Designation: C 913 – 02

Standard Specification for Precast Concrete Water and Wastewater Structures[1]

This standard is issued under the fixed designation C 913; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers the recommended design requirements and manufacturing practices for monolithic or sectional precast concrete water and wastewater structures with the exception of concrete pipe, box culverts, utility structures, septic tanks, and items included under the scope of Specification C 478.

NOTE 1—Water and wastewater structures are defined as solar heating reservoirs, cisterns, holding tanks, leaching tanks, extended aeration tanks, wet wells, pumping stations, grease traps, distribution boxes, oil-water separators, treatment plants, manure pits, catch basins, drop inlets, and similar structures.

NOTE 2—Insulation and sealant requirements should receive special consideration due to special features of the application.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

A 82 Specification for Steel Wire, Plain, for Concrete Reinforcement[2]

A 184/A 184M Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement[2]

A 185 Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement[2]

A 416/A 416M Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete[2]

A 421 Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete[2]

A 496 Specification for Steel Wire, Deformed, for Concrete Reinforcement[2]

A 497 Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement[2]

A 615/A 615M Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement[2]

A 616/A 616M Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement[2]

A 617/A 617M Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement[2]

C 33 Specification for Concrete Aggregates[3]

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens[4]

C 94 Specification for Ready-Mixed Concrete[3]

C 150 Specification for Portland Cement[5]

C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method[3]

C 260 Specification for Air-Entraining Admixtures for Concrete[3]

C 330 Specification for Lightweight Aggregates for Structural Concrete[3]

C 478 Specification for Precast Reinforced Concrete Manhole Sections[6]

C 494 Specification for Chemical Admixtures for Concrete[3]

C 595 Specification for Blended Hydraulic Cements[5]

C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete[3]

C 685 Specification for Concrete Made by Volumetric Batching and Continuous Mixing[3]

C 890 Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures[6]

C 990 Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants[6]

2.2 *American Concrete Institute Standard:*

ACI318 Building Code Requirements for Reinforced Concrete[7]

2.3 *Federal Specification*:

SS-S-210A Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints[8]

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[1] This specification is under the jurisdiction of ASTM Committee C27 on Precast Concrete Products and is the direct responsibility of Subcommittee C27.30 on Water and Wastewater Containers.

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[2] *Annual Book of ASTM Standards*, Vol 01.04.

[3] *Annual Book of ASTM Standards*, Vol 04.02.

[4] *Annual Book of ASTM Standards*, Vol 04.07.

[5] *Annual Book of ASTM Standards*, Vol 04.01.

[6] *Annual Book of ASTM Standards*, Vol 04.05.

[7] Available from American Concrete Institute, P.O. Box 19150, Detroit, MI 48219.

[8] Available from Standardization Documents, Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094. Attn: NPODS.

3. Ordering Information

3.1 Unless otherwise designated by the purchaser before placing an order, a structure designed in accordance with Section 5 of this specification and found to satisfactorily meet the requirements imposed when tested and inspected as described herein shall be acceptable. The test of materials as required shall be done in accordance with applicable ASTM standards. Inspection, when required, shall include checks on fabrication and placing of reinforcement and concrete in accordance with approved design drawings.

4. Materials

4.1 *Cement*—Portland cement shall conform to the requirements of Specification C 150 or shall be portland blast-furnace slag cement or portland-pozzolan cement conforming to the requirements of Specification C 595.

4.2 *Aggregates*—Aggregates shall conform to Specification C 33 and lightweight aggregates shall conform to Specification C 330, except that the requirements for grading shall not apply.

4.3 *Water*—Water used in mixing concrete shall be clean and free of injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances incompatible with concrete or steel.

4.4 *Admixtures*—Admixtures shall conform to Specification C 494 or C 618 and shall not be injurious to other products used in the concrete.

4.4.1 *Air-Entraining Admixtures*—Air-entraining admixtures conforming to Specification C 260 shall be used when there is a risk that the concrete may be exposed to freeze-thaw cycles. The concrete mixture shall contain 5.5 ± 1.5 % air by volume as determined by Test Method C 231.

