:
http://www.state.ms.us/frameset.jsp?URL=http%3A%2F%2Fwww.gomdot.com

MONTANA:
http://www.mdt.state.mt.us/roaddesign/manual.shtml

NEW JERSEY:
http://www.state.nj.us/transportation/eng/documents/RDME/

NEW YORK:
http://www.dot.state.ny.us/cmb/consult/hdmfiles/hdm.html

NORTH CAROLINA:
http://www.doh.dot.state.nc.us/preconstruct/highway/dsn_srvc/value/manuals/

NORTH DAKOTA:
http://www.state.nd.us/dot/designmanual.html

OHIO:
http://www.dot.state.oh.us/roadwayengineering/LDM1_link.htm

PENNSYLVANIA:
ftp://ftp.dot.state.pa.us/public/Bureaus/design/PUB13M/insidecover.pdf

SOUTH DAKOTA:
http://www.sddot.com/pe/roaddesign/plans_rdmanual.asp

TENNESSEE:
http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/Des_Resources.htm

TEXAS:
http://manuals.dot.state.tx.us/dynaweb/coldesig/rdw/@Generic__BookView;cs=default;ts=default

UTAH:
http://www.udot.utah.gov/esd/Manuals/Roadway/rw-design.htm

VERMONT:
http://www.aot.state.vt.us/progdev/standards/statabta.htm

VIRGINIA:
http://www.virginiadot.org/business/manuals-default.asp

WASHINGTON:
http://www.wsdot.wa.gov/fasc/EngineeringPublications/manuals/Designmanual.pdf

Nebraska Department of Roads
Operating Instruction 45-1
February 15, 2002

UTILITY REHABILITATION NEGOTIATIONS

1. **Purpose:** To provide policy for negotiating the relocation and adjustment of utility facilities concerning the basis of payment to the utility and for requesting federal participation in the non-betterment costs. The office of primary responsibility for this DOR-OI is the Project Development Division. This DOR-OI supersedes DOR-OI 45-1 dated April 21, 1995.

2. Highway construction projects frequently require the revision and relocation of utilities. Reimbursable costs represent the eligible non-betterment expenditures of the utility required to accomplish these revisions and relocations. These expenditures may be paid on a lump sum or actual cost basis and with state funds only or, under certain conditions, federal participation may be requested. See Federal-Aid Policy Guides 23 CFR 645A, "Utility Relocations, Adjustments, and Reimbursement, and 23 CFR 645B, "Accommodation of Utilities."

3. Federal participation in utility agreements normally will be requested only under the following conditions, where:

A. Federal funds available to Nebraska would increase substantially. Generally, this would be the case if the federal appropriations type is one of the following: Interstate, Emergency Relief, Discretionary Bridge Replacement, Demonstration, or Defense Access.

B. Federal funds available to Nebraska are in danger of lapsing if not obligated.

C. A need exists to accelerate the obligation of federal funds to utilize obligation authority by administratively imposed deadlines.

D. Local contributors specifically request federal participation and would be required to provide a greater share of project costs if federal participation was not approved.

4. Subject to the approval of the Project Development Division Engineer, or the Roadway Design Division Engineer, the Utilities Engineer or Assistant Roadway Design Division Engineer may recommend the following actions:

A. Designation of various utility items as non-participating for federal funds on any project, regardless of appropriation type, when technical engineering and administrative difficulties indicate it would be impractical and uneconomical to request approval of federal participation, except when the use of state or local funds is illegal.

B. Negotiation of lump-sum agreements with utility companies when the non-betterment portion of the utility rehabilitation estimate is $25,000 or less and federal participation is not to be requested.

Operating Instruction 45-1

C. Negotiation of lump-sum agreements with utility companies in accordance with Federal-Aid Policy Guide 23 CFR 645.113 when the non-betterment portion of the utility rehabilitation estimate is $25,000 or less and federal participation is to be requested.

D. Processing actual cost agreement final billings of $25,000 or less as lump sum payments when federal participation is not to be requested (not requiring a contract audit).

Monty W. Fredrickson
Deputy Director-Engineering

Nebraska Department of Roads
Operating Instruction 45-2
October 19, 1993

UTILITY AND RAILROAD PAYMENTS

1. **Purpose:** To provide policy for expediting payments to utility and railroad companies. The office of primary responsibility for this DOR-OI is the Project Development Division. This DOR-OI supersedes DOR-OI 45-2 dated April 17, 1991.

2. Highway construction projects frequently require the installation, revision, and relocation of utility and railroad facilities. Costs incurred are borne entirely by the companies until reimbursed by the state or other governmental subdivisions. This instruction is intended to minimize the time that company funds are tied-up in work related to department activities. Prompt partial and progress payments to utility and railroad companies will be made upon receipt of company billings. Retained amounts due on final billings will be paid promptly upon completion of applicable department or FHWA audit procedures.

3. **The Controller Division will:**

A. Make 90 to 95 percent partial payment to utility companies upon receipt of progress or final billings and a request from the Utilities Engineer.

B. Make 90 to 95 percent partial payment to railroad companies upon receipt of progress or final billings and a request from the Railroad Liaison Engineer.

C. Make immediate and full payment to utility companies of "lump sum" type billings that are submitted in accordance with previously executed agreements or as recommended for payment by the Utilities Engineer.

D. Forward a copy of each utility payment accounting coding document and a copy of each railroad final payment memorandum to the Project Development Division.

4. **The Project Development Division will:**

A. Advise the utility companies of their option of submitting periodic progress billings to avoid unnecessary tie-up of their funds pending submission of one final and complete bill.

B. Advise the railroad companies, but not necessarily as part of agreements, of their option of submitting progress bills to avoid unnecessary tie-up of their funds pending submission of final billings.

Operating Instruction 45-2

C. Include a requirement in agreements that railroads affix the following notice, or similar language, on all final billings: "This billing is rendered with the understanding that the proportionate shares of cost stated are complete and the final obligations of participants are subject to audit. Proportionate shares of audit citations will be promptly repaid to the participants by the railroad upon acceptance of final settlement offered by the Department of Roads."

Monty W. Fredrickson
Deputy Director-Engineering

Nebraska Department of Roads
Operating Instruction 45-5
January 17, 2001

AGREEMENTS

1. **Purpose:** To provide policy for the preparation, distribution, and disposition of agreements between the department and an outside party. This DOR-OI supersedes DOR-OI 45-5 dated November 2, 1992. The office of primary responsibility is the Project Development Division.

2. Due to the extensive number of agreements, the variable nature of technical performance, and the governmental requirements originating in many different areas, the Project Development Division (PDD) will prepare, coordinate, distribute, monitor, and maintain departmental agreements, excluding those agreements associated with bid lettings, right-of-way acquisition, purchasing, and the contracts and bonds for highway construction. Those divisions, which normally prepare their own agreements, or use a standard form of agreement, will submit prepared agreements to the PDD for review prior to execution by outside parties.

3 When necessary, managers will request that agreements be prepared by the PDD and will submit a DR Form 65, "Request for Agreement."

4. Agreements will be reviewed "in-house" by the Controller Division and PDD prior to execution by any party.

5. Except for standard agreements, which have had prior review, all agreements prepared outside the PDD should be submitted to the PDD for review before negotiations are begun. When a standard agreement is revised, it should also be submitted for review.

6. The originating office is responsible for obtaining the signatures of parties outside the department. Following execution by an outside party, agreements will be **hand-carried** to the PDD for internal coordination.

7. Internal coordination will be accomplished by using a RDP Form 656-A, "Agreement Monitoring System - Agreement File Update." The originating office will complete the description and coordination portion of the form. The computer portion will be completed by the PDD.

8. Individuals to whom agreements are routed for coordination will promptly coordinate and have the agreement hand-carried to the next office indicated on the coordination sheet and immediately advise the PDD, via telephone, if he/she disagrees with the contents of the agreement or believes that further coordination with other offices is required.

9. Signatory responsibility for agreements is defined by DOR-OI 45-6.

Operating Instruction 45-5

10. Following execution by the department and approval (when necessary) of the FHWA, the PDD will coordinate with the originating office for the distribution of the agreements. The department's original, or a copy if the department is not a party to the agreement, will be retained in the PDD files. The PDD will then enter the basic data into the computerized agreement monitoring system.

11. Agreements retained in the PDD files will be microfilmed after ten years from the execution date. At that time, most originals will be destroyed. Agreement microfilm cards and a reader are available in the PDD for use by others.

12. The agreement number, which is a descriptive number indicating the originating office, agreement type, year, and sequence will be used by the PDD for filing purposes. Cross-reference listing by the agreement number, control number, and project number will be available in the PDD.

13. **Requirements for Agreement Preparation and Review:**

A. **Offer, acceptance, and a "meeting of the minds":**

(1) The preliminary definition of performance specifications is normally established through personal contact and written proposals.

(2) Where federal financing is involved, it is imperative to caution against beginning work before receiving notice to proceed, since work performed before federal authorization is ineligible for federal reimbursement.

(3) Failure of the contracting parties to interpret and understand all contract provisions identically tends to generate misunderstandings, disagreements, and legal problems. Accordingly, check each contract or agreement carefully for clarity and complete coverage of performance requirements as it affects each party to the contract.

(4) A "closing conference" with all parties is highly recommended on agreements containing complex performance details to assure complete understanding before contract execution.

B. **Cost Principles:** Managers will establish cost principles for use in determining the allowability of individual items of cost. These cost principles will be appropriately identified or referenced in each contractual document. If federal-aid is involved, cost principles will be those established by the applicable provisions of the governing Federal-Aid Highway Program Manual, grant agreement, Office of Management & Budget circular, other directives, and the contract cost principles and procedures set forth in the Federal Acquisition Regulations System (48 CFR, 1.31), as appropriate.

Operating Instruction 45-5

C. **Consideration:**

(1) Check each agreement to see if the following are clearly answered. What are the pay items? When will payment be made? How will the amount to be paid be determined? Who is to be paid and who pays? Form of payment, i.e., cash offset against cost sharing, etc.?

(2) In some cases, the requirement of consideration may be satisfied without monetary payment for work performance. An example of this would be obtaining covenants from counties, cities, and other political subdivisions to cause certain restrictions and to perform certain acts in consideration of the department making certain highway revisions either on its own behalf, or as an agent for the FHWA.

D. **Performance:**

(1) Extra care and attention in defining and describing the detailed work to be done will do much toward eliminating misunderstanding, extra correspondence, and the need for supplemental agreements. Check each agreement carefully to see if the following are clearly answered. What is to be done? When will it be done? Where will it be done? Who will do it? How will it be done?

(2) Attention should be directed to provisions in event of nonperformance.

(3) Where applicable, attention should be directed to provisions concerning the handling of credits for materials recovered.

E. **Authority:** Contracts and agreements should be thoroughly checked for accurate inclusion, reference, and compliance with applicable laws, rules, and regulations.

F. **Cost Sharing:** Contracts and agreements should be reviewed for clear definition of the participants, sharing formula, when participants contribute, and how participants contribute.

G. **Covenants:** Contracts and agreements should be reviewed for clear definition of stewardship, liability, inspection, audit permission, retention of records, Disadvantaged Business Enterprises, and nondiscrimination.

H. **Guidelines for Requesting Contract and Agreement Reviews from the Legal Counsel:**

(1) Agreements covering simple work performance and nominal amounts of consideration -- no review necessary.

(2) Standard agreements and contracts -- request a review once for form and legal sufficiency unless changed and after each state legislative session or issue/revision of applicable FHWA publications.

Operating Instruction 45-5

(3) Agreements and contracts involving complex provisions – review regardless of consideration amount.

(4) Formulation of policy is not a responsibility of the Legal Counsel. Questions involving policy will be taken to the applicable deputy director.

I. **Guidelines for Requesting Contract and Agreement Reviews by the Operational Analysis & Audit Division (OAAD):**

(1) Contracts exceeding $50,000 must be sent to the OAAD for a pre-award audit.

(2) Contracts not based on a firm, fixed price must go to the OAAD for a post-audit to determine the total allowable contract costs.

J. **General Guidelines:**

(1) Avoid indefinite or ambiguous language and be explicit. The terms "and/or" should never be used.

(2) Insure that each agreement includes all of the proper parties, but not more parties than necessary to perform the subject of the agreement.

(3) Do not automatically make the state a party to every agreement – only when necessary.

(4) FHWA publications will be included by reference, as applicable.

Monty W. Fredrickson
Deputy Director-Engineering

Nebraska Department of Roads
Operating Instruction 45-6
October 27, 2004

DELEGATION OF AUTHORITY

1. **Purpose:** To provide policy, delegate authority, and establish accountability for selected financial obligations and activities. This DOR-OI supersedes DOR-OI 45-6 dated January 14, 2002. The office of primary responsibility is the Controller Division.

2. **Annual Operating Budget:**

   A. Division heads/district engineers are responsible for preparing an annual budget for their respective divisions/districts.

   B. Deputy directors are responsible for reviewing and recommending an annual budget for their respective areas of responsibility.

   C. The final budget must be submitted to the director for approval.

   D. Any adjustments (increases, decreases, or transfers) to the operating budget must be approved by the division head / district engineer then submitted to the Controller Division. The Controller Division, Budget Office is responsible for obtaining the appropriate level of approval for any adjustment greater than $5,000.

3. **Six-Year Plan for Highway Construction:**

   A. The Deputy Director-Engineering, in consultation with the state highway commissioners, district engineers, and appropriate division heads, is responsible for annually updating the Nebraska Surface Transportation Program.

   B. The Nebraska Surface Transportation Program and changes thereto must be submitted to the Director for approval.

4. **Computer Development Projects:** Computer Technology projects ideas and proposals must be forwarded to the Information Systems Administrator. ISD will work with the submitter to fully understand the desired outcome of the project, develop a preliminary estimate of time, cost, and resources to complete the project. This information will be forwarded to the Data Processing Advisory Team (DPAT) for review, acceptance, prioritization, and inclusion into the ISD work program. The DPAT consists of the deputies, financial administrator, and ISD Administrator.

5. **Contracts and Agreements:**

   A. Agreements with cities, counties, utilities, and irrigation districts may be executed by the division head, or their designated representative, responsible for administering the agreement. District engineers shall provide their concurrence for these agreements. Unusual or complicated agreements may be referred to the appropriate deputy for signing. Relinquishment agreements will be executed by a deputy director in accordance with DOR-OI 60-13.

Operating Instruction 45-6

B. Agreements with federal agencies, state agencies, and other states must be submitted to the Director, or appropriate deputy director in the Director's absence, for execution. **Exception:** A deputy director or the appropriate division head, responsible for administering the agreement, may execute routine agreements.

C. Other agreements (such as service, research, registered land surveying, underground fuel leak investigations, and consultant agreements) will be executed by the division head or district engineer responsible for administrating the agreement.

D. Agreements between local governments and private consulting firms, for which the department's role is limited to providing federal funds (such as construction engineering for "off system" projects and enhancement projects) shall be "approved as to form" by the division head responsible for administering the agreement.

E. Construction contracts awarded through the letting process will be executed by the deputy director-engineer, construction engineer or contract lettings manager.

6. **Miscellaneous:** The Project Concept Review (engineering review) for each state highway construction project must be submitted to the Deputy Director-Engineering for approval.

John R. Jacobsen
Deputy Director – Operations

Nebraska Department of Roads
Operating Instruction 60-9
August 7, 2003

CORRIDOR PROTECTION

1. **Purpose:** To provide policy for establishing corridor protection on state highways and notifying the public that corridor protection has been filed. The office of primary responsibility for this DOR-OI is the Right-of-Way Division. This DOR-OI supersedes DOR-OI 60-9 dated August 28, 2000.

2. Highways in areas having the potential to develop prior to a planned highway improvement will be reviewed for corridor protection as defined in Sections 39-1311 through 39-1311.05, Nebraska Statutes. If there is a need for corridor protection, a recommendation will be made by the Planning and Project Development Division, Roadway Design Division, Right-of-Way Division, or District Engineer.

3. The following are required before initiating corridor protection for a project on a **new alignment**: (a) a location public hearing, (b) if applicable, FHWA approval of the draft environmental impact statement, (c) a State Highway Commission recommendation, and (d) approval by the Governor. For a project on an **existing alignment**, the above requirements are unnecessary in order to initiate

4. The Planning and Project Development Division, Roadway Design Division, or Property Management Section of the Right-of-Way Division will write a letter to the Right-of-Way Division Manager, through the Deputy Director- Engineering, requesting that corridor protection procedures be initiated on the proposed project (see attachment). Copies of the letter will be sent to the Planning and Project Development Division, Roadway Design Division, District Engineer, Property Management Section, and Right-of-Way Design Section of the Right-of-Way Division.

5. For projects using an existing alignment for which it is deemed necessary to file corridor protection, a strip 300 feet wide will be designated on both sides of the existing right-of-way. In the case of projects on a new alignment, a strip 400 feet wide on both sides of the proposed centerline will be designated for corridor protection. These widths are guidelines and may vary depending on the terrain and design. Projects will have corridor protection procedures initiated after the project concept and alignment has been defined.

6. The Right-of-Way Design Section will begin title research and prepare corridor protection maps after the corridor centerline, length, and width have been established by joint action of the Planning and Project Development Division, Roadway Design Division, and Right-of-Way Division. After a corridor protection plan is completed by the Right-of-Way Design Section, said plan will be sent to the Property Management Section.

7. The Property Management Section will file the corridor protection plan with the appropriate city and/or county officials as outlined in Sections 39-1311 through 39-1311.05, Nebraska Statutes. A signed receipt will be obtained from the appropriate governmental official receiving the corridor protection plan, acknowledging that such plan has been received.

Operating Instruction 60-9

8. The Property Management Section shall send an annual notice to each zoning authority and all utility companies as listed with the Utilities Section of Planning and Project Development, where corridor protection is currently filed. This notice shall be prepared in April of each year.

9. After corridor protection has been filed, functional plans will be prepared to determine the right-of-way requirements. After the functional plans are completed, they will be reviewed to determine if an amended corridor protection plan should be filed. An amended corridor protection plan is filed in the same manner as an original filing.

10. The Property Management Section will forward copies of the corridor protection map and the signed filing receipt to the Planning and Project Development Division, Roadway Design Division, District Engineer, and Highway District Right of Way Permits Officer.

11. At appropriate locations along the proposed highway project, the district engineer will erect signs which are visible to the public and which state that corridor protection has been filed.

12. The Property Management Section shall obtain approvals for the release of a corridor protection project from the District Engineer, Roadway Design Engineer and the Planning and Project Development Engineer on an annual basis. Such requests for release shall be routed in January of each year.

13. The Property Management Section will promptly notify the appropriate city and/or county official of corridor protection release after receiving approval from the District Engineer, Roadway Design Engineer and the Planning and Project Development Engineer.

Attachment #1 of 1

Monty W. Fredrickson
Deputy Director-Engineering

Operating Instruction 60-9

DATE

TO Right-of-Way Division Manager

FROM Location Studies Section Engineer ______________

THRU Planning and Project Development Division Engineer ______________
Deputy Director-Engineering ______________

SUBJECT Request for Corridor Protection
Project No.
Location:
C.N.

The design of the project (_____________________________________) will be along 1) the existing highway alignment, 2) on new alignment. Corridor protection is needed for the area annotated on the attached map. Notes: (that corridor protection has already been established along US-75 south of the N-2 junction.)

After concurrence by the deputy director, please initiate the process to provide corridor protection at this location. The Planning and Project Development Division will supply additional information as may be necessary.

GEK/60-9

Attachment

xc: Planning and Project Development Division
Roadway Design Division
District Engineer
Property Management Section
Right-of-Way Design Section

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Nebraska Department of Roads
Operating Instruction 60-11
September 4, 2003

MUNICIPAL COST SHARING

1. **Purpose:** To provide policy for the calculation of the municipal share of project costs for **non-interstate** projects on state highways located within or adjacent to the corporate limits of a municipality. This policy applies to all **non-interstate** state highway projects including: "New and Reconstructed" projects, "Resurfacing, Restoration and Rehabilitation" (3R) projects, and "Maintenance" projects. This policy does not apply to projects determined by the Department to be economic development projects. Economic development projects are projects that are being built primarily to accommodate adjacent economic development and are projects that have not been included within the Department's Six-Year Plan. The municipal share of economic development projects will be negotiated on a case-by-case basis. The office of primary responsibility for this DOR-OI is the Roadway Design Division. This DOR-OI supersedes DOR-OI 60-11 dated November 6, 1997. This policy is in compliance with and supplementary to Nebraska Statutes.

2. **Statutory References:** Sections 39-1339 and 39-2105, Nebraska statutes (see Attachment A).

3. **Municipal Share – all Municipalities:**

   A. A municipality will not be required to share in project costs if the estimated municipal share is $1,000 or less.

   B. A municipality will pay 100 percent of the project cost of a project that is at the request of and for the sole benefit of the municipality. For exceptions, see paragraphs 3.A. and 3.C(1).

   C. **Traffic signals and lighting systems:**

      (1) The project costs for traffic signals and/or lighting systems, not part of a "New and Reconstructed" project, will be allocated 50 percent to the state and 50 percent to the municipality. Project costs include the cost of all work required for the construction of the traffic signals and/or lighting systems, such as intersection geometric improvements.

      (2) The municipality will pay 100 percent of the cost of operating, repairing and maintaining the traffic signal and/or lighting system.

   D. **Rail/highway grade crossing safety projects:** Project costs will be funded with a combination of state, federal, local and railroad funds. The cost sharing on specific projects will be determined by an agreement between the parties involved. Eligible project items may include preliminary and construction engineering, right-of-way, utilities, and construction costs.

Operating Instruction 60-11

E. **Highway and Municipal Drainage Facilities:**

(1) Definitions and apportionment of costs:

Highway drainage facilities are the curb inlets, storm sewers, drainage ditches and other facilities designed to collect and drain waters from the highway, the right-of-way and adjoining lands. These highway drainage facilities are usually located within the highway right-of-way. Project costs include all costs associated with the highway drainage facilities. Cost sharing will be as calculated in paragraph 5.B.

Municipal drainage facilities are the storm sewers, drainage ditches, drainage ways and other facilities used by the city for the drainage of waters including waters draining from the highway drainage facilities. These municipal drainage facilities are usually located outside of highway right-of-way. The municipality will pay all costs associated with the upgrade of municipal drainage facilities, including the costs of engineering, right-of-way, utilities and construction.

Additional drainage waters – If the state determines that significant additional drainage waters will be conveyed to the municipal drainage facilities because of the design of the project, the state will determine, on a case-by-case basis, whether the municipal drainage facilities will be upgraded and whether the state will share in any portion of the cost of such upgrade. The extent of the upgrade to the municipal drainage facilities and the division of cost for such upgrade will be a matter of negotiation to be resolved and set forth in an agreement with the municipality.

(2) Drainage design – No additional drainage waters:

The State will design its highway drainage facilities to collect and discharge storm water based on the design guidelines set out in the Roadway Design Division's "Drainage Design Manual", if feasible, based on all applicable considerations. When the highway drainage facilities connect or drain into the municipal drainage facilities, the state will calculate and notify the municipality of the capacity of the municipal drainage facilities necessary to convey waters away from the highway. When the capacity of the municipal drainage facilities does not comply with the state's design guidelines, the state will notify the municipality that it should upgrade its municipal drainage facilities. The state will request, for safety and liability reasons, that the municipality commit to one of the plans for upgrading their municipal drainage facilities as described below.

(a) The municipality provides the state with reasonable written assurances of a present plan for a future upgrade of its municipal drainage facilities. The municipality shall provide the state with the details of its proposed improvements that will convey the design event determined by the state to be feasible based on all applicable considerations.

(b) The municipality requests that the project include an upgrade of its municipal drainage facilities to be paid for solely by the municipality, and the municipality shall enter into an agreement with the state concerning this upgrade of its facilities prior to the state beginning the design of the project.

F. **Municipal Utility Reimbursement Policy:**

(1) Relocation of city owned utilities made necessary by the construction or reconstruction of state highways within the city corporate limits are eligible as a project cost for non-betterment reimbursement by the State. The relocated city owned utilities shall meet any applicable standards or codes that govern the installation, operation, and maintenance of said facilities.

(2) Relocation of city owned utilities made necessary by the construction or reconstruction of state highways outside the corporate limits and contained within the state right-of-way are not eligible for reimbursement by the State. Relocation of city owned utilities due to construction or reconstruction of state highways located outside the city corporate limits and that exist outside the state right-of-way on a private easements are eligible as a project cost for non-betterment reimbursement by the State. The relocated city owned utilities shall meet any applicable standards or codes that govern the installation, operation, and maintenance of said facilities.

(3) Any city owned utility cost that is eligible for reimbursement as a project cost will be included in the project cost sharing. When it is determined that a municipality is required to participate in the cost of a project, the cost sharing will be in accordance with paragraphs 3, 4 and 5.

4. **Municipal Share – Municipalities with a Population of 5,000 or Less:**

A. Except as provided in this section, the municipality with a population of 5,000 or less will not ordinarily be required to participate in the cost of a project.

B. **On Highway Parking Areas:** The municipality will pay 100 percent of the costs of constructing additional parking areas and the reconstruction of existing parking areas, which are at the request of the municipality. One hundred percent of the costs of resurfacing existing parking areas will be the responsibility of the state.

