Development Services

From Concept to Construction

Phone: 503-823-7300 Email: bds@portlandoregon.gov 1900 SW 4th Ave, Portland, OR 97201
More Contact Info (http://www.portlandoregon.gov//bds/article/519984)

APPEAL SUMMARY

Status: Hold for Additional Information

Appeal ID: 19071	**Project Address:** 5681 & 5687 NE Glisan St
Hearing Date: 3/6/19	**Appellant Name:** ed bruin
Case No.: P-001	**Appellant Phone:** 5032927733
Appeal Type: Plumbing	**Plans Examiner/Inspector:** Jed Stoken, Joe Blanco, McKenzie James
Project Type: commercial	**Stories:** 3 **Occupancy:** R-2 **Construction Type:** V-B
Building/Business Name: Edge Development	**Fire Sprinklers:** Yes - NFPA 13R
Appeal Involves: Erection of a new structure	**LUR or Permit Application No.:** 18-280949-CO & 18-280954-CO
Plan Submitted Option: pdf [File 1] [File 2] [File 3] [File 4]	**Proposed use:** Multifamily residential

APPEAL INFORMATION SHEET

Appeal item 1

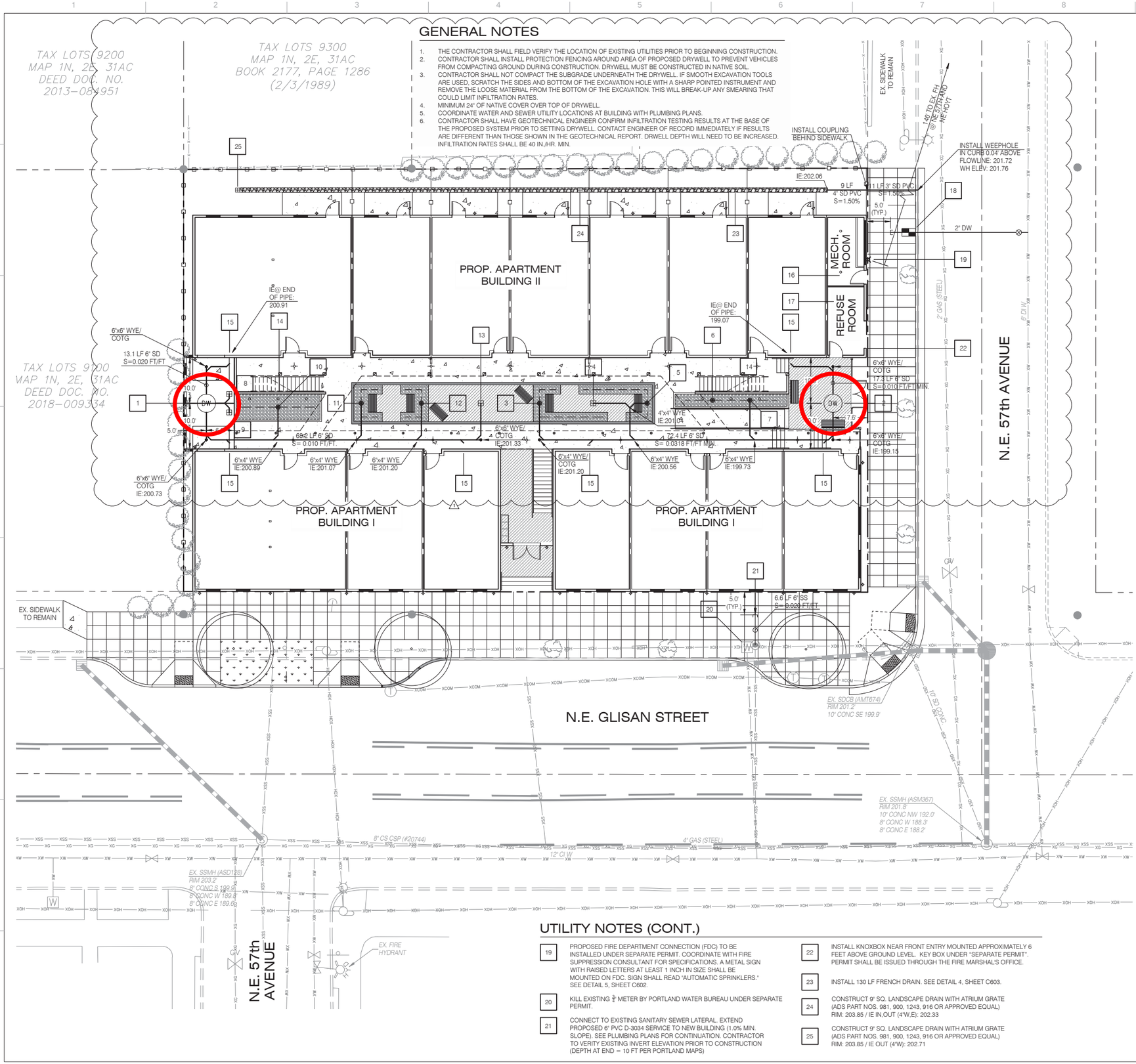
Code Section	OPSC 2014, 1101.5.3.2
Requires	OSPC 2014, 1101.05.3.2: No drywell shall be located closer than 5' of a property line nor closer than 10 feet to a building unless approved by the building official.
Proposed Design	Place two stacking drywells in the central courtyard are 10' from the 3-story structures, as measured from face of foundation to center of drywells and allowed by right. Areas of the 2-story structures supporting the 2nd floor corridor and exterior balconies encroach into portions of the 10' clearance rings but at no point closer than 5'.
Reason for alternative	Per the attached structural memo, the footings on the 3-story buildings are designed to 2,000 psi. The minimum compressive strength for the concrete drywells are 4,000 psi. The drywells are designed to withstand greater than 2x the pressure exerted by the proposed structures.

