715.00 CONCRETE BOX CULVERTS (*SSHC Section 717*)

715.01 DESCRIPTION

A. A culvert may be defined as a structure to convey water under a roadway. Concrete box or arch culverts are used when drainage areas are too large for the conventional culvert pipe or when cattle passes under the roadway are desired. These structures are cast-in-place according to standard or special plans under *SSHC Sections 702, 704, 705 and 717.*

B. The contractor may request that culverts be built to the nearest whole English units. Any material savings will be deducted from the payments due the contractor.

715.02 MATERIAL REQUIREMENTS

A. See Section 706.02. Note in SiteManager the date the reinforcing steel is verified on-site.

715.03 CONSTRUCTION METHODS

A. General - The concrete placement for box and arch culverts is discussed in Section 706 of this manual. *SSHC Subsection 717.04* further provides that foundation excavations shall be "as dry as practicable before concrete is poured". This requirement recognizes the necessity of an adequate foundation for roadway structures. When the excavation for a footing is completed, the project manager or his/her representative should be contacted for his/her approval of the footing subgrade before any concrete is placed. In the event that unsuitable foundation subgrades are encountered, suitable ones composed of sand, gravel, concrete aggregates or a concrete seal course must be constructed (see *SSHC* Subsections 702 of this manual).

1. Construction of curtain walls on culvert footings usually is quite a problem because of the difficulty in maintaining the excavation in proper condition while placing concrete.

2. If material to be excavated is of such nature that neat lines for the curtain wall cannot be maintained, the Project Manager may allow forming and placing the curtain wall to the bottom of the footing. Mud must be prevented from working up into the concrete.

3. Currently, the plans for box culverts show the backside of the wing battered 3/8” in 12”, which results in a varying wall thickness. Contractors may be permitted to construct walls using the wall’s base thickness, thus eliminating the batter. A plan revision or change order will not be required to effect this change.

B. Placing Concrete and Form Removal

C. Placing Concrete

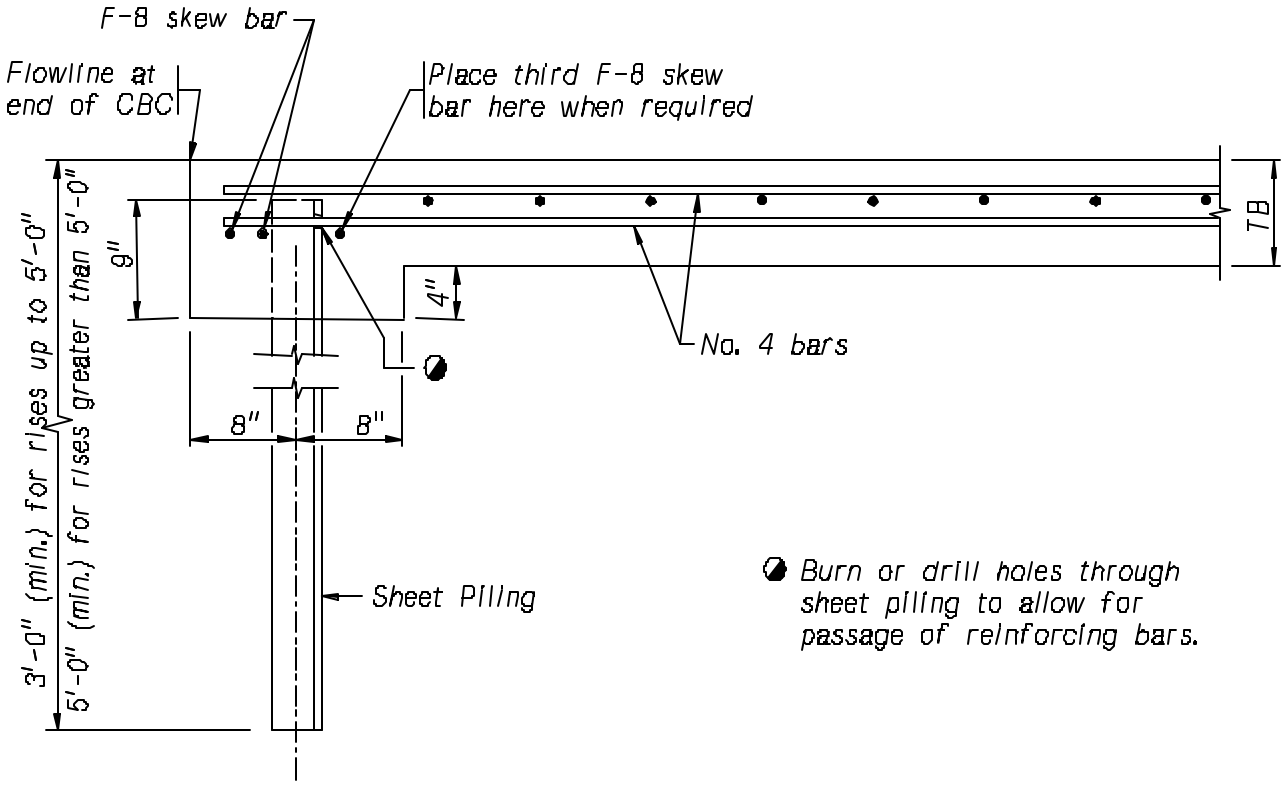
1. Placing Concrete in Walls and Top Slab. *SSHC Subsection 704.03* states that culvert, sidewalls, and top of slab may be constructed as:

