

Roadway Design Manual Changes July 2006

The following changes have been made to the July 2005 edition of the Roadway Design Manual (RDM). Changes in design guidance are noted in **red**.

The Table of Contents, the List of Exhibits, and the Index have been updated.

Entire Manual:

- The **Roadway Design Project Manager** is now the **Roadway Design Unit Head**.
- The **Drafting Unit** is now the **Roadway Design Plans Development Unit**.
- A drafter is now a design technician.
- The **Roadside Development Unit** is now a part of the **Planning and Project Development Division**.
- Where appropriate, insure has been corrected to ensure.
- Where appropriate, i.e. has been replaced with e.g.
- For consistency and continuity throughout the manual: foot, feet, and ‘ have been replace with ft.; inch, inches, and “ have been replaced with in.; and meter has been replaced with m.
- Section and Exhibit numbers have been updated as needed.
- Chapter Eleven was re-titled Highway Plans Assembly (it was previously titled Plan Preparation).
- Chapter Twelve was re-titled Cost Estimating & Funding (it was previously titled Cost Estimating).

Introduction:

Section 2. HOW TO USE THE MANUAL:

- Second paragraph, third and fourth sentences; removed ~~less-stringent~~ when referring to AASHTO’S guidelines.
- Third paragraph, third sentence; higher values **may** be used rather than ~~should~~ be used.
- Fourth paragraph, third bullet point; rewritten to “it is recommended that the designer make reasonable efforts ...” (instead of, ~~The designer should make reasonable efforts to~~”).

Chapter One: Design Standards

Section 3.B Needs Study Criteria Policy Guidelines:

- Point 1 (Top Width), sections A and B; the metric pavement width was corrected to 7.3 m, (from ~~7.2 m~~), for consistency.

Section 4.A Maintenance Project Policy Guidelines:

- Point 2.A; **the ½" grade raise shall be measured at the edge of the pavement.**
- Point 3, first sentence; the metric equivalent of 2 ft. was changed to 0.6 m, (from ~~600 mm~~), for consistency.
- Point 3, second sentence; the metric overlay depth was changed to 63 mm, (from ~~64 mm~~), for consistency.
- Point 4, first sentence; **the acceptable grade raise has been changed from ~~2-in. (50 mm)~~ to 2 ½ in., (63 mm) measured at the edge of the pavement.**
- Point 4, second and third sentences; **the ½ in. (13 mm) grade raise shall be measured at the edge of the pavement.**
- Point 7; instead of ~~A city agreement will not be required unless requested by the District Engineer~~, the current design guidance is, **If more than a 2 in. (50 mm) depth is placed at the centerline a city agreement may be required.**
- Point 10; removed all references to ADA.
- Point 11 was added to this section; **Curb ramps will be built where needed when surfacing overlays of 2 in. (50 mm) or more are placed (2 in. (50 mm) total lift even if the surface is milled first). A city agreement may be required.**

Section 4.B Pavement Extension Plan (PEP) Policy:

- First paragraph, added new first sentence; "Pavement Extension Program (PEP) projects extend the life of asphalt or composite surfacing and usually precede a full construction or rehabilitation of the highway."
- First paragraph, second sentence; **PEP projects may include shoulder construction.**
- This section has been re-ordered, separating the conditions which make a project PEP eligible from the conditions exempting a project from PEP eligibility.

Section 4.B.1 PEP Project Considerations:

- **This section has been added to the RDM.**

Section 5.E Accessibility Requirements for Handicapped Individuals:

- First paragraph, last bullet point; added a reference to Chapter Ten, Section 10.

Exhibit 1.5 Example Design Relaxation Letter:

- The zip code was corrected to 68509-4759, and the project information was placed above the salutation.

Section 7.D.1 Priority Commercial System

- Third paragraph, second sentence; **the design year traffic volume shall be the volume at the initial year of construction plus 20 years (rather than 20 years after construction begins).**

Section 7.E 28 ft. (8.5 m) Surfaced Top System:

- Entire section; the metric width was changed to 8.5 m, (from ~~8.4 m~~), for consistency.

Section 8.A Design Year Forecast Traffic:

- First paragraph; the design year was changed from ~~the year twenty years after the completion of the project~~. **The new design guidance regarding the design year is twenty years after the initial construction of the project for DR projects. For 3R projects, the design year shall be the year twelve years after the initial construction of the project.**
- First paragraph, removed the final sentence (July 2005); ~~The DHV is the targeted value for design year traffic for rural expressways and major arterials (DR1 through DR3), and municipal streets.~~
- Second paragraph, first sentence; the sentence now begins with "Traffic", (~~Twenty year~~ was removed from the beginning of the sentence).

Chapter One: Design Standards (Cont.)

Section 8.B Design Speed:

- This section has been rewritten and expanded, changing the design speed from ~~the anticipated posted speed or greater~~ to a desirable design speed of 5 mph greater than the anticipated posted speed. The minimum design speed is that which is listed in the Nebraska Minimum Design Standards. A rural roadway project should be designed to one design speed. Deviation from the established design speed will require **Assistant Design Engineer** approval.