APPEAL DECISION

Drywell location within 10 feet of a building: Hold for additional information.
For geotech questions. Appellant may contact Jed Stoken (503-823-7579) with questions.
For plumbing questions. Appellant may contact McKenzie James (503-823-7317) for additional information.
For general appeal information. Appellant may contact John Butler (503 823-7339) with questions.

GENERAL NOTES

1. THE CONTRACTOR SHALL FIELD VERIFY THE LOCATION OF EXISTING UTILITIES PRIOR TO BEGINNING CONSTRUCTION.
2. CONTRACTOR SHALL INSTALL PROTECTION FENCING AROUND AREA OF PROPOSED DRYWELL TO PREVENT VEHICLES FROM COMPACTING GROUND DURING CONSTRUCTION. DRYWELL MUST BE CONSTRUCTED IN NATIVE SOIL.
3. CONTRACTOR SHALL NOT COMPACT THE SUBGRADE UNDERNEATH THE DRYWELL. IF SMOOTH EXCAVATION TOOLS ARE USED, SCRATCH THE SIDES AND BOTTOM OF THE EXCAVATION HOLE WITH A SHARP POINTED INSTRUMENT AND REMOVE THE LOOSE MATERIAL FROM THE BOTTOM OF THE EXCAVATION. THIS WILL BREAK-UP ANY SMEARING THAT COULD LIMIT INFILTRATION RATES.
4. MINIMUM 24" OF NATIVE COVER OVER TOP OF DRYWELL.
5. COORDINATE WATER AND SEWER UTILITY LOCATIONS AT BUILDING WITH PLUMBING PLANS.
6. CONTRACTOR SHALL HAVE GEOTECHNICAL ENGINEER CONFIRM INFILTRATION TESTING RESULTS AT THE BASE OF THE PROPOSED SYSTEM PRIOR TO SETTING DRYWELL. CONTACT ENGINEER OF RECORD IMMEDIATELY IF RESULTS ARE DIFFERENT THAN THOSE SHOWN IN THE GEOTECHNICAL REPORT. DRWELL DEPTH WILL NEED TO BE INCREASED. INFILTRATION RATES SHALL BE 40 IN./HR. MIN.



LEGEND

- DW — PROPOSED DOMESTIC WATER LINE
- FW — PROPOSED FIRE SERVICE LINE
- DW — PROPOSED DRYWELL
- PROPOSED CLEANOUT
- PROPOSED AREA DRAIN
- SS — PROPOSED SANITARY SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED STORM DRAIN LINE (PERFORATED)
- PROPOSED FIRE DEPARTMENT CONNECTION (FDC)
- PROPOSED STORM DRAIN LINE (PUBLIC) UNDER SEPARATE PERMIT

UTILITY NOTES

1. CONSTRUCT 48"Ø CONCRETE DRYWELL
IE IN (4"E; 6"N,S): 200.65
RIM: 200.15 (6' MIN. BELOW IE IN OF PIPE)
DEPTH: 10 FEET (PER SIMPLIFIED APPROACH)
SEE DETAIL 4 & 6, SHEET C602.