   a. A monolith unit or,

   b. Concrete in sidewalls may be placed and allowed to harden before the top slab is placed.

2. If the contractor chooses to use the hardened concrete method, keyways will have to be installed to anchor the cover slab.

D. Sheet Pile Turndown. Option to Use Steel Sheet Piling in Lieu of the Planned Turndowns at Box Culvert Ends.



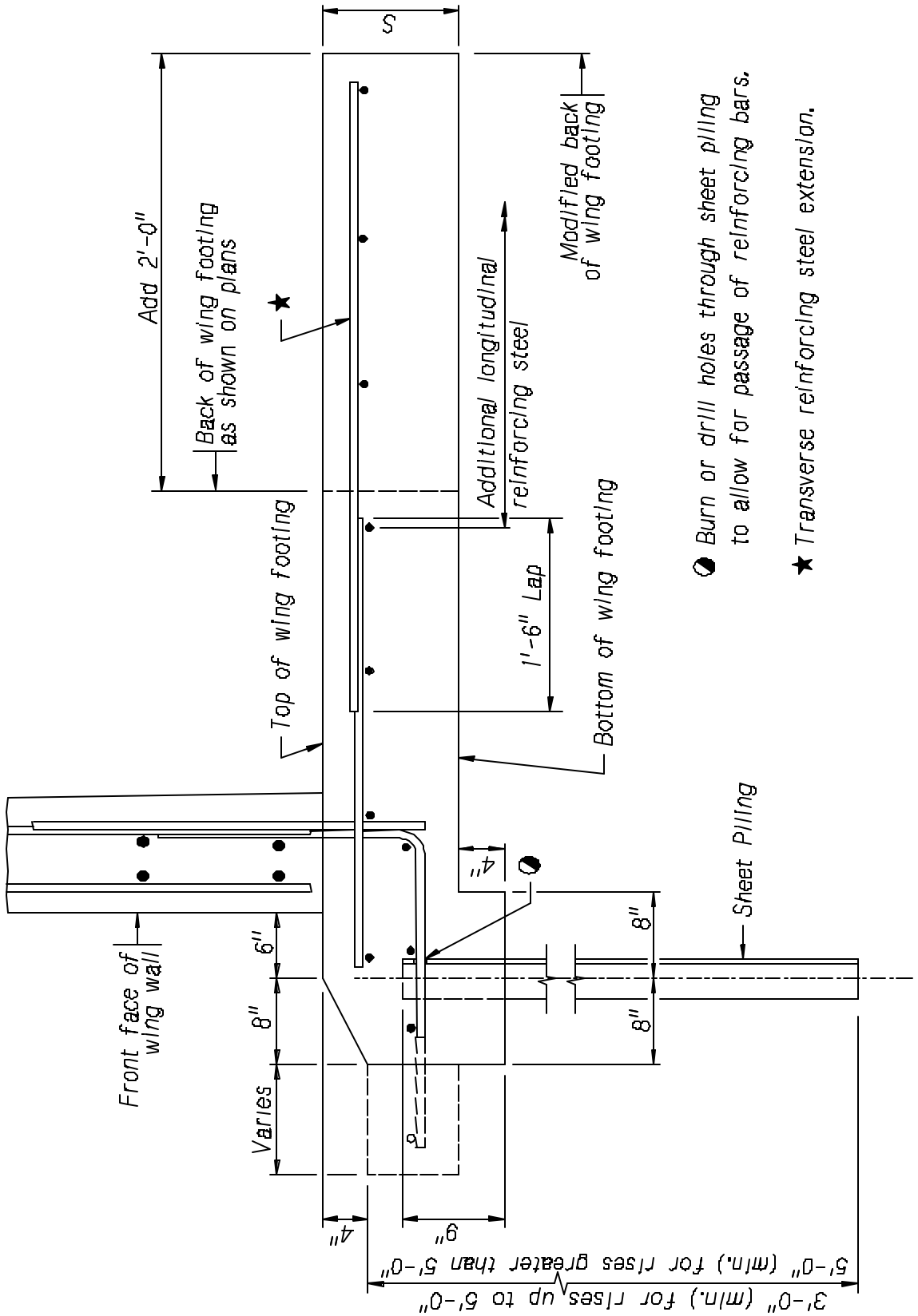
OPTIONAL SHEET PILING TURNDOWN AT END OF BARREL FLOOR

(Longitudinal section taken at midspan)