Section 9.B Economic Analysis:

- Final sentence; the reader is now referred to Section 1.A.3 of Chapter Twelve.

Chapter Two: Design Process

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

- Final sentence; this activity applies to **all** projects with bridge structures (removed ~~5 or more~~ from the sentence).

Section 5.A Obtain Preliminary Data:

- Third paragraph, second sentence; either the designer or the “design technician” (rather than ~~Drafting~~) **will** (rather than ~~may~~) be responsible for “plan production” (rather than ~~drafting~~).
- The final paragraph, regarding survey needs, was moved to this section from Section 5.B.

Section 5.B Project Scope Review and Scoping Changes:

- This section was re-titled from ~~Confirm Scope of Project~~
- This section has been expanded, detailing the level of administrative approval required for project scope changes as shown in the table at the end of the section.
- The second paragraph states that an updated cost estimate **must** be requested whenever there is a change in the scope of a project.
- The fifth paragraph advises that scoping changes occurring after the Plan-in-Hand Report should be handled as a supplement to the report.
- The previous final paragraph, regarding surveys, is now the final paragraph of Section 5.A.

Section 5.D Request Information from Other Divisions:

- First paragraph, added the final sentence regarding the accident records report; **This information is for NDOR use only and shall not be shared with the general public.**
- Second paragraph, first sentence; obtain the “load” ratings for bridges (rather than the ~~H and HS~~ ratings).

Section 5.F Initiate Special Investigations:

- First paragraph, eighth bullet point; erosion control shall be reviewed by the **Roadside Development Unit** of the **Planning and Project Development Division**, rather than by the ~~Agronomist~~.

Section 6 COST UPDATE 1 – STATUS 30 (ACTIVITY 5403):

- Fifth sentence; the reader is now referred to Section 2 of Chapter Twelve.

Section 7.A Plan-in-Hand Plans

- Second paragraph; the reader is now referred to Section 4 of Chapter Eleven.

Section 7.C Conduct the Plan-in-Hand Inspection:

- Added a new second paragraph; **If there are changes to the project resulting from the plan-in-hand inspection, the designer will meet with the Environmental Program Manager to review the changes and to determine if changes to the pre-permit application consultation process will be necessary.**

Section 11 COST UPDATE 2 – STATUS 40 (ACTIVITY 5406):

- Final sentence; the reader is now referred to Section 2 of Chapter Twelve.

Chapter Two: Design Process (Continued)

Section 12.A Public Hearings:

- Fifth paragraph, second bullet point; ~~water pollution~~ has been replaced with “erosion and sediment control”.

Section 15 **COST UPDATE 3 – STATUS 45 (ACTIVITY 5408):**

- Fifth sentence; the reader is now referred to Section 2 of Chapter Twelve.

Section 17.A Removal Items and Notes:

- This section was added to the RDM.

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

- Third paragraph; the reader is now referred to Section 4 of Chapter Eleven.

Section 22.B Percentage of Work Near Railroad:

- Fourth paragraph; the reader is now referred to Section 4.D of Chapter Twelve.

Section 22.E Final Plan Review For PS&E:

- Added a new fourth paragraph; **PS&E checks the plans and quantities and informs the designer of any required plan changes. When the corrected plans are returned to PS&E, the CADD files are locked to prevent unauthorized changes to the contract plans. The roadway designer shall contact the Roadway Design Plans Unit Manager to unlock the CADD files prior to making plan revisions, (See Section 23.A and Chapter Eleven: Highway Plans Assembly, Section 7, for further information).**

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

- Added a new first sentence; “Activity 5375/5376 covers all post letting Design functions including the Pre-Construction Conference, construction review of any type, Plan Revisions, and the Post-Construction Conference.”
- Removed the final five sentences of the July 2005 edition; ~~*The Roadway Design Division may be involved in revisions at any time during the construction of a project. If a project 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: Plan Preparation, Section __, for plan revision procedures.*~~ Plan Revision procedures are now addressed in Section 23.A.1 and in Chapter Eleven.

Section 23.A Changes to the Design Plans:

- This section has been added to the RDM. Note that any changes to the plans (occurring after the project has been let to contract) which require engineering should be handled as a plan revision while any changes which are merely adjustments to the existing plans should be handled by change orders.

Section 23.A.1 **Plan Revisions:**

- This section has been added to the RDM. Note that the **Assistant Design Engineer** must give written authorization for a plan revision and that all plan revisions must be signed and sealed by a P.E., including plan revisions transmitted via fax, phone, or e-mail.

Chapter Three: Roadway Alignment

Section 3.B Superelevation:

- Second paragraph, second sentence; removed the reference to ~~*EXHIBIT 3.8*~~.
- Second paragraph, third sentence; **an 8% Superelevation rate should be designed in accordance with A Policy on Geometric Design of Highways and Streets.**
- Third paragraph, first sentence; **High-speed urban roadways are preferably designed using a maximum Superelevation rate of 6%, (instead of 4%).**
- Third paragraph; removed the second sentence, ~~*If there are no traffic stops or signal present or anticipated in the future, a maximum Superelevation rate of 6% may be acceptable if compatible with roadside conditions.*~~

Chapter Three: Roadway Alignment (Continued)

Exhibit 3.3 Superelevation Rates:

- Max. Allowable Superelevation/Rural Roadways; the reader is now referred to Reference 3.1 for an 8% superelevation (instead of ~~EXHIBIT 3.8~~).
- The references to other Exhibit numbers have been updated.