2. CONSTRUCT 48"Ø CONCRETE DRYWELL
IE IN (6"N,S): 198.90
RIM: 198.40 (6' MIN. BELOW IE IN OF PIPE)
DEPTH: 10 FEET (PER SIMPLIFIED APPROACH)
SEE DETAIL 4 & 6, SHEET C602.

3. CONSTRUCT 8" DRAIN BASIN WITH 8" DOME GRATE AND 8"X4" ADAPTER. (NYLOPLAST OR APPROVED EQUAL). INSTALL 8.0 LF 4" PVC SD @ S=2.00%. INSTALL ±20 LF 4" PVC PERF SD @ S=0.5% ALONG BOTTOM OF PLANTER. CONNECT TO CATCH BASIN LEAD WITH 4"x4" TEE. SEE DETAIL 3, SHEET C603 FOR PLANTER SECTION. RIM: 204.36 / IE OUT (4"S): 201.36

4. CONSTRUCT 14" SQ. TRAPPED AREA DRAIN WITH PEDESTRIAN RATED METAL GRATE (SEE DETAIL 3, SHEET C602).
INSTALL 16.0 LF 4" PVC SD @ 6.00%
RIM: 204.52
IE OUT (4"E): 201.52

5. CONSTRUCT 8" DRAIN BASIN WITH 8" DOME GRATE AND 8"X4" ADAPTER. (NYLOPLAST OR APPROVED EQUAL). INSTALL 3.8 LF 4" PVC SD @ S=8.44%. INSTALL ±23 LF 4" PVC PERF SD @ S=0.5% ALONG BOTTOM OF PLANTER. SEE DETAIL 3, SHEET C603 FOR PLANTER SECTION.
RIM: 204.36 / IE IN,OUT (4"N,S,W): 201.36

6. CONSTRUCT 8" DRAIN BASIN WITH 8" DOME GRATE AND 8"X4" ADAPTER. (NYLOPLAST OR APPROVED EQUAL). INSTALL ±14 LF 4" PVC PERF SD @ 0.5% ALONG BOTTOM OF PLANTER. SEE DETAIL 3, SHEET C603 FOR PLANTER SECTION. RIM: 204.42 / IE IN,OUT (4"W,E): 201.42

7. CONSTRUCT 8" DRAIN BASIN WITH 8" DOME GRATE AND 8"X4" ADAPTER. (NYLOPLAST OR APPROVED EQUAL). INSTALL 9.0 LF 4" PVC SD AT S=18.4%. INSTALL ±6 LF 4" PVC PERF SD @ 0.5% ALONG BOTTOM OF PLANTER. SEE DETAIL 3, SHEET C603 FOR PLANTER SECTION.
RIM: 204.42 / IE IN,OUT (4"E,W): 201.38

8. CONSTRUCT 9" SQ. LANDSCAPE DRAIN WITH ATRIUM GRATE (ADS PART NOS. 981, 900, 1243, 916 OR APPROVED EQUAL)
INSTALL 7.0 LF 4" PVC SD @ S= 17.9%
RIM: 203.90 / IE OUT (4"W): 201.90

9. CONSTRUCT 9" SQ. LANDSCAPE DRAIN WITH ATRIUM GRATE (ADS PART NOS. 981, 900, 1243, 916 OR APPROVED EQUAL)
INSTALL 2.0 LF 4" PVC SD @ S= 17.9% AND CONNECT TO LEAD FROM STRUCTURE #8 WITH 4"x4" WYE.
RIM: 203.90 / IE OUT (4"W): 201.90

10. CONSTRUCT 8" DRAIN BASIN WITH 8" DOME GRATE AND 8"X4" ADAPTER. (NYLOPLAST OR APPROVED EQUAL). INSTALL 7.2 LF 4" PVC SD AT S=6.81%. INSTALL ±16 LF 4" PVC PERF SD @ 0.5% ALONG BOTTOM OF PLANTER. SEE DETAIL 3, SHEET C603 FOR PLANTER SECTION.
RIM: 204.38 / IE IN,OUT (4"E,W,S): 201.38

11. CONSTRUCT 8" DRAIN BASIN WITH 8" DOME GRATE AND 8"X4" ADAPTER. (NYLOPLAST OR APPROVED EQUAL). INSTALL 8.0 LF 4" PVC SD @ S=3.63%. INSTALL ±10 LF 4" PVC PERF SD @ S=0.5% ALONG BOTTOM OF PLANTER. CONNECT TO CATCH BASIN LEAD WITH 4"X4" TEE. SEE DETAIL 3, SHEET C603 FOR PLANTER SECTION. RIM: 204.36 / IE IN,OUT (4"N,S): 201.36

