Designation: C1675 – 17a

Standard Practice for Installation of Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers[1]

This standard is issued under the fixed designation C1675; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the installation of precast reinforced concrete box sections cast monolithically and intended to be used for the conveyance of storm water, industrial wastes and sewage, and for passageways.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C822 Terminology Relating to Concrete Pipe and Related Products

C1433 Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers

C1433M Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers (Metric)

C1577 Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD

D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

2.2 *ASCE Standard:*[3]

ASCE 26 Standard Practice for the Direct Design of Buried Precast Concrete Box Sections

2.3 *AASHTO Standards:*[4]

AASHTO Standard Specifications for Highway Bridges, Div. II, Section 27

AASHTO LRFD Bridge Construction Specifications, Section 27

AASHTO LRFD Bridge Design Specifications

AASHTO M145 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

3. Terminology

3.1 For definitions of terms relating to precast box sections, see Terminology C822.

3.2 For terminology related to soil classifications, see Practice D2487.

3.3 For terminology and definitions of terms relating to structural design, see ASCE 26.

3.4 Fig. 1 illustrates the installation terminology.

4. Significance and Use

4.1 This practice is useful as a reference by an owner and the owner's engineer in preparing project specifications.

5. General

5.1 The precast reinforced concrete box section/soil system shall be constructed to conform to the dimensions and requirements specified or shown on the plans and to this practice. Additionally, for highway projects, the precast reinforced concrete box section/soil system shall conform to requirements

[1] This practice is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.05 on Special Projects.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

[4] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

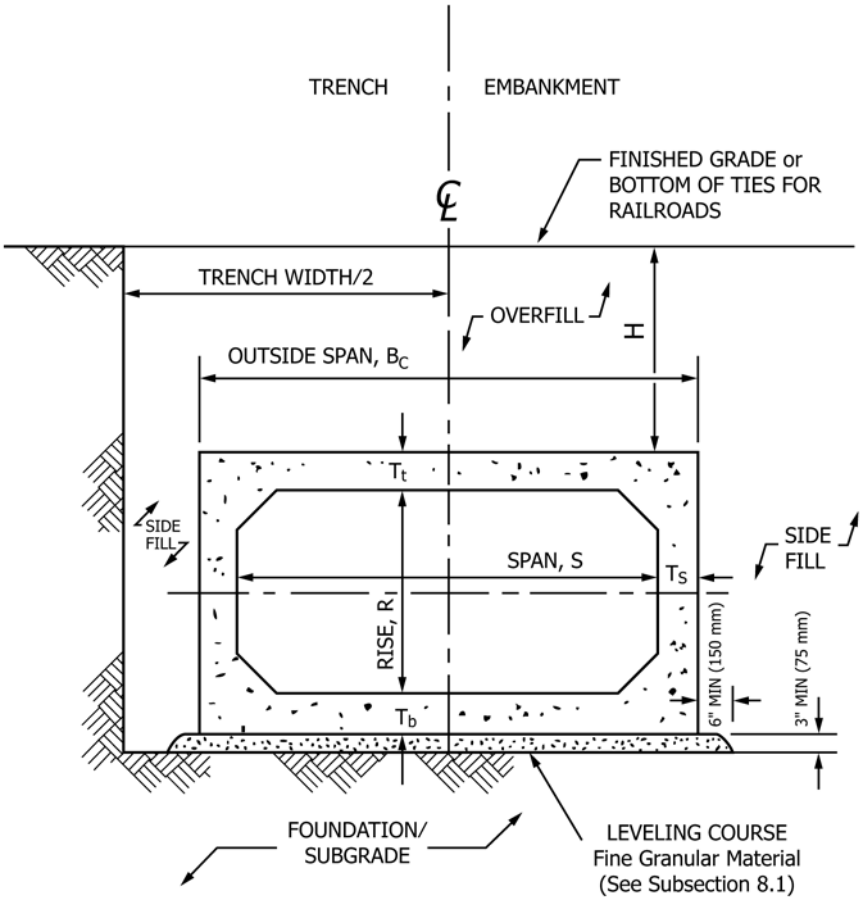

FIG. 1 Box Section/Installation Terminology

of Section 27 of AASHTO Standard Specifications for Highway Bridges or AASHTO LRFD Bridge Construction Specifications as appropriate. The owner is advised to provide or require adequate inspection of the box section installation at the construction site.