Section 3.B.2 Axis of Rotation:

- Third paragraph, first sentence; the axis of rotation and profile grade point for multi-lane facilities with crowned surfaces and depressed medians of 40 ft. (12.2 m) or less in width shall be about the inside (median) lane edge of each roadway (instead of ~~about the inside (median) edge of the shoulder~~).
- Third paragraph, second sentence; the metric equivalent of the 2 ft. ditch depth was changed to 0.6 m, (from ~~600 mm~~), for consistency.
- Added the sixth paragraph; The roadway designer should always check the overhead clearance based on the high point of the superelevated roadway (including the turf shoulders), which may or may not be at the profile grade point, and should allow sufficient clearance for a future 6 in. (150 mm) overlay, if possible.

Section 3.B.3 Smoothing of Pavement Edge Profile:

- Third sentence; removed ~~(meters)~~ and ~~(kilometers)~~, added "(for metric projects the minimum vertical curve length can be set as numerically equal to 0.2 times the design speed in kilometers per hour).
- Fourth sentence; removed "where possible ~~and consideration should be given to~~ using a standard"

Section 3.B.4 Superelevation for 3R Projects:

- Added the fourth bullet point; Existing spiral transitions should be retained on overlay projects. The full superelevation rate should be attained at the transition from the spiral to the curve (CS or SC). If the full length of superelevation transition cannot be attained on the spiral, the additional transition length should be in the tangent section.

Exhibit 3.4 Superelevation for Dual Highways (Crowned Surface):

- The axis of rotation and the profile grade point were shifted from the ~~inside edge of the median shoulder~~ to the inside (median) edge of the lanes.

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

- Removed the 45 mph (60 and 70 km/h) column(s) from the table.
- The relative gradients were changed to the values found in the 2004 edition of [A Policy on Geometric Design of Highways and Streets](#).

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

- Removed this Exhibit from the RDM. An 8% Superelevation rate should be designed according to [A Policy on Geometric Design of Highways and Streets](#).

Exhibit 3.9 Values for Design Elements Related to Design Speed and Horizontal Curvature, High-Speed Roadways ($e_{\max} = 4\%$):

- Removed this Exhibit from the RDM. High-speed roadways should be designed to an e_{\max} of 6%.

Exhibit 3.10 Values for Design Elements Related to Design Speed and Horizontal Curvature, Desirable Design for Low-Speed Roadways ($e_{\max} = 4\%$):

- Re-titled as **EXHIBIT 3.8** and added "Urban" to the title.
- Added the 50 mph (80 km/h) column to the table.
- The relative gradients were changed to the values found in the 2004 edition of [A Policy on Geometric Design of Highways and Streets](#).

Chapter Three: Roadway Alignment (Continued)

Exhibit 3.11 Values for Design Elements Related to Design Speed and Horizontal Curvature, Minimum Design for Low-Speed Urban Roadways ($e_{\max} = 4\%$):

- Re-titled as **EXHIBIT 3.9**.
- The relative gradients were changed to the values found in the 2004 edition of A Policy on Geometric Design of Highways and Streets.

Section 3.D Pavement Widening on Curves:

- Second paragraph, first sentence; the metric equivalent of 2 ft. was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Section 4.A.2 Minimum Grades:

- Point 3, Non-curbed Roadways, was re-written as follows; A preferred grade of 0.35% should be used to ensure drainage in the standard ditch section. Level longitudinal gradients are acceptable where the pavement is crowned 2% or more, provided that consideration is given to the need for special ditches. (Instead of ~~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.~~).
- Point 4, Superelevation Runout; the existing final sentence (July 2005) is now the first sentence (July 2006), "The desirable profile grade in this area is 1.5%."

Section 4.E Low-Speed Municipal Streets:

- First sentence; vertical curves are not required on **low-speed** municipal streets (**≤ 45 mph**) where the algebraic difference in grades is less than **1%** (rather than ~~0.2%~~). The citation to Reference 3.7 was added to the sentence.

Section 4.G.1 Vertical Curve with Obstructions:

- First paragraph, added a new second sentence; The minimum vertical clearance shall be measured from the high point in the roadway, including the turf shoulders.
- First paragraph, third sentence (July 2006); added "minimum vertical clearance" to the sentence for clarification.

Section 5 ALIGNMENT DESIGN VALUES:

- First paragraph, second sentence; the reader is now referred to Section 4 of Chapter Eleven.

Section 6 REFERENCES:

- Added reference 3.7.

Chapter Four: Intersections, Driveways and Channelization

Section 1.C.1 Capacity and Level of Service:

- Eighth paragraph, second sentence; the project design year shall be the year 20 years after the **initial construction** of the project (not after the ~~completion~~ of the project).