C. **Federal-Aid Safety Projects:** The municipal share is 20 percent of the total cost of a federal-aid safety project for projects on streets or roads that are not on the state highway system. No municipal contribution is required for a federal-aid safety project on the state highway system.

D. **Americans with Disabilities Act (ADA) Upgrades – Sidewalks and Curb Ramps:**

(1) **"New and Reconstructed" Projects:** The municipality will not be required to share in the costs of constructing or reconstructing sidewalks and curb ramps when included in the normal scope of a "New and Reconstructed" project.

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(2) **“3R” or “Maintenance” Projects:** Sidewalks will not ordinarily be reconstructed as a part of a “3R” or “Maintenance” project, unless the municipality requests that sidewalks be reconstructed, at its sole cost, as a part of the project. Curb ramps will be constructed or reconstructed to meet ADA accessibility guidelines under “3R” and “Maintenance” projects at no cost to the municipality. The cost of constructing or reconstructing any sidewalk required to blend these curb ramps into the adjoining sidewalk will also be at no cost to the municipality.

(3) **All Projects:** The municipality will be responsible for 100 percent of the costs for upgrading existing sidewalks and curb ramps to meet ADA accessibility guidelines, which are outside the normal scope of the project and are at the request of the municipality.

5. **Municipal Share – Municipalities with a Population Over 5,000:**

A. Municipalities with a population over 5,000 (see paragraph 8) may be required to participate in the cost of a project within, or in some instance, adjacent to the corporate limits of the municipality.

B. **Computation of Total Cost for “New and Reconstruction” Projects:**

Project costs shall include the cost of all thru-traffic lanes, turn lanes, medians, parking areas, surfaced shoulders and **transition tapers**. Turn lanes, medians, parking areas and surfaced shoulders shall not be considered to be thru-traffic lanes.

(1) **Projects including no more than two thru-traffic lanes:** The municipality will not be required to share in the cost of a project that includes no more than two thru-traffic lanes.

(2) **Projects including no more than four thru-traffic lanes:** The municipality will pay 20 percent of the project cost attributable to any portion of the project that includes four thru-traffic lanes.

(3) **Projects including more than four thru-traffic lanes:** The municipality will pay a share of the cost of the project attributable to any portion of the project that includes more than four thru-traffic lanes. The municipality’s share will be based upon the number of thru-traffic lanes in excess of the lesser number of lanes entering or leaving the municipality, however, the municipality’s minimum share will be 20 percent.

Example one: If the highway enters the municipality with two thru-traffic lanes and leaves the municipality with four thru-traffic lanes and the project has a two thru-traffic lane segment, a four thru-traffic lane segment and a six thru-traffic segment, the municipal cost share is 0 percent of the cost of the two thru-traffic lane segment, 20 percent of the cost or the four thru-traffic lane segment and 66.67 percent of the cost of the six thru-traffic lane segment of the project.

Example two: If the highway enters and leaves the municipality with four thru-traffic lanes and the project has a four thru-traffic lane segment and a six thru-traffic lane segment, the municipal cost share is 20 percent of the cost of the four thru-traffic lane segment and 33.33 percent of the cost of the six thru-traffic lane segment of the project.

Example three: If the highway enters and leaves the municipality with six thru-traffic lanes and the project has a six thru-traffic lane segment and an eight thru-traffic lane segment, the municipal cost share is 20 percent of the six thru-traffic lane segment and 25 percent of the cost of the eight thru-traffic lane segment of the project.

C. **Computation of Total Cost for "3R" and Maintenance" Projects:**

Project costs shall include the cost of all thru-traffic lanes, turn lanes, medians, parking areas, surfaced shoulders and **transitions tapers**. Turn lanes, medians, parking areas and surfaced shoulders shall not be considered to be thru-traffic lanes.

(1) When the highway enters and exits the municipality with the same number of thru-traffic lanes, the municipality is responsible for the cost of all additional thru-traffic lanes.

Example one: If the highway enters and exits the municipality with two thru-traffic lanes and the project has a two thru-traffic lane segment and a four thru-traffic lane segment, the municipal cost share is 0 percent of the cost of the two thru-traffic lane segment and 50 percent of the cost of the four thru-traffic lane segment of the project.

Example two: If the highway enters and exits the municipality with four thru-traffic lanes and the project has a four thru-traffic lane segment and a six thru-traffic lane segment, the municipal cost share is 0 percent of the cost of the four thru-traffic lane segment and 33.33 percent of the cost of the six thru-traffic lane segment of the project.

(2) When the highway enters and leaves the municipality with a different number of thru-traffic lanes, the municipality's share will be the cost of the number of thru-traffic lanes in excess of the lesser number of thru traffic lanes entering or leaving the municipality.

Example one: If the highway enters the municipality with two thru-traffic lanes and exits the municipality with four thru-traffic lanes and the project has a two thru-traffic lane segment, a four thru-traffic lane segment and a six thru-traffic lane segment, the municipal cost share is 0 percent of the cost of the two thru-traffic lane segment, 50 percent of the cost of the four thru-traffic lane segment and 66.67 percent of the cost of the six thru-traffic lane segment of the project.

Example two: If the highway enters the municipality with four thru traffic lanes and exits the municipality with six thru-traffic lanes and the project has a four thru-traffic lane segment, a six thru-traffic lane segment and an eight thru-traffic lane segment, the municipal cost share is 0 percent of the cost of the four thru-traffic lane segment, 33.33 percent of the cost of the six thru-traffic lane segment and 50 percent of the cost of the eight thru-traffic lane segment of the project.

(3) Municipalities will not normally share in the cost of resurfacing projects accomplished as part of a relinquishment agreement.

(4) Because funding is limited for municipal resurfacing projects, and because many municipalities have their own annual resurfacing programs, district engineers may elect to require the municipality to design, let, and construct municipal resurfacing projects. In such cases, the preliminary and construction engineering costs are 100 percent the responsibility of the municipality.

D. **Bridges:**

(1) The municipal share of the total cost of new construction, replacement, re-decking, widening, and adding sidewalks to bridges will be determined pursuant to paragraph 5.B.

(2) The following types of bridge work will not require municipal cost participation: deck overlays, abutment repair, pier repair, deck repair, joint repair, curb repair, curb replacement, and approach slab repair.

(3) Paragraphs 5.D.(1) and 5.D.(2) also apply to bridges on highways to be relinquished.

E. **Americans with Disabilities Act (ADA) Upgrades – Sidewalks and Curb Ramps:**

(1) **“New and Reconstructed” Projects:** The municipality will share in the costs of constructing or reconstructing sidewalks and curb ramps when included in any “New and Reconstructed” project. Cost sharing will be calculated in accordance with paragraph 5.B.

(2) **“3R” or “Maintenance” Projects:** Sidewalks will not ordinarily be reconstructed as a part of a “3R” or “Maintenance” project, unless the municipality requests that sidewalks be reconstructed, at its sole cost, as a part of the project. Curb ramps will be constructed or reconstructed to meet ADA accessibility guidelines under “3R” and “Maintenance” projects. The municipality will share in the cost of constructing or reconstructing these curb ramps and any sidewalk required to blend these curb ramps into the adjoining sidewalk in accordance with paragraph 5.C.

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(3) **All Projects:** The municipality will be responsible for 100 percent of the costs for upgrading existing sidewalks and curb ramps to meet ADA accessibility guidelines, which are outside the normal scope of the project and are at the request of the municipality.

F. **On Highway Parking Areas:** The municipality will be responsible for 100 percent of the costs of constructing additional parking areas and/or the reconstruction or resurfacing of existing parking areas, which are at the request of the municipality.

G. **Federal-Aid Safety Projects:** The municipal share of a federal-aid safety project either **on** or **off** the state highway system is 20 percent of the total cost of the project.

H. **Traffic Signals and Lighting Systems:** The municipal share of traffic signals and/or lighting systems installed as part of a “New and Reconstructed” project will be as indicated in paragraph 5.B.

6. **Agreements:**

A. **Projects involving a municipal contribution:** The state and municipality shall enter into a written agreement establishing the scope of the project and a tentative construction schedule. It is the intent of the state that the project be coordinated throughout the project term with the municipality.

B. **Projects involving no municipal contribution:** When a municipality is not required to make a financial contribution to a project, a written agreement for parking restrictions, encroachments, municipal-owned utilities, and other matters is required. If an existing municipal maintenance agreement adequately covers parking restrictions, encroachments, municipal-owned utilities, and other aspects of the project, and if no financial participation or change in participation is required, no new or modified agreement is necessary.

7. **State Highways Abutting, Adjoining or Adjacent to the Municipal Corporate Limits:**

A. In accordance with paragraphs 3, 4, and 5, a municipal corporation will be required to participate in the cost of the entire width of a project if:

(1) Any portion of a State highway abuts, or adjoins the corporate limits of the municipality, or

(2) Any portion of a State highway that is adjacent to the corporate limits when it appears to be Department that the State highway is being used by the municipal traffic as if it were within the corporate limits of the municipality.

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B. Apportionment of costs will be based upon the municipal corporate limits existing on the date that the department signs the municipal agreement. Project costs will include costs for preliminary engineering, utilities, construction, right-of-way and construction engineering.

8. **Municipalities with a Population over 5,000:**

Alliance
Beatrice
Bellevue
Blair
Chadron
Columbus
Crete
Elkhorn
Fremont
Gering
Grand Island
Hastings
Holdrege
Kearney
LaVista
Lexington
Lincoln
McCook
Nebraska City
Norfolk
North Platte
Ogallala
Omaha
Papillion
Plattsmouth
Ralston
Schuyler
Scottsbluff
Seward
Sidney
South Sioux City
Wayne
York

Monty W. Fredrickson
Deputy Director-Engineering

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ATTACHMENT "A"

39-1339
State highway system; connecting links, defined; duty of Department of Roads

Except as provided in section 39-1372, the responsibility of the department for the maintenance of connecting links on the state highway system shall be determined in accordance with the following provisions:

(1) The department shall be liable for the cost of surface maintenance of the traveled way of connecting links, not including the parking lanes thereon, in cities of the metropolitan, primary, and first classes; PROVIDED, such connecting links were constructed under the authority of the department and construction costs were paid in whole or in part with county, state or federal-aid funds. The department shall not be responsible for the maintenance of any connecting link or portion thereof, which was not built in whole or in part with county, state or federal-aid funds;

(2) The department shall be liable for all of the surface maintenance of the traveled way of connecting links, including parking lanes thereon, in cities of the second class and villages; PROVIDED, such connecting links were constructed under the authority of the department and construction costs were paid in whole or in part with county, state or federal-aid funds. The department shall not be responsible for the maintenance of any connecting link or portion thereof which was not built with county, state or federal-aid funds;

(3) The responsibility of the department for the maintenance of the connecting links, described in subdivisions (1) and (2) of this section, shall be limited to such things as are caused either by wear and tear of travel on such connecting links or by acts of God. Maintenance shall not be construed to include (a) snow removal, (b) maintenance caused by constructing, placing, replacing, repairing, or servicing water mains, sewers, gas lines, pipes, utility equipment, or other similar things placed beneath, across, or upon the surface of any portion of a connecting link, or (c) repairs or reconstruction going beyond the scope or normal surface maintenance or wear and tear of travel;

(4) The maintenance of structures, on the connecting links described in subdivisions (1) and (2) of this section, shall not be limited to the traveled way but shall include the entire structure; PROVIDED, the department shall have no responsibility for the maintenance of appurtenances to such connecting links and the structure thereon, except by special agreement with the city or village in which the connecting link is situated. Appurtenances shall include, but are not limited to, sidewalks, storm sewers, guardrails, handrails, steps, curb or grate inlets, driveways, fire plugs, or retaining walls;

(5) The department shall maintain and keep in repair all public bridges and the approaches thereto when located in cities of the first class and on connecting links, which were constructed under the authority of the department and construction costs were paid in whole or in part with state or federal funds;

(6) Nothing contained in this section shall be construed to prevent the department from entering into special agreements with cities or villages regarding the reconstruction and maintenance of connecting links in such cities and villages; and

(7) As used in this section, unless the context otherwise requires, connecting link shall mean a street now designated as a state highway.

39-2105
Functional classifications; jurisdictional responsibility

Jurisdictional responsibility for the various functional classifications of public highways and streets shall be as follows:

(1) The state shall have the responsibility for the design, construction, reconstruction, maintenance, and operation of all roads classified under the category of rural highways as interstate, expressway, and major arterial, and the municipal extensions thereof, except that the state shall not be responsible for that portion of a municipal extension which exceeds the design of the rural highway leading into the municipality. When the design of a rural highway differs at the different points where it leads into the municipality, the state’s responsibility for the municipal extension thereof shall be limited to the lesser of the two designs. The state shall be responsible for the entire interstate system under either the rural or municipal category, and for connecting links between the interstate and the nearest existing state highway system in rural areas: PROVIDED, if such a connecting link has not been improved and sufficient study by the Department of Roads results in the determination that a link to an alternate state highway would provide better service for the area involved, the department shall have the option of providing the alternate route, subject to satisfactory local participation in the additional cost of the alternate route;

(2) The various counties shall have responsibility for the design, construction, reconstruction, maintenance, and operation of all roads classified as other arterial, collector, local, and minimum maintenance under the rural highway category;

(3) The various incorporated municipalities shall have the responsibility for the design, construction, reconstruction, maintenance, and operation of all streets classified as expressway, which are of a purely local nature, that portion of municipal extensions of rural expressways and major arterials which exceeds the design of the rural portions of such systems, and responsibility for those streets classified as other arterial, collector, and local within their corporate limits; and

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(4) Jurisdictional responsibility for all scenic-recreation roads and highways shall remain with the governmental subdivision, which had jurisdictional responsibility for such road or highway prior to its change in classification to scenic-recreation made pursuant to sections 39-2103, 39-2105, 39-2109, and 39-2113.

Note – Department policy defines the “excess” in design as the difference in the number of thru traffic lanes. The test of “excess” in design applies to any point where the highway enters and/or leaves the municipality and not necessarily at the site of the improvement. Department policy defines the point where the highway enters and/or leaves the municipality to be the point where the highway enters and/or leaves the corporate limits of the municipality.

Website for Chapter 39 Nebraska Highway and Bridge Law State Statutes
http://statutes.unicam.state.ne.us/corpus/chapall/Chap39.html

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Nebraska Department of Roads
Operating Instruction 60-13
February 15, 2002

RELINQUISHMENT OF ROADS FROM THE HIGHWAY SYSTEM

1. **Purpose:** To provide policy for the relinquishment of roads, by preparation, distribution, and disposition of relinquishment agreements between the Nebraska Department of Roads and an outside party. The office of primary responsibility for this DOR-OI is the Materials & Research Division. This DOR-OI supersedes DOR-OI 60-13 dated January 30, 2002.

2. **General:**

When a segment of highway is relocated, the functional classification of the old highway will be changed. The Department will offer to relinquish to the political or governmental subdivision(s) or public corporation(s), any portion of the old state highway that has been relocated. If an offer to relinquish a highway segment is not accepted by the local jurisdiction(s), the State may abandon it as provided by law (See Section "Abandonment of Roadway"). The Department will relinquish the highway to the local agency after following the approved policy for relinquishment of highways.

Before relinquishment, the Department may improve the surface of existing highways if the roadway has a Nebraska Serviceability Index (NSI) or Present Serviceability Index (PSI) less than or equal to:

	NSI	**PSI**
Bituminous Pavements	70	2.5
Composite (overlay) Pavements	60	2.5
Portland Cement Concrete Pavements	50	2.5

Other than surface rehabilitation, improvements to the roadway will not be made. At the time of relinquishment, the Nebraska Department of Roads (NDOR) will assess the adequacy of structures and determine if any reparation or corrective action is required. It is the intent of the State to relinquish only those structures which are structurally and functionally adequate for the purpose for which they will be used.

In any relinquishment or closure proceeding where the Department of Roads owns fee simple title to the underlying land, ownership should be reserved by the Department of Roads. However, the land may be sold according to Nebraska Statute Sec. 39-1325. If sold, the contract must guarantee that utility companies have a perpetual right to utilize the former state right of way. Whenever a public hearing for a highway project is held, the Department of Roads' presentation will include a statement explaining the proposed changes in the highway system and the proposed segments of the existing highway to be relinquished to local jurisdiction.

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A highway may be automatically relinquished by the state when its functional classification changes. However, it is preferable to acquire a signed relinquishment agreement with the County or City prior to highway removal or location approval.

The relinquishment or abandonment of a highway segment must be recommended by the Department of Roads and the Highway Commission and approved by the Governor. This action should take place at the location approval stage.

3. **Procedure for Completing Agreements:**

Materials & Research, Functional Classification is the activity manager for relinquishment activities in the Project Scheduling System (PSS), and will initiate all agreements pertaining to relinquishments and changes in classification and jurisdictional responsibility. The development of the agreement will be according to the time frame defined in the PSS.

The activity manager will coordinate this effort with Roadway Design, Planning and Project Development, Right of Way, Traffic Engineering and the District Engineer. Throughout this entire process, the PSS will be updated by the activity manager to reflect the progress of the relinquishment activity for each applicable project.

Materials & Research, Functional Classification will attend dry-run hearings to review projects with relinquishments.

4. **Covenant Agreement Process:**

A. Expressway Projects

Alignment concepts are studied by Planning and Project Development. Example projects are expressway studies and could include, new railroad viaduct construction, major river crossings or city bypass routes.

(1.) During the course of such studies, Planning and Project Development will discuss the possibility of relinquishment with the governmental entity affected. Whenever possible, a commitment in the form of a resolution or letter of intent to accept the relinquishment will be obtained from each governmental entity involved.

a. When potential changes in the National and/or State Functional Classification of roadways is an issue, Materials & Research staff will be a part of the discussion with Local entities.

(2.) Once an alignment is selected as the preferred route, a location hearing normally conducted. Relinquishment information is provided in the engineering presentation and public comment is received.

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(3.) Planning and Project Development will notify Materials & Research when a relinquishment agreement is needed. Planning and Project Development will advise Materials & Research of any special or specific information necessary to accurately define any previously agreed upon circumstances.

(4.) A covenant agreement covering the proposed relinquishments is prepared by Materials & Research. The draft review process will include Planning and Project Development, Roadway Design, Materials & Research and the respective District Engineer.

(5.) If a petition or resolution has not been received from the local jurisdiction, then the relinquishment agreement will contain a paragraph stating that by signing the agreement, the governmental entity is petitioning the State to relinquish said State Highway, according to Nebraska Statute Section 30-1314.

(6.) Materials & Research will be advised of any subsequent revision(s) or supplementals to the relinquishment(s), by the initiating division, and will prepare the necessary Supplemental Document(s).

(7.) Materials & Research will send the agreement(s) to the appropriate District Engineer to obtain the local signatures and certification.

B. Non-Expressway Projects

(1.) The Planning and Project Development Division or the Roadway Design Division will notify the Materials & Research Division when a Relinquishment agreement is needed.

(2.) Whenever possible, a commitment, in the form of a resolution or letter of intent to accept the relinquishment, will be obtained from each governmental entity involved.

(3.) If the PSS calls for action, Materials & Research will notify Roadway Design that project details are needed to start the relinquishment process.

(4.) A covenant agreement covering the proposed relinquishments is prepared by Materials & Research. The draft review process will include Planning and Project Development, Roadway Design, Materials & Research and the respective District Engineer.

(5.) Materials & Research will be advised of any subsequent revision(s) or supplementals to the relinquishment(s), by the initiating division and will prepare the necessary Supplemental Document(s).

(6.) Materials & Research will send the agreement(s) to the appropriate District Engineer to obtain the local signatures and certification.

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C. Expressway and Non-Expressway Projects

(1.) The District Engineer will receive agreement(s) from Materials & Research and will obtain signatures from representatives of local jurisdiction(s).

(2.) The District Engineer will return signed agreements to Materials & Research.

(3.) The Agreement Monitoring System will be initiated and updated by Materials & Research.

(4.) Planning and Project Development will file one completely executed agreement and return the others to Materials & Research for final distribution.

(5.) Materials & Research will send executed document(s) to the District Engineer along with a copy for the District's file.

(6.) The District Engineer will return the fully executed agreement(s) to the local jurisdiction(s).

(7.) Materials & Research will be advised of any subsequent revision(s) or supplementals to the relinquishment(s), by the initiating division, and will prepare the necessary Supplemental Document(s).

5. **Final/Supplemental Agreement Process:**

A. For all projects, if a covenant agreement exists, the Materials & Research Division will furnish a copy of the agreement to the Roadway Design Division for review and definition of reference points describing final areas of relinquishment. The Roadway Design Division will furnish the required geometric details to the Materials & Research Division for incorporation into the agreement.

B. Materials & Research will review all information with the applicable Division(s) to finalize the agreement.

C. If not previously stated in the covenant agreement, and no petition of relinquishment exists, the agreement will contain a paragraph stating that by signing the agreement, the County or City is petitioning the State to relinquish said State Highway, according to Nebraska Statute Section 39-1314.

D. A draft agreement will be sent to the: Classification, Needs and Pavement Management Engineer; Planning and Project Development Division; Roadway Design Division and the respective District Engineer for review. If significant changes or additions are made during this review process, another review may be necessary.

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E. Appropriate changes will be made only with consensus, and will be accomplished by Materials & Research, Functional Classification Activity Manager.

F. After final review, agreements will be provided to the District Engineer by Materials & Research.

G. The District Engineer will obtain signatures from representatives of local jurisdiction(s).

H. The District Engineer will return signed agreements to Materials & Research.

I. The Agreement Monitoring System will be initiated and updated by Materials & Research.

J. Planning and Project Development will file one completely executed agreement and return the others to Materials & Research for final distribution.

K. Materials & Research will send executed document(s) to the District Engineer along with a copy for the District's file.

L. The District Engineer will return the fully executed agreement(s) to the local jurisdiction(s).

M. Materials & Research will be advised of any subsequent revision(s) to the relinquishment(s), and prepare the necessary Supplemental Document(s).

6. **Internal Distribution:**

After the agreements are signed the following distribution will be made by the Materials & Research Division within the Department:

(1.) Roadway Design

(2.) Traffic Engineering

(3.) Right of Way

(4.) Controller: Maintenance Unit

(5.) District Engineer

(6.) Planning and Project Development:
Mapping Section and Statistical Unit

(7.) Materials & Research: Classification and Needs Unit

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7. **Document Recording and Final Disposition:**

When the Right of Way Division receives notice of the executed agreement, they will file all necessary legal documents, for the relinquishment, at the appropriate County Office and notify the District Engineer and Materials & Research when the relinquishment was recorded.

The District Engineer shall notify the appropriate local officials, in writing, with copies to Materials & Research, Director, all Deputy Directors, the appropriate Highway Commissioner, and all appropriate Division Heads, of the effective date of change of jurisdictional responsibility.

Materials & Research, Functional Classification will make final submittal to the Federal Highway Administration, perform all the necessary documentary changes in functional classifications, and update the official state highway and local road/street Functional Classification maps.

If necessary the Traffic Engineer will issue a highway route revision informing all concerned officials of the new highway location, number, and identify the old highway.

8. **Abandonment of Roadway:**

Projects should not progress to the design hearing stage without a signed agreement covering all relinquishments of highways affected by the project.

If the local government refuses to accept the relinquishment, the Department of Roads will delay the project until an agreement with the local jurisdictions can be reached. If an agreement is not obtainable, the Department may abandon the segment as a public road, as provided by Section 39-1314 of State Statute, so the project may continue.

Monty W. Fredrickson
Deputy Director – Engineering

Date: January 2004

To: All Roadway Design Personnel

From: Eldon Poppe ____________________________

Subject: CADD Coordination Policy

The following is the revised CADD Coordination Policy Dated January 1, 2004. All previous editions are to be recycled. This policy is endorsed by the Roadway Design's Division Quality Council and is administered by the CADD Coordination Group. The CADD Coordination Policy is a companion document to the Design Process Outline and is to be used by all Roadway Design personnel.

This policy will become part of the Roadway Design Manual. Future revisions to the policy will be announced via Lotus Notes and will be distributed with the Design Manual updates. An Adobe Acrobat Reader version of this policy will be located on the server: L:\CADD policy\caddpolicy.pdf.

PURPOSE:

The CADD Coordination Policy was revised by the Geopak Coordination Committee using input from CADD users. Its purpose is to promote better communication, save time, and increase efficiency for everyone involved. To ensure success, the CADD Coordination Group will monitor, review and revise the CADD Coordination Policy and the section and Roadway Design Project Managers will be involved with the implementation and enforcement.

POLICY:

1. Follow the Design Process Flow Chart.

2. Utilize the Preliminary Project Setup and CADD Coordination Checklists. Both Designer and Technician will maintain a copy of the checklists.

3. Follow the standards detailed in the CADD Coordination Policy when working in CADD files.

4. The most current version of all files should be backed up to the appropriate server.

5. Follow General Responsibilities Chart.

6. Roadway Design Project Managers will provide P.S.S. schedules to all Designers and Technicians

7. Designers and Technicians will follow all standards when setting up sheet files.

CADD Coordination Policy
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GENERAL RESPONSIBILITIES TO CADD COORDINATION POLICY

DESIGN UNIT

DESIGNER

- Adhere to policy.
- Schedules and conducts Preliminary Setup meeting.
- Communicates changes, etc. to Technician.
- Strive for efficiency/economics.
- Give feedback on policy process breakdown.
- Set-up meetings “A”,”B” & “C”.
- Adhere to Design Process Outline (DPO).