12. CONSTRUCT 8" DRAIN BASIN WITH 8" DOME GRATE AND 8"X4" ADAPTER. (NYLOPLAST OR APPROVED EQUAL). INSTALL 8.0 LF 4" PVC SD @ S=2.00%. INSTALL ±10 LF 4" PVC PERF SD @ S=0.5% ALONG BOTTOM OF PLANTER. CONNECT TO CATCH BASIN LEAD WITH 4"X4" TEE. SEE DETAIL 3, SHEET C603 FOR PLANTER SECTION. RIM: 204.36 / IE IN,OUT (4"N,S): 201.36

13. CONSTRUCT 14" SQ. TRAPPED AREA DRAIN WITH PEDESTRIAN RATED METAL GRATE (SEE DETAIL 3, SHEET C602).
INSTALL 8.0 LF 4" PVC SD @ 2.38%.
RIM: 204.52
IE OUT (4"S): 201.52

14. INSTALL 3"Ø WEEPHOLE THROUGH WALL AT LOWPOINT. INVERT OF WEEPHOLE SHALL BE ½" BELOW LOWPOINT ELEVATION. IE (WEEPHOLE): 204.52

15. ROOF DRAIN CONNECTION, TYP. CONNECT TO STORM MAIN WITH 6"x6" WYE.
INSTALL 2.0 LF 6" SD @ 0.0200 FT/FT MIN.
IE @ BLDG: 201.82
(SEE ARCHITECTURAL PLANS FOR COORDINATION)

16. SEE PLUMBING SHEET P2.4 FOR WATER ENTRY SCHEMATIC. DETAIL SHOWS BACKFLOW PREVENTION DEVICE AND RSV-1 RESIDENTIAL SHUT OFF VALVE FOR FIRE SUPPRESSION SYSTEM.

17. SEE PLUMBING PLANS FOR FLOOR DRAIN CONNECTION IN TRASH ROOM.

18. INSTALL 2" METER BY PORTLAND WATER BUREAU UNDER SEPARATE PERMIT. CONTRACTOR TO CONNECT TO THE SHORT STUB-OUT ON THE BACKSIDE OF THE NEW WATER METER BOX.

UTILITY NOTES (CONT.)

19. PROPOSED FIRE DEPARTMENT CONNECTION (FDC) TO BE INSTALLED UNDER SEPARATE PERMIT. COORDINATE WITH FIRE SUPPRESSION CONSULTANT FOR SPECIFICATIONS. A METAL SIGN WITH RAISED LETTERS AT LEAST 1 INCH IN SIZE SHALL BE MOUNTED ON FDC. SIGN SHALL READ "AUTOMATIC SPRINKLERS." SEE DETAIL 5, SHEET C602.

20. KILL EXISTING ¾" METER BY PORTLAND WATER BUREAU UNDER SEPARATE PERMIT.

21. CONNECT TO EXISTING SANITARY SEWER LATERAL. EXTEND PROPOSED 6" PVC D-3034 SERVICE TO NEW BUILDING (1.0% MIN. SLOPE). SEE PLUMBING PLANS FOR CONTINUATION. CONTRACTOR TO VERITY EXISTING INVERT ELEVATION PRIOR TO CONSTRUCTION (DEPTH AT END = 10 FT PER PORTLAND MAPS)

22. INSTALL KNOXBOX NEAR FRONT ENTRY MOUNTED APPROXIMATELY 6 FEET ABOVE GROUND LEVEL. KEY BOX UNDER "SEPARATE PERMIT", PERMIT SHALL BE ISSUED THROUGH THE FIRE MARSHAL'S OFFICE.

23. INSTALL 130 LF FRENCH DRAIN. SEE DETAIL 4, SHEET C603.

24. CONSTRUCT 9" SQ. LANDSCAPE DRAIN WITH ATRIUM GRATE (ADS PART NOS. 981, 900, 1243, 916 OR APPROVED EQUAL)
RIM: 203.85 / IE IN,OUT (4"W,E): 202.33

25. CONSTRUCT 9" SQ. LANDSCAPE DRAIN WITH ATRIUM GRATE (ADS PART NOS. 981, 900, 1243, 916 OR APPROVED EQUAL)
RIM: 203.85 / IE OUT (4"W): 202.71

SCALE
10 0 5 10
1 INCH = 10 FEET

Edge
Invest. Develop. Grow.
EDGE DEVELOPMENT
2233 NW 23RD AVENUE | SUITE 100
PORTLAND, OREGON 97210
P 503.292.7733