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

- Second paragraph, second sentence; re-written as follows: "When designing new and reconstructed projects, **an a maximum** intersection skew of **30°** is allowable, with a **15°** skew being preferred. ~~15° does not unreasonably increase the intersection crossing distance or decrease the driver's field of vision and is usually considered an acceptable design.~~
- Second paragraph; added a new third sentence; The allowable skew for 3R projects will be based on the recommendations from the **Traffic Engineering Division** and on the accident history of the intersection.
- Second paragraph; removed the existing (July 2005) second sentence; ~~EXHIBIT 4.7 shows the maximum recommended allowable skew for new and reconstructed projects~~

Chapter Four: Intersections, Driveways and Channelization (Cont.)

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

- This Exhibit was removed from the RDM.

Exhibit 4.9 Guidelines for the Selection of Intersection Design Vehicles:

- Renumbered to **EXHIBIT 4.8**.
- The following note was added to the Exhibit; The use of a design vehicle smaller than the minimum listed in the table requires **Roadway Design Unit Head** approval.

Section 1.D.2 Turn Lane Length:

- First paragraph; added the first bullet point, **Through Traffic Volumes**.
- Second paragraph, the following was added to the second sentence; **based on a comfortable deceleration rate of 11.2 ft./sec.**
- Second paragraph; deleted the existing final sentence and the Minimum Deceleration Lengths Table, *Minimum deceleration lengths (excluding taper) for auxiliary lanes on arterial streets with grades of 2% are:*

Design Speed		Minimum Deceleration Lengths	
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)

- Fourth paragraph; added the new first sentence; **Storage Lane Length** - The following procedure for determining turn lane storage length is provided for use during the preliminary design of intersection geometrics.”

Section 1.D.4 Transition:

- The second and third sentences were re-written as follows; Typically, ~~a 1:20 taper ratio is used for left turn lanes on expressways and a 1:15~~ a **15:1** taper ratio is used ~~for right turn lanes on expressways and for right and left turn lanes on rural roadways.~~ **Right and left turn** Turn lanes ~~will~~ **should** have a ~~1:10~~ **10:1** taper rate in urban areas with speeds less than 50 mph (80 km/h).

Section 1.D.5 Free Right-Turn Lanes:

- Third paragraph, first bullet point; **the design year shall be the year 20 years after the initial construction of the project (not after project construction).**

Section 2.A Rural Driveways:

- First paragraph; added the last bullet point, “On a project where the earthwork is measured in embankment, the earthwork required for the construction of the driveways and field entrances must be included in the earthwork totals.”

Exhibit 4.14 Rural Driveway Width Criteria:

- Renumbered to **EXHIBIT 4.13**.
- **Added a grading width of 42 ft. (13 m) and a radius of 25 ft. (7.5 m) for Joint Use Field Entrances.**

Section 2.A.1 Rural Driveway Culvert Pipes:

- Fourth bullet point; the reader is now referred to Sections **6, 7, & 8** of Chapter One of the Drainage Design and Erosion Control Manual (instead of Sections ~~11 and 12~~).
- Fifth bullet point; the reader is now referred to **Appendix C, “Pipe Material Policy”** of the Drainage Design and Erosion Control Manual (instead of ~~Chapter One, Section 14~~).

Chapter Four: Intersections, Driveways and Channelization (Cont.)

Exhibit 4.15 Rural Driveway Without a Special Ditch:

- Renumbered to **EXHIBIT 4.14**.
- Plan view, cut section (lower right corner of Exhibit); the 15 ft. (4.5 m) transition should be measured from the lateral obstacle clear distance (not from the ~~tee of the backslope~~).

Section 3.B.1 Rural Driveways:

- First paragraph, first bullet point; the metric equivalent of 2 ft. was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Section 5.A Islands:

- Seventh paragraph, second bullet point; the design speed for high-speed facilities was corrected to > 45 mph (instead of \geq).

Section 5.B.2 Median Types:

- Second paragraph, fourth sentence; the metric equivalent of a 2 ft. mow strip was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Section 5.B.3 Median Design Considerations:

- First paragraph, fourth sentence; replaced ~~Median widths~~ with **Minimum** median widths.
- First paragraph, added a new fifth sentence; “The desirable median width for a 4-lane freeway is 52 ft. (15.8 m).”
- First paragraph, added the final two sentences; “Roadway designers should check the width and placement of any piers in the median and, if necessary, adjust the roadway design accordingly. The width of the pier cap should also be checked to ensure that the minimum allowable vertical clearance is being maintained (See Chapter Ten: Miscellaneous Design Issues, Section 2.E).”

Section 5.B.4 Median Breaks:

- There are now four types of median breaks; Type A, Type B, Type C, and Type D.
- First paragraph, first sentence; the minimum median opening width **should** be 72 ft. (22 m) (rather than ~~shall~~).

Section 5.B.4.a Type A Median Breaks:

- This section was added to the RDM.
- First paragraph, the first sentence was rewritten as follows (this had been part of Section 5.B.4); “Type A median breaks (**EXHIBIT 4.24 4.25**) may be used at intersections of the mainline with roadways having a classification of “Other Arterial” or higher and at intersections with paved public roads, major county roads, streets and major state highway intersections where there is high probability of turning vehicles blocking the opposing turning driver's view.
- First paragraph; added the bullet points detailing the salient points of a Type A median break.