SQUAD LEADER

- Enforcement of policy.
- Monitor schedule demands & communicate to Technician.
- Give feedback on policy process breakdown.
- Attend Preliminary Setup meeting and meeting “A”.

ROADWAY DESIGN PROJECT MANAGER

- Enforcement of policy.
- Accountability.
- Monitor process and communicate with employees.
- Monitor efficiency/economics.
- Positive attitude on policy process.
- Monitor P.S.S. and communicate changes to Designer and Technician.

ASSISTANT DESIGN ENGINEER

- Enforcement of policy.
- Positive attitude on policy process.

TECH. UNIT

TECHNICIAN

- Adhere to policy.
- Minimize shelf time
- Communicate with Designer.
- Give feedback on policy process breakdown.
- Attend coordination meetings “A”,”B” & “C”.

SQUAD LEADER

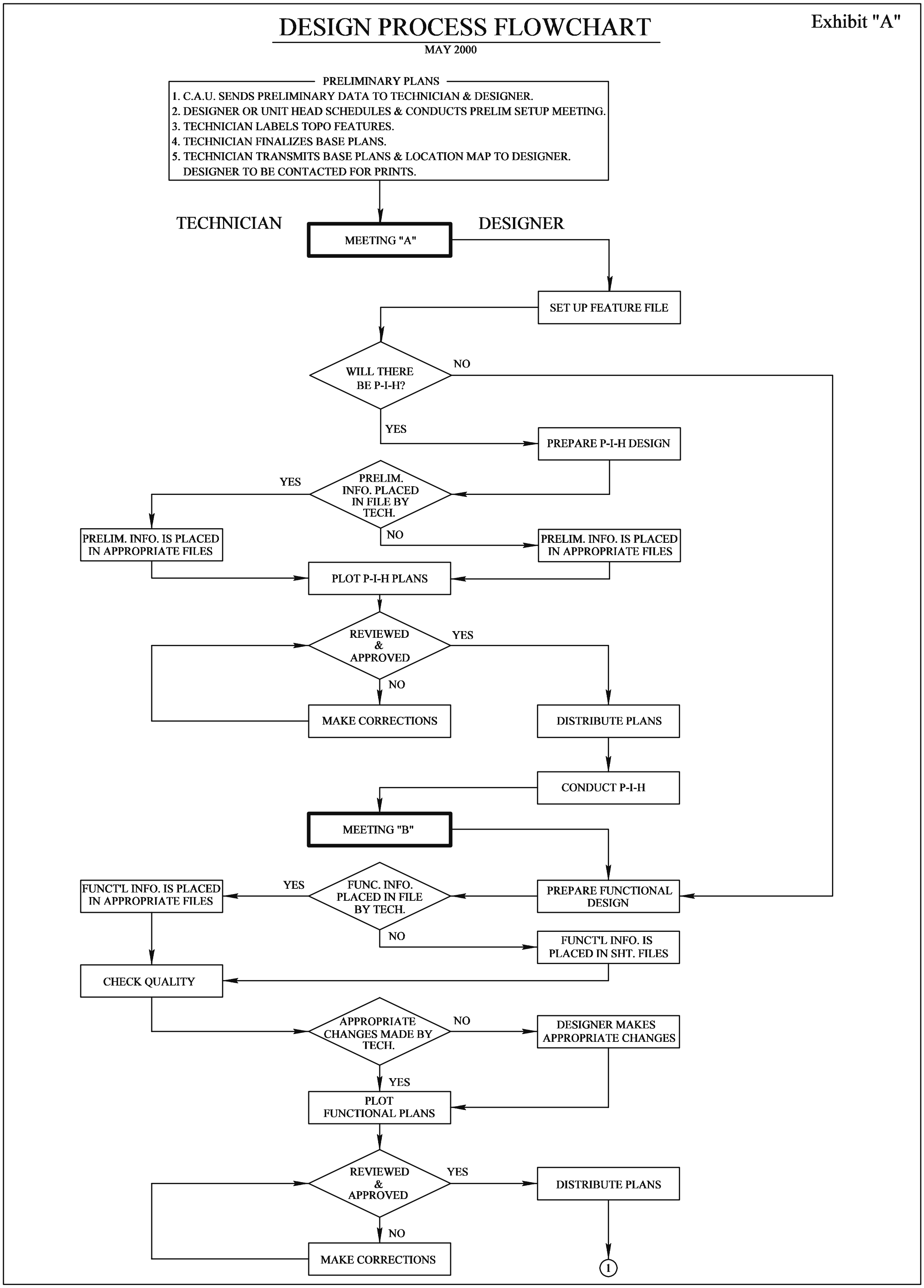
- Enforcement of policy.
- Attend Preliminary Setup meeting and meeting “A”.
- Monitor schedule demands and communicate to Designer.
- Give feedback on policy process breakdown.

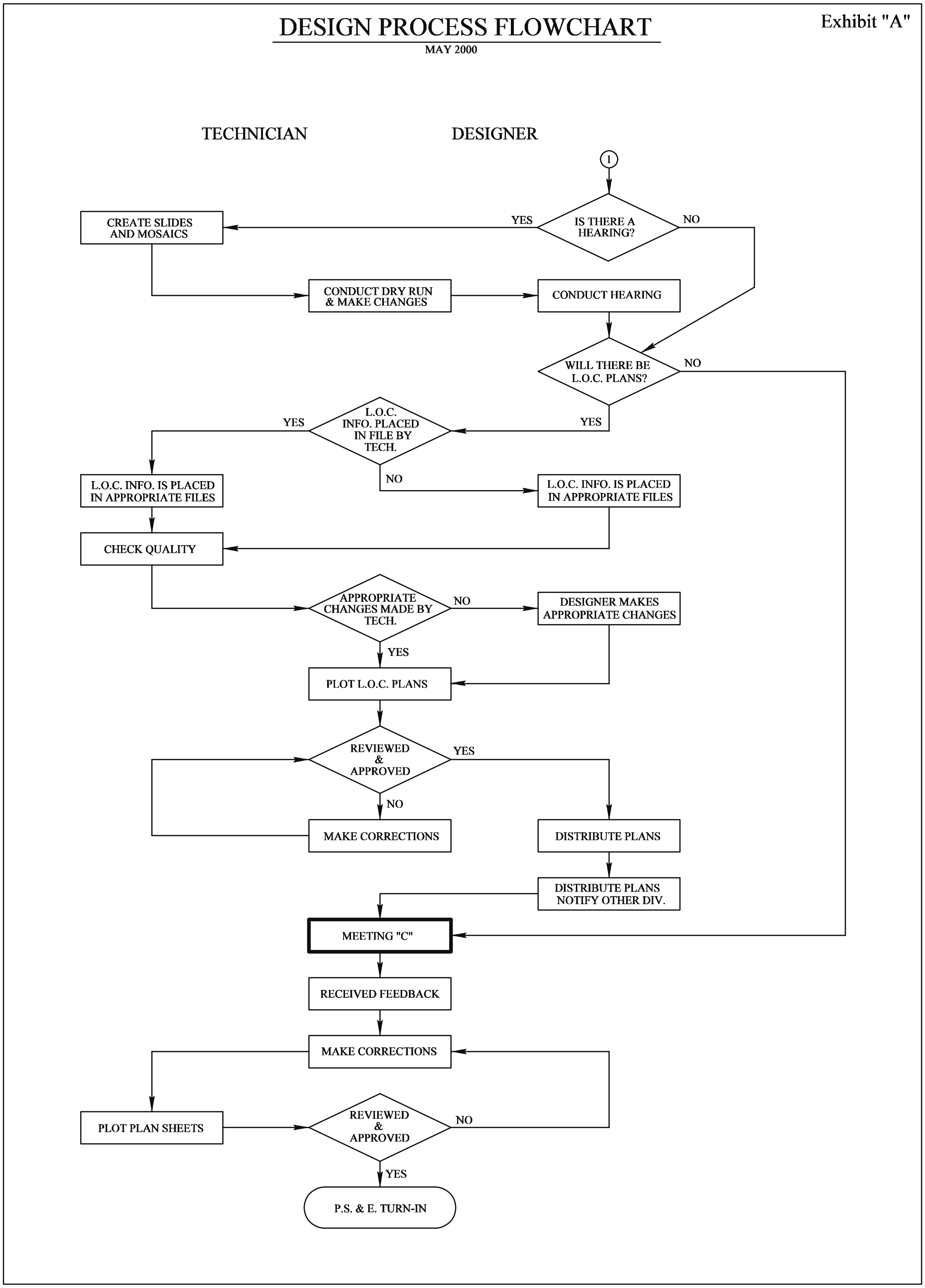
ROADWAY DESIGN PROJECT MANAGER

- Enforcement of policy.
- Accountability.
- Monitor policy process and communicate with employees.
- Monitor efficiency/economics.
- Positive attitude on policy process.

ASSISTANT DESIGN ENGINEER

- Enforcement of policy.
- Positive attitude on policy process.


DESIGN PROCESS FLOWCHART
MAY 2000
Exhibit "A"
PRELIMINARY PLANS
1. C.A.U. SENDS PRELIMINARY DATA TO TECHNICIAN & DESIGNER.
2. DESIGNER OR UNIT HEAD SCHEDULES & CONDUCTS PRELIM SETUP MEETING.
3. TECHNICIAN LABELS TOPO FEATURES.
4. TECHNICIAN FINALIZES BASE PLANS.
5. TECHNICIAN TRANSMITS BASE PLANS & LOCATION MAP TO DESIGNER. DESIGNER TO BE CONTACTED FOR PRINTS.
TECHNICIAN
MEETING "A"
DESIGNER
SET UP FEATURE FILE
WILL THERE BE P-I-H?
NO
YES
PREPARE P-I-H DESIGN
PRELIM. INFO. PLACED IN FILE BY TECH.
YES
NO
PRELIM. INFO. IS PLACED IN APPROPRIATE FILES
PRELIM. INFO. IS PLACED IN APPROPRIATE FILES
PLOT P-I-H PLANS
REVIEWED & APPROVED
YES
NO
MAKE CORRECTIONS
DISTRIBUTE PLANS
CONDUCT P-I-H
MEETING "B"
FUNCT'L INFO. IS PLACED IN APPROPRIATE FILES
YES
FUNC. INFO. PLACED IN FILE BY TECH.
PREPARE FUNCTIONAL DESIGN
NO
FUNCT'L INFO. IS PLACED IN SHT. FILES
CHECK QUALITY
APPROPRIATE CHANGES MADE BY TECH.
NO
DESIGNER MAKES APPROPRIATE CHANGES
YES
PLOT FUNCTIONAL PLANS
REVIEWED & APPROVED
YES
DISTRIBUTE PLANS
NO
MAKE CORRECTIONS
1


DESIGN PROCESS FLOWCHART
MAY 2000
Exhibit "A"
TECHNICIAN
DESIGNER
1
IS THERE A HEARING?
YES
NO
CREATE SLIDES AND MOSAICS
CONDUCT DRY RUN & MAKE CHANGES
CONDUCT HEARING
WILL THERE BE L.O.C. PLANS?
NO
YES
L.O.C. INFO. PLACED IN FILE BY TECH.
YES
NO
L.O.C. INFO. IS PLACED IN APPROPRIATE FILES
L.O.C. INFO. IS PLACED IN APPROPRIATE FILES
CHECK QUALITY
APPROPRIATE CHANGES MADE BY TECH.
NO
DESIGNER MAKES APPROPRIATE CHANGES
YES
PLOT L.O.C. PLANS
REVIEWED & APPROVED
YES
NO
MAKE CORRECTIONS
DISTRIBUTE PLANS
DISTRIBUTE PLANS NOTIFY OTHER DIV.
MEETING "C"
RECEIVED FEEDBACK
MAKE CORRECTIONS
PLOT PLAN SHEETS
REVIEWED & APPROVED
NO
YES
P.S. & E. TURN-IN

Preliminary Project Setup

PROJECT NO.:_________________________ CONTROL NO.:______________________
PROJECT NAME:________________________ BOOK NO.:__________________________
COUNTY:______________________________ REF. POST:_________ TO __________
DESCRIPTION:_________________________ STA. __________ TO STA. __________

ROADWAY DESIGN PROJECT
MANAGER/DESIGNER:________________________________ EXT.: ______________
SQD. LDR/TECHNICIAN:_______________________________ EXT.: ______________
R.O.W. ROADWAY DESIGN PROJECT
MANAGER/DESIGNER:__________________________ EXT.: ______________

IS THIS TO BE A CONSULTANT PROJECT ? ______________________________

SHEET SET UP
WHO WILL SET UP SHEETS? ____

SCALE OF SHEETS

ENGLISH TYPE (P/P or 2-L)	____ CONVERT	METRIC TYPE (P/P or 2-L)
_____ 20 __________________		_____ 200 __________________
_____ 50 __________________		_____ 500 __________________
_____ 100 _________________		_____ 1000 _________________

PHOTOGRAMMETRY INFORMATION RECEIVED:_____________________________
SURVEY INFORMATION RECEIVED:____

FILE INFORMATION:____
____
____
____
MISC. INFORMATION:____
____
____
____

BASE PLAN COMPLETION DATES:
PSS : _____________________________
ESTIMATED: _______________________

CADD Coordination Checklist

PROJECT NO.:_________________ ROADWAY DESIGNER/EXT.:______________________
CONTROL NO.:_________________ TECHNICIAN/EXT.:_______________________________
R.O.W. DESIGNER/EXT.:_________________________

DATES:
MEETING “A” ______________ MEETING “B” ______________MEETING “C”________________
TRANSMIT P.I.H. PLANS: ________________ INFO MEETING _________________________
TRANSMT FUNCTIONAL PLANS: __________ HEARING _______________________________
TRANSMIT L.O.C. PLANS: ________________ P.S. & E TURN-IN _______________________

HORIZONTAL ALIGNMENT INFORMATION:
P.I.H PLANS FILE NAME ____ ALIGNMENT CHANGE ____ TOPOG UPDATE ____
FUNCTIONAL PLANS FILE NAME ____ ALIGNMENT CHANGE ____ TOPOG UPDATE ____
L.O.C PLANS FILE NAME ____ ALIGNMENT CHANGE ____ TOPOG UPDATE ____
FINAL PLANS FILE NAME ____ ALIGNMENT CHANGE ____ TOPOG UPDATE ____

WHO IS GENERATING THE FOLLOWING ITEMS IN CADD FILES:			
DES	**TECH**		**REMARKS**
		DRAINAGE	
X		EDGE OF PAVEMENT	
		EROSION CONTROL	
		FENCING	
		GEOMETRICS ANOTATION	
		GRADES	
X		GUARDRAIL	
X		JOINTS	
X		LIGHTING	
X		LIMITS OF CONSTRUCTION	
		NOTES	
		PHASING	
		SPECIAL DITCHES	
	X	SPECIAL PLANS	
		TYPICALS	
		2-N SHEET	
X		LANDSCAPING	
		WETLANDS	

NOTES:
____
____
____
____
____

FILE NAMING CONVENTIONS

January, 2004

X X X X X 0 _ _ .d g n

UNIT BASE FILE

FIRST 5 CHARACTERS ARE PROJECT CONTROL NUMBER.
6th CHARACTER WILL BE ZERO (0) OR THE ALPHA CHARACTER IN THE CONTROL NUMBER.

1. UNIT DESIGNATION (7th Character)

1 2 3 4 5 0 _ _. dgn

a	EXPRESSWAYS UNIT “A”
c	CONSULTANT UNIT
d	TECHNICIAN UNIT
e	EXPRESSWAYS UNIT “B”
i	INTERSTATE UNIT
l	LIGHTING UNIT
m	ROADSIDE DEVELOPMENT UNIT
o	RESURFACING UNIT
p	PHOTOGRAMMETRY UNIT
r	RIGHT-OF-WAY DESIGN
s	SURVEY UNIT
u	URBAN UNIT
w	WETLANDS
z	RAIL AND PUBLIC TRANSPORTATION

2. BASE FILE NAME

1 2 3 4 5 0 x a ? . dgn	Overall Project (a = Design Alignment File)
1 2 3 4 5 0 x b. dgn	Overall Project (b = Drainage Culvert Cross Sections)
1 2 3 4 5 0 x c. dgn	Overall Project (c = Contours)
1 2 3 4 5 0 x d. dgn	Overall Project (d = DTM File)
1 2 3 4 5 0 x f.? dgn	Overall Project (f = Design Feature File)
1 2 3 4 5 0 x p. dgn	Overall Project (p = Planimetrics)
1 2 3 4 5 0 x s. dgn	Overall Project (s = Mainline Cross Sections)
? ? ? ? ? 0 x s. dgn**	Overall Project (Other Alignment Cross Sections)
1 2 3 4 5 0 x n.? dgn	Overall Project (n = Notes File)
1 2 3 4 5 0 x z. dgn	Overall Project (z = Phasing File)
1 2 3 4 5 0 x p a t. dgn	Overall Project (Pattern shapes)
1 2 3 4 5 0 x p l t. dgn	Overall Project (Mainline Cross Section Plots)
? ? ? ? ? 0 x p l t. dgn**	Overall Project (Other Alignment Cross Section Plots)
1 2 3 4 5 0 x p r o. dgn	Overall Project - Optional Profile File (Profile may be drawn in the alignment file)

? = Multiple files may be necessary.
Example: 1 2 3 4 5 0 i a 1. dgn (Alignment file #1)
Example: 1 2 3 4 5 0 e n 1. dgn (Notes file #1)

****File to be named by Designer, name not limited to 5 characters.**

3a. TYPE OF SHEET FILE (8th Character)

1 2 3 4 5 0 d _ _ . dgn

a _____________AERIALS (includes Wetland Delineation)
c _____________CONSTRUCTION (includes Resurfacing Projects)
d _____________DRAINAGE
e _____________GRADES
f _____________FENCE
g _____________GEOMETRICS or GEOMETRICS and GRADES
h _____________ALIGNMENT ORIENTATION (Alignment Info., Ties and Bench Marks)
j _____________JOINTS
k _____________SUMMARY of SOILS and MATERIALS SURVEY INFORMATION
l _____________LIGHTING
m _____________MISCELLANEOUS (Location Maps and Exhibits)
n _____________GENERAL INFORMATION
p _____________PLAN AND PROFILE (includes Full Profile)
q _____________QUANTITIES (includes Earthwork and Design Data)
r _____________REMOVALS
s _____________SPECIAL PLAN (Guardrail, etc.)
t _____________TYPICALS (includes Joint Repair)
w _____________LANDSCAPING
x _____________EROSION CONTROL
z _____________PHASING

3b. SHEET FILE NUMBER

Number files 1-999 (One border sheet per file)
Example: 1 2 3 4 5 0 d p 5. dgn (Plan and Profile sheet file #5)
Example: 1 2 3 4 5 0 d p 1 1 6. dgn (Plan and Profile sheet file #116)

3c. REQUIRED REFERENCE FILE LOGICAL NAMES

Border sheets must use a logical name that begins with “s”. i.e. “s1” or “sheet1”
Planimetrics files must use a logical name that begins with “t”. i.e. “t1” or “topog1” (dashed on plot)

3d. REVISION – ADDED SHEET

When adding a sheet for a revision, the file shall end with an “a”.
Example: 1 2 3 4 5 0 d p 5 a. dgn (Plan and Profile, added sheet file #5a)

3e. AS BUILT FILE NAMES

As Built file names shall start with the letter “a”.
Example: a 1 2 3 4 5 0 d p 5. dgn (As Built, Plan and Profile sheet #5)

4. AERIAL FILE NAMES

Example: 1 2 3 4 5 0 p o 1. hmr (Photogrammetry Digital Ortho file #1)
Photogrammetry will provide an index file (.dgn format) if multiple digital orthophotos exist.
Index example: 1 2 3 4 5 0 p o index.dgn
Example: 1 2 3 4 5 0 d a 1. hmr (Aerial corresponds to sheet file 123450da1.dgn)
The warped 9x9 photos shall be named according to their flight and frame numbers.
Example: 9 5 0 1 0 4. hmr (Flight number = 9501 and Frame number = 04)

STANDARD METRIC TEXT SIZES

June, 2002 Plot Scale 1000:1

PRELIMINARY SURVEY

	CASE	TX	WEIGHT	FONT
Station & Offset Text	N/A	2.5	1	5
Topog. & Driveway Notations	UPPER	2.5	1	5
Section-Township-Range	UPPER	3	1	5
Example: SEC. 35-T31N-R1E				
Hwy. No., Co. Rd. & Street Names	UPPER	3	2	5
Notes for Pipes & Structures	UPPER	3	1	5
Streams, Rivers, Railroads	UPPER	3	1	5 *
County Names	UPPER	3.5	2	5
City Names	UPPER	5	2	9
Contours	N/A	2.5	1	5
Section Line	UPPER	3	1	5

DESIGN

HORIZONTAL ALIGNMENT				
Stationing Text	N/A	3.5	2	5
P.C. or P.T. on Alignment	UPPER	3	1	5
Equations & P.I. Data	UPPER	3	1	5
VERTICAL ALIGNMENT				
Reference Line	N/A	3.5	2	5
Alignment Annotation	N/A	3.5	2	5
V.P.I. Data	U/L	3.5	2	5
Profile Elevations – Existing	N/A	3	1	5
Profile Elevations – Design	N/A	3.5	2	5
Construction Notes	U/L	3.5	2	5 *
Contours	N/A	3	2	5
Tabular Note Information		3	2	5
(Prelim. info. UPPER case. Design info. U/L case)				

* 15 degree slant. Note: Line spacing should be .75 of TX

STANDARD METRIC TEXT SIZES

June, 2002 Plot Scale 500:1

PRELIMINARY SURVEY

	CASE	TX	WEIGHT	FONT
Station & Offset Text	N/A	1.25	1	5
Topog. & Driveway Notations	UPPER	1.25	1	5
Section-Township-Range	UPPER	1.5	1	5
Example: SEC. 35-T31N-R1E				
Hwy. No., Co. Rd. & Street Names	UPPER	1.5	2	5
Notes for Pipes & Structures	UPPER	1.5	1	5
Streams, Rivers, Railroads	UPPER	1.5	1	5 *
County Names	UPPER	1.75	2	5
City Names	UPPER	2.5	2	9
Contours	N/A	1.25	1	5
Section Line	UPPER	1.5	1	5

DESIGN

	CASE	TX	WEIGHT	FONT
HORIZONTAL ALIGNMENT				
Stationing Text	N/A	1.75	2	5
P.C. or P.T. on Alignment	UPPER	1.5	1	5
Equations & P.I. Data	UPPER	1.5	1	5
VERTICAL ALIGNMENT				
Reference Line	N/A	1.75	2	5
Alignment Annotation	N/A	1.75	2	5
V.P.I. Data	U/L	1.75	2	5
Profile Elevations – Existing	N/A	1.5	1	5
Profile Elevations – Design	N/A	1.75	2	5
Construction Notes	U/L	1.75	2	5 *
Contours	N/A	1.5	2	5
Tabular Note Information		1.5	2	5
(Prelim. info. UPPER case. Design info. U/L case)				

* 15 degree slant. Note: Line spacing should be .75 of TX

STANDARD METRIC TEXT SIZES

June, 2002 Plot Scale 200:1

PRELIMINARY SURVEY

	CASE	TX	WEIGHT	FONT
Station & Offset Text	N/A	.5	1	5
Topog. & Driveway Notations	UPPER	.5	1	5
Section-Township-Range	UPPER	.6	1	5
Example: SEC. 35-T31N-R1E				
Hwy. No., Co. Rd. & Street Names	UPPER	.6	2	5
Notes for Pipes & Structures	UPPER	.6	1	5
Streams, Rivers, Railroads	UPPER	.6	1	5 *
County Names	UPPER	.7	2	5
City Names	UPPER	1.0	2	9
Contours	N/A	.5	1	5
Section Line	UPPER	.6	1	5

DESIGN

HORIZONTAL ALIGNMENT				
Stationing Text	N/A	.7	2	5
P.C. or P.T. on Alignment	UPPER	.6	1	5
Equations & P.I. Data	UPPER	.6	1	5
VERTICAL ALIGNMENT				
Reference Line	N/A	.7	2	5
Alignment Annotation	N/A	.7	2	5
V.P.I. Data	U/L	.7	2	5
Profile Elevations – Existing	N/A	.6	1	5
Profile Elevations – Design	N/A	.7	2	5
Construction Notes	U/L	.7	2	5 *
Contours	N/A	.6	2	5
Tabular Note Information (Prelim. info. UPPER case. Design info. U/L case)		.6	2	5

* 15 degree slant. Note: Line spacing should be .75 of TX

STANDARD ENGLISH TEXT SIZES

January, 20024 Plot Scale 100:1

PRELIMINARY SURVEY

	CASE	TX	WEIGHT	FONT
Station & Offset Text	N/A	10	1	5
Topog. & Driveway Notations	UPPER	10	1	5
Section-Township-Range	UPPER	12	1	5
Example: SEC. 35-T31N-R1E				
Hwy. No., Co. Rd. & Street Names	UPPER	12	2	5
Notes for Pipes & Structures	UPPER	10	1	5
Streams, Rivers, Railroads	UPPER	12	1	5 *
County Names	UPPER	14	2	5
City Names	UPPER	18	2	9
Contours	N/A	10	1	5
Section Line	UPPER	12	1	5