PDG
PIONEER DESIGN GROUP, INC.
9020 SW WASHINGTON SQ. RD.
SUITE 170
PORTLAND, OREGON 97223
P 503.643.8286
www.pd-grp.com

NE GLISAN APARTMENTS
5663-5665 NE GLISAN ST
PORTLAND, OREGON 97213

EDGE DEVELOPMENT
2233 NW 23RD AVE. SUITE 100
PORTLAND, OREGON 97210

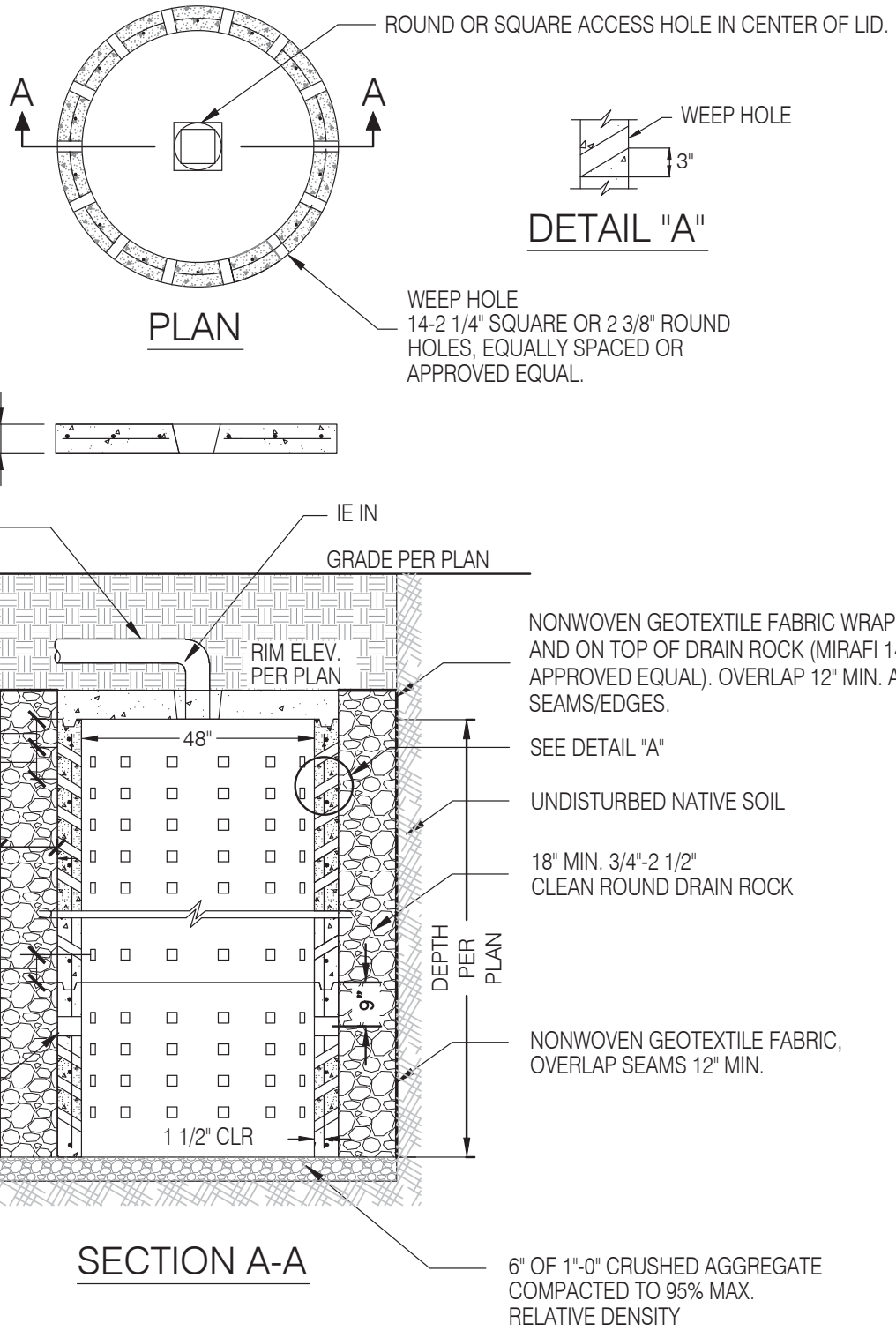
PROJECT NUMBER	18-20
DATE	2/20/19

REVISIONS
⚠ 02/20/19
CHECKSHEET RESPONSE / LRL

2/20/2019
REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 13, 2004
LUKE R. LAPPIN
VALID THROUGH 12-31-20

UTILITY PLAN

SHEET NUMBER
C401



NOTES:

1. ALL PRECAST SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C 478.
2. PRIVATE SUMPS TO BE INSTALLED WITHOUT CONCRETE BASE.
3. PROVIDE A MIN. OF 4" OF 1"-0" OR 3/4"-0" CLEAN CRUSHED ROCK UNDER ALL PIPES.