6. Excavation

6.1 Trenches shall be excavated to the dimensions and grade specified on the plans or as ordered by the owner. The width of trenches shall be kept to the minimum required for installation of the box sections and proper compaction of the sidefill.

6.2 When ledge rock, compacted rocky, or other unyielding foundation material is encountered, it shall be removed to the requirements shown on the plans. Over-excavated areas shall be backfilled with approved materials specified for the leveling course.

6.3 The contractor shall make such provisions as required to ensure adequate drainage of the trench to protect the leveling course during the construction operations. Where surface water or groundwater conditions exist, the site and trench shall be dewatered.

7. Foundation

7.1 The foundation shall be moderately firm to hard in situ material, stabilized soil, or compacted fill material.

7.2 When unsuitable or unstable material is encountered, the foundation shall be stabilized or removed and replaced with firm and stable foundation material.

7.3 Where groundwater and soil characteristics contribute to the migration of soil fines into or out of the foundation, leveling course, or overfill materials, methods to prevent migration shall be provided.

7.4 Box sections installed over an unyielding foundation, including concrete, shall be cushioned so as to prevent non-uniform bearing in accordance with Section 8.

8. Leveling Course

8.1 A minimum 3 in. (75 mm) leveling course, as shown in Fig. 1, shall be constructed of clean coarse grained soils: USCS SW, SP, GW, GP or any soil beginning with one of those symbols and with 12 % or less passing a #200 (75 µm) sieve (AASHTO M145, A-1, A-3). The nominal maximum aggregate size shall not be greater than 1 in. (25 mm) (#57 aggregate). In the event that the leveling course consists of layers with the upper layer being clean, uncompacted sand, that layer shall be a maximum thickness of 2 in. (50 mm) to prevent non-uniform settlement from personnel and equipment during the installation process.

8.2 In situ material that provide a suitable leveling course in accordance with this practice shall be acceptable.

8.3 If rock strata or boulders are encountered under the box section within the limits of the required leveling course, the rock or boulders shall be removed and replaced with additional leveling course material.

8.4 A concrete slab is not an appropriate leveling course.

9. Box Section Placement and Joining

9.1 Box sections shall be installed to the line and grade shown in the contract documents. Joining shall be in accordance with the box section manufacturer's recommendations.

NOTE 1—(Advisory): Work should be started at the lowest end of the box section line, and with the bell or groove end pointing upstream, laying spigots into bells where applicable.

9.2 Adjustments in grade by exerting force on the box section with excavating equipment or by lifting and dropping the box section shall be prohibited. If the installed box section is not on grade, the box section shall be completely unjoined, the grade corrected, and the box section then rejoined.

9.3 Proper facilities and equipment shall be provided for hoisting and lowering the box sections without disturbing the leveling course and the sides of the excavation or damaging the box sections.

9.4 The ends of the box sections shall be free of any deleterious materials that would prevent proper joining or sealing of adjacent sections.

9.5 The box section shall be joined so that when laid on the leveling course, it shall form a smooth, uniform line of sections.

NOTE 2—(Advisory): Proper equipment, such as a come-along or puller, should be utilized to join the sections together.

9.6 Unless designed otherwise, multiple box sections in parallel multi-cell installations require positive lateral bearing between the sides of adjacent box sections. Compacted granular backfill, flowable fill, or grouting between the sections are considered means of providing positive bearing.

NOTE 3—(Advisory): Continuous, uniform contact between the backfill material and the sides of adjacent boxes is necessary to achieve positive lateral bearing. The designer should define and detail the appropriate spacing between the multiple cells to facilitate the installation and compaction, if necessary, of the specified material that is to be placed between the sides of the adjacent boxes.

9.7 Precast reinforced concrete box sections shall be handled with reasonable care. If dragging sections causes damage, then this practice shall be discontinued. Care shall be taken to prevent box sections from striking rock or other hard objects during placement.

9.8 Each joint shall be sealed to prevent migration of soil fines as specified in the project specifications and installed in accordance with the manufacturer's recommendations.

9.9 If required by the contract documents, each joint shall meet the specified infiltration and exfiltration requirements.

9.10 Unless otherwise approved by the owner, surcharge loads and loads from construction equipment transferred to a box section before, during, or after fill placement, either directly or through the fill, shall not be greater than the loads assumed in the design (see Section 14, Adequate Protection from Surcharge and Construction Loads).