DESIGN

	CASE	TX	WEIGHT	FONT
HORIZONTAL ALIGNMENT				
Stationing Text	N/A	14	2	5
P.C. or P.T. on Alignment	UPPER	12	1	5
Equations & P.I. Data	UPPER	12	1	5
VERTICAL ALIGNMENT				
Reference Line	N/A	14	2	5
Alignment Annotation	N/A	14	2	5
V.P.I. Data	U/L	14	2	5
Profile Elevations – Existing	N/A	12	1	5
Profile Elevations – Design	N/A	14	2	5
Construction Notes	U/L	14	2	5 *
Contours	N/A	12	2	5
Tabular Note Information (Prelim. info. UPPER case. Design info. U/L case)		12	2	5

* 15 degree slant. Note: Line spacing should be .75 of TX

STANDARD ENGLISH TEXT SIZES

January, 2004 Plot Scale 50:1

PRELIMINARY SURVEY

	CASE	TX	WEIGHT	FONT
Station & Offset Text	N/A	5	1	5
Topog. & Driveway Notations	UPPER	5	1	5
Section-Township-Range	UPPER	6	1	5
Example: SEC. 35-T31N-R1E				
Hwy. No., Co. Rd. & Street Names	UPPER	6	2	5
Notes for Pipes & Structures	UPPER	5	1	5
Streams, Rivers, Railroads	UPPER	6	1	5 *
County Names	UPPER	7	2	5
City Names	UPPER	9	2	9
Contours	N/A	5	1	5
Section Line	UPPER	6	1	5

DESIGN

HORIZONTAL ALIGNMENT				
Stationing Text	N/A	7	2	5
P.C. or P.T. on Alignment	UPPER	6	1	5
Equations & P.I. Data	UPPER	6	1	5
VERTICAL ALIGNMENT				
Reference Line	N/A	7	2	5
Alignment Annotation	N/A	7	2	5
V.P.I. Data	U/L	7	2	5
Profile Elevations – Existing	N/A	6	1	5
Profile Elevations – Design	N/A	7	2	5
Construction Notes	U/L	7	2	5 *
Contours	N/A	6	2	5
Tabular Note Information		6	2	5
(Prelim. info. UPPER case. Design info. U/L case)				

* 15 degree slant. Note: Line spacing should be .75 of TX

STANDARD ENGLISH TEXT SIZES

January, 2004 Plot Scale 20:1

PRELIMINARY SURVEY

	CASE	TX	WEIGHT	FONT
Station & Offset Text	N/A	2	1	5
Topog. & Driveway Notations	UPPER	2	1	5
Section-Township-Range	UPPER	2.4	1	5
Example: SEC. 35-T31N-R1E				
Hwy. No., Co. Rd. & Street Names	UPPER	2.4	2	5
Notes for Pipes & Structures	UPPER	2	1	5
Streams, Rivers, Railroads	UPPER	2.4	1	5 *
County Names	UPPER	2.8	2	5
City Names	UPPER	3.6	2	9
Contours	N/A	2.	1	5
Section Line	UPPER	2.4	1	5

DESIGN

HORIZONTAL ALIGNMENT

Stationing Text	N/A	2.8	2	5
P.C. or P.T. on Alignment	UPPER	2.4	1	5
Equations & P.I. Data	UPPER	2.4	1	5

VERTICAL ALIGNMENT

Reference Line	N/A	2.8	2	5
Alignment Annotation	N/A	2.8	2	5
V.P.I. Data	U/L	2.8	2	5
Profile Elevations – Existing	N/A	2.4	1	5
Profile Elevations – Design	N/A	2.8	2	5
Construction Notes	U/L	2.8	2	5 *
Contours	N/A	2.4	2	5

Tabular Note Information		2.4	2	5
(Prelim. info. UPPER case. Design info. U/L case)				

* 15 degree slant. Note: Line spacing should be .75 of TX

STANDARD WEIGHTS AND STYLES FOR DESIGN FILES

June, 2002

WEIGHT	STYLE	
2	0	ALL DRAINAGE ITEMS
1	DIKE	DIKES-INTERCEPTING MEDIAN
2	0	EDGE OF PAVEMENT & DRIVES (ASPH. / CONC.)
2	0	BACK OF CURB
0	0	FACE OF CURB
2	0	BARRIER CURB
2	0	SIDEWALKS AND STEPS
1	0	SURFACED SHOULDERS
3	0	STATIONED CENTERLINES
3	3	SURVEYED CENTERLINES. USE IF SHIFTED ALIGNMENT EXISTS
0	4	NON-STATIONED CENTERLINES
0	CENTER OF DRIVE	DRIVE CENTERLINES
2	0	BRIDGES AND APPROACH SLABS
1	3	AGGREGATE SURFACING & EARTH DRIVES
1	3	TANGENT LINES. VERTICAL ALIGNMENTS
0	3	TANGENT LINES. HORIZONTAL ALIGNMENTS AND GEOMETRICS
2	SILT FENCE HIGH	SILT FENCE – HIGH POROSITY
2	SILT FENCE LOW	SILT FENCE – LOW POROSITY
2	SILT FENCE WPWW	SILT FENCE - WPWW
2	FENCE ROW OR WIRE	R.O.W. FENCE – WIRE
2	FENCE CHAIN LINK	R.O.W. FENCE – CHAIN LINK
2	0	WALLS – RETAINING, NOISE, ETC.
2	0	JERSEY BARRIER
2	0	EXPANSION JOINTS
1	5	CONTRACTION JOINTS
1	3	LONGITUDINAL JOINTS
2	GUARDRAIL	SAFETY BEAM GUARDRAIL

LEVEL GUIDE FOR ENGLISH ALIGNMENT FILE

GEOPAK Projects – January, 2004

1	Mainline – Alignment	21	Other – Alignment
2	**20 Scale** P.I. Cells and Tangent Lines	22	**20 Scale** P.I. Cells and Tangent Lines
3	Tic Mark, Station Text	23	Tic Mark, Station Text
4	P.I. Data & Control Points (PC, PT)	24	P.I. Data & Control Points (PC, PT)
5	**50 Scale** P.I. Cells and Tangent Lines	25	**50 Scale** P.I. Cells and Tangent Lines
6	Tic Mark, Station Text	26	Tic Mark, Station Text
7	P.I. Data & Control Points (PC, PT)	27	P.I. Data & Control Points (PC, PT)
8	**100 Scale** P.I. Cells and Tangent Lines	28	**100 Scale** P.I. Cells and Tangent Lines
9	Tic Mark, Station Text	29	Tic Mark, Station Text
10	P.I. Data & Control Points (PC, PT)	30	P.I. Data & Control Points (PC, PT)
11	**200 Scale** P.I. Cells and Tangent Lines	31	**200 Scale** P.I. Cells and Tangent Lines
12	Tic Mark, Station Text	32	Tic Mark, Station Text
13	P.I. Data & Control Points (PC, PT)	33	P.I. Data & Control Points (PC, PT)
14	Small Tic Text (50, 100 and 200 Scale)	34	Small Tic Text (50, 100 and 200 Scale)
15		35	
16		36	
17		37	
18		38	
19		39	
20		40	

41	Existing – Alignment
42	**20 Scale** P.I. Cells and Tangent Lines
43	Tic Mark, Station Text
44	P.I. Data & Control Points (PC, PT)
45	**50 Scale** P.I. Cells and Tangent Lines
46	Tic Mark, Station Text
47	P.I. Data & Control Points (PC, PT)
48	**100 Scale** P.I. Cells and Tangent Lines
49	Tic Mark, Station Text
50	P.I. Data & Control Points (PC, PT)
51	**200 Scale** P.I. Cells and Tangent Lines
52	Tic Mark, Station Text
53	P.I. Data & Control Points (PC, PT)
54	Small Tic Text (50, 100 and 200 Scale)
55	
56	Vertical & Horizontal Axis Information
57	Special Ditch Profiles
58	Minor Stationing (Profile-Horizontal Axis)
59	Existing Ground Elevations
60	Existing Ground Profile
61	Proposed Profile Elevations
62	Proposed Profiles
63	Profile Cell

Project Number -
Control Number -
Project Name -
Designer -
Drafter -

LEVEL GUIDE FOR METRIC ALIGNMENT FILE

GEOPAK Projects – January, 2004

1	Mainline – Alignment	21	Other – Alignment	41	Existing – Alignment
2	**200 Scale** P.I. Cells and Tangent Lines	22	**200 Scale** P.I. Cells and Tangent Lines	42	**200 Scale** P.I. Cells and Tangent Lines
3	Tic Mark, Station Text	23	Tic Mark, Station Text	43	Tic Mark, Station Text
4	P.I. Data & Control Points (PC, PT)	24	P.I. Data & Control Points (PC, PT)	44	P.I. Data & Control Points (PC, PT)
5	**500 Scale** P.I. Cells and Tangent Lines	25	**500 Scale** P.I. Cells and Tangent Lines	45	**500 Scale** P.I. Cells and Tangent Lines
6	Tic Mark, Station Text	26	Tic Mark, Station Text	46	Tic Mark, Station Text
7	P.I. Data & Control Points (PC, PT)	27	P.I. Data & Control Points (PC, PT)	47	P.I. Data & Control Points (PC, PT)
8	**1000 Scale** P.I. Cells and Tangent Lines	28	**1000 Scale** P.I. Cells and Tangent Lines	48	**1000 Scale** P.I. Cells and Tangent Lines
9	Tic Mark, Station Text	29	Tic Mark, Station Text	49	Tic Mark, Station Text
10	P.I. Data & Control Points (PC, PT)	30	P.I. Data & Control Points (PC, PT)	50	P.I. Data & Control Points (PC, PT)
11	**2000 Scale** P.I. Cells and Tangent Lines	31	**2000 Scale** P.I. Cells and Tangent Lines	51	**2000 Scale** P.I. Cells and Tangent Lines
12	Tic Mark, Station Text	32	Tic Mark, Station Text	52	Tic Mark, Station Text
13	P.I. Data & Control Points (PC, PT)	33	P.I. Data & Control Points (PC, PT)	53	P.I. Data & Control Points (PC, PT)
14		34		54	
15		35		55	
16		36		56	Vertical & Horizontal Axis Information
17		37		57	Special Ditch Profiles
18		38		58	Minor Stationing (Profile-Horizontal Axis)
19		39		59	Existing Ground Elevations
20		40		60	Existing Ground Profile
Project Number -				61	Proposed Profile Elevations
Control Number -				62	Proposed Profiles
Project Name -				63	Profile Cell
Designer -					
Drafter -					

LEVEL GUIDE FOR FEATURE FILE

June, 2002

1	Edge of Pavement	21	Steps	41	Limits of Construction Text
2	Edge of Shoulder	22	Front and Back of Sidewalk	42	Geometrics
3	Face and Back of Curb	23	Retaining Walls	43	Grades
4	Edge of Surfaced & Non-Surfaced Drives	24	Concrete Ditch Liners and Flumes	44	Ditch Checks, Erosion Control and Silt Fence
5	Temp. Road Edges	25	Adjust Manhole to Grade	45	Guardrail Grading Line
6	Mailbox Turnout	26	Misc. Construction Items	46	Ditch Bottoms
7	Temporary Pipe	27	All Permanent Fence	47	Ditch Flow Arrows
8		28	Guardrail	48	Ditch Flow Text
9		29	Dikes and Riprap	49	
10		30	Culvert Items. See Levels 31 through 33	50	
11		31	Reinforced Concrete Sewer Pipe	51	
12		32	Inlets, Junction Boxes and Manholes	52	
13		33	Concrete Box Culverts	53	
14		34	Lighting	54	
15		35	Phase 1 Lighting. If Required	55	
16		36	Phase 2 Lighting. If Required	56	
17		37	Phase 3 Lighting. If required	57	
18		38	Phase 4 Lighting. If Required	58	
19		39	Proposed Utilities	59	
20	Bridges and Approach Slabs	40	Limits of Construction	60	
Project Number -				61	
Control Number -				62	
Project Name -				63	
File Name -					
Note: Levels 49 through 63 are for the Designers notes and miscellaneous drawing. These levels will be turned off for final plotting.					

LEVEL GUIDE FOR NOTES FILE

January, 2004

	1	Note Boxes, Leaders and Terminators		21	Hatching for 2-W's		41	Revision…R1
	2	Section, Township and Range Text		22			42	Revision…R2
	3	Curve Data Text		23	Geometrics		43	Revision…R3
	4	Label Project Centerline (Hwy No.)		24	Grades		44	Revision…R4
	5			25	Construction		45	Proposed Water Line
	6			26	Removals (Notes Only)		46	Proposed Gas Line
	7	Alignment Ties (If needed)		27	Removal Hatching and Shading		47	Proposed Power Line
	8	Alignment Ties (If needed)		28	Removal Hatching and Shading		48	Proposed Telephone Line
	9	Alignment Ties (If needed)		29	Removal Hatching and Shading		49	Proposed Sanitary Sewer Line
	10	All Existing Descriptions (Drainage, Bridges, etc.)		30	Drainage (Symbols w/numbers)		50	
	11			31	Lighting – Phase 1		51	Roadway (Phase 1) Hatching, Shading, Notes
	12			32	Lighting – Phase 2		52	Roadway (Phase 2) Hatching, Shading, Notes
	13			33	Lighting – Phase 3		53	Roadway (Phase 3) Hatching, Shading, Notes
	14			34	Lighting (Final Design or no Phasing)		54	Roadway (Phase 4) Hatching, Shading, Notes
	15			35			55	Roadway (Phase 5) Hatching, Shading, Notes
	16			36			56	Roadway (Phase 6) Hatching, Shading, Notes
	17			37			57	
	18			38			58	
	19			39			59	
	20			40			60	North Arrow

Project Number -	Level 61 = Blank
Control Number -	Level 62 = Blank
Project Name -	Level 63 = Note Guide Cell, Sheet Shapes
File Name -	

LEVEL GUIDE FOR PLANIMETRICS FILE

January, 2004

	1	Design Origin, Horizontal Control Points, Bench Mark and Photo Code Symbol		21	Gas *		41	Text for Level 11
	2	Photo Center, Pug Points and Mapping Limit. Locator Position		22	TV / Telephone *		42	Text for Level 12
	3	Section Lines, Text for Section Information, State, County and City Names shall be placed on Level 33		23	Power *		43	Text for Level 13
	4	Contours and Text shall be placed in separate file. Grid Ticks		24	Culverts and Ditch Liners		44	Text for Level 14
	5	Shrubs, Stumps and Trees		25	Guardrail, Guardpost & Impact Attenuator		45	Text for Level 15
	6	Flowline, Lake, Marsh Pond, River, Reservoir, Stream and Spot Elevation		26			46	Text for Level 16
	7	Building, Center Pivot, Crop Line, Dam, Deck, Dike, Fence, Foundation, Gabion, Porch, Propane Tank, Quarry, Retaining Wall, Riprap, ROW Marker, Sign, Stairs, Ref. Post, Gasoline Pump, Gas Filler Pipe		27			47	Text for Level 17
	8	Concrete Slab, Concrete Barrier, Billboard, Driveway, Flagpole, Mail Box, Oil Well, Paved Area, Satellite Dish, Sidewalk, Stock Tank, Windmill		28			48	Text for Level 18
	9	Water: Line, Meter, Valve and Well. Fire Hydrant		29			49	Text for Level 19
	10	Gas: Line, Meter, Valve and Vent		30	Highway Symbols		50	Text for Level 20
	11	Telephone: Box, Line and Pole Television: Box, Cable and Line		31	Text for Level 1		51	Text for Level 21
	12	Power: Box, Line and Pole, Guy Anchor, Guy Wire, Sub Station, Trans. Tower		32	Text for Level 2		52	Text for Level 22
	13	Sanitary and Storm Sewer: Inlets, Manholes and Vents		33	Text for Level 3		53	Text for Level 23
	14	Railroad: Lights, Track and Warning Signs		34	Text for Level 4		54	Text for Level 24
	15	Edge of: Gravel Roads, Shoulder, Surfaced Rds, Trail, Curbs, Bridge & Viaduct, Hwy Symbols		35	Text for Level 5		55	Text for Level 25
	16	Light Pole, Street Light, Yard Light, Traffic Signal and Traffic Signal Box		36	Text for Level 6		56	P.T. Name
	17	Existing Highway and Drive Centerline, Stationing, P.I.'s and Tangent Lines		37	Text for Level 7		57	Elevation
	18	Surveyed Highway Centerline, Stationing. P.I.'s and Tangent Lines		38	Text for Level 8		58	Field Comment
	19	Sanitary / Storm Sewer *		39	Text for Level 9		59	Breaklines & Locator
	20	Water *		40	Text for Level 10		60	Border Sheets

Project Number -	Level 61 =
Control Number -	Level 62 =
Project Name -	Level 63 = Drainage Meander
File Name -	

* Note: Levels 19 through 23 are for utilities that are taken from sources other than Photogrammetric or field surveys.

ROW DESIGN LEVEL GUIDE

January, 2004

LINES/TEXT

		ENGLISH	**METRIC**					
	LV	**TX**	**TX**	**CO**	**WT**		**LC**	**COMMENTS**
BOUNDARY LINES	45	10	2.5	198	1		0	
EXIST. CA	42	10	2.5	54			CUST	Control Access exist-e
NEW CA	55	12	3	117			CUST	Control Access new-e
EXIST. ROW LINE	48	12	3	54	1		3	
NEW ROW LINE	52			117	3		0	
NEW ROW TEXT	54	12	3	117	2			
SEC. LINE	44			2	5		0	
QTR. SEC. LINE	36			4	5		0	
METES & BOUNDS TEXT	43	10	2.5	0	1			
LOT NUMBERS/LINES	46	10	2.5	198	1		0	
BLOCK NUMBERS	46	24	7	54	2			
SUBDIVISIONS	46	50	15	198	2			FT = 7
STREETS	46	14	3.5	54	2			FT = 23
TOWN NAMES	46	70	21	54	2			FT = 7
EXIST. EASE	49	10	2.5	6	1		0	
NEW TEMP. EASE. LINE	61			114	1		0	
NEW TEMP. EASE. TEXT	62	10	2.5	114	1			
NEW PERM. EASE. LINE	53			6	1		0	
NEW PERM. EASE. TEXT	39	10	2.5	6	1			
RR ROW LINE	14	10	2.5	6	1		CUST	Railroad row-e
RR CENTERLINE	15	12	3	6	1		CUST	Railroad cl-e
NEW RR TEMP. EASE LINE	16			114	1		0	
NEW RR PERM. EASE. LINE	18			6	1		0	
EXIST. RR EASE. LINE	20			1	1			
PROP. LINE	47			73	5		0	
SURVEY TEXT	44	12	3	2	2			
OWNERSHIP/TRACT#	47	12	3	73	2			
MIN. ROW	56			3	3		0	
GENERAL ROW TXT. (Title Block Info.)	57	12	3	13	2			
BUILD NOTES	57	14	3.5	0	1			
STATION TEXT (Top of Sheet)	7	14	3.5	3	2			

LEVEL GUIDE FOR CROSS SECTION FILE

GEOPAK Projects – June, 2002

1	Pavement	21	Baseline Name Text	41	
2	Paved Shoulders	22	Sidewalks	42	Existing Ground (Recommended)
3	Curbs	23	Building Label Text Retaining Walls	43	
4	Temp. Road Pavement, Shoulder and Slopes	24		44	
5	Medians	25		45	
6		26		46	
7	Barrier Walls	27		47	
8	Existing Shoulder Material	28		48	R.O.W. Labels (R.O.W. Criteria)
9	Existing Pavement Material	29		49	
10	Earth Shoulders, Dikes & Shoulder Construction	30	Label Text (Label Criteria)	50	Milling Symbology
11	Bridge Text Warning Text	31		51	
12	Offset Text	32		52	
13	Side Slope Text	33		53	
14	Elevation Text	34		54	
15	Foundation Course	35		55	
16	Shoulder Undercut Side Slopes	36		56	
17	PGL Elevation Text	37		57	
18	Shoulder Slope Text	38		58	
19	Pavement and Drive Slope Text	39		59	Station, Elevation & Offset text in XS Sheet File
20	Station Text Bridge Rail	40	Micro Text for Reports	60	Earthwork Shapes (Recommended)
Project Number -				61	Irregular Pavement Text
Control Number -				62	Existing Pavement & Shoulder Text
Project Name -				63	GEOPAK XS Cell
Designer -					
Drafter -					

LEVEL GUIDE FOR PHASING FILE

June, 2002

	1	Topog. from previous project		21	Previous construction		41	
	2	Temporary asphalt		22	Temporary asphalt		42	
	3	New concrete pavement		23	New concrete pavement		43	
	4	Traffic control		24	Traffic control		44	
	5	Previous construction		25			45	
	6	Temporary asphalt		26			46	
	7	New concrete pavement		27			47	
	8	Traffic control		28			48	
	9	Previous construction		29			49	
	10	Temporary asphalt		30			50	
	11	New concrete pavement		31			51	
	12	Traffic control		32			52	
	13	Previous construction		33			53	
	14	Temporary asphalt		34			54	
	15	New concrete pavement		35			55	
	16	Traffic control		36			56	
	17	Previous construction		37			57	
	18	Temporary asphalt		38			58	
	19	New concrete pavement		39			59	
	20	Traffic control		40			60	

Project Number -	Level 61 = Blank
Control Number -	Level 62 = Blank
Project Name -	Level 63 = Blank
File Name -	
Designer -	

LEVEL GUIDE FOR SHEET FILE

January, 2004

	1	Project & Control Numbers		21			41	
	2	Sheet Number		22			42	
	3	Engineer's Seal		23			43	
	4			24			44	
	5			25			45	
	6			26	Legend (Wetlands, Phasing, Lighting, etc.)		46	
	7			27			47	
	8			28			48	
	9			29			49	
	10	All information placed directly in Sheet File*		30	Sheet Titles (Geometrics, Grades, Construction, etc.)		50	
	11			31			51	
	12			32			52	
	13			33			53	
	14			34			54	
	15	Wetlands (Flight, Date, & Scale Text)		35			55	
	16			36			56	
	17			37			57	
	18			38			58	Sidebar Elevations Plan & Profile Sheets
	19			39			59	Datum Elev. Information Plan & Profile Sheets.
	20			40	SPECIAL PLAN_C		60	P.N.F Cell

Project Number -	Level 61 = Blank
Control Number -	Level 62 = Blank
Project Name -	Level 63 = Blank
File Name -	*2-T, 2-H and 2-N Sheets

Subject: PUBLIC INTEREST LETTERS

MEMORANDUM OF UNDERSTANDING

This MOU implements the provisions of 23CFR635.309(b), (c), (g) and (h) for State Highway Projects. The statements required in these paragraphs are contained in a document called the Right of Way certificate (certificate), and need to be prepared prior to any bid advertisement. The certificate will be certified by the Right of Way Division's Property Management Supervisor and will be approved by the Right of Way Division Manager.

The Monthly Project Scheduling Team is responsible for reviewing individual projects to determine if the provisions of (c)(3) are applicable. When the team decides that those provisions are applicable a letter will be prepared justifying why it is in the publics interest to proceed with advertising the project. The letter will be signed by the Roadway Design Engineer and will include a brief description of each unacquired tract sufficient to form a reasonable conclusion of the significance of the tract.

The Deputy Director-Engineering will review the public interest letter and give consideration to the following factors in determining if advertising the project is in the public interest.

1. The proposed starting date of the contract
2. The feasibility of moving the project to another letting
3. The number and significance of the remaining unacquired tracts
4. The exact status in the acquisition process of the unacquired tracts
5. The overall justification of exactly why it is in the public interest to have the project in a particular letting.

On those projects not involving residential or business displacees still in occupancy the Deputy Director's decision will be final. No approval is required by the FHWA.

The Contracts Section of the Construction Division will provide an information copy of all ROW certificates and public interest letters to the FHWA prior to each letting.

If a Residential or business displacee is still in occupancy the above-described letter will be presented to the FHWA for approval.

ORIGINAL SIGNED BY:

Allan L. Abbott	Bruce Lind
Director-State Engineer	Division Administrator
Nebraska Department of Roads	Federal Highway Administration

12/07/1998

Types of Projects Not Usually Requiring A Status of Utilities

Listed below are types of projects that typically do not conflict with utilities and will not usually require a Status of Utilities. On the **PS&E** Required Sheet check the "Not Applicable" box under Status of Utilities for these types of projects. Please contact the **Highway Utility Coordinator** for assistance if there is a question.

Armor Coat
Aggregate Resurfacing
Bridge Deck Concrete Overlay
Bridge Deck Overlay
Bridge Deck Overlay & Curb
Bridge Deck Overlay & Repair
Bridge Painting
Concrete Crossing
Concrete Crossing & Upgrade
Concrete Pavement Patching
Concrete Pavement Repair
Concrete Pavement Repair Resurface
Concrete Barrier
Crack Seal
Crack Sealing
Dowel Bar Retrofit Grinding
Fog Seal
Fog Seal Surface Shoulders
Grind & Concrete Repair
Joint Repair Grinding
Joint Seal
Joint Repair Resurface
Joint Repair Milling & Resurface
Joint Repair Resurface Surface Shoulder
Joint Seal Plowable Marker
Joint Seal Concrete Repair
Mill & Concrete Pavement
Mill & Inlay
Mill & Inlay Armor Coat
Mill & Resurface
Mill Armor Coat
Mill Concrete Inlay
Mill Inlay Surface Shoulder
Milling Inlay
Milling Resurface
Patching Joint Seal
Roadway Expansion Devices
Rumble Strips
Seeding
Slurry Seal
Slurry Seal Surface Shoulders
Surface Rehabilitation
Upgrade Circuitry
Upgrade Warning Devices

UPGRADING RURAL INTERCHANGES ON I-80 IN NEBRASKA

The following is a guide for upgrading I-80 interchange bridges and approaches in rural areas. These guidelines are based on economic analyses that compare the benefits derived from accident cost reduction to the cost of the improvement. This should be used for interchange projects and projects involving intersecting highways at an interchange.