4.5 *Steel Reinforcement*—Steel reinforcement shall conform to Specification A 82 or A 496 for wire; Specification A 185 or A 497 for wire fabric; Specifications A 416/A 416M and A 421 for prestressed wire and strand; or Specification A 184/A 184M, A 615/A 615M, A 616/A 616M or A 617/A 617M for bars.

5. Design Requirements

5.1 *Design Method*—The method of structural design of reinforced concrete as outlined in the ACI—318 Building Code shall be used to design the concrete sections, including the reinforcement required, when the structure is subjected to the loading conditions covered in Practice C 890. Design requirements in excess of these specifications shall be identified by the purchaser.

5.1.1 *Alternative Method to Design*—An alternative method to the design of a structure is acceptable, with the permission of the purchaser, by performing required performance tests on the completed structure to confirm adequate strength.

5.2 *Access Openings*—The structural design shall take into consideration the number, placement, and size of access openings.

5.3 *Floors*—The minimum floor thickness resulting from slope shall be considered as nominal floor thickness in the structure.

5.4 *Knockouts and Sumps*—Knockouts and sumps shall be designed to carry the loads imposed upon them. The basic structure shall be designed to carry all imposed loads with knockouts removed.

5.5 *Placement of Reinforcement*—The minimum concrete cover for reinforcing bars, mats, or fabric shall not be less than 1 in. (25 mm) for water retaining structures and ¾ in. (19 mm) for other structures subject to the provisions of Section 7.

5.6 *Concrete Strength*—The minimum compressive strength (f'_c) for design shall be 4000 psi (28 MPa) at 28 days of age.

5.7 *Joints*—Where required, sealed joints in sectional precast concrete structures shall be of such a design to prevent unacceptable leakage when used with a sealant (Note 3) approved by the purchaser and acceptable to the manufacturer. The criteria for unacceptable leakage will be determined by the purchaser's specifications. Where potable water is involved, caution advises selecting a sealant that will not contaminate the water for its intended purposes.

NOTE 3—Refer to Specification C 990 or Federal Specification SS-S-Z10A for guidance.

5.8 *Lifting Devices*—Design of embedded lifting devices shall conform to requirements as specified in 8.4 under Special Loading Considerations of Practice C 890.

6. Manufacture

6.1 *Mixture*—The aggregates, cement, and water shall be proportioned and mixed to produce a homogeneous concrete meeting the requirements of this specification, and in accordance with Specification C 94 or C 685.

6.2 *Forms*—The forms used in manufacture shall be sufficiently rigid and accurate to maintain the dimensions of the structure within the tolerances given in Section 7. All casting surfaces shall be of smooth nonporous material. Form releasing agents used shall not be injurious to the concrete.

6.3 *Reinforcement*—Reinforcement must be securely tied or welded (as allowed by the design) in place to maintain position during concrete placing operations. Where specified all chairs, bolsters, braces, and spacers in contact with forms shall have a corrosion-resistant surface.

6.4 *Concrete Placement*—Concrete shall be placed in the forms at a rate such that the concrete is plastic at all times and consolidates in all parts of the form and around all reinforcement steel and embedded fixtures without segregation of materials.

6.5 *Curing*—The precast concrete sections shall be cured by any method or combination of methods that will develop the specified compressive strength at 28 days or less.

6.6 *Concrete Quality*—The quality of the concrete shall be in accordance with the chapter on concrete quality of ACI 318, current edition, except for frequency of tests, which shall be specified by the purchaser. Concrete tests shall be conducted in accordance with Test Method C 39.

7. Tolerances

7.1 *Dimensional Tolerances*—The length, width, height, or diameter measurements of the structure when measured on the inside surface shall not deviate from the design dimensions more than the following:

Dimension	Tolerance
0 to 5 ft (0 to 1.5 m)	±¼ in. (±6 mm)
5 to 10 ft (1.5 to 3.0 m)	±⅜ in. (±10 mm)
10 to 20 ft (3.0 to 6.1 m)	±½ in. (±13 mm)
20 ft (6.1 m) and over	as agreed upon between manufacturer and purchaser

7.2 *Squareness Tolerance*—The inside of the rectangular precast concrete component shall be square as determined by diagonal measurements. The difference between such measurements shall not exceed:

Measured Length	Allowable Difference
0 to 10 ft (0 to 3.0 m)	½ in. (13 mm)
10 to 20 ft (3.0 to 6.1 m)	¾ in. (19 mm)
20 ft (6.1 m) and over	as agreed upon between manufacturer and purchaser

7.3 *Joint Surfaces*—The following joint tolerances for water retaining structures shall apply:

7.3.1 *Flexible Joint*—The inside joint seam gap between two sections placed together before a joint sealant is applied shall not exceed ⅜in. (10 mm).