LEWIS &
VAN VLEET
incorporated

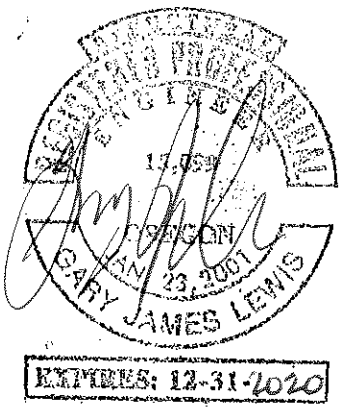
principals
gary j. lewis, p.e.
scott debo, mba

TO: Ed Bruin, Edge Development
FROM: Emily Toner, P.E.
DATE: 2/22/2019
RE: Glisan Apartments
Dry Well Loading

Ed,

The Glisan apartments have been designed with a max loading of less than or equal to 2000 psi. While there are foundations located within the 10' radius of the drywells, the maximum bearing loads of 2000 psi is less than the 4000 psi bearing loads that the drywells are designed for.

Emily Toner, PE
Lewis and Van Vleet, Inc



consulting engineers
18660 s.w. boones ferry road
tualatin, oregon 97062
(503) 885-8605 phone
(503) 885-1206 fax

Designation: C 478 – 97

Standard Specification for Precast Reinforced Concrete Manhole Sections[1]

This standard is issued under the fixed designation C 478; 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.

PART I—GENERAL

1. Scope

1.1 This specification covers the manufacture and purchase requirements of products used for the assembly and construction of precast reinforced concrete manholes used in sewer and water works.

1.2 Part I, Sections 1-11, of this specification presents general requirements and requirements that are common to each precast concrete product covered by this specification.

1.3 Part II of this specification presents specific requirements for each manhole product in the following sections:

Product	Section
Grade Rings	12
Flat Slab Tops	13
Risers and Conical Tops	14
Base Sections	15
Steps and Ladders	16

NOTE 1—Future products will to be included in Part II in a future revision of this specification.

1.4 A complete metric companion to this specification has been developed, Specification C 478M; therefore, no metric equivalents are presented in this specification.

NOTE 2—This specification is a manufacturing and purchase specification only and does not include requirements for backfill, or the relationship between field load conditions and the strength requirements of the manhole products and appurtenances. Experience has shown, however, that the successful performance of this product depends upon the proper selection of the product strength, type of foundation and backfill, and care in the field installation of the manhole products and connecting pipes. The owner of the project for which these products are specified herein is cautioned to require inspection at the construction site.

2. Referenced Documents

2.1 *ASTM Standards:*

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

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

C 33 Specification for Concrete Aggregates[3]

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens[3]

C 150 Specification for Portland Cement[4]

C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete[3]

C 497 Test Methods for Concrete Pipe, Manhole Sections, or Tile[5]

C 595 Specification for Blended Hydraulic Cements[4]

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

C 822 Terminology Relating to Concrete Pipe and Related Products[5]

2.2 *ACI Standard:*

318 Building Code, Requirements for Reinforced Concrete[6]

3. Terminology

3.1 *Definitions*—For definitions of terms relating to precast reinforced concrete manholes, see Terminology C 822.

4. Materials and Manufacture

4.1 General material requirements for precast reinforced concrete manhole products are presented in 4.1.1-4.1.5. Other materials or additional requirements for a product, if any, are covered in the Part II section for that specific product.

4.1.1 *Reinforced Concrete*—Reinforced concrete shall consist of cementitious materials, mineral aggregates, and water, in which steel reinforcement has been embedded in such a manner so that the steel reinforcement and concrete act together.

4.1.2 *Cementitious Materials*:

4.1.2.1 *Cement*—Cement shall conform to the requirements

[1] This specification is under the jurisdiction of ASTM Committee C-13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.06 on Manholes and Specials.

Current edition approved April 10, 1997. Published March 1998. Originally published as C 478 – 61T. Last previous edition C 478 – 96.

[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 04.01.