1. Crossroads with a design year ADT of less than 3000:

   A. If the bridge width meets "Needs Study" criteria and the structural condition is sufficient to use in place, repair the bridge as needed. Upgrade the guardrail and bridge rail, use the existing gradeline in place, and upgrade the pavement surface as needed. Sign the roadway for reduced speed, if necessary.

   B. If the bridge width does not meet "Needs Study" criteria or if the bridge has major structural deficiencies, replace the bridge to "New and Reconstructed" standards. The clear roadway width on the new bridge must meet minimum design standards and should match the width of the approach roadway plus shoulders. The new bridge should be a two-span structure providing adequate lateral clearance for the outside travel lanes on I-80. Retaining walls should be considered where it is possible to use a shorter bridge length. Upgrade the guardrail.

   C. Use the existing gradeline in place if it meets "Needs Study" criteria (max. allowable speed for crest vertical curves: 40 mph below 400 ADT and 45 mph at and above 400 ADT) and upgrade the pavement surface as needed. Sign the roadway for reduced speed, if necessary.

2. Crossroads with a design year ADT of 3000 or greater:

   A. If the bridge width meets "Needs Study" criteria and the structural condition is sufficient to use in place, repair the bridge as needed. If the existing gradeline meets "Needs Study" criteria, use the gradeline in place, widen the roadway at the ramp terminals to provide left-turn lanes if justified by the Traffic Engineering Division, upgrade the pavement surface as needed, upgrade the guardrail, and sign the roadway for reduced speed, if necessary. Further study may be needed to determine if the bridge should be widened or replaced to accommodate left-turn-lane storage.

   B. If the bridge width does not meet "Needs Study" criteria or if the bridge has major structural deficiencies, replace the bridge to meet "New and Reconstructed" standards. The new bridge should be a two-span structure providing adequate lateral clearance for the outside travel lanes on I-80. Retaining walls should be considered where it is possible to use a shorter bridge length.

   C. Rebuild the crossroad if the existing vertical alignment does not meet "New and Reconstructed" standards. However, if the impact to adjacent property is significant, consider design features closer to minimum or lower design speeds. If the vertical alignment is sufficient, upgrade the pavement surface as needed.

ORIGINAL SIGNED BY:

Approved ____________________________ Date 6-19-96

Monty W. Fredrickson
Deputy Director – Engineering

SUPPLEMENT TO THE
I-80 RURAL INTERCHANGE STUDY

This supplement describes the economic analyses that provide the guidelines contained in "**UPGRADING RURAL INTERCHANGES ON I-80 IN NEBRASKA**". The information that helped develop the guidelines came from a 1995 study of rural I-80 interchanges.

BACKROUND

In Nebraska, I-80 was built between 1957 and 1974. Many of its rural interchanges have four-span bridges and vertical geometrics that do not meet modern "New and Reconstructed" standards.

The four-span bridges, typically, have piers located three to four meters from the edge of the driving lane of I-80. This does not meet the DR-1 lateral obstacle clearance of 11 meters. New two-span bridges provide the required lateral clearance.

Roadway approaches of the crossroad were originally designed to provide minimum stopping sight distances for 80 km/h (50 mph). Under modern criteria, many of these vertical alignments now have minimum stopping sight distances for only about 70 km/h (45 mph).

ACCIDENTS

A review of accidents occurring during the five-year period from June 1989 to May 1994 revealed a significant increase in the number of accidents on the crossroad over I-80 when current ADT exceeds 2,500. Most of these accidents occurred near the ramp terminals where slowing, stopping, and turning maneuvers occur.

Interchanges where the crossroad carries less than 2,500 current ADT have less than one accident per year on the average. Major improvements, such as reconstruction of the gradeline, may not be cost effective since the potential for reducing accidents is low.

Because the current ADT of 2,500 appeared to be the dividing line for accidents, a design year ADT of 3,000 is used in the recommendations.

Some accidents may be attributed to sight distance. As stated above, many of these crossroads have only 70 km/h (45 mph) speeds for minimum stopping sight distance for crest vertical curves. Stopping sight distance at the ramp terminals will generally be higher for a passenger vehicle.

Sight distance for vehicles turning onto the crossroad from the ramp was evaluated. Vehicles on the crossroad would normally have to slow down to less than 85 percent of the mainline speed of 90 km/h (55 mph) when a passenger vehicle pulls out from a stop condition at the ramp terminal, turns either left or right, and proceeds. Sight distance requirements are met for a 90 km/h (55 mph) design speed to allow a passenger vehicle to turn left onto the crossroad and not interfere with a passenger vehicle approaching from the left.

Accidents on I-80 near interchanges are relatively few. Most occur at a grade separation, normally hitting the guardrail and occasionally the piers.

GEOMETRIC DEFICIENCIES

Three primary geometric deficiencies exist at many of the interchanges. First, there is the lateral obstacle clearance deficiency for through-traffic lanes on I-80 because of pier location. Second, there is a bridge width deficiency for the crossroad over I-80. Third, there is also less than a 90 km/h (55 mph) minimum sight distance on the crossroad. Replacing the bridge with a two-span structure which meets "New and Reconstructed" standards would correct the first of these deficiencies, but not the third.

A substantial investment went into constructing the I-80 interchanges and justification for correcting the current deficiencies should be based on an effective cost analysis. A benefit/cost analysis compares the reduction in accident costs derived from a safety improvement to the cost of the improvement.

Depending on the pavement history, the guardrail would normally be replaced three times (minimum) or four times (maximum) over a 50-year period. The benefit/cost analysis considers both possibilities.

BRIDGE WIDTH

For new or reconstructed bridges on state highways, the clear roadway width must meet minimum design standards and should match the width of the approach roadway plus shoulders. The width of most bridge approaches is 44' (24' roadway and 10' shoulders).

CALCULATIONS AND CONCLUSIONS

1. If bridge widening is required, it is more cost effective to replace the existing four-span bridge with a two-span bridge that meets "New and Reconstructed" standards, than to widen and redeck the existing bridge.

    A. Assuming an average bridge length of 235' and a crossroad approach of 44', the cost of widening and redecking an existing bridge to 46.4' (44' plus 2.4' for width of rails) is $501,584.

       235' x 46.4' x $46 / sf = $501,584

    B. Assuming that the average bridge could be shortened by 35' using retaining walls, the latter costing $115,000, the cost of replacing an existing bridge with a new structure is $642,104.

       200' x 46.4' x $56.80 / sf = $527,104
       $527,104 + $115,000 = $642,104

    C. A life-cycle, 50-year, cost analysis of upgrading the guardrail three or four times to protect the outside piers of an existing four-span bridge indicates the following <u>additional cost</u> for widening an existing bridge. The costs of installation, maintenance, and accidents are included.

	Three Guardrail Upgrades	Four Guardrail Upgrades
Low volume traffic	$130,170	$148,175
Medium volume traffic	$175,878	$193,878
High volume traffic	$218,196	$236,196

<u>Note:</u> "Low volume traffic" refers to western I-80, Wyoming border to I-76 (5,800 ADT). "Medium volume traffic" refers to central I-80, I-76 to Grand Island (12,460 ADT). "High volume traffic" refers to eastern I-80, Grand Island to Seward (17,680 ADT).

D. Therefore, the total cost of widening and redecking an overpass bridge is:

Three Guardrail Upgrades

Low volume traffic	\$501,584 + \$301,170 = \$631,754
Medium volume traffic	\$501,584 + \$175,878 = \$677,462
High volume traffic	\$501,584 + \$218,196 = \$719,780

Four Guardrail Upgrades

Low volume traffic	\$501,584 + \$148,175 = \$649,759
Medium volume traffic	\$501,584 + \$193,878 = \$695,462
High volume traffic	\$501,584 + \$236,196 = \$737,780

E. Comparing the cost to replace an overpass bridge (\$642,104) to the figures in paragraph D above, it is more cost effective to replace a bridge than to widen and redeck it. Note that for low volume, three guardrail upgrades, the life-cycle cost is slightly less than the cost of replacement. The difference is less than two percent and, therefore, is considered adequate justification for replacement.

2. Along I-80, it is cost effective to remove the outside guardrail at pier locations and provide adequate lateral obstacle clearance. This is true for both low-volume and high-volume traffic sections. The clearance would be provided if the four-span bridges were replaced with two-span bridges. For two-span bridges, the center pier still requires guardrail. This conclusion supplements the cost effectiveness of paragraph one above.

3. On low-volume crossroads (under 3,000 design year ADT), it is not cost effective to build short left-turn lanes between the ramp terminals and the overpass bridge. The cost to add short left-turn lanes at the ramp terminals is about \$180,000. Evaluating the accident report information indicated that there are very few cases where a separate left-turn lane would have prevented the accident. However, for design year ADT's exceeding 3,000, accidents prevented using left-turn lanes may actually be cost effective where sight distance is restricted.

SURVEY/PLAN ACCURACY

DESCRIPTION		ENGLISH (Ft.)	METRIC (m)
Alignment PI's, PC's, PT's, etc.	(Project Stationing)	0.01	0.001
Farmstead Drives	(Stationing)	1	0.1
Field Entrances	(Stationing)	1	0.1
County Roads	(Stationing)	0.1	0.01
Intersecting Hwy / Streets	(Stationing)	0.01	0.001
Tel Poles / Power Poles	(Sta/Offset)	1	0.1
Drainage Pipes	(Stationing)	1	0.1
	(Length of Pipe)	1	0.1
	(Skew Angle)	Nearest Degree	Nearest Degree
Drainage Box Culverts	(Stationing)	1	0.1
	(Length of Box)	0.1	0.01
	(Skew Angle)	Nearest Degree	Nearest Degree
Bridges	(Stationing)	0.01	0.001
Wells	(Stationing / Offset)	1	0.1
ROW Markers	(Coordinate Survey)	Not Required	Not Required
Control Points	(Coordinate Survey)	Not Required	Not Required
	(Surveyed by Station & Offset)	0.01	0.001
Bench Marks	(Coordinate Survey)	Not Required	Not Required
	(Surveyed by Station & Offset)	0.01	0.001

DESIGN QUANTITIES / PLAN ACCURACY

DESCRIPTION	ENGLISH (Ft.)	METRIC (m)
Each		
All contract items with a unit of each	Whole number	Whole number
Cubic Yards / Cubic Meters		
All contract items with a unit of Cu. Yd. or m^3 except:	Nearest Cu. Yds.	Nearest m^3
1. Aggregate surfacing items	Nearest 5 Cu. Yds.	Nearest 5 m^3
2. Concrete	0.01 Cu. Yds.	0.01 m^3
3. Base Course Material, Granular Foundation Course Material, Sand Soil Binder, Filler & Material Aggregates	Nearest 10 Cu. Yds.	Nearest 10 m^3
Square Yards / Square Meters		
All contract items with a unit of Sq. Yd. or m^2	Nearest Sq. Yd.	Nearest m^2
Mile / Kilometer		
All contract items with a unit of Mile or Kilometer.	0.001 mile	0.001 km
Station		
All contract items with a unit of Station.	0.001 Sta.	0.001 Sta.
Lin. Ft. / Lin. Meter		
All contract items with a unit of Lin. Ft. or Lin. m except:	Nearest Lin. Ft.	Nearest 0.1 m
1. Safety Beam Guardrail (multiples of 6 ft.-3 in.) or (multiples of 3.8 meters).	Nearest ½ Lin Ft.	Nearest 0.1 m
2. Cable Guardrail (multiples of 16 ft.) or (multiples of 5 m)	Nearest Lin. Ft.	Nearest 0.1 m
3. Bridge Railing, Handrail , Etc.	0.01 (2 decimal places)	Nearest 0.01 m
4. Wood Sign Supports	Nearest ½ Lin. Ft.	Nearest 0.1 m
5. Concrete Protection Barriers (Nearest Lin. Ft.) or (multiples of 3m)	Nearest Lin. Ft.	Nearest 0.1 m
6. Pipe Culverts (Elbows to the nearest degree)	Nearest Lin Ft.	Nearest 0.5 m
7. Box Culverts (Span 1 ft., Rise 1 ft.) (Span 0.3 m, Rise 0.3 m)	Nearest Lin. Ft.	Nearest 0.1 m
8. Lighting Conduit / Conduit Under Roadway	Nearest Lin. Ft.	Nearest meter
Vertical Foot / Vertical Meter		
All contract items with a unit of Vertical Ft. or Vertical m	.1 (1decimal place)	.1 (1 decimal place)
Day		
All contract items with a unit of Day.	Nearest ½ Day	Nearest ½ Day
Ton / Megagram		
All contract items with a unit of Ton or Megagram except:	Nearest Ton	Nearest Mg
1. Asphaltic Concrete	Nearest 10 Tons	Nearest 10 Mg
Cubic Yard Station / Cubic Meter Station		
All contract items with a unit of Cu. Yd. Sta. or m^3 Sta.	(Whole Number) Nearest Cu. Yd. Sta.	(Whole Number) Nearest m^3 Sta.

DESIGN QUANTITIES / PLAN ACCURACY (CONTINUED)

DESCRIPTION	ENGLISH (Ft.)	METRIC (m)
Acre / Hectare All items with a unit of Acre or Hectare	Nearest Acre	Nearest 0.5 Hectare
Hour All contract items with a unit of Hour.	Nearest Hour	Nearest Hour
Lb. / Kilogram All contract items with a unit of Pound or kilogram.	Nearest lb.	Nearest kg
Gallon / Liter All contract items with a unit of Gallon or Liter.	Nearest 10 Gal.	Nearest 10 liters
M. Gal / Kiloliter All contract items with a unit of Thousand gallons or Thousand Liters.	Nearest M. Gal.	Nearest kL

Degree	Radius (ft.)	Degree	Radius (ft.)	Degree	Radius (ft.)
0° 15’	22,918.312	8° 15’	694.494	16° 15’	352.589
0° 30’	11,459.156	8° 30’	674.068	16° 30’	347.247
0° 45’	7639.437	8° 45’	654.809	16° 45’	342.064
1° 00’	5729.578	9° 00’	636.620	17° 00’	337.034
1° 15’	4583.662	9° 15’	619.414	17° 15’	332.149
1° 30’	3819.719	9° 30’	603.113	17° 30’	327.404
1° 45’	3274.045	9° 45’	587.649	17° 45’	322.793
2° 00’	2864.789	10° 00’	572.958	18° 00’	318.310
2° 15’	2546.479	10° 15’	558.983	18° 15’	313.549
2° 30’	2291.831	10° 30’	545.674	18° 30’	309.707
2° 45’	2083.483	10° 45’	532.984	18° 45’	305.577
3° 00’	1909.859	11° 00’	520.871	19° 00’	301.557
3° 15’	1762.947	11° 15’	509.296	19° 15’	297.640
3° 30’	1637.022	11° 30’	498.224	19° 30’	293.825
3° 45’	1527.887	11° 45’	487.624	19° 45’	290.105
4° 00’	1432.394	12° 00’	477.465	20° 00’	286.479
4° 15’	1348.136	12° 15’	467.721	20° 30’	279.492
4° 30’	1273.240	12° 30’	458.366	21° 00’	272.837
4° 45’	1206.227	12° 45’	449.379	21° 30’	266.492
5° 00’	1145.916	13° 00’	440.737	22° 00’	260.435
5° 15’	1091.348	13° 15’	432.421	22° 30’	254.648
5° 30’	1041.741	13° 30’	424.413	23° 00’	249.112
5° 45’	996.448	13° 45’	416.697	23° 30’	243.812
6° 00’	954.930	14° 00’	409.256	24° 00’	238.732
6° 15’	916.732	14° 15’	402.076	24° 30’	233.860
6° 30’	881.474	14° 30’	395.143	25° 00’	229.183
6° 45’	848.826	14° 45’	388.446	25° 30’	224.689
7° 00’	818.511	15° 00’	381.972	26° 00’	220.368
7° 15’	790.287	15° 15’	375.710	26° 30’	216.210
7° 30’	763.944	15° 30’	369.650	27° 00’	212.207
7° 45’	739.300	15° 45’	363.783	27° 30’	208.348
8° 00’	716.197	16° 00’	358.099	28° 00’	204.628

Degree of Curve = 5729.578 ÷ Radius

1. GLOSSARY

A. Acronyms, Abbreviations and Symbols

2-A	Aerial photo plan sheets
2-H	Horizontal alignment and control points plan sheets
2-K	Summary of soil and materials survey information plan sheets
2-L	Large scale plan sheets
2-N	General information plan sheets
2-S	Summary of quantities plan sheets
2-T	Typical cross-section plan sheets
2-W	Wetlands plan sheets
3C	Continuing, cooperative, comprehensive planning process
3R	Resurfacing, restoration and rehabilitation projects
AASHTO	**American Association of State Highway and Transportation Officials**
ADA	Americans with Disabilities Act
ADT	Average daily traffic
BCT	Breakaway cable terminals
CA	Certification acceptance program agreement
CADD	Computer-aided drafting and design
CE	Categorical exclusion
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CRT	Controlled releasing terminals
DA	Diameter of culvert
DEA	Draft environmental assessment
DEIS	Draft environmental impact statement
DHV	Design hourly volume
DR Form 73	Highway Improvement Planning Request Form
DR Form 342	Project Information Sheet
DR Form 343	Cost Item Sheet

DR Form 333	Initial Project Data Sheet
DR Form 334	Project Data Revision Sheet
DR Form 335	Request for Project Authorization Form
EA	Environmental assessment
EIS	Environmental impact statement
EPA	**Environmental Protection Agency**
ESAL	Equivalent single axle load
e	Superelevation rate
e_{max}	Maximum superelevation rate
f	Side friction factor
f_{max}	Limiting side friction factor
FEMA	**Federal Emergency Management Agency**
FHWA	**Federal Highway Administration**
FONSI	Finding of no significant impact
H rating	**AASHTO** bridge live load rating corresponding to weight of a two-axle truck or lane loading (i.e., a uniformly distributed and concentrated load)
HS Rating	**AASHTO** bridge live load rating representing a tractor truck with semitrailer, or the corresponding lane loading
HW	Headwater
IES	**Illuminating Engineering Society**
K	Rate of vertical curvature, the length of vertical curve per percentage change in the algebraic difference between two tangent grades
L	Length of curve, distance from the PC to PT along a curve
L_r	Superelevation runoff length
L_{min}	Minimum superelevation runoff length
MELT	Modified eccentric loader terminals
mph	Miles per hour
MPO	Metropolitan planning organization
MSE	Mechanically stabilized earth

MUTCD	Manual of Uniform Traffic Control Devices
NC	Normal crown section
NCHRP	**National Cooperative Highway Research Program**
NDEQ	**Nebraska Department of Environmental Quality**
NDOR	**Nebraska Department of Roads**
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NWP	Nationwide permits
OI	Nebraska Department of Roads Operating Instruction
OSHA	**Occupational Safety and Health Administration**
P	Any point on a curve
$\mathbf{P_o}$	The high or low point of the curve
PC	Point of curvature for a horizontal curve
PCC	Point of compound curvature
PI	Point of intersection of tangents for a horizontal curve
PRC	Point of reverse curvature
PS&E	**Plans, Specifications and Estimates Section** in the **Construction Division**
PSI	Pavement serviceability index
PSS	Preconstruction Scheduling System
PT	Point of tangency for a horizontal curve
PVC	Point of curvature for a vertical curve
PVI	Point of intersection of tangents for a vertical curve
PVT	Point of tangency for a vertical curve
Q	Culvert capacity
$\mathbf{Q_{design}}$	Overtopping frequency or the frequency based on the allowable water surface elevation, whichever is more critical
R	Radius of a horizontal curve
R-*	Right-of-way plan sheets
RCRA	Resource Conservation and Recovery Act
ROW	Right-of-way

RR	Railroad
SCS	**Soil Conservation Service**
SEE	Social, economic and environmental review
SHPO	**State Historic Preservation Officer**
SPUI	Single point urban interchange
STP	Surface Transportation Program
T	Tangent length, distance from PC or PT to PI
TCP	Traffic control plan
TR	Tangent runout length
TRB	**Transportation Research Board**
TWLTL	Two-way left turn lane
USDOT	**United States Department of Transportation**
USGS	**U.S. Geologic Survey**
VC	Vertical curves
X-*	Roadway cross-section sheets

B. Terms and Definitions

Abandonment	The act of abandoning an existing roadway and right-of-way when the road is not needed on the state highway system.
Access	A means of ingress or egress between a highway and abutting property or an intersecting local public road or street.
Access Control	Restriction of the number and location of access points along the highway; it varies by the functional classification of the roadway.
Accessibility	A measure of the ability of users to utilize the transportation system.
Adjusted Embankment	The volume of embankment that results from the balance factor being multiplied by the measured embankment.
Alignment Book	A construction book that provides a listing of alignment information for referencing and relocating the centerline.
Allocation	Assigning funds to particular uses.

Ambient Air Quality	The quality of the surrounding air measured in terms of presence of ozone, hydrocarbons, nitrogen oxide, and carbon monoxide based on national standards.
Annual General Stormwater Runoff Permit	A permit obtained annually by the **Construction Division** relative to stormwater discharge.
Archeological Resources	Prehistoric cultural assets.
Armor Coat	A surface treatment consisting of sequential applications of asphalt and stone chips which may be made either in one or more layers to build up a structure roughly one inch or more in thickness.
At-Grade Intersections	Locations where two or more roadways or entrances cross and/or meet each other at the same elevation.
Auxiliary Lanes	Lanes that are not considered through travel lanes that are intended for use by vehicular traffic for specific functions, such as left and right turns, climbing/passing, acceleration/ deceleration, weaving, etc.
Average Daily Traffic	The average of 24 hr traffic counts collected over a number of days greater than one but less than a year.
Backslope	A cut slope, the segment of the roadside geometry that slopes up from the outside edge of a ditch to intersect with the existing ground.
Balance	When the amount of available excavation equals the amount of needed embankment.
Balance Points	A location along a roadway where an earthwork balance occurs.
Balance Factors	Multipliers applied to embankment volumes to adjust for shrinkage or swell of the soils used for embankment.
Barrier	A structure used to protect traffic from hazardous conditions along the roadside or medians.
Barrier Curb	Steep-face curb design to inhibit encroachment on state right-of-way.
Base Course	The layer or layers of specified or selected material of designed thickness placed on a subbase or a subgrade to support a pavement surface course.
Benefit-Cost Comparison	An economic evaluation to determine if a given design is warranted and justified based on the costs and benefits associated with it.
Bid	A contractor's written offer to construct a project based on the contract documents (plans, specifications, special provisions, etc.) at a specified price.

Bicycle Lane	A portion of a roadway that has been designated by striping, signing and pavement markings for either preferential or exclusive use by bicyclists.
Bicycle Path	A facility physically separated from motorized traffic facilities, either within a highway right-of-way or on another alignment, for either the preferential or exclusive use by bicyclists.
Blue Top Book	A construction book that provides a format for finish stake (blue top) notes to be recorded. Stations and subgrade elevations at the centerline, edge of surface and edge of subgrade shoulder are the information provided.
Borrow	Additional material required when the amount of embankment needed exceeds the amount of excavation available.
Borrow Pit	Areas that are approved by the state for the source of borrow; they can be either contractor-furnished or state-furnished.
Borrow Restoration	Upon completion of removal of borrow from a site, the pit is to be scarified and then stockpiled topsoil replaced and seeded.
Breakaway Support	A support used for traffic signs, traffic signals, streetlights, etc. that is designed to breakaway or bend on impact with an errant vehicle.
Bridge	A structure for carrying traffic erected over a depression or an obstruction and having an opening greater than 20 ft (6 m) as measured along the centerline of the roadway.
Bridge Approach Section	A transition section from guardrail to a bridge rail.
Broken Back Curve	A curve consisting of two consecutive curves deflecting in the same direction joined by a short tangent section.
Budgeting	The process of outlining future funding needs based on anticipated highway projects.
Buffer Area	The area between the back of curb and the sidewalk.
Bullnose Guardrail	A guardrail configuration in which the guardrail is curved around a hazard, forming a “nose”. It is often used in medians to shield a hazard from traffic in both directions.
Cable Guardrail	Guardrail constructed of multiple steel cables stretched between support posts.
CADD Coordination Plan	A schedule of required drafting activities for roadway design.
Capacity	The maximum flow in vehicles per hour that can be reasonably expected on a segment of highway during a given time period under prevailing roadway, traffic and control conditions.