7.3.2 *Grout Joint*—The opening to be grouted in a group joint shall not exceed 1 in. (25 mm).

7.4 *Reinforcement Location*—With reference to thickness of wall or slab, reinforcement shall be within ± ¼ in. (6 mm) of the design location, but in no case shall the cover be less than 1 in. (25 mm) for water-retaining structures and ¾ in. (19 mm) for nonwater-retaining structures. The varations in reinforcement spacing shall not be more than one tenth of the designed bar spacing nor exceed 1½ in. (38 mm). The total number of bars shall not be less than that computed using the design spacing.

7.5 *Slab and Wall Thickness*—The slab and wall thickness shall be uniform and shall not be less than that shown in the design by more than 5 % or ⅜ in. (10 mm), whichever is greater. A thickness greater than that required in the design shall not be a cause for rejection.

8. Repairs

8.1 Repairs shall be performed by the manufacturer in a manner to ensure that the repaired structure will conform to the requirements of this specification.

9. Rejection

9.1 Precast concrete structures or sections of structures shall be subject to rejection because of failure to conform to any of the requirements contained herein.

10. Marking

10.1 The following information shall be clearly marked on each structure or section of structure, by indentation, waterproof paint, or other approved means:

10.1.1 Date of manufacture,

10.1.2 Name or trademark of the manufacturer, and

10.1.3 Initials or symbols to indicate the intended use of the structure.

11. Keywords

11.1 concrete; precast; structures; wastewater; water

APPENDIXES

(Nonmandatory Information)

X1. DESIGNS FOR RECTANGULAR BOXES

X1.1 Description of Designs

X1.1.1 The designs in Table X1.1 are provided as a convenience for specifying, purchasing, and manufacturing. Riser and base sections are shown in Fig. X1.1.

X1.1.2 The successful performance of the product depends upon the proper selection (based on field conditions), good manufacturing practices, and proper installation.

X1.1.3 Refer to Appendix X2 for instructions on the use of the designs.

X1.2 Structural Analysis

X1.2.1 The analysis is based on the slope-deflection solution of a frame with nonprismatic members.

X1.2.2 Loads are based on Practice C 890.

X1.3 Design Calculations

X1.3.1 The concrete shall be designed to be proportioned for f_c' = 4000 psi (28 MPa).

X1.3.2 Reinforcing steel shall be Grade 60 (minimum yield strength of 60 000 psi) (3.84 MPa).

X1.3.3 The strength design method described in ACI-318 is used with U.L.F. = 1.7.

X1.3.4 Minimum reinforcement is 0.002 times the gross concrete area of the cross section.

X1.3.5 Calculations for units with integral slab (top or bottom) do not take into consideration rigidity or support from slab.

X1.4 Definitions

X1.4.1 *t*—Total thickness of wall (Fig. X1.2).

X1.4.2 *d*—Distance from centerline of horizontal steel to inside face of wall (Fig. X1.2).

X1.4.3 A_{sh}—Area of horizontal steel per vertical foot (Fig. X1.2).

X1.4.4 A_{sv}—Area of vertical steel per horizontal foot (Fig. X1.3).

X1.4.5 *Class*—a term that can be used to describe the product, for example, 300, 500, 700. The number also refers to the capacity of the unit in terms of lb/ft^2 (Pa).

TABLE X1.1 Designs for Rectangular Boxes[A]

Size L by W	t (in)	d (in)	Class w (psf)			Reinforcing	
						A_{sh} (in.^{2}/ft)	A_{sv} (in.^{2}/ft)
2 ft by 2 ft	6	3	300	500	700	0.14	0.14
2 ft 6 in. by 2 ft	6	3	300	500	700	0.14	0.14
2 ft 6 in. by 2 ft 6 in.	6	3	300	500	700	0.14	0.14
3 ft by 2 ft	6	3	300	500	700	0.14	0.14
3 ft by 2 ft 6 in.	6	3	300	500	700	0.14	0.14
3 ft by 3 ft	6	3	300	500	700	0.14	0.14
3 ft 6 in. by 2 ft	6	3	300	500	700	0.14	0.14
3 ft 6 in. by 2 ft 6 in.	6	3	300	500	700	0.14	0.14
3 ft 6 in. by 3 ft	6	3	300	500	700	0.14	0.14
3 ft 6 in. by 3 ft 6 in.	6	3	300	500	700	0.14	0.14
4 ft by 2 ft	6	3	300	500	700	0.14	0.14
4 ft by 2 ft 6 in.	6	3	300	500	700	0.14	0.14
4 ft by 3 ft	6	3	300	500	700	0.14	0.14
4 ft by 3 ft 6 in.	6	3	300	500	700	0.14	0.14
4 ft by 4 ft	6	3	300	500	700	0.14	0.14
4 ft 6 in. by 2 ft 6 in.	6	3	300	500	700	0.14	0.14
4 ft 6 in. by 3 ft	6	3	300	500	700	0.14	0.14
4 ft 6 in. by 3 ft 6 in.	6	3	300	500	700	0.14	0.14
4 ft 6 in. by 4 ft	6	3	300	500	700	0.14	0.14
4 ft 6 in. by 4 ft 6 in.	6	3	300	500	700	0.14	0.14
6 ft by 5 ft 6 in.	6	3	300			0.14	0.14
6 ft by 5 ft 6 in.	6	3		500		0.17	0.14
6 ft by 5 ft 6 in.	6	3			700	0.24	0.14
6 ft by 6 ft	6	3	300			0.14	0.14
6 ft by 6 ft	6	3		500		0.18	0.14
6 ft by 6 ft	6	3			700	0.27	0.14

[A] One in. = 25.0 mm.

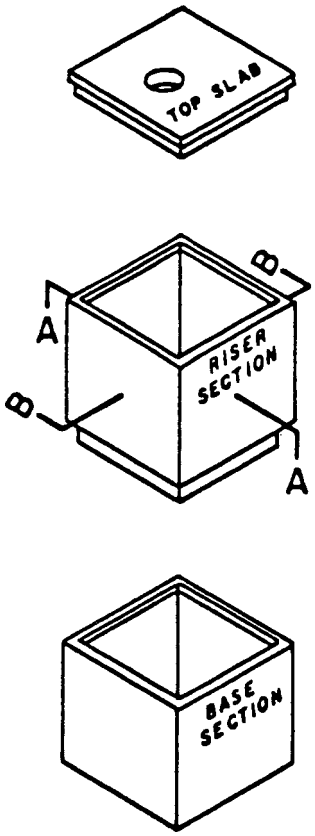

FIG. X1.1 Typical Assembly

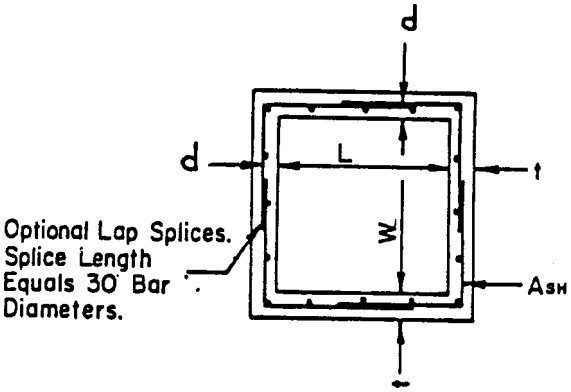

FIG. X1.2 Section AA

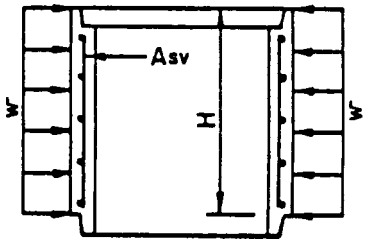

FIG. X1.3 Section BB

X2. INSTRUCTIONS FOR USE OF DESIGNS IN TABLE X1.1

X2.1 Each section can be designed individually but in an effort to save time select the section that carries the heaviest loads and use it for the whole box.

X2.1.1 Assume the height of each section based upon the size and location of pipes entering or leaving the box. The designs in the tables assume continuity of steel around the box. If a hole is made in a section, there should be concrete above and below and sufficient additional reinforcing to transfer forces across the opening.

X2.1.2 Determine depth of section to be designed (h_1 and h_{11} in Fig. X2.1).

X2.1.3 Determine depth of water table (d in Fig. X2.1).

X2.1.4 Assume a lateral soil pressure of 40 psf/ft of height and water weighing 62.4 lb/ft^3.

X2.1.5 From Fig. X2.1:

$$P(1) = 40\,h_1 + 62.4\,h_2 \quad \text{(X2.1)}$$

$$P(2) = 40\,h_{11} + 62.4\,h_{22}$$

$$P = \frac{P(1) + P(2)}{2}$$

X2.1.6 Choose a Class (300, 500, 700) with capacity greater than P. Enter the table with desired size to obtain wall thickness, amount of reinforcing steel, and location of steel in the wall.

X2.2 Example Problem

X2.2.1 Select a Class for a concrete rectangular box to be used as a catch basin when the invert of the base is 11 ft (3.4 m) below grade and water level is 5 ft (1.5 m) below grade. Catch basin is in a highway.

X2.2.2 Since the catch basin is in a highway, a live load (LL) from truck traffic must be considered. Refer to Fig. X2.2 for load diagram.

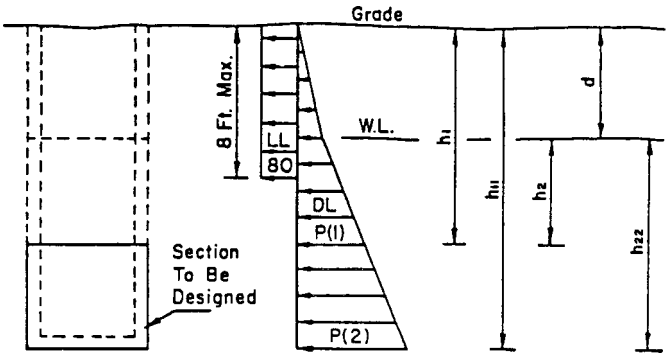

FIG. X2.1 Depth of Section

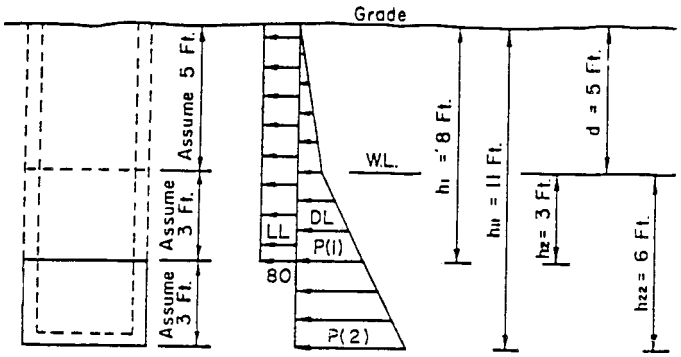

FIG. X2.2 Load Diagram

X2.2.3 From Fig. X2.2:

$$h_1 = 8 \text{ ft } (2.4 \text{ m}) \quad \text{(X2.2)}$$

$$h_{11} = 11 \text{ ft } (3.4 \text{ m})$$

$$h_2 = 3 \text{ ft } (0.91 \text{ m})$$

$$h_{22} = 6 \text{ ft } (1.8 \text{ mm})$$

$$P\,(1) = 40 \times 8 + 62.4 \times 3 = 507 \text{ lbf/ft}^2 (24.3 \text{ kPa})$$

$$P\,(2) = 40 \times 11 + 62.4 \times 6 = 814 \text{ lbf/ft}^2\ (38.9 \text{ kPa})$$

$$P = \frac{507 + 814}{2} = 660 \text{ lbf/ft}^2 (31.6 \text{ kPa})$$

X2.2.4 Choose Class 700 since 700 is greater than 660. Go to the tables with desired size to obtain information necessary to produce the box.

X2.2.5 If P is greater than 700, the tables do not apply. An engineer should be engaged to provide design.