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

[6] Available from the American Concrete Institute, Box 4754, Redford Station, Detroit, MI 48219.

for portland cement of Specification C 150, or shall be portland blast-furnace slag cement or portland-pozzolan cement conforming to Specification C 595, except that the pozzolan constituent of the Type IP portland-pozzolan cement shall be fly ash and shall not exceed 25 % by weight.

4.1.2.2 *Fly Ash*—Fly ash shall conform to the requirements of Class F or Class C of Specification C 618.

4.1.3 *Allowable Combinations of Cementitious Materials*—The combination of cementitious materials used in the concrete shall be one of the following:

4.1.3.1 Portland cement only,

4.1.3.2 Portland blast-furnace slag cement only,

4.1.3.3 Portland pozzolan cement only, or

4.1.3.4 A combination of portland cement and fly ash wherein the proportion of fly ash is between 5 and 25 % by weight of total cementitious material (portland cement plus fly ash).

4.1.4 *Aggregates*—Aggregates shall conform to Specification C 33, except that the requirements for gradation shall not apply.

4.1.5 *Admixtures and Blends*—Admixtures and blends may be used with the approval of the owner.

4.1.6 *Steel Reinforcement*—Reinforcement shall consist of wire conforming to Specification A 82 or Specification A 496, of wire fabric conforming to Specification A 185 or Specification A 497, or of bars of Grade 40 steel conforming to Specification A 615/A 615M.

4.1.7 *Secondary Synthetic Fiber*—Collated fibrillated polypropylene virgin fibers may be optionally used in steel reinforced concrete manholes as a non-structural manufacturing enhancement. Only fibers designed and manufactured specifically for use in concrete and so certified by the manufacturer shall be accepted.

4.1.8 *Other Materials*—Other materials required for a product and not covered in Section 4 will be covered in the Part II section for that specific product.

5. Design

5.1 Design requirements for a product are prescribed in the specific Part II section for that product.

5.1.1 The minimum compressive strength of concrete manhole products covered by this specification shall be 4000 psi unless specified otherwise in Part II of this specification.

5.2 *Modified or Special Design*

5.2.1 Manufacturers may submit to the owner, for approval prior to manufacture, designs other than those prescribed in the specific section for a product. If such approval is obtained, then the product shall meet all the tests and performance requirements specified by the owner in accordance with the appropriate sections on manufacture and physical requirements.

5.2.2 If permitted by the owner, the manufacturer may request approval of designs of special sections, such as reducers, tees, and bases.

6. Reinforcement

6.1 This section presents requirements for reinforcement cover, continuity, laps, welds, and splices. Other reinforcement requirements are presented in Section 4 and any additional requirements are given in the Part II section for a specific product.

6.2 *Cover*—The exposure of the ends of reinforcement, stirrups or spacers used to position the reinforcement during placement of the concrete shall not be cause for rejection.

6.3 *Continuity*—The continuity of the circumferential reinforcement shall not be destroyed during the manufacture of the product, except when lift holes or pipe openings are provided in the product.

6.4 *Welded Steel Cage Laps, Welds, and Splices*:

6.4.1 If splices are not welded, the reinforcement shall be lapped not less than 20 diameters for deformed bars, and 40 diameters for plain bars and cold-drawn wire. In addition, where lapped cages of welded wire fabric are used without welding, the lap shall contain a longitudinal wire.

6.4.2 When splices are welded and are not lapped to the minimum requirements in 6.4.1, pull tests of representative specimens shall develop at least 50 % of the minimum specified strength of the steel, and there shall be a minimum lap of 2 in. For butt welded splices in bars or wire, permitted only with helically wound cages, pull tests of representative specimens shall develop at least 75 % of the minimum specified strength of the steel.

6.5 *Steel Hoop Splices*—A representative sample steel hoop with welded splices shall develop at least 50 % of the minimum specified strength of the steel, and there shall be a minimum lap of 2 in. For butt welded splices, the representative steel hoop sample shall develop at least 75 % of the minimum specified strength of the steel.

7. Precast Concrete Manufacture

7.1 *Mixture*—The aggregates shall be sized, graded, proportioned, and mixed with such proportions of cementitious materials and water as will produce a homogeneous concrete mixture of such quality that the products will conform to the test and design requirements of this specification. All concrete shall have a water-cementitious ratio not exceeding 0.53 by weight. Cementitious materials shall be as specified in 4.1.2 and shall be added to the mix in a proportion not less than 470 lb/yd^3, unless mix designs with a lower cementitious materials content demonstrate that the quality and performance of the product meet the requirements of this specification.