NOTES

The wing footing width, including the horizontal taper (dimension P to dimension Q), must be increased at the same footing thickness by an additional 2'-0". Additionally, the distance from the top of the wingwall footing to the bottom of the sheet piling turndown shall be 3'-0" for rises up to 5'-0", and, 5'-0" for rises greater than 5'-0". This option shall include the extension of the transverse reinforcing steel, placement of additional longitudinal reinforcing (same spacing as the No. 4 bars in the top of the footing), and the placement of additional concrete. The wing footing extension shall be poured monolithically with the rest of the wing footing. All sheet piling, additional concrete, reinforcing steel, preparation, equipment, tools, labor and incidentals necessary to complete the work shall be supplied at no additional cost to the Department.

All sheet piling shall be interlocking. Steel sheet piling shall have a 7 gage thickness (minimum). Plastic sheet piling may be used with permission from the Bridge Division.



OPTIONAL SHEET PILING TURNDOWN AT WING FOOTING

(For concrete box culvert wings)

E. Removal of Wall Forms

1. On large culvert jobs, it is a distinct advantage for the contractor to remove wall forms before the top slab has attained sufficient age to remove supporting forms. This will be permitted under the following conditions:

   a. Vertical forms may be removed as provided in *SSHC Subsection 704.03*.

   b. Slab forms must be supported independently of the wall forms.

   c. Vertical supports for the slab forms must be capped with timbers. Longitudinal spacing of supports with 4x6 inch (100 x 150 mm) caps on edge should not exceed 4.5 ft (1.4 m). With 4x8 inch (100 x 200 mm) caps, spacing should not exceed 6 ft (1.8 m). Rows of supports must not be over 4 ft (1.2 m) apart. There must be at least two rows of support, with the outside rows not more than 2 ft (0.6 m) from walls. Variance from the above suggested spacing should be reviewed by the Project Manager.

   d. Vertical posts shall not be smaller than 4x4 inches (100 x 100 mm), but may be built up of two 2x4 inches (50 x 100 mm) pieces of lumber. Lateral bracing will be required. A vertical clearance of ¼ inch (6 mm) must be provided between the wall form studs and the slab form joists.

NOTE: Lumber may be sized in metrics using actual, not the conventional nominal sizes.

   e. The slab form must remain in place as provided in *SSHC Subsection 704.03*.

   f. The interior walls of the culvert must be coated with white pigmented curing compound as provided in *SSHC Subsection 704.03*.

F. Flume Reinforcement

1. Regarding Type I, II, IV, and V Flumes, welded wire fabric reinforcing is now required on the Special Plan C (4341, 4342, 4344, 4345 – both E & M) for the flume and spillway areas. This wire can be awkward to place and keep in position. Contractors may place **intersecting No. 3 rebar at 12" centers** as an alternative to the welded wire fabric.

G. Backfilling Culverts – Typical Grading

1. The plans define the area used to calculate plan quantities for flowable mortar and granular backfill. (Flowable mortar plan quantities should include 30% additional for anticipated consolidation of the granular backfill and shrink due to loss of water.) If the Contractor opts to excavate a larger area than assumed for plan quantity, additional excavation, backfill, and flowable mortar will not be considered for pay. We will however, require additional excavation to be backfilled in a manner as identified by the plans or typicals.

2. Placement of flowable mortar shall always be computed from "top down." This means allow for:

a. Pavement thickness.

b. 1 foot (0.3 m) of special backfill, if required.

c. Variable thickness of earth fill where cover heights are over 8 ft (2.5 m).

H. Joints (*SSHC Subsection 704.03*)

1. The location and dimensions for construction joints will generally be shown on the plans.

2. In cases where the pour is larger than can be accomplished at one time, or for some other reason it is necessary to make a construction joint not shown on the plans, approval should come from the Construction Engineer.

3. When an emergency arises, construction joints shall be placed as directed by the Project Manager. If there is some doubt as to the proper location of the joint, the District Construction Engineer should be contacted.