10. Sidefill

10.1 When the soil-structure interaction factor used in the design is based on compacted fill at the sides of the box, the sidefill shall be as required by the contract documents, but not less than clean, coarse-grained soils (USCS SW, SP, GW, GP or AASHTO M145, A-1, A-3), or coarse-grained soils with fines (USCS GM, GC, SM, SC or AASHTO M145, A-2-4, A-2-5, A-2-6) compacted to at least 85 % Standard Proctor (see Test Methods D698). The sidefill shall be brought up on both sides of the box section such that placement will not disjoint or create lateral movement of the box section.

10.2 When the soil-structure interaction factor used in the design is not based on compacted fill at the sides of the box section, the use of native soils is acceptable. Sidefill shall be free of debris, organic matter, frozen material or large stones with a diameter greater than 3 in. (75 mm).

10.3 Ponding or jetting to compact the sidefill shall be permitted only where soil conditions permit free drainage and only with the approval of the owner.

11. Overfill

11.1 Overfill shall be constructed as specified. Overfill material shall be placed in layers with no greater than the maximum thickness specified and compacted to the required density.

11.2 The soil shall be approved material containing no debris, organic matter, frozen material, or large stones with a diameter greater than one-half the thickness of the compacted layers being placed or 3 in. (75 mm), whichever is less.

11.3 When impact or vibratory equipment is used for compaction, care shall be taken in accordance with the manufacturer's recommendations, to avoid damaging the box sections.

12. Sheathing Removal and Trench Shield Advancement

12.1 Unless sheathing is to be left in place, it shall be pulled out in vertical increments to permit placement and compaction of fill material for the full width of the trench.

12.2 When trench shields or boxes are moved, the previously placed box section shall not be disturbed. If such disturbance occurs, deadman anchors or other means shall be used to restrain previously placed box sections. Voids in the sidefill that are created by movement of a shield or box shall be filled and compacted in accordance with Section 10 of this practice.

13. Precast Concrete Appurtenances

13.1 Manholes, pipe, junction boxes, and other adjoining appurtenances shall be installed in a manner that will minimize differential settlement between the box section and appurtenance.

13.2 Precast concrete fittings, such as tees and wyes, shall be bedded, installed, and overfilled with the same material and

in the same manner as the precast concrete box sections to prevent differential settlement between box section and fittings.

14. Adequate Protection from Surcharge and Construction Loads

14.1 Construction procedures, such as heavy equipment movement or stockpiling of material over or adjacent to a box structure, can induce higher live or surcharge loads than those used for the structure's final design. The installer is cautioned to ensure these added loadings have been included in the final design of the furnished box structure. Construction loads shall be considered in design if construction equipment must pass over the boxes during project construction. If necessary, compacted overfill in the form of a ramp shall be constructed over the top of the box section such that the equipment load on the box section does not exceed the box section design strength. The ramp profile shall be free of abrupt changes in grade that would cause concentrated loads or prevent the uniform distribution of loads through all axles of passing equipment. In an embankment installation, the overfill shall extend a minimum of one box section span or 3 ft (900 mm), whichever is greater, beyond each side of the box section to prevent possible lateral displacement of the box section. If a large volume of construction traffic must cross an installed line of box sections, the point of crossing shall be changed occasionally to minimize the possibility of lateral displacement.

15. Safety

15.1 Safety requirements for construction shall be in accordance with the applicable federal, state, and local regulations.

16. Keywords

16.1 box culverts; box sections; concrete; install; installation; placement; precast; precast concrete

APPENDIX

(Nonmandatory Information)

X1. COMMENTARY

X1.1 Scope—The buried, concrete box sections are part of a composite system comprised of the box and the surrounding soil envelope, which interact and contribute to the strength and structural behavior of the system.

X1.2 The soil-structure interaction factors mentioned in Section 10 are part of this practice. They are based on the results of research on box/soil interaction, together with evaluation of current construction practice, equipment, procedures, and experience. For further information, reference the AASHTO LRFD Bridge Design Specifications.

X1.3 The design of a concrete box for a particular installation type is based on the assumption that the specified design bedding and backfill requirements will be achieved during construction of the installation. The bedding/leveling course is assumed to provide a slightly yielding, uniformly distributed support over the bottom width of the box section.

X1.4 Specifications C1433, C1433M, and C1577 provide standard designs for precast reinforced concrete box sections in accordance with AASHTO Standards.