Capacity Analysis	Study that estimates the amount of traffic that can be accommodated by a given facility while maintaining a predetermined level of service.
Categorical Exclusion	An environmental classification for a project indicating that no significant environmental impacts are anticipated (Class II project).
Center Of Gravity	The location where a vertical line divides an area of cut or fill into two equal areas; the area left of the center of gravity equals the area right of the center of gravity.
Center Pivot	A structure that pumps water from the ground to an aerial sprinkler system that rotates about the structure; used for crop irrigation.
Changes In Concept	Alterations in the original project idea during the planning and/or design stages.
Changes In Scope	Modifications in the extent or size of the project.
Change Order	A written order to the contractor covering changes in the contract.
Channelization	The physical separation of vehicular and/or pedestrian traffic movements to regulate conflicting movements.
Channelized Intersection	An intersection at which various traffic movements are separated by auxiliary lanes, medians, islands, etc.
Class I Project	A project that may significantly impact the environment and for which an environmental impact statement is required.
Class II Project	A project that has been determined will not significantly affect the environment.
Class III Project	A project on which the environmental impact must be determined and for which an environmental assessment must be prepared.
Clean Air Act	A federal law passed to protect and enhance the quality of the nation's air resources.
Clean Water Act	A federal law passed in 1977 to protect the quality of the nation's water resources.
Clear Zone	The total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width depends on the traffic volumes and speeds, and on the roadside geometry. Also called the recovery area or lateral obstacle clearance distance.

Climbing Lanes	Additional lane(s) provided on crest vertical curves to accommodate slow moving vehicles.
Cloverleaf Interchange	Four-leg interchanges with loop ramps to accommodate left turn movements. A full cloverleaf has loops in all quadrants.
Collector-Distributor Roads	An auxiliary road system parallel to but separate from a freeway/interstate that collects and distributes local traffic with the intent of limiting the number of entrance and exit points on a freeway while satisfying the demand for access to the freeway. Similar to frontage roads but collector-distributor roads do not provide access to abutting properties.
Comfort Criteria	Design consideration of motorists' willingness and/or ability to accept discomfort while traversing a roadway.
Complex Interchanges	A combination of two or more interchange configurations, within very limited spacing, connecting several different roadways.
Compound Curve	Two curves which join on the same side of a common tangent with no tangent length between the curves.
Comprehensive Plan	A plan developed for a local, regional or statewide area that considers social, economic, cultural, transportation, environment, and other concerns.
Condemnation	A legal proceeding **NDOR** pursues when an agreement cannot be reached with a landowner on the purchase of right-of-way.
Consolidation	The settling of existing ground under the weight of embankment, causing the embankment to settle.
Construction Joint	A joint made necessary by a prolonged interruption in the placing of concrete.
Construction Sequencing	The construction of a roadway in different phases so that the project may be built while maintaining through traffic and/or access to local residences or businesses.
Contaminated Soils	Soil that has unacceptable impurities in it.
Contour Grading Plans	Plans that show proposed contour lines for the areas adjacent to the roadway surfaces for use in construction.
Contract Plans	Plans used to bid on and construct a project.
Contraction Joint	A joint normally placed at recurrent intervals in a rigid slab to control transverse cracking.
Controlled Access Facility	A facility designed for through traffic and upon which **NDOR** may regulate, restrict or prohibit access for efficient traffic flow and the reduction of areas of traffic conflict.

Corridor Protection	A procedure whereby **NDOR** notifies appropriate local governmental agencies and the general public of the intent to acquire right-of-way along a highway corridor in order to restrict the amount of development which may occur adjacent to the intended improvement minimizing acquisition costs and design complexity.
Corridor Protection Plans	Plans, often aerial sheets, filed with the local government that show property ownership and the corridor width to be protected.
Corridor Studies	Studies of projects that may involve some relocation and/or community bypass. Study results usually are published in report form and include alignment location factors and cost estimates. Plan and profile sheets may also be included.
Cost Estimate	The anticipated cost of a project at different stages of planning and design.
Cost Sharing	The division of project expenses among governmental (and possibly other) entities involved in the project.
Covenant Agreement	A written agreement or contract between the state and local cities, towns or villages that outlines the respective responsibilities in planning, designing, constructing or maintaining a highway or their associated facilities, such as roadway lighting, traffic signals, etc.
Covenant Relinquishment Agreements	Agreements prepared prior to public hearings in which the provisions of relinquishment of roadway maintenance and operation functions to a local government are described.
Crash Cushions	A protective system that prevents errant vehicles from impacting roadside obstacles by decelerating the vehicle to a safe stop when the cushion is hit head on or redirecting the vehicle away from the obstacle when the cushions are hit from the side.
Critical Length Of Grade	The maximum length of a designated upgrade on which a loaded truck can operate without an unreasonable reduction in speed.
Critical Path	Tasks and activities that must be completed prior to the start of other activities.
Critical Slope	A slope that is considered non-recoverable, non-traverseable and one on which a vehicle is likely to overturn. A slope steeper than 3:1.
Cross Slope	The slope across traffic lanes and shoulders perpendicular to the flow of traffic.

Crossover Temporary pavement constructed on divided highways to temporarily route traffic across the median to the opposite lanes so that construction can occur on the vacated side.

Crosswalks Pedestrian crossings, usually at intersections, delineated by pavement markings and/or surfacing materials.

Crowned Typical Section A cross-section of roadway that has the high point of the pavement located at the center of the travelway and slopes to both shoulders.

Cul-De-Sacs A turning area provided at the closed end of a street opened at one end only.

Culvert Any structure under the roadway with a clear opening of less than 20 ft as measured along the center of the roadway.

Curb Cut A depression in the curb that is provided at curb ramps and entrances.

Curb Ramps Sidewalk ramps provided in curbed roadways to provide accessibility for the handicapped.

Cut Slope A positive grade sideslope generally going upward and outward from the shoulder edge or ditch bottom to intersect the natural ground.

Daylighting Flattening the roadway backslope to intersect with the natural ground at a lower elevation than the typical backslope. This is done to gain excavation or to improve sight distance.

Decision Sight Distance The distance required for a driver to complete the following actions: 1) detect an unexpected or otherwise difficult-to-perceive information source or obstacle in a roadway environment; 2) recognize the obstacle or its threat potential; 3) select an appropriate speed and path; and 4) initiate and complete the required maneuver safely and efficiently.

Deed A signed legal document to convey or transfer rights, ownership, etc.

Delineators Retroreflective devices mounted at the side of the roadway used to guide traffic, especially at night.

Depressed Median A median that is constructed at a lower elevation than the travel lanes. They are typically used on freeways and other divided arterials.

Design Checklist A list of tasks associated with roadway design activities.

Design Hourly Volume The two-way design hourly volume in number of vehicles during the thirtieth highest hour for the design year.

Design Process Outline An outline of regular roadway design activities.

Design Relaxation or Exception	A deviation from the design standards requiring approval by the appropriate state and/or federal officials.
Design Speed	The maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern. Limits of curvature, sight distance, roadway clearance, maximum gradient and other geometric features are a function of design speed.
Design Vehicle	A theoretical motor vehicle whose weight, dimensions and operating characteristics are used to establish highway design controls such as radius returns and turning roadways.
Design Year	The year 20 years after the completion of the project.
Detour	A signed alternate route within an existing roadway system that guides traffic around a construction zone outside of the project right-of-way instead of through the construction zone.
Diamond Interchange	A simple interchange with four ramps configured similarly to a diamond and having a stop condition on the side road.
Directional Island	Raised, flush or painted medians used to guide and protect traffic during turning movements. Also, known as channeling islands.
Directional Interchange	An interchange that provides continuous high-speed free-flow operations for both through and turning movements.
Distribution Analysis	An analysis of the volumes of excavation and embankment by station for the purpose of determining if the project earthwork will be balanced, borrow or waste.
Dowel	A load transfer device in a rigid slab, usually consisting of a plain round steel bar.
Driver Expectancy	A drivers' memory of previous roadway experiences that he/she relies on when responding to new situations.
Driveways	Access openings to adjoining properties from roadways.
Dry Run	Rehearsal for public hearing.
Easement	A legal right afforded a person, agency, etc. to make limited use of another's land usually for specific purposes, such as construction, utility, access, etc. Easements may be permanent or temporary.
Embankment	Material that must be filled or placed to construct the proposed roadway and its associated components.
Embankment Foundation Report	A report by the **Soils Mechanics Unit** recommending steps to minimize settlement and slope stability problems in areas of poor foundation soils.

End Areas	The areas of cut and fill computed between cross-sections from which total volumes of embankment and excavation may be made for the entire project.
Endangered Species	Any species that is in danger of extinction throughout all or any portion of its range.
Endangered Species Act	A federal law passed in 1973 to insure that actions authorized, funded or carried out by state or federal agencies do not jeopardize, destroy or critically modify the continued existence of endangered or threatened species and their habitat.
Engineering Review	A process by the **Planning and Project Development Division Location Studies Section** early in the project to establish the concept of work to be performed and the initial itemized cost estimate for major, non-interstate projects. The review summarizes the existing highway conditions, traffic, classification, adjacent sections, alignment, and environmental conditions. It is sometimes completed by the **Roadway Design Division** for smaller projects.
Enhancement Projects	Transportation infrastructure projects by local, regional and state governments that are not eligible for funding from other programs, e.g., historic preservation, trails and scenic byways projects.
Entrance Ramp	A ramp that provides access onto an expressway or interstate.
Environmental Assessment	A study required for environmental Class III projects for which the significance of environmental effects of a proposed project must be determined. If it is determined that the project will have no significant environmental impacts, it remains a Class III project and a finding of no significant impact (FONSI) statement is prepared. If significant effects are possible, the project is reclassified as a Class I project.
Environmental Classification	Federal designation of a project based on its potential impact on the environment.
Environmental Impacts	The possible affects of projects on the quality of the social, cultural or natural environment.
Environmental Impact Statement	A statement that describes the anticipated social, economic and environmental impacts of a Class I project (projects that may have significant impact on the environment).

Environmental Summary Sheet	A form from the **Planning and Project Development Division** that outlines the measures to be taken to mitigate the effects of a project on the environment, the applicable permits, etc.
Equivalent Single Axle Loads	Summation of equivalent 18,000-pound single axle loads used to combine mixed traffic to design pavement for traffic in the design period.
Erosion	A process in which soil and/or rock is loosened from its resting place and is carried by wind and/or runoff and deposited elsewhere.
Erosion Control	A program to control the displacement of soil particles by water, wind or other agents.
Erosion Control Permit	A part of the Section 404 permit process related to controlling water and siltation due to runoff into any water body including wetlands.
Established Quantities	Quantities of earthwork material determined from cross-sections by Design and used for the payment of earthwork.
Estimate Checklist	A listing of items required for a cost estimate.
Excavation	Material that must be cut to construct the proposed roadway, ditches, channels, entrances, etc.
Exempt Projects	Projects exempt from **FHWA** oversight, e.g., any new/reconstructed or 3R NHS projects estimated at less than $1 million or off-NHS projects.
Exit Ramp	A ramp that provides egress from an expressway or interstate.
Expansion Joint	A joint located to provide for the expansion of a rigid slab, without damage to itself, adjacent slabs or structures.
Exposure Factor	A factor used to evaluate whether grade separation of a railroad/roadway crossing is necessary based on the number of vehicles times the number of trains per day. If this factor is 50,000 or greater, a grade separation should be considered.
Expressway	A divided highway for through traffic with full or partial control of access with interchanges at major intersections and at-grade intersections at designated minor public road intersections. It serves urban centers of 15,000 population or more not served by the interstate system.

Federal Aid Projects	Projects that are partially or entirely funded by the federal government. They must comply with federal regulations, including environmental regulations.
Federal Funding	Funds provided by the federal government from various funding appropriation sources for transportation-related projects. Depending on the appropriation restrictions, some portions of projects may be participating, i.e., federal funds may be used for those items; or nonparticipating, i.e., items are not eligible for those particular federal funds.
Fill Slope	A downward embankment slope connecting the graded shoulder at the hinge point to the ditch bottom or natural ground.
Final Plans	Contract plans used by contractors, inspectors, etc. to construct the project.
Flare Rate	The allowable variable offset distance of a barrier to move the barrier end further from the travelway.
Floodplain	The area adjoining a watercourse or drainway that has been or may be covered by floodwaters.
Floodway	The channel of a watercourse or drainway and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a reasonable height.
Flush Median	A median that is on the same plane as the travel lanes, it is usually delineated by paint stripping on the pavement.
Fog Seal	A surface application of dilute emulsion with no aggregate that seals the pavement surface and generally provides a very distinct delineation between the mainline pavement and the shoulder.
Foreslope	The segment of the roadway cross-section from the hinge point sloping downward to the inside edge of the ditch.
Foundation Course	The graded portion of a highway prepared as the foundation for the pavement structure and shoulder.
Foundation Report	A report that summarizes field investigations of foundation soils and makes recommendations to minimize settlement and slope stability problems.
Frontage Roads	Restricted access roads, paralleling the mainline, to maintain capacity on the mainline and provide access to adjoining property.

Functional Classification	The grouping of highways and roads by the primary service they provide, access, mobility or a combination of access and mobility. It is used to determine the design standards to be used.
Functional Design	The stage of design after the plan-in-hand inspection and prior to the public hearing.
Future Access	A future means of ingress or egress between a highway and abutting property or an intersecting local public road or street that will not be built by **NDOR** but will be built by the owner at some future date when the development of the property requires construction of the driveway.
Gore	The area between a through roadway and an exit/entrance ramp.
Gore Neutral Area	The triangular area between the gore nose and the physical nose and the triangular area between the physical nose and the painted nose.
Gore Nose	A point, having some dimensional width separating the shoulders of the through travelway and the ramp, upstream from the gore area.
Grade Separation	The separation of traffic at an intersection of two or more roadways by constructing the roadways at different elevations; provides for free flow of traffic on all highways through the intersection but does not provide for access for turning traffic.
Granular Subdrain	A drain that is constructed of a porous, granular material designed to drain water from the foundation of the pavement.
Guardrail	A longitudinal barrier that shields roadside hazards from vehicles that may leave the travelway.
Habitat	The place(s) a given species of animal or plant naturally lives or grows that has the necessary food, cover, water and other species-specific conditions essential to well being.
Haul	The distance that excavated material is moved, as shown on the plans, from the location where the material is obtained to the location where the material is to be deposited.
Headwater	The depth of water impounded upstream of a culvert due to the influence of the culvert construction, friction and configuration.

Height Of Eye	The height of driver's eye above the road surface used for calculating sight distances. For stopping and passing sight distances, passenger vehicle height of eye is 3.5 ft. (1070 m).
Height Of Object	The height of an object within the roadway used for calculating sight distances.
Highway Commission Statement	An official communication from **Roadway Design** to the **Highway Commission** regarding a proposed project.
Hinge Point	The point where the rate of slope either continues at 6:1 or changes to a steeper slope based on the difference in elevation between the edge of the finished shoulder and the end of the foreslope.
Horizontal Alignment	The line of roadway curvature as related to the horizontal direction.
Horizontal Sight Distance	The clearance required from the center of the inside lane to an obstruction located off the pavement area on the inside of a horizontal curve. The straight-line distance a driver can look through a horizontal curve to the road ahead.
Impact Attenuators	Barriers designed to act as cushions, absorbing most of the energy from errant vehicles that leave the roadway before striking a roadside hazard.
Inertial Barriers	Impact attenuators that are modules filled with sand used for protection of poles, column bases, lighting supports, etc.
Intercepting Dikes	Small dikes constructed at the top of cut slopes that prevent stormwater from flowing down the cut slopes by intercepting the runoff and redirecting the flow to where it can safely be discharged into a ditch, creek, stream, etc.
Interchange	A combination of ramps and grade separations designed to increase capacity, reduce or eliminate traffic conflicts, and improve safety at the junction of two or more roadways. They separate the through traffic movements and also provide for turning traffic movements.
Intergovernmental Agreements	Agreements prepared by the **Agreements Unit** in the **Planning and Project Development Division** that outline the scope and participation of all governmental parties involved in a project and are executed for projects involving other units of government.
Intersection Sight Distance	The unobstructed sight distance along both road approaches at an intersection and across their included corners for a distance that will allow vehicle operators, approaching simultaneously, to see each other in time to prevent collisions.

Interstate A national defense highway system established to connect most cities of 50,000 or more population in the U.S., with complete access control and a minimum of two 12 ft. (3.6 m) lanes in each direction, divided in most instances by wide medians.

Interval A discrete portion of a traffic signal cycle during which signal indications do not change.

Island A flush or raised channelizing device.

Joint Access A single access provided to two or more properties.

Land Water Conservation Fund Act An act administered by the **National Park Service** to preserve public parklands. The Act provides funds to purchase and develop public parklands, and to preserve those lands from conversion to other uses.

Landscaping Plantings, scenic view development, retaining walls, median treatments, slope rounding or berms, aesthetic treatment, etc. for environmental, functional or aesthetic purposes.

Lane Balance A condition in which there is a balance in the number of traffic lanes on a freeway and the number of lanes on ramps to ensure safe and efficient traffic operations through and beyond interchanges. The number of lanes and the rate that lanes are added and dropped at interchanges are appropriate for the interchange.

Lateral Extent Of Hazard The distance from the edge of the travelway to the far side of a hazard, if the hazard is a fixed object, or to the outside edge of the clear zone if the hazard is an embankment or fixed object that extends beyond the clear zone.

Lateral Obstacle Clearance Distance The unobstructed, relatively flat area provided beyond the edge of the travel way for the recovery of errant vehicles. The width depends on the traffic volumes, design speed and side slopes of roadway section. Also known as the recovery area or clear zone.

Level Of Service A rating system from A to F that classifies roads or highways according to the operating conditions of the roadway given the design traffic volumes, A being a roadway providing an optimum level of service and F being a roadway providing a very poor level of service. The operating conditions that characterize levels of service are described in terms of density, average travel speeds, volume to capacity ratios, and stop delays at intersections.

Life Cycle Cost Analysis The economic analysis of pavement design alternatives based on initial construction costs, maintenance costs, salvage values at the end of the life of the pavement and replacement costs.

Limits Of Construction Plans Design plans, developed after the public hearing, showing the extent of the area required for the construction of the project. They include all culverts, driveways, intersections, dikes, etc. for use in right-of-way design

Living Snow Fence A barrier of trees and shrubs planted to reduce snow drifting along a highway, usually at or near the right-of-way line.

Load Transfer Device Devices, e.g., steel dowel bars, used at transverse joints to properly distribute load stresses without offering resistance to longitudinal movement at the joint.

Local Roads All rural roads not classified otherwise except minimum maintenance roads.

Location Studies Studies to address social, economic, environmental and other issues associated with alternative project locations for specific "spot" projects or for longer corridors.

Longitudinal Slope The slope of the travel lane along the length of the travel lane.

Longitudinal Joint A joint normally placed between traffic lanes in rigid pavements to control longitudinal cracking.

Loop A curved ramp that has a less direct travel path and distance than normal ramps and often will redirect the path of a vehicle almost 290°.

Lump Sum Funding Splits A method of allocating funds from several funding sources by dividing the total costs on a pro rata basis.

Mailbox Turnout A designated area, outside the travel lanes, provided for the use of vehicles accessing mailboxes.

Major Arterials Roadways linking cities, towns and other traffic generators, that are capable of carrying long distance travel and form a network with higher systems to provide interstate and inter-county service.

Major Collectors Roadways that serve the dual function of property access and feeding arterials; they generally consist of shorter trip lengths.

Markings Traffic control devices, such as pavement markings, object markings or delineators, used to channelize traffic into proper lane position on the roadway. They may either supplement regulatory and warning signs or independently warn or regulate traffic.

Mass Diagram	A graphical representation of the amount of embankment and excavation on a project and the way in which the earth is to be moved. It shows balance point locations, direction of haul and amounts of earth taken from or to each location.
Mass Ordinate	The cumulative algebraic sums of volumes of cut and fill by station.
Medians	The portion of a divided highway separating the traveled ways for traffic in opposite directions.
Median Barrier	A longitudinal barrier placed on the left side of traffic lanes of a divided highway designed to redirect vehicles striking either side of the barrier.
Median Openings	A gap in a median provided for crossing and turning traffic.
Median Width	The distance between the inside edges of the inside travel lanes of a multi-lane divided highway.
Metropolitan Planning Organization (MPO)	Transportation planning organization composed of state and local government officials and citizens responsible for continuing, cooperative and comprehensive planning process in metropolitan areas.
Milling	A process in which asphalt is removed from the roadway by a machine that “scrapes” off the top layer of asphalt.
Minimum Maintenance Roads	Rural roads used occasionally by limited numbers of people as alternative access roads.
Minimum Maintenance Standards	Maintenance for each functional classification of roadway type as established by **the Board of Public Roads Classifications and Standards.**
Minor Arterials	Routes to provide linkage of cities, towns and other traffic generators, integrating interstate and inter-county service.
Mitigation	Measures taken to offset or minimize the impact of construction on the environment.
Mobilization	The costs associated with startup activities such as movement of personnel, equipment, supplies and other incidentals to the project site.
Moisture Content	The amount of water in the soil which impacts compaction.
Mountable Curb	A curb designed so that errant vehicles can cross them safely.
Mow Strip	A 2 ft (600 mm) surfaced section between the curb and a turf median or around area inlets.

MSE Wall	A mechanically stabilized earth retaining wall of blocks or panels.
Multi-Leg Intersections	Intersections having five or more legs.
National Highway System	An interconnected system of principal arterial routes which will serve major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities and other major travel destinations.
National Register Of Historic Places	A federal listing of places with significant historic value.
Nationwide Permits	A type of permit issued by the **U.S. Army Corps of Engineers** for projects that have minimal environmental impacts.
Needs Study Criteria	Criteria to provide a higher level of rehabilitation than minimum 3R standards for rural projects.
Needs Study Segment Evaluation	An annual review of the condition of existing roadways throughout the state conducted by the **Classification, Needs, and Pavement Management Unit** in the **Materials and Research Division.**
New Jersey Barriers	Concrete safety shape rigid barriers generally used as median barriers and as barriers in work zones.
Noise	Unwanted sound.
Noise Abatement	Measures taken to reduce noise through design features or location of a project.
Noise Barriers	Devices installed beyond the lateral obstacle clearance distance to reduce the effects of noise on nearby noise sensitive areas.
Nonparticipating	That portion of a project that a particular federal fund does not cover, e.g., federal bridge funds may not be used for mainline construction.
Nonpoint Source Pollution	Pollution that cannot be attributed to a specific source.
Non-Recoverable Slope	A slope on which a motorist will not be able to stop his/her vehicle or return to the roadway but generally will reach the bottom of the slope without overturning; a slope between 4:1 and 3:1.

No Passing Zones	Segments of two-lane, two-way highways that do not have sufficient passing sight distance for motorists to safely pass slower moving vehicles. Pavement markings and warning signs are used to inform drivers of no passing zones.
Object Markers	Traffic control devices that warn motorists of physical obstructions or roadside conditions within or adjacent to the roadway that pose a hazard to motorists. They are considered a maintenance item and are not included in roadway quantities and cost estimates.
Off-Street Parking	A parking facility, parking lot or garage that is provided outside of the roadway right-of-way and is not considered a part of the roadway.
Off-System County Roads	County roads that are not part of the federal or state highway system.
Off-System Rural Projects	Projects on rural roads for which local road standards have been developed.
Off-System Urban Projects	Urban transportation projects in cities of the first class that are eligible for specific federal funding.
On-Street Parking	Parking that is provided adjacent to the travelway of a roadway within the roadway right-of-way; it is considered a part of the roadway.
Operating Speed	The highest overall speed at which a driver can travel on a given highway under favorable weather conditions and under prevailing traffic conditions without at any time exceeding the safe speed as determined by the design speed on a section-by-section basis.
Outer Separation	The area between the traveled way of a roadway for through traffic and a frontage road or street.
Overlay	The resurfacing of an existing pavement to a specified depth to extend the structural life of the pavement.
Painted Gore Nose	A point, having no dimensional width, occurring at the separation of the pavements at a ramp.
Parallel Fill Slope	A fill slope that parallels the roadway.
Partial Cloverleaf Interchange (Parclo)	A cloverleaf interchange with loops in some but not all quadrants.
Passing Sight Distance	The distance required for an overtaking vehicle to pass another vehicle safely on a two-lane, two-way roadway.
Pavement Markings	Traffic devices in the form of line markings, symbols, arrows, raised reflective markers, etc. that are on the roadway pavement to channelize the traffic and to warn motorists.

Pavement Structure	A combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.
Pavement Serviceability Index	A numerical value derived by formula from measurements of certain physical features of the pavement.
Pavement Subdrain	Subgrade drainage treatments, which vary depending on the subgrade soils plasticity index.
Pedology	Study of the genesis and classification of soils.
Permanent Easement	A property easement in which **NDOR** has the use of or access to land that remains in private ownership. The owner may do as he/she chooses with the property as long as it does not conflict with the purpose of the easement.
Phasing	The division of a construction project into several stages over time.
Physical Gore Nose	A point, having a dimensional width separating the pavements, upstream of the gore area.
Pivot Irrigation System	Custom irrigation systems varying in size and configuration that consist of center pivot structure and a boom that holds the sprinkler heads and rotates around the center pivot.
Plan-In-Hand	A field inspection of the proposed project, after preliminary design, by **NDOR** representatives and others as appropriate.
Planning	Advance consideration, development and description of anticipated projects, activities and scheduling.
Point Of Convergence	The point of intersection of a ramp and the through travel lane.
Posted Speed	The speed limit on advisory signs posted on the roadway; usually the 85th percentile speed.
Preconstruction Scheduling System (PSS)	A computerized system that programs, schedules and monitors projects through preconstruction stages. The **Project Scheduling and Program Management Section** manages it.
Preliminary Design	The initial design of a project following the engineering review.
Preliminary Plans	Plans developed prior to preliminary design, from a survey or as-built plans, showing existing features only.
Principal Arterials	Roadways that provide corridor movement with trip length and density compatible with significant statewide or interstate travel.