7.2 *Curing*—Concrete products shall be subjected to any one of the methods of curing prescribed in 7.2.1-7.2.4 or to any other method or combination of methods approved by the owner that will give satisfactory results.

7.2.1 *Steam Curing*—Concrete products may be placed in a curing chamber, free of outside drafts, and cured in a moist atmosphere maintained by the injection of steam for such time and such temperatures as may be needed to enable the products to meet the strength requirements. The curing chamber shall be so constructed as to allow full circulation of the steam around the entire product.

7.2.2 *Water Curing*—Concrete products may be water-cured by covering with water-saturated material, or by a system of perforated pipes, mechanical sprinklers, porous hose, or by any other approved method that will keep the products moist during the curing period.

7.2.3 *Sealing Membrane*—A sealing membrane conforming

to the requirements of Specification C 309 may be applied and should be left intact until the required concrete strength requirements are met. The concrete at the time of application of the membrane shall be within 10°F of the atmospheric temperature. All concrete surfaces shall be kept moist prior to the application of the membrane and shall be damp when the membrane is applied.

7.2.4 The manufacturer may, at his option, combine the methods prescribed in 7.2.1-7.2.3 provided the required concrete compressive strength is attained.

8. Acceptance

8.1 *Acceptance Procedures*:

8.1.1 Unless otherwise designated by the owner at the time of, or before, placing an order, acceptance procedures for precast reinforced concrete manhole products shall be as specified in the Part II section for a particular product, and may consist of one or more of the following:

8.1.1.1 Acceptance of a product on the basis of tests of materials, including concrete compressive strength and absorption.

8.1.1.2 Acceptance of a product on the basis of inspection of the finished product, including amount and placement of reinforcement to determine conformance with the design prescribed under this specification, and freedom from defects.

8.2 *Test Methods*:

8.2.1 *Concrete Compressive Strength Test*:

8.2.1.1 *Type of Specimen*—Compression tests for satisfying the minimum specified concrete strength requirement shall be made on either concrete cylinders or, at the option of the manufacturer, on cores cut from the concrete manhole product.

8.2.1.2 *Compression Testing of Cylinders*—Cylinders shall be made in accordance with Test Methods C 497, and shall be tested in accordance with Test Method C 39. For manhole products, an owner may require concrete compressive tests on cylinder specimens numbering in the amount of 5 % of the total order of a manhole product, but not to exceed two cylinders for each day's production. The average compressive strength of all cylinders tested shall be equal to or greater than the specified strength of the concrete. Not more than 10 % of the cylinders tested shall fall below the specified strength of the concrete. In no case shall any cylinder tested fall below 80 % of the specified strength of the concrete.

8.2.1.3 *Compression Testing of Cores*—Cores shall be cut from the concrete manhole product and tested in accordance with Test Methods C 497, except that the requirements for moisture conditioning shall not apply. One core shall be taken from a manhole product selected at random from each day's production run of a single concrete strength. When the concrete compressive strength of the core is equal to or greater than 80 % of the specified strength of the concrete, the concrete strength of the production run is acceptable. If the core does not meet the preceding concrete strength requirement, another core from the same manhole product may be taken and tested.

8.2.1.4 If the concrete compressive strength of the recore is equal to or greater than 80 % of the specified strength of the concrete, the concrete strength of the production run is acceptable. If the recore does not meet the preceding concrete strength requirement, that manhole product shall be rejected. Two manhole products from the remainder of the day's production run shall be selected at random and one core taken from each manhole product and tested. When the average concrete strength of the two cores is equal to or greater than 80 % of the specified strength of the concrete with no core below 75 % of the specified strength of the concrete, the concrete strength of the day's production run shall be acceptable.

8.2.1.5 If the concrete strength of the two cores does not meet the preceding concrete strength requirement, then the remainder of the day's production run shall be either rejected, or, at the option of the manufacturer, each manhole product of the remainder of the day's production run may be cored and accepted individually.

8.2.1.6 *Plugging Core Holes*—Core holes on accepted concrete manhole products shall be plugged and sealed by the manufacturer in a manner such that the manhole products will meet all of the requirements of this specification. Manhole sections so sealed shall be considered as satisfactory for use.

8.2.2 *Absorption Test*:

8.2.2.1 The absorption of a specimen from a concrete product, as determined in Test Methods C 497, shall not exceed 9 % of the dry mass for Test Method A procedure or 8.5 % for Test Method B procedure. All specimens shall be free of visible cracks and shall represent the full thickness of the product.

8.2.2.2 Specimens for