Section 5.B.4.b Type B Median Breaks:

- This section was added to the RDM.
- First paragraph, the first sentence was rewritten as follows (this had been part of Section 5.B.4); “Type B median breaks (**EXHIBIT 4.25 4.26**) are appropriate for use at mainline intersections with low volume gravel county roads, with housing development intersections, and with residential and light rural commercial drives.
- First paragraph; deleted the existing second sentence; ~~Type C median breaks (EXHIBIT 4.27), are used at intersections with field entrances.~~
- First paragraph; added the bullet points detailing the salient points of a Type B median break.

Section 5.B.4.c Type C Median Breaks:

- This section was added to the RDM.
- This is a new type of median break for use at a mainline intersection with farmstead/rural residence drives.

Chapter Four: Intersections, Driveways and Channelization (Cont.)

Section 5.B.4.d Type D Median Breaks:

- This section was added to the RDM.
- The new **Type D** median break is the previous ~~Type C~~ median break.

Exhibit 4.25 Median Break Type A:

- Renumbered to EXHIBIT 4.24.
- This Exhibit was redrawn to reflect the new details of a Type A median break (see Section 5.B.4.a).
- Note that the taper rate was changed from ~~20:1~~ to **15:1**.

Exhibit 4.26 Median Break Type B:

- Renumbered to EXHIBIT 4.25.
- This Exhibit was redrawn to reflect the new details of a Type B median break (see Section 5.B.4.b).
- Note that the taper rate was changed from ~~20:1~~ to **15:1**.

New Exhibit 4.26 Median Break Type C:

- This is a new Exhibit reflecting the details of the Type C median break (see Section 5.B.4.c).

Exhibit 4.27 Median Break Type D:

- This Exhibit was re-titled; it had previously shown the details for a ~~Type C~~ median break.

Chapter Five: Interchanges and Grade Separations

This chapter is still under construction.

Chapter Six: The Typical Roadway Cross-Section

Section 1.A.2 Travel Lane Cross Slopes:

- First paragraph, second sentence; the metric equivalent of the 2 ft. median depth was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Exhibit 6.2 Typical Section of a Crowned Multi-Lane Roadway With a Depressed Median:

- The profile grade point was shifted from the ~~centerline of the travel lanes~~ to the **inside (median) edge of the inside travel lanes**.

Exhibit 6.3 Typical Section of a Tangent Multi-Lane Roadway With a Depressed Median:

- The following note was added to the Exhibit; “For details of superelevated multi-lane roadways with depressed medians 40 ft. (12.2 m) or less in width see Exhibit 3.5.”

Section 1.G.2 Curb Types:

- Second paragraph, first bullet point; the design speed for high-speed roadways was corrected to > 45 mph (from ~~≥ 45 mph~~).

Section 1.G.3 Curb Design Considerations:

- First paragraph (Drainage); the reader is now referred to Section **10** of Chapter One of the Drainage Design and Erosion Control Manual (instead of Section ~~9~~).
- Fourth paragraph (Erosive Soils), first sentence; the reader is now referred to Section **8.E** of Chapter Two of the Drainage Design and Erosion Control Manual (instead of Section ~~6-G~~).
- Fourth point 1; the reader is now referred to Section **8.E** of Chapter Two of the Drainage Design and Erosion Control Manual (instead of Section ~~6-G~~).
- Fourth paragraph, point 2; the metric equivalent of the 2 ft. gutter line was changed to 0.6 m, (from ~~600 mm~~), for consistency.
- Fourth paragraph, point 3; the metric equivalent of the 2 ft. turf shoulder was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Chapter Six: The Typical Roadway Cross-Section (Cont.)

Section 2.A.2 Fill Slopes (Parallel) – Curbed:

- Second paragraph; the reader is now referred to Section 8.E of Chapter Two of the Drainage Design and Erosion Control Manual.

Section 3.H Drainage:

- Second paragraph, third sentence; the reader is now referred to Section 4.J of Chapter Eleven.

Section 3.I Erosion Control:

- Second paragraph; the reader is now referred to all of Chapter Two of the Drainage Design and Erosion Control Manual (rather than specifically to ~~Section 6~~).

Section 3.K Landscaping:

- First paragraph, first sentence; the **Roadside Development Unit** is identified as being part of the **Planning and Project Development Division** (it is no longer a part of the **Roadway Design Division**).

Section 4 **3R PROJECTS:**

- First paragraph, added the last bullet point; **On the plan-in-hand field inspection the designer should note any obstacles which are on a traversable, non-recoverable slope but are beyond the fixed obstacle clear distance and discuss their treatment with the District representatives, (e.g., remove trees if there is sufficient R.O.W.).**

Chapter Seven: Earthwork

- First paragraph, third and fourth bullet points; the reader is now referred to Section 8.R of Chapter One of the Drainage Design and Erosion Control Manual (rather than Section ~~4.2.7~~).

Exhibit 7.7 **Additional Requirements for Earthwork Calculations:**

- ITEM 6; the balance points should be shown on the **2-N** Sheet (rather than the ~~2-S~~ Sheet).
- Added ITEM 9; “On a project where the earthwork is measured in embankment, the earthwork for the construction of driveways and field entrances must be included in the earthwork totals.”

Section 3.D Driveways:

- First paragraph, second bullet point; added “field entrances” to the list.

Chapter Eight: Surfacing

Section 1.A Pavement Design Input:

- Second paragraph, first sentence; **the design year shall be the year 20 years after the initial construction for New and Reconstructed projects (not ~~the completion of the project~~).**

Section 2.A.1 **Portland Cement Concrete Pavement Design Policy:**

- Point 2, final sentence; the reader is now referred to Section 4.B of Chapter Eleven.

Section 2.A.4 **Tining:**

- Second paragraph, final sentence; the reader is now referred to Section 4.B of Chapter Eleven.

Section 3.A Concrete Shoulders:

- First paragraph, third sentence; the reader is now referred to Section 4.B of Chapter Eleven.

Chapter Eight: Surfacing (Cont.)

Section 3.C Shoulder Construction:

- First paragraph, first sentence; **the subgrade shall be designed an additional 0.2 ft. high for trimming (not 2").**
- First paragraph, first sentence; the following was removed from the sentence, “~~...so that when the contractor completes subgrade trimming there will be enough material to complete the shouldering operation,...~~”
- First paragraph, new second sentence; begin the sentence with “This excess material should be incorporated into the earth shoulder ...”
- Second paragraph, third sentence; the reader is now referred to Section 6 of Chapter Two of the Drainage Design and Erosion Control Manual (rather than Section 5).

Section 4.C Pavement Patching:

- First paragraph, first sentence; the reader is now referred to Section 4.F of Chapter Twelve.
- Third paragraph, final sentence; the reader is now referred to Section 4.F of Chapter Twelve.

Section 4.E.1 Template Correction:

- Final sentence; the reader is now referred to Section 4.F of Chapter Twelve.

Section 5 SURFACING QUANTITY COMPUTATIONS:

- Final sentence; the reader is now referred to Section 4.F of Chapter Twelve.

Section 6 RUMBLE STRIPS:

- Added a new second paragraph; **Milled-in rumble strips should be constructed on the surfaced shoulders of rural high-speed highways, ($V > 45$ mph), whether new construction or resurfacing. Projects with curbed shoulders and concrete flumes will be reviewed by **Roadway Design** for the inclusion of milled-in rumble strips.**
- Last paragraph, second sentence; the reader is now referred to Section 4.G of Chapter Eleven.
- Last paragraph, added new third sentence; “The appropriate pay item is “Rumble Strip, Asphalt” and/or “Rumble Strip, Concrete”.

Section 7 SURFACING ELEVATIONS:

- Removed the first sentence; ~~See Chapter Eleven: Plan Preparation, Section __, for details showing the required accuracy for surfacing elevations of concrete pavement.~~
- **Added all of the other text in this section, detailing the locations where surfacing elevations should be given to the design technician.**

Exhibit 8.4 Surfacing Elevation – Urban Undivided:

- **This Exhibit was added to the RDM.**

Exhibit 8.5 Surfacing Elevation – Urban Divided:

- **This Exhibit was added to the RDM.**

Exhibit 8.6 Surfacing Elevation – Intersections:

- **This Exhibit was added to the RDM.**

Chapter Nine: Guardrail and Roadside Barriers

Section 1.A Warrants for Guardrail and the Benefit/Cost Analysis:

- The first paragraph was re-written as follows; “Warrants for guardrail are based on a benefit/cost (B/C) analysis in the Roadside Safety Analysis Program (RSAP) and the premise that ~~guardrail~~ shielding should be installed only if it will reduce the severity of ~~potential accidents~~ possible crashes. RSAP is the preferred benefit/cost analysis of the **Roadway Design Division** of **NDOR**. The RSAP program is for calculating the benefit to cost ratio comparing possible crash costs of roadside hazards to the expected benefit of shielding such hazards. The warrant analysis ~~is generally based upon a benefit/cost analysis, which~~ considers the costs of the guardrail, maintenance of the guardrail, ~~accidents~~ crashes involving the guardrail, the potential costs of accidents involving the roadside obstacle, and the cost of removing, ~~or~~ minimizing, ~~or~~ shielding the obstacle. In some cases it may be more cost effective to leave the obstacle unshielded. **NDOR** uses 1.5 as a minimum benefit, and prefers to see a benefit of 2.0 or greater when building shielding for roadside hazards. **EXHIBIT 9.1** lists general considerations for barriers for non-traversable and fixed object obstacles.

Exhibit 9.1 **Considerations for Barriers for Non-traversable and fixed Object Obstacles:**

- Decision Considerations/Culverts, pipes, headwalls; removed the third sentence, ~~EXHIBIT 9.2 should be used to determine the need for guardrail for culvert protection.~~

Exhibit 9.2 **W-Beam Guardrail Warrants for Culverts (Headwall or Parapet not exposed more than 4 in. (100 mm)):**

- ~~This Exhibit was removed from the RDM.~~

Section 1.B.10 **Determine the Details of Surfacing under Guardrail:**

- Second paragraph, second sentence; the metric equivalent of the 2 ft. turf shoulder was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Section 1.B.11 **Determine the Pay Item Quantities:**

- Final paragraph; the reader is now referred to **EXHIBIT 12.6** of Chapter Twelve (rather than to a specific section of Chapter Twelve) .

Section 1.C Deflection Distance:

- Second paragraph, fifth sentence; the metric equivalent of the 2 ft. clearance from the back of the post was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Section 1.I Guardrail Over Low Fill Culverts:

- Second paragraph, second sentence; the metric equivalent of the 2 ft. clearance was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Section 1.J Guardrail and Curbs:

- Second sentence; the metric equivalent of the 2 ft. clearance between guardrail post and curb was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Section 1.K.2 **Guardrail Design at Culverts:**

- First bullet point; ~~warrants for w-beam guardrail should be checked using RSAP (not EXHIBIT 9.2).~~

Chapter Ten: Miscellaneous Design Issues

Section 2.E.1 Grade Separations:

- First paragraph, added new second sentence; **The minimum vertical clearance shall be measured from the high point of the roadway, including turf shoulders, which may or may not be at the profile grade point.**

Section 3 AIRWAY HIGHWAY CLEARANCES:

- First paragraph, added new second sentence; **The minimum vertical clearance shall be measured from the high point of the roadway, including turf shoulders, which may or may not be at the profile grade point.**
- Second paragraph; added the metric equivalents of 305 m (for 1000 ft.), 122 m (for 400 ft.), and 49 m (for 160 ft.).

Exhibit 10.7 Airway Highway Clearance Requirements (Civil Airports):

- The following note was added below Table A; **The minimum vertical clearance shall be measured from the high point of the roadway, including the turf shoulders.**

Section 4. LANDSCAPING:

- First paragraph, first sentence; landscaping is the responsibility of the **Planning and Project Development Division** (instead of the **Roadway Design Division**).
- Third paragraph, point 1; **the Roadside Development Unit** is identified as a part of the **Planning and Project Development Division** (it is no longer a part of **Roadway Design**).

Section 4.A Tree Planting and Removal:

- First paragraph, third sentence; **the Roadside Development Unit** is identified as a part of the **Planning and Project Development Division** (it is no longer a part of **Roadway Design**).

Section 9. OLD ROAD OBLITERATION:

- Third sentence; the reader is now referred to Section **4.G** of Chapter Eleven.

Exhibit 10.9 Sidewalk and Bikeway Minimum Widths:

- Under SIDEWALK/MINIMUM WIDTHS; **the NDOR preferred minimum sidewalk width is identified as 5 ft. (1.5 m).**
- The ADAAG minimum sidewalk width of 3 ft. (915 mm) was added to the notes.

Exhibit 10.10 Typical Sidewalk Section:

- The sidewalk width was increased to 5 ft. (from ~~4 ft.~~).

Section 10.B.1.b Design Considerations – Sidewalks:

- Second paragraph (Buffer Areas), fourth sentence; the metric equivalent of the 2 ft. buffer area was changed to 0.6 m, (from ~~600 mm~~), for consistency.
- Sixth paragraph (Underpasses), first sentence; **when a culvert is to be used as a dedicated pedestrian underpass, the minimum box size shall be 12 ft. x 8 ft. for lengths of 60 ft. or less** (instead of ~~10 ft. x 10 ft.~~) with a recommended width of 14 ft. if the facility is shared with bicycles.
- Sixth paragraph (Underpasses), added a new second sentence; **For culverts over 60 ft. in length, both dimensions should be increased.**

Section 10.B.2 Bikeways:

- Second paragraph, fourth bullet point; the metric equivalent of the 2 ft. rumble strip width was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Chapter Ten: Miscellaneous Design Issues (Cont.)

Section 10.B.3 Curb Ramps:

- Second paragraph, first bullet point; added the reference to Section 10.B.1.
- Second paragraph, fourth bullet point; removed *Design*.
- Second paragraph, sixth bullet point; added “obstacles (e.g. fire hydrants,” …
- Third paragraph, added a new first sentence; “Pavement drainage is a particular concern at curb ramps.”
- Third paragraph, last sentence; added the reference to Chapter One: Drainage, Section 10.B.1.
- Fourth paragraph, last sentence; the placement of curb ramps at 45° to the vehicular traffic is “**not desirable**” (instead of *not acceptable*).
- Fifth paragraph, removed the first sentence; ~~*The maximum allowable running slope of any curb ramp is 8.3%.*~~
- Fifth paragraph, added new first and second sentences; **While the maximum allowable running slope of any curb ramp is 8.3%, the roadway designer is advised to design curb ramps to an 8% maximum slope whenever possible. This will allow for any future settling or upheaval of the ramp.**
- Eighth paragraph, second sentence; the metric equivalent of 2 ft. was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Exhibit 10.12 Public Sidewalk Curb Ramps:

- The 5 ft. (1.5 m) ramp width was added to Detail c.
- “(**desirable maximum = 8%**)” was added to the note re maximum ramp running slope.

Section 10.B.4 Pedestrian Ramps:

- First paragraph, second sentence; added “(**with a desirable maximum slope of 8%, See Section 10.B.3**)”

Section 10.B.6 Handrails for Pedestrian Ramps and Stairs:

- First paragraph; added “(AADAG)” prior to (Reference 10.11).

Section 10.B.7 ADA Access During Construction:

- **This section was added to the RDM regarding pedestrian access during construction of the project.**
- Previous Section 10.B.7 (ADA Upgrades) is now Section 10.B.8.

Section 11.B Temporary Roads:

- Ninth paragraph (CURVES), second sentence; **horizontal curves for temporary roads should be designed to an e_{max} of 6% re EXHIBIT 3.7 (not 4% re EXHIBIT 3.9).**
- Sixteenth paragraph (Surfacing), second bullet point; the reader is now referred to **EXHIBIT 12.9** rather than to a section of Chapter Twelve.

Exhibit 10.14 Typical Temporary Road Section:

- In the bottom left detail, *Sheefly* was replaced with “Temp. Road”.

Section 11.C Crossovers:

- Last sentence; the reader is now referred to **EXHIBIT 12.8** (rather than to a section of Chapter Twelve).

Section 11.D Temporary Surfacing:

- Second paragraph, last sentence; added a reference to Chapter Twelve, **EXHIBITS 12.5 & 12.8.**

Chapter Eleven: Highway Plans Assembly

This Chapter was added to the RDM.

Chapter Twelve: Cost Estimating & Funding

This Chapter was added to the RDM.

Chapter Thirteen: Planning and Project Development

Section 3.A Engineering Review:

- First paragraph, last sentence; the reader is now referred to Section 2 of Chapter Twelve.
- Second paragraph, second sentence; the reader is now referred to Section 2 of Chapter Twelve.

Section 4.B.6 Channel Changes:

- Second paragraph, point 5; added the metric equivalent of 30.5 m to the 100 ft. channel length.
- Second paragraph, point 6; added the metric equivalent of 91.4 m to the 300 ft. channel length.

Section 4.B.7 Floodplains:

- Second paragraph, first sentence; the reader is now referred to Section 5.C of Chapter One of the Drainage Design and Erosion Control Manual (instead of Section 6-6).

Section 4.F Social, Economic, and Environmental Impacts:

- First paragraph, point 3; the reader is now referred to Section 4.B.4 of Chapter Twelve.

Section 5.A Agreements:

- Final sentence; removed the reference to Chapter Eleven.

Section 6.D.1 Aerial Lines:

- Third paragraph, point 1; added "(the minimum clearance shall be measured from the high point of the roadway, including the turf shoulders).

Section 6.D.2 Underground Electrical Power and Communication Lines:

- First paragraph, fourth bullet point; the metric equivalent of 102 mm was added to the 4 in. allowable manhole protrusion.

Section 6.D.3 Pipelines:

- First paragraph, fifth bullet point; the metric equivalent of 102 mm was added to the 4 in. allowable manhole protrusion.

Chapter Fourteen: Traffic Engineering

Section 1.A Capacity Analysis:

- Last sentence; removed the reference to Chapter Five.

Section 1.C At-Grade vs Interchange Recommendations:

- Removed the last sentence referencing Chapter Five.

Chapter Fifteen: Right-of-Way

Section 2.C Preliminary Right-of-Way Design:

- First paragraph, second bullet point; the alignment will be "plotted" rather than *drafted*.

Section 2.C.1 New Right-of-Way Design:

- First paragraph, point 1; the metric equivalent of the 2 ft. buffer area behind the sidewalk was changed to 0.6 m, (from ~~600 mm~~), for consistency.

Section 6 RIGHT-OF-WAY CERTIFICATION:

- Added the second paragraph; **The Right-of-Way Design Section should provide the roadway designer with a listing of all removal items which will appear on the Right-of-Way Certificate during the Review Appraisal Process, approximately three months prior the project letting. For additional information, see Chapter Two: Roadway Design Process, Section 17.A.**

Section 7.B Right-of-Way Markers:

- Third paragraph, second sentence; removed the reference to Chapter Twelve.

Appendix A: Project Numbering System

No Changes.

Appendix B: Guardrail Design Examples

No Changes.

Appendix C: Design Exceptions For NHS Projects

No Changes.

Appendix D: Earthwork Book

Still under construction.

Appendix E: Internet Links to Design Manuals of Other States

- Added links for Arizona, Colorado, and Delaware.
- Updated the links for Idaho, Massachusetts, Montana, North Carolina, and Ohio.
- Deleted the link for Utah.

Appendix F: Selected NDOR Operating Instructions

No Changes.

Appendix G: CADD Coordination Policy

- Project Managers are now referred to as Unit Heads.
- Drafters are now design technicians.

Appendix H: Public Interest Letters

No Changes.

Appendix I: Projects Not Usually Requiring a Status of Utilities

No Changes.

Appendix J: Rural Interchanges

No Changes.

Appendix K: Plan Accuracy

- Removed “DESIGN QUANTITIES/PLAN ACCURACY”, which is now part of Chapter Twelve.

Appendix L: Degree of Curvature

No Changes.

Glossary

- Design Year has been redefined as; **The year 20 years after the initial construction of the project (not the completion).**