Priority Commercial System	A roadway designation for routes that carry heavy traffic volumes and/or large volumes of commercial vehicles.
Profile	The grade line of a roadway, usually along the roadway centerline.
Project Numbering	The assignment of a unique number to a transportation project which identifies the funding source, type of project, and project location.
Public Hearing	A formal process presided over by a **Highway Commissioner** to present the proposed project to the public and to obtain public input. Hearing guidelines must be followed for notice of hearing, information presented and hearing procedures. The hearing is recorded and a transcript is made of the verbal testimony.
Public Information Meetings	Informal meetings held to inform the public of the proposed project location and /or design, to obtain public input and to answer questions from the public. They are usually held for major relocations and location studies, right-of-way appraisal, design and scope changes and sometimes for engineering review.
Radius Return	The turning radius of an intersection.
Raised Median	A median that is elevated above the travel lanes to control access and left turns on urban highways and streets.
Ramp Angle	The angle the ramp makes with the mainline highway.
Ramps	Any type, arrangement and size of turning roadway that connects two or more legs at an interchange.
Ramp Terminal	The portion of a ramp adjacent to the through traveled way, including speed change lanes, tapers and islands.
Reconstructed Bridges	An existing bridge that is to be either widened, significantly remodeled or rehabilitated.
Recoverable Slope	A slope on which a motorist can stop his/her vehicle or slow it and then return safely to the roadway; a slope of 4:1 or flatter.
Recovery Taper	The taper downstream of a weaving section that enables motorists to merge with the traffic on the expressway.
Reimbursable Costs	The eligible non-betterment expenditures a utility owner incurs in relocating utilities to accommodate a proposed project.
Relinquishment	A process by which **NDOR** maintains ownership of right-of-way for utility easement purposes but cedes responsibility for maintenance and operation of the roadway to a local government.

Relocation Assistance	Financial assistance provided to residents and business entities that are relocated due to right-of-way acquisition.
Reverse Curves	Two curves on opposite sides of a common tangent with a relatively short tangent length between the curves.
Right-Of-Way	Land, property or interest therein, usually in strip, dedicated for transportation purposes.
Right-Of-Way Appraisal Plans	R.O.W. Ownership plans with the addition of limits of construction, construction details, right-of-way design, permanent and/or temporary easements, access control and summary of areas.
Right-Of-Way Certification	Certificate stating that all right-of-way is available to the contractor and clear of improvements or the estimated date when all non-complying tracts will be clear and available.
Right-Of-Way Costs	Costs associated with acquisition of right-of-way including real property, relocation assistance, fencing, improvements, etc.
Right-Of-Way Marker	A concrete monument, iron pipe, or pin marker used to indicate the location of a highway's right-of-way, where the right-of-way changes width or where a curve in the right-of-way begins or ends.
Right-Of-Way Negotiation Plans	Right-of-way plans that reflect right-of-way contracts and any changes made during negotiations.
Right-Of-Way Ownership Plans	Right-of-way plans showing plotted section and quarter section lines, surveyed centerline, topography, property lines, existing R.O.W. boundaries, and ownership data.
Right-Of-Way Survey	A survey conducted to establish section corners, quarter-section corners and lot corners.
Rivers And Harbors Act	A federal act originally passed in 1899 to regulate structures or work affecting navigable waters of the U.S.
Roadside Geometry	The area outside of the hinge points; it is comprised of sideslopes, foreslopes, backslopes, ditch bottoms, benches, etc.
Roadway Lighting	Lighting which is provided along a roadway or highway to improve nighttime visibility and safety.
Rollover Rate	The algebraic difference in rate of cross slope between adjacent lanes.
Route Continuity	Providing a continuous through route on which the motorist is not expected to change lanes or "exit" a roadway. Route continuity of minor roadways should yield to preserve road continuity of major roadways.

Running Speed	The actual speed of a vehicle over specified section of highway; the distance traveled divided by the time the vehicle is in motion (running time).
Runout Length	The theoretical distance needed for an errant vehicle that has left the roadway to come to a stop.
Rural Area	An area where property abutting the roadway is predominately used for agricultural purposes and lies outside municipal boundaries. It may include isolated tracts devoted to light industrial purposes.
Safe Drinking Water Act	Federal regulations of potable water supply.
Safety Improvement Project	A project that is generally small in size and located at specific high accident sites.
Scenic Byways	A road or byway with roadsides or corridors of aesthetic, cultural or historic value.
Scoping	The initial estimation of project magnitude once a DR 73 form has been initiated.
Section 4(f)	A portion of the 1966 Transportation Act which limits use of publicly owned parks, recreation areas, wildlife/waterfowl refuges, and lands having historic sites of national, state or local significance.
Section 6(f)	A portion of the Land and Water Conservation Fund Act restricting use of public park land funded with Section 6(f) monies.
Section 10 Permits	Permits for construction activity that impacts navigable waterways.
Section 401 Permits	Permits from the **Nebraska Dept. of Environmental Quality** for activities involving waters of Nebraska, including wetlands. This permit is generally acquired in conjunction with Section 404 individual permits.
Section 402 Permits	Permits required for projects with point source discharge, e.g., rest areas.
Section 404 Permits	Permits from the **U.S. Army Corps of Engineers** for activities involving waters of the U.S., including wetlands.
Segregation Damages	Damages that may occur to a landowner when property is split by the construction of a highway.

Select Placement	The setting aside of certain excavated soils and/or materials during earthwork construction for a specific placement within the limits of the project. For example, topsoil will often be excavated and separated from other soils for final placement in the top four inches within the construction area.
Semi-Directional Interchange	An interchange that has some high-speed free-flow connections but has one or more connections that are indirect in alignment yet more direct than loops.
Serviceability	The ability, at the time of observation, of a pavement to serve the traffic (autos and trucks) that uses the facility.
Service Volumes	The number of vehicles traveling in a lane for a given time period. The number of vehicles “served” by a traffic lane for a given time period.
Service Ramps	Ramps, usually low-speed, that transfer traffic between an interstate or expressway and an arterial.
Shear Lines	Lines used for simplifying earthwork calculations at intersections and other locations where irregularly shaped excavations or embankments may be encountered due to channel changes, etc.
Shop Plans	Plans developed by the contractor to show how the contractor intends to construct specific structures, such as bridges, retaining walls, etc.
Shoulder	The area adjacent to the travel lanes for rural cross-sections or the area behind the curb and gutter for urban cross-sections.
Shrinkage	The decrease in volume of soil when it is excavated, hauled and compacted into an embankment.
Sidewalks	A walkway primarily for pedestrian traffic at the side of a roadway.
Sight Distance	The length of roadway ahead that is visible to the driver.
Signalized Intersection	An intersection where traffic movement is controlled by traffic signals.
Single Axle Load	The total load transmitted by all wheels whose centers may be included between two parallel transverse vertical planes 40 inches apart, extending across the full width of the vehicle.
Single Point Urban Interchange	An interchange configuration where all legs of the interchange intersect at a single point.
Skew Angle	The degree of deviation from a 90° intersection.

Slope Stake Book	A construction notebook that provides elevation and distance information necessary for the construction of back slopes, fore slopes and side slopes.
Slurry Seal	An application of diluted asphalt emulsion mixed with sand-size aggregate and then squeegeed onto the pavement surface. It is generally less than 3/8-inch in depth.
Snowshots	Cut stations where the toe of the backslope is less than 60 ft. (20 m) from the centerline and the backslope elevation is greater than the centerline elevation.
Soil Horizon	The underlying formations of soil layers.
Soil Profile	The combined horizons or layers of soil.
Soil Survey	Research of the soil characteristics and water table condition provided by the **Materials and Research Division**.
Soil And Situation Report	A report of the results of the soil survey.
Spacing	The number of access locations to the mainline per mile between each mile road or county road.
Special Investigations	Research about specific topics for a proposed project (i.e. accident records, traffic counts, etc.).
Special Plans	Plans used for items subject to frequent change, e.g., guardrail.
Special Provisions	A document that outlines unique construction items or procedures not covered in the Standard Specifications.
Speed-Change Lane	An auxiliary lane, including taper, used primarily for the acceleration or deceleration of vehicles entering or exiting the through traffic lanes.
Spot Speed Studies	A traffic study that measures the individual speeds of a sample of vehicles passing a given point (spot) on a roadway.
Spread	The width of stormwater from the curb onto the roadway that flows along the pavement.
Stage Construction	The phasing of an entire construction project over several time periods.
Standard Details	Details not large enough to warrant a special plan or standard plan or details of items that are not paid for directly.
Standard Items	Construction and other items, as defined by **NDOR** that are common project materials or activities.
Standard Plans	Plans that have been developed for common construction items and have been approved by the **Standard Plans Committee**.

Standard Specifications	The definition and delineation of how activities, materials, etc. are to be provided for **NDOR** projects.
State-Funded Projects	Projects that are partially or entirely funded by state agencies. They are not required to comply with all federal regulations, but must address environmental concerns.
State Highway Commission	A group of individuals appointed by the **Governor** to conduct studies, advise the public, and hold public hearings regarding Nebraska highways and the activities of **NDOR**.
State Highway Inventory Report	A summary of results from the needs study segment evaluation.
Station Funding Definition	The identification of limits of funding source coverage by station location.
Stopping Sight Distance	The minimum length of roadway ahead visible to the driver that is long enough to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. Stopping sight distance is the sum of the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant that the brakes are applied and the distance required to stop the vehicle from the instant brake application begins.
Storage Area	The portion of a turn lane used for vehicle queuing.
Storage Length	The length of lane needed to store vehicles for a given time period.
Structural Snow Fence	Temporary or permanent fencing panels installed along a highway to reduce the snow drifting along a highway.
Subbase	The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course (or in the case of rigid pavements, the Portland cement concrete slab).
Subgrade	The top surface of a roadbed on which the pavement structure and shoulders are constructed.
Subgrade Survey	A survey conducted for projects to surface previously graded roads to identify soil sections, stability, and other conditions.
Subgrade And Situation Report	A report issued when there is a period of time between grading and preparation of paving plans. The report describes existing surface conditions, foundation course requirements, existing topography and pedology, drainage, compaction requirements, etc.
Subsidiary Earthwork	Earthwork that is not paid for directly but is included in other earthwork or other construction pay items.

Subsoil	Soils beneath the topsoil that vary in thickness from a few inches to three or more feet. They are characterized by the presence of additional clay and soluble material that has been removed from the topsoil.
Substructure	The part of a structure below the bearings of simple and continuous spans, skewbacks or arches and the top of footings of rigid frames including backwalls, wingwalls, and wing protection railings.
Superelevation	Raising the outer edge of a curve to offset the tendency for vehicles to slip on the outward sloping of a crowned roadway, allowing the driver to maintain average speed through the curve without having to overcorrect steering.
Superelevation Runoff Length	The length of highway needed to accomplish the change in cross slope from a section with adverse crown removed to a fully superelevated section, or vice versa.
Superstructure	The part of a structure above the bearings of simple and continuous spans, skewbacks of arches and top of footings of rigid frames, excluding backwalls, wingwalls and wing protection railings.
Surcharge	The placement of additional embankment on top of a fill to account for settlement or to speed up settlement.
Surcharge Loading	The loading or forces a retaining wall may experience from embankment and traffic.
Surface Transportation Program	A federal funding program which includes public roads not on the NHS and not functionally classified as minor rural collectors or local roads or streets.
Swell	The increase in volume of rock when it is excavated, broken and placed into the embankment.
System Ramps	High-speed ramps that transfer traffic from freeway to freeway and /or interstate to interstate.
Tangent Runout	The distance required to transition a roadway from a normal crown section to a section with the adverse crown removed, or vice versa.
Tangent Section	A segment of roadway that has a “straight” horizontal alignment with no curvature.
Tangent Typical Section	A cross-section of a roadway that has the high point of the pavement on the inside shoulder and slopes continuously from the inside shoulder to the outside shoulder.

Taper Ramp	A ramp that only consists of a taper either before or after the point of convergence depending on whether it is an exit or entrance ramp, respectively. On taper entrance ramps, acceleration occurs before the point of convergence. On taper exit ramps, deceleration occurs after the point of convergence.
Temporary Easements	Easements that permit the use of private property for a time period not to exceed the duration of the project and for specific purposes such as channel cleanout.
Temporary Road	Temporary detours within the project right-of-way, generally on temporary embankments, to bypass a construction site.
Threatened Species	Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its habitat.
Thrie Beam Guardrail	A roadside barrier system similar to W-beam but with an additional rib in the rail to accommodate a wider range of vehicle sizes.
Tie Bar	A deformed steel bar or connector embedded across a joint in a rigid slab to prevent separation of abutting slabs.
Title	Legal evidence of right to property or the right itself.
Title Research	A search conducted by right-of-way agent of records for property ownership, existing easements, encumbrances and other interests. Provides information for plotting property lines and identifying ownership.
Toe Of Slope	The intersection of the foreslope with level ground or with a backslope, forming a ditch.
Topsoil	Soil, usually dark in color, that extends from the surface of the ground to a depth of as much as two ft.
Traffic Control Device	A sign, signal, marking or other device on or adjacent to a roadway to regulate, warn or guide traffic.
Traffic Control Plan	An essential part of the overall design of the roadway that provides for the routing of traffic safely through and/or around the construction zone while providing a safe and adequate working area for the contractor.
Traffic Signals	Traffic control devices used to direct conflicting movements of vehicles and/or pedestrians by assigning the right-of-way to various movements at different times.
Transit	A public transportation service.

Transition Length The distance required transitioning a roadway from a normal crown section to full superelevation. It consists of the tangent runout and the superelevation runoff length.

Transition Section A section of roadway that provides a gradual change between different typical cross-sections.

Transverse Contraction Joint Contraction joints in concrete pavement placed either perpendicular to the centerline with load transfer devices across the joint or skewed from the perpendicular for noise reduction and riding comfort.

Transverse Construction Joint Joints placed at the end of each day's work or when paving ceases for over 30 minutes. They are placed perpendicular to the centerline.

Transverse Fill Slope A fill slope that is perpendicular to the roadway and is associated with cross roads, entrances, median crossings or ditch plugs, etc. It is generally more critical to vehicles than parallel fill slopes because errant vehicles tend to run into the transverse slope head on.

Trumpet Interchange An interchange configuration used where there are only three approaches to be served.

Turning Roadways Channelized turn lanes at at-grade intersections to provide free flow turn movements.

Unchannelized Intersection An at-grade intersection consisting of two crossing roadways connected by radius returns, without channelizing devices.

Underdrain Pipe A pipe in a granular trench, that parallels the edge of pavement and base course, designed to intercept water that gets into the base and subgrade and carry it away from the pavement structure.

Unsuitable Material Materials (soil, rock, muck, debris, etc.), which are inappropriate for use in the embankment.

Urban Area A built-up area located adjacent to or within municipal boundaries.

Utility A privately, publicly or cooperatively owned line, facility or system for producing, transmitting or distributing communications, cable television, electricity, light, heat, gas, oil, crude products, water, steam, waste, stormwater not connected with highway drainage, or any other similar commodity including any fire or police signal system or street lighting system.

Valley Gutter A depressed pavement area that is constructed across a side road at an intersection to carry runoff across the side road.

Vertical Alignment	The line of the roadway curvature as related to the vertical direction.
Vertical Clearance	The clearance provided above the roadway to allow vehicles to successfully pass under a structure.
Vertical Sight Distance	The distance a driver can see through a vertical curve to the roadway ahead.
Visual Impacts	Impacts of the proposed project on potential viewers of and from the project.
Volume Studies	Traffic studies conducted to determine the levels of traffic during specified time periods, e.g., average daily traffic (ADT), peak hour traffic, etc.
W-Beam Guardrail	A roadside barrier system with railing that is W-shaped.
Waste	The situation where the amount of available excavation exceeds the amount of needed embankment.
Waste Sites	Areas established for the disposal of excess excavation or unsuitable materials.
Waterway Permit Data Sheet	A data form from the **Environmental Permits Unit** that includes information about waterway permits, historic bridges and other environmental issues.
Weaving Sections	Highway segments where the pattern of traffic entering and leaving at contiguous points of access/egress result in vehicle paths crossing each other.
Wetlands	Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

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Request for Agreement

Project No.: ______________________ Control No.: __________

Agreement With: ______________________

Type of Agreement: ☐ City Covenant ☐ City Financial ☐ City Program ☐ Other

Location *(include termini)*: ______________________

Description of Work: ______________________

Project Detour Within Corporate Limits? ______________________

Funding: City __________ State __________ Federal __________ Other __________

Project Estimate: *(within corporate limits)* $__________ Pavement Width: __________

Nonbetterment Utilities Estimate: *(work by others)* $______________________

Nonbetterment Utilities Estimate: ☐ Lump Sum ☐ Actual Cost

Population of City: __________ 1-Year City Allocation: $__________

Payments *(one lump sum, 4 equal payments, etc.)*: ______________________

Payments to be based on actual or estimated unit prices? ______________________

actual or estimated quantities? ______________________

Parking Restrictions, if any: ______________________

Roadway Lighting? ☐ Yes ☐ No Traffic Signals? ☐ Yes ☐ No

Other provisions or comments: ______________________

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____

____

See Reverse Side for Additional Comments

Requested by: ______________________ ______________________

(Unit Head Signature) *(Designer)*

Date Requested: __________ Date Desired: __________

Attachments:
- ☐ Location Map *(2 originals, 4 copies)*
- ☐ Project Estimate *(2 originals, 4 copies)*
- ☐ Nonbetterment Utilities Estimate *(2 originals, 4 copies)*
- ☐ Other *(2 originals, 4 copies)*

For Agreement Section Use:

Existing Agreements: ☐ Yes, Agreement Number __________ ☐ No

To Typist: __________ Returned: __________ Distributed: __________

☐ New ☐ Revised

State of Nebraska Department of Roads

Highway Improvement Programming Request

TO BE COMPLETED BY PROJECT SCHEDULING AND PROGRAM MANAGEMENT SECTION

CONTROL NUMBER:

PROJECT NUMBER:

PROJECT NAME:

TO BE COMPLETED BY PROJECT REQUESTER

HIGHWAY NO.	FROM REFERENCE POST	TO REFERENCE POST	LENGTH	COUNTY

DESCRIPTION OF LOCATION AND PROPOSED IMPROVEMENT: *(Specify in detail)*

CONSTRUCTION PROJECT MANAGER:

PAVEMENT MANAGEMENT DATA					TRAFFIC VOLUMES		
AGE	NSI	PSI	RUT DEPTH	OPTIMUM YEAR	CURRENT ADT	20-YEAR ADT	% TRUCKS

SUGGESTED SCHEDULE

FISCAL YEAR:

BEGIN CONSTRUCTION:

LETTING DATE:

END CONSTRUCTION:

CONSIDER SAFETY FUNDS: ☐ Yes ☐ No

CONSIDER ENHANCEMENT FUNDS: ☐ Yes ☐ No

NAME OF REQUESTER:

TITLE:

DATE OF REQUEST:

TO BE COMPLETED BY PROJECT SCHEDULING AND PROGRAM MANAGEMENT SECTION

PROGRAM FUNDING	☐ Federal ☐ State	PROGRAMMED FOR FISCAL YEAR:
LET BY CONTRACT LETTING	☐ Yes ☐ No	PROGRAMMED LETTING DATE:
PUBLIC HEARING ANTICIPATED	☐ Yes ☐ No	

TO BE COMPLETED BY PLANNING AND PROJECT DEVELOPMENT DIVISION (OR OTHERS)

ENGINEERING REVIEW NEEDED: ☐ Yes ☐ No

PROPOSED ENVIRONMENTAL CLASS:

Estimated Cost: $

NAME OF ESTIMATOR:

DATE:

COMMENTS:

DESIGN ASSIGNMENT:

APPROVED BY DEPUTY DIRECTOR-ENGINEERING		APPROVED BY PROJECT SCHEDULING AND PROGRAM MANAGEMENT ENGINEER	
SIGNATURE:	DATE:	SIGNATURE:	DATE:

ENTIRE PAGE TO BE COMPLETED BY PROJECT REQUESTER

DESIGN DETAILS

	EXISTING	PROPOSED	REMARKS
Surfacing Width			
Surface Type			
Shoulder Width			
Shoulder Type			
Right of Way Width			

Safety Section	☐ Yes If ☐ No ➡	*If Existing is No, check the applicable proposed* ☐ New & Reconstruction Standards ☐ Needs Study Criteria ☐ 3R Standards ☐ Maintenance

Existing Deficiencies: ☐ None ☐ N/A	☐ Number of Lanes ☐ Shoulder Surface	☐ Pavement Width ☐ Vertical Curves	☐ Total Shoulder Width ☐ Surface

EXISTING STRUCTURES

REFERENCE POST	TYPE OF STRUCTURE	LENGTH	WIDTH	SUFFICIENCY RATING	PROPOSED TREATMENT

Concurred by Bridge Division	DESIGNATED REPRESENTATIVE:	DATE:

SUPPORTING DATA	YES	NO	REMARKS *(If Yes, identify)*
Additional Right of Way Needed *(If Yes, indicate extent of)*			
Survey Needed			Survey Type ☐ Ground ☐ Photogrammetric
Relocation Anticipated ☐ Business ☐ Residential			
Culvert Extensions Anticipated			
Irrigation Structures Affected			
Railroad on Project ☐ Crossing ☐ Parallel			
Within the City Limits of:			Population: ☐ Over 5000 ☐ Under 5000
City Participation Expected			% *(percentage of participation)*
Wetlands Anticipated			
Detour Needed			
Relinquishments			
4(f) Encroachment			
Lighting Needed			☐ Existing ☐ Check Warrants
Traffic Signals Needed			☐ Existing ☐ Check Warrants
Permanent ITS Elements			If yes, include DR Form 73c *(ITS Checklist)*

COMMENTS:

Railroad Project Information Sheet

Distribution Railroad Liaison Designer	Date:	

TO: Rail & Public Transportation Division Railroad Liaison Unit		Project No.:	
Location:		Control No.:	Letting Date:
Designer:	Phone:	Name of Railroad:	
Railroad Work Needed: ☐ Yes ☐ No Type: ______________		Project Mainline: ☐ Parallel ☐ Crossing	

Is Right-of-Way Needed? ☐ Yes ☐ No	Meets At-Grade and Width? ☐ Yes ☐ No	Asphalt or Concrete Paving up to the Crossing or Crossings *(Show locations on map)*	Attach City or County Map **Please complete data below.**

Existing Roadway Width and Type			______		______	
Proposed Roadway Width and Type			______		______	
Existing Shoulder Width and Type..................................			______		______	
Proposed Shoulder Width and Type................................			______		______	
Existing Crossing	Length	______	Type	______	Skew Angle	______
Condition of Existing Crossing...	Good	______	Fair	______	Poor	______
Easements Required			*Yes	______	No	______
Existing Signals			**Yes	______	No	______
Lens Size			8”	______	12”	______
Location of Existing Signals from Centerline			Lt.	______	Ft.	______
At-Grade or Any Track Revisions Necessary			______			
Drain Pipes			*Yes	______	No	______
Current and Future ADT			______		______	
Core Out or Feather...			______		______	

* Plan Sheets showing amount of easement required.