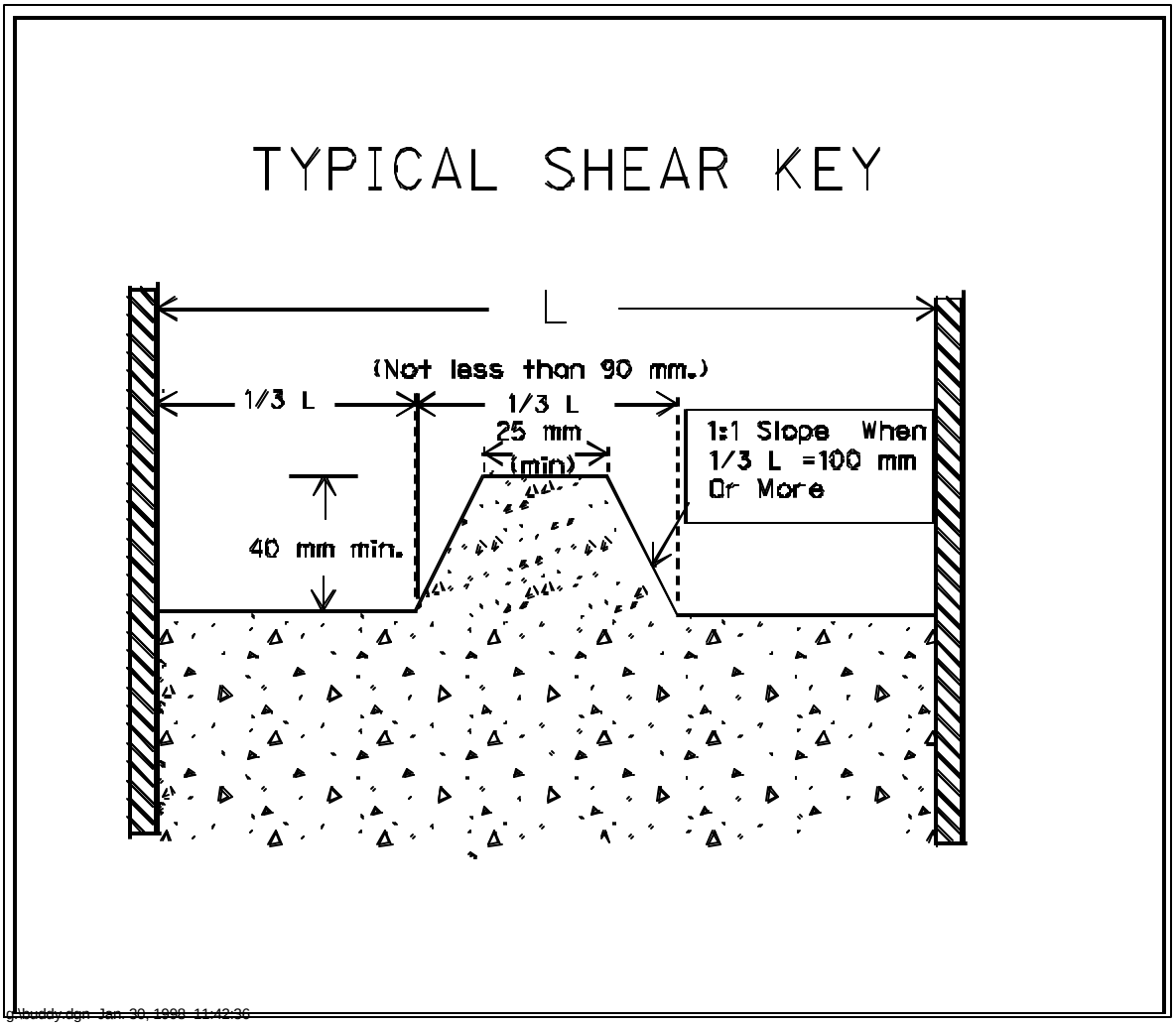
4. Construction joints shall be paid for as outlined in SSHC 704.04.

5. Where it is necessary to transfer shear, shear keys or inclined reinforcement shall be used. It should be pointed out that in practically all cases, shear transfer is essential and therefore shear keys or inclined reinforcement will usually be required. When inclined reinforcement is used as a means of shear transfer No. 5 bars at 1 foot (300 mm) centers should be considered a minimum. The angle of inclination should be approximately 15 degrees from the direction of shear and the length of bar should be at least 2'-3" (685 mm) in order that 20 bar diameters can be placed in both sections of the pour.

6. Shear keys should be formed with beveled strips or boards at right angles to the direction of shear. Typical dimensions for a shear key are shown in the following sketch.

7. If the volume of concrete culvert pour is greater than can be placed in a normal day's operation, or in case of emergency, construction joints located in accordance with the details shown in the drawing "Construction Joints for Box Culverts" may be constructed. Construction joints between roadway shoulder lines are not shown in this drawing since they are not to be so constructed unless authorized by the Construction Engineer.

8. Construction joints in box culverts should be located as follows: Vertical floor joints, wall joints and top slab joints should be constructed in accordance with the sketches in this article and should be staggered by approximately 3 ft (1.0 m). When the walls and top slab are placed simultaneously, the top slab should be stopped and jointed approximately 3 ft (1.0 m) before ending the wall. (Refer to sketch "Construction Joint for Box Culverts".)



[The side slopes of the key will be less than one to one until the widest dimension of the key reaches 4 inches (100 mm).]