** If signals are at crossing, do they need modernization? ☐ Yes ☐ No

If the crossing has no signals, should they be considered? ☐ Yes ☐ No

Comments:

Designer’s Signature:	Date:

DR Form 95, Apr 95/

Design Plans Transmittal

Distribution
Forward with Job
Correspondence File

Project No. ______ Name ______ C.N. ______

To ______

Designer ______

Date ______

Attached are the following: ______ Prints ______ Originals

No. of Copies

______ Typical Cross Sections ______

______ Location Map ______

______ Plan & Profile, Sta. ______ to Sta. ______

______ Cross Sections Sta. ______ to Sta. ______

______ 2A Sheets, Sta. ______ to Sta. ______

______ 2L Sheets, Sta. ______ to Sta. ______

______ Special Plans, Sta. ______ to Sta. ______

______ Summary of Driveways & Surfaced Intersections ______

______ *(Other)* ______

Remarks: ______

Copy to: ______ ______
Unit Head
Roadway Design

DR Form 135, Jul 79/

P. S. & E. Required Sheet

DESIGN DESIGNATION 3R

☐ RURAL
Sta. + to
Sta. +
☐ INTERSTATE
☐ MUNICIPAL
☐ CURBED
Sta. + to
Sta. +
☐ NON-CURBED
Sta. + to
Sta. +

TRAFFIC
YEAR:
ADT:
DHV:
T = %

DESIGN DESIGNATION
NEW & RECONSTRUCTED

☐ RURAL
☐ INTERSTATE
Sta. + to
Sta. +
TERRAIN:
☐ LEVEL
Sta. + to
Sta. +
☐ ROLLING
Sta. + to
Sta. +
☐ MUNICIPAL
☐ INTERSTATE
Sta. + to
Sta. +
☐ CURBED
Sta. + to
Sta. +
☐ NON-CURBED
Sta. + to
Sta. +
TRAFFIC
YEAR:
ADT:
DHV:
T = %
DESIGN NO.:
N.F.C.:

DESIGN DESIGNATION

LOCAL ROADS AND STREETS

TRAFFIC
☐ RURAL
☐ MUNICIPAL
☐ 3R
YEAR:
ADT:
DHV:
T = %

CLASSIFICATION OR DESIGN NO.:

DESIGN DESIGNATION
MAINTENANCE

TRAFFIC
YEAR:
(of construction)
ADT:

PLAN ORDER
2-T
2-K
2-W/2-A
2-H
2-N
2-P
2-L
P & P
SHOO-FLY
TRAFFIC
PAVEMENT MARKING
LIGHTING
LANDSCAPE
DESIGN DATA
EARTHWORK
DRAINAGE X-SECTION
BRIDGE
SPECIAL PLAN
R.O.W.
ROADWAY X-SECTION

PROJECT NO.: ------------------------
CONTROL NO.: ------------------------
LOCATION:

SECTION HEAD: ------------------------
DESIGNED BY: ------------------------ PHONE: ------------
CHECKED BY: ------------------------ DATE: ------------
DATE RECEIVED BY P. S. & E.: ------------------------
DATE SENT TO CONTRACTS: ------------------------

DR Form 280, Mar 04/

★ ***If required and not included, provide explanation and delivery date.***

P. S. & E. Package

Not Applicable	Required	Included★	
☐	☐	☐	Construction Comps. & Plans ----------
☐	☐	☐	Construction Special Provisions ----------
☐	☐	☐	Bituminous Comps. ----------
☐	☐	☐	Bituminous Specials ----------
☐	☐	☐	Soils & Materials Survey Plans ----------
☐	☐	☐	Photo Maps ----------
☐	☐	☐	Bridge Plans ----------
☐	☐	☐	Bridge Comps. & Specials ----------
☐	☐	☐	Traffic Plans ----------
☐	☐	☐	Traffic Comps. & Specials ----------
☐	☐	☐	Lighting Plans ----------
☐	☐	☐	Lighting Comps. & Specials ----------
☐	☐	☐	Special Plans ----------
☐	☐	☐	Detour Information ----------
☐	☐	☐	R.O.W. Certificate ----------
☐	☐	☐	Status of Utilities ----------
☐	☐	☐	Miscellaneous Agreements ----------
☐	☐	☐	City Agreement ----------
☐	☐	☐	Railroad Special Provisions ----------
☐	☐	☐	Railroad Agreement or Info. Letter ----------
☐	☐	☐	Railroad Easement or Info. Letter ----------
☐	☐	☐	Construction Items on Railroad R.O.W. ----------
☐	☐	☐	Design Data & Earthwork Sheets ----------
☐	☐	☐	Soil Reports ----------
☐	☐	☐	Project Development Summary Sheet *(Special Environmental Conditions)* ----------
			----------
☐	☐	☐	R.O.W. Plans ----------
☐	☐	☐	Seeding Specials ----------
☐	☐	☐	Erosion Control Specials ----------
☐	☐	☐	Funding Split ----------
☐	☐	☐	Current 404 Permit ----------
☐	☐	☐	Floodplain Permit ----------
☐	☐	☐	ITS Architecture ----------
☐	☐	☐	----------

Nebraska Department of Roads

WATERWAY PERMIT DATA SHEET

FIGURES ARE TO BE COMPLETED IN ACRES

DATE:

FROM:

TO: Jason Jurgens, Environmental Permits Unit Manager

Project Name: **Letting Date:**

Project Number: **Delineation Date:**

Control Number: **Biologist:**

County:

IS THE PROJECT LOCATED IN A MAPPED FLOODPLAIN/FLOODWAY AREA: ☐ **Yes** ☐ **No**

If YES, please attach Certification and Compliance with Floodplain and Floodway Regulations

Please provide the following:

- ☐ Location Map.
- ☐ 2 – ½ size copies of 2W plans *(turn on wetland feature file levels 54, 61, 62, 63 for 2W sheets submitted to EPU for Section 404 permitting)*.
- ☐ Report wetland impacts *(attached)*.
- ☐ Report all roadway structure crossings that will be replaced or modified *(attached)*.
- ☐ Report all channel change information with applicable cross sections *(attached)*.
- ☐ Provide applicable bridge/structures data sheets and/or TS&L *(Type, Span & Length)* plans provided by Bridge Division.
- ☐ Provide plans for specific features (weirs, jetties, drop structures, etc.)
- ☐ Provide a discussion of all wetland/stream channel impact avoidance and minimization measures that were assessed for the project.

Project Description: *(include existing facility, proposed improvements, design standard, etc. Please describe special features affecting delineated waterways such as weirs, jetties, drop structures, etc.)*

WETLANDS DRAFTING INFORMATION:
Wetland delineation information available in Falcon by:
Project Control No./division/wetlands/_____wf.dgn

DR Form 290, Mar 05

Nebraska Department of Roads

IMPACTED WETLANDS (ACRES)

Return to:
Planning & Project Development
Environmental Permits Unit

Project Name: **Control No.:**

Project No.: **Date Submitted:**

Station to Station	PEMA	PEMC	PEMF	PSSA	PFOA1	Other	Stream Channel	
							Area	Length (Ft.)
Totals	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Nebraska Department of Roads

CHANNEL CHANGES

Project Name:
Project No.:
Control No.:
Structure No.:
Project Station:

Stream Name:
Location:
County:
Date Submitted:

EXISTING CHANNEL:

Depth:

Width:

Side Slopes:

Length:

NEW CHANNEL:

Depth:

Width:

Side Slopes:

Length:

RIP-RAP REQUIRED:

Type:

Length:

Cubic Yards Below Ordinary High Water:

Purpose:

Describe Channel Shaping/Grading Activities: *(Please attach cross sections)*

Reason for Channel Change:

Attach Structure Data Sheet/TSL Plans, if applicable

Return to:
Planning and Project Development Division
Environmental Permits Unit

Nebraska Department of Roads

STRUCTURES

(Road Crossings)

Project Name:
Project No.:
Control No.:

Project Station:
Date Submitted:

Project Station/Structure No. and Feature Crossed	Existing Structure Size And Type	Proposed Improvement

If shoo-flys are built, enclose Plan & Profile and typical section of shoo-fly.

Return to:
Planning and Project Development Division
Environmental Permits Unit

INITIAL PROJECT DATA

CONTROL NO.	

PROJECT		
PREFIX	NUMBER	UNIT

ADT			CLASS OF FUNDS	REFERENCE POST		LOCATION
PRESENT	FUTURE	YEAR		BEGIN	END	

COUNTY NAME:	COUNTY NO.:	NAME OF URBAN AREA:	URBANIZED AREA CODE:	NAT'L. FUNC. CLASS.	STATE HWY. NO:	U.S. HWY. NO.:

CODE	PHASE OF WORK	DESCRIPTION OF TERMINI	LENGTH	APPR. CODE	ESTIMATED PROJECT COST BY PHASES: TOTAL	FEDERAL FUNDS	STATE FUNDS	OTHER FUNDS	CHARACTER OF PROPOSED WORK
	PE								
	ROW								
	CONST								FHWA REVIEW: No Comment ☐ Comment: This action may be advanced as Class If Class II, Group, No.
PROJECT TOTALS									SIGNED FOR DIVISION ADMINISTRATOR: / DATE;

PROJECT APPROVAL			REMARKS
REQUESTED	RECOMMENDED	APPROVED	
Signature:	*Signature:*	*Signature:*	CONSTRUCTION STANDARDS: 3R Reconstr. Not Apply
TITLE:	TITLE: Federal Aid Administrator	TITLE: Project Scheduling/Pgm. Mgt. Engineer	
DATE:	DATE:	DATE:	

DR Form 333, Oct 90/

Project No.: Control No.:

SKETCH MAP

	TRAVELED WAY		SHOULDER		
	TYPE	**WIDTH**	**TYPE**	**WIDTH**	**CONDITION**
1. Existing Road					
Sec. to E or N:					
Sec. to W or S:					

2. **EXISTING ALIGNMENT:** *(Complete only if project includes resurfacing)*

Design Speed	Max. Grade	Max. Horiz. Curve	Min. Stop Sight Dist.

3. **EXISTING MAJOR STRUCTURES:**

NO.	TYPE	LENGTH	WIDTH	CONDITION	TREATMENT	LOAD RATING	POSTED

4. Railroad Crossing Hazard Index Sheet Attached: Yes ☐ No ☐

5. Project Affected by Water Development: Yes ☐ No ☐
If YES - Water Development Project: Agency:

6. Anticipated Environmental Class of Project: If Class II, Group No.

7. Public Hearing Required: Yes ☐ No ☐ If YES - 1 Hearing or 2 Hearing

8. In 3-C Urbanized Area: Yes ☐ No ☐ On T.I.P. Yes ☐ No ☐ Item No.

9. Additional R.O.W. required for this construction: None ☐ Minor ☐ Significant ☐

10. Section 404 Permit Required: Yes ☐ No ☐ If YES - Wetlands on project Yes ☐ No ☐

11. Potential Hazardous Waste Sites on Project: Yes ☐ No ☐

12. Historic Sites on Project: Yes ☐ No ☐

13. Scenic River on Project: Yes ☐ No. ☐

PROJECT DATA REVISION

REVISION NO.

CONTROL NO.	

PROJECT		
PREFIX	NUMBER	UNIT

ADT			CLASS OF FUNDS	REFERENCE POST		LOCATION
PRESENT	FUTURE	YEAR		BEGIN	END	

COUNTY NAME:	COUNTY NO.:	NAME OF URBAN AREA:	URBANIZED AREA CODE:	F.A. ROUTE NO.:	STATE HWY. NO:	U.S. HWY. NO.:

CODE	PHASE OF WORK	DESCRIPTION OF TERMINI	LENGTH	APPR. CODE	ESTIMATED PROJECT COST BY PHASES				CHARACTER OF PROPOSED WORK
					TOTAL	FEDERAL FUNDS	STATE FUNDS	OTHER FUNDS	
	PE								
	ROW								
	CONST								
PROJECT TOTALS									

PROJECT APPROVAL			REMARKS
REQUESTED	RECOMMENDED	APPROVED	
Signature:	*Signature:*	*Signature:*	
TITLE:	TITLE: Federal Aid Administrator	TITLE: Project Scheduling/Pgm. Mgt. Engineer	
DATE:	DATE:	DATE:	

DR Form 334, Apr 76/

Design Decision Documentation Sheet

Project No.:	Control No.:	Date:
Project Name/Location:		
Designer:		
Item/Subject:		

Identify Design Guideline/Desirable Condition:

Reason Design Guideline/Desirable Condition Will Not be Met: ***(Cost, ROW, etc.)***

Design Solution Used and Why:

Review/Comment by Others: ***(District, Traffic, M&R, Wetlands, etc.)***

Attached Documentation: ***(Photograph, Email, etc.)*** --

Approval: -- (Name) -- (Print Name) ***OR*** Approval Document Attached

DR Form 335, Apr 05

Project Information Sheet

Estimate Status Code

☐ 10 = Original Est. ☐ 30 = Update 1/Pre-PIH
☐ 15 = Pre-design Concept ☐ 40 = Update 2/Functional
☐ 20 = Proj. Dev. Est. ☐ 45 = Update 3/Post-LOC
☐ 25 = Proj. Dev. Est. Update ☐ 50 = Letting

Distribution
P.S.&E.
Section Head
Proj. Scheduling & Program Management
Designer

☐ Metric ☐ English

Date: ____________
Designer: ____________ Phone: ____________
Control No.: ____________ Project No.: ____________
County(ies): ____________ Design Std.: ____________
Location: ____________ RP ____________ to RP ____________
Type of Improvement: ____________ Length: ____________

ROW: ha/m^2 ha/m^2
☐ Yes ______ AC/SF @ $ ______ per AC/SF
☐ Yes $ ______ Lump Sum
☐ Relocation $ ______ Lump Sum
☐ Building, etc. $ ______ ☐ Fence $ ______
1.4 Factor Applied ☐ Yes ☐ No
☐ No

Utilities:
☐ Yes Calculated by P.S.&E.
☐ Yes $ ______ Lump Sum
☐ RR $ ______ Lump Sum
☐ No

Preliminary Engineering:
☐ Yes Calculated by P.S.&E.
☐ Consultant
☐ Yes $ ______ Lump Sum
☐ No

CONSTRUCTION DATA

STA. – STA.	Reconstruction	Resurfacing	Mainline Surfacing Type	Depth (inches)	Width (feet)	Exist. Surf. Shld.	Build Surf. Shld.	Shoulder Surfacing Type	Depth (inches)	Width (feet)	Traffic Control: Work Done Under Traffic	Traffic Control: Project Detoured	Traffic Control: No. of Shooflies	Traffic Control: Phasing *(Explain Below)*

BRIDGES

RP	STA	New	Widen	Rehab.	Other	Type of Structure	Exist. Length	Exist. Width Out-to-Out	Proposed Length	Proposed Width Out-to-Out	Feature Crossed

Anticipated Number of Construction Seasons: ____________

Notes: ____________

DR Form 342, May 96/

Project Quantity Sheet *(English)*

Control No.:

GRADING

		Quantity	Unit	Unit Price
L006.00	COVERCROP SEEDING		ACRE	
L020.00	EROSION CONTROL		SY	
L020.	EROSION CONTROL, TYPE		SY	
L021.	EROSION CHECKS, TYPE		BALE	
L021.	EROSION CHECKS, TYPE		BALE	
L022.	FABRIC SILT FENCE, TYPE		LF	
L022.	FABRIC SILT FENCE, TYPE		LF	
1040.00	SLOPE PROTECTION		SY	
1040.06	SLOPE PROTECTION MULCH (2 lb/sy/2000) 1 lb/ton		TON	
0030.10	MOBILIZATION		LS	
1000.00	LARGE TREE REMOVAL		EA	
1009.00	GENERAL CLEARING AND GRUBBING		LS	
1010.00	EXCAVATION		CY	
1010.01	EXCAVATION (E.Q.)		CY	
1010.10	EXCAVATION, BORROW		CY	
1030.00	EMBANKMENT		CY	
1011.00	WATER		MGAL	
1012.00	ROW MARKER		EA	
1101.00	REMOVE PAVEMENT		SY	
1102.00	REMOVE ASPHALT SURFACE		SY	
1106.00	REMOVE DRIVEWAY		SY	
1107.00	REMOVE WALK		SY	
1108.00	REMOVE COMB. CURB & GUTTER		LF	
1109.00	REMOVE CURB		LF	
1122.01	REMOVE CONC. MEDIAN SURFACING		SY	
7017.00	REMOVE GUARDRAIL		LF	

DRIVEWAY CULVERT PIPE

	Size	18”	24”	30”	36”	42”	48”	54”	60”	72”
	DR. CULV. PIPE, TYPE									
	DR. CULV. PIPE, TYPE									
	DR. CULV. PIPE, TYPE									
	DR. CULV. PIPE, TYPE									

MSE WALLS

		Quantity	Unit	Unit Price
4095.00	CONCRETE FACE PANEL		SF	
4095.10	CONCRETE LEVELING PAD		LF	
4095.20	COPING		LF	
8024.75	SELECT GRANULAR BACKFILL		CY	

AGGREGATES

		Quantity	Unit	Unit Price
2001.	GRAVEL SURFACE COURSE		CY/T*	
2010.	CRUSHED ROCK SURFACE COURSE		CY/T*	
2009.	GRAVEL EMBEDMENT		SY/STA	

* DISTRICTS 1 & 2 – TON
ALL OTHERS – CY

SURFACING ★

		Quantity	Unit	Unit Price
0003.51	INSTALL CONC. PROTECTION BARRIERS		LF	
0003.75	TEMPORARY TRAFFIC SIGNAL		EA	
0010.04	FIELD OFFICE		EA	
0030.	MOBILIZATION		LS	
3014.	COMB. CONCRETE CURB & GUTTER		LF	
3016.	CONCRETE SIDEWALKS		SY	
3017.	CONCRETE MEDIAN SURFACING		SY	
3020.	CONCRETE DRIVEWAYS		SY	
	CONCRETE PAVEMENT REPAIR, TYPE		LS★	
3075.	” CONCRETE PAVEMENT, CLASS		SY	
3075.	” CONCRETE PAVEMENT, CLASS		SY	
3075.	” DOWELED CONCRETE PAVEMENT, CLASS		SY	
8029.	AGGREGATE FOUNDATION COURSE, IN.		SY	
8029.	BITUMINOUS FOUNDATION COURSE, IN.		SY	
8032.	CRUSHED CONCRETE FOUNDATION COURSE, IN.		SY	
8060.01	GRANULAR SUB-DRAIN, TYPE		EA	
8111.	SHOULDER SUBGRADE PREPARATION		SY/STA	
9005.00	ASPHALT CONCRETE FOR PATCHING, TYPE		TON	
9009.00	PLACE ASPH. CONC. INTERSECT. & DRIVES		SY	
9021.	PERFORMANCE GRADED BINDER, TYPE		TON	
9021.	PERFORMANCE GRADED BINDER, TYPE		TON	
9034.00	PREP. OF INTERSECTIONS & DRIVES		SY	
	ASPHALTIC CONCRETE, TYPE		TON	
	ASPHALTIC CONCRETE, TYPE		TON	
	ASPHALTIC CONCRETE, TYPE		TON	
	ASPHALTIC CONCRETE, TYPE		TON	
9053.00	TACK COAT		GAL	
9110.01	RENTAL OF LOADER		HR	
9110.02	RENTAL OF MOTORGRADER		HR	
9110.03	RENTAL OF DUMP TRUCK		HR	
9110.07	RENTAL OF SKID LOADER		HR	
9111.00	WATER		MGAL	
9170.00	EARTH SHOULDER CONSTRUCTION		STA	
9173.	SUBGRADE PREPARATION		SY/STA	
9173.15	TRENCHED WIDENING		STA	
9179.	COLD MILLING, CLASS DEPTH		SY/STA	
9179.	COLD MILLING, CLASS DEPTH		SY/STA	

★ ATTACH M&R COMPS, IF AVAILABLE

Control No.

DRAINAGE

		Quantity	Unit	Unit Price
0030.40	MOBILIZATION		LS	
4003.00	CAST IRON		LB	
4016.00	MANHOLES		EA	
4035.00	REMOVE FLARED END SECTION		EA	
4040.00	REMOVE HEADWALL FROM CULVERT		EA	
4043.00	REMOVE PIPE CULVERT		LF	
4044.00	PREPARATION OF STRUCTURE		EA	
	SIZE:			
	SIZE:			
	SIZE:			
4045.00	REMOVE STRUCTURE		EA	
	DESCRIPTION:			
	DESCRIPTION:			
	DESCRIPTION:			
4050.01	EXCAVATION FOR PIPE CULV. & HEADWALL		CY	
4051.01	EXCAVATION FOR BOX CULVERT		CY	
4100.06	CONCRETE FOR HEADWALL		CY	
4101.06	CONCRETE FOR BOX CULVERT		CY	
4105.59	CONCRETE FOR INLET & JUNCTION BOX		CY	
4107.07	CONCRETE FOR COLLAR		CY	
4150.00	RE-STEEL FOR HEADWALL		LB	
4151.00	RE-STEEL FOR BOX CULVERT		LB	
4155.50	RE-STEEL FOR INLET & JUNCTION BOX		LB	
4157.00	RE-STEEL FOR COLLAR		LB	

CULVERT PIPE

	Size	18”	24”	30”	36”	42”	48”	54”	60”	72”
	CULV. PIPE, TYPE									
	CULV. PIPE, TYPE									
	CULV. PIPE, TYPE									
	CULV. PIPE, TYPE									
	CULV. PIPE, TYPE									
	CULV. PIPE, TYPE									
	CULV. PIPE, TYPE									
	CULV. PIPE, TYPE									
	RD. EQ. CULV. PIPE, TYPE									
	RD. EQ. CULV. PIPE, TYPE									

FLARED END SECTIONS

	Size	18”	24”	30”	36”	42”	48”	54”	60”	72”
	FLARED END SECTION									
	FLARED END SECTION									
	ROUND EQUIVALENT FES									

LANDSCAPING

		Quantity	Unit	Unit Price
L001.01	SEEDING, TYPE “A”		AC	
L001.02	SEEDING, TYPE “B”		AC	
L010.00	SODDING		SY	
L032.75	MULCH (2 Ton/Ac-Hay or 2.25 Ton/Ac-Straw)		TON	

BRIDGES ★

		Quantity	Unit	Unit Price
0030.60	MOBILIZATION		LS	
	BRIDGE:		SF/LS ★★	
	BRIDGE:		SF/LS ★★	
	BRIDGE:		SF/LS ★★	
	(USE OUT-TO-OUT FOR WIDTH)			
6040.00	REMOVE STRUCTURE		EA	
	DESCRIPTION:			
	DESCRIPTION:			
	DESCRIPTION:			
3050.15	CONC. FOR PAVEMENT APPROACHES		CY	
3051.10	STEEL FOR PAVEMENT APPROACHES		LB	

★ ATTACH DETAILED QUANTITIES, IF AVAILABLE
★★ TOTAL SQ. FT. OF PROPOSED STRUCTURE OR LUMP SUM AMOUNT SUPPLIED BY BRIDGE DIVISION

GUARDRAIL

		Quantity	Unit	Unit Price
0030.70	MOBILIZATION		LS	
7011.20	W-BEAM GUARDRAIL		LF	
7015.00	CABLE GUARDRAIL		LF	
7020.00	BRIDGE APPROACH SECTION		EA	
7021.	GUARDRAIL END TREATMENT, TYPE		EA	
7023.00	TERMINAL ANCHORAGE SECTION		EA	

FENCING

		Quantity	Unit	Unit Price
0030.71	MOBILIZATION		LS	
	FENCE TYPE		LF	
	END POSTS		EA	
	CORNER POSTS		EA	
	PULL POSTS		EA	

ELECTRICAL ★

		Quantity	Unit	Unit Price
0030.81	MOBILIZATION		LS	
0820.00	LIGHTING		LS	
0830.00	TRAFFIC SIGNALS		LS	

★ ATTACH DETAILED QUANTITIES, IF AVAILABLE

SIGNING ★

		Quantity	Unit	Unit Price
0030.82	MOBILIZATION		LS	
0840.00	PERMANENT SIGNING		LS	

★ ATTACH DETAILED QUANTITIES, IF AVAILABLE

Public Hearing Notice Worksheet

Please return to the Public Hearings Office in the Communication Division prior to your hearing dry run or scheduling of your open house.

Your Name:

Division, Section, Unit:

Phone No.:

Fax No.:

Type of Hearing: *(Check one)*

- ☐ Notice of highway corridor hearing
- ☐ Notice of highway design hearing
- ☐ Notice of information open house
- ☐ Pre-appraisal meeting
- ☐ Other *(please specify)*

Date of Hearing:

Time of Hearing or Information Meeting:

Starting: ------------------ Ending: ------------------ *(if appropriate)*

Hearing Location: *(Building, Address, and City)*

Time of Preceding Information Discussions, if any:

Starting ------------------ Ending ------------------

Division(s) and/or District(s) Providing Personnel for Informal Discussions:

- ☐ Roadway Design
- ☐ Planning & Project Development
- ☐ Right-of-Way
- ☐ District

Project No(s). and "Known As" Descriptions:

Control No.:
(For internal referencing only)

Briefly Describe Location and Type of Proposed Improvement: *(Major Elements)*

Total Lanes in the Completed Project:

Project to be Constructed Under Traffic?
☐ Yes ☐ No

Highway Access Control Information:

Detour Information:		
Shoo-fly Information:		
Right of Way Information:		
Roadway Removal, Relinquishment:		
Acquisition of Business, Residence or Other Structures:		
Environmental Areas, including Wetlands to be Affected by the Project:		
Location and Address Where Preliminary Plans may be Inspected:	Contact Person for News Release:	
	Phone No.: *(Include Area Code)*	
	Have you attached the most current map detailing the location of the proposed improvement?	☐ Yes ☐ No
Is the project politically sensitive? *(Explain – for background purposes only)*		

Section/Unit Manager Reviewing & Approving Hearing Notice Materials:	Phone No.:	Fax No.:

STATE OF NEBRASKA
DEPARTMENT OF ROADS

LETTER OF TRANSMITTAL

TO:

Date: 10/25/04	Control No.:
Attention:	
Reference:	

We are sending you ☐ Attached ☐ Under separate cover via _____ the following items:

☐ Plans ☐ Prints ☐ Agreement(s) ☐ Specifications
☐ Estimate(s) ☐ Correspondence ☐ Other _____

COPIES	DATE	NO.	DESCRIPTION

THESE ARE TRANSMITTED AS CHECKED BELOW:

☐ For your use ☐ For review and comment ☐ Return _____ corrected prints
☐ As requested ☐ Return for corrections
☐ For approval ☐ Submit _____ copies for distribution ☐ Other _____

Remarks:

IF ENCLOSURES ARE NOT AS NOTED, KINDLY NOTIFY US AT ONCE	Division:
Person to Contact and Phone No.:	
Copy(s) To:	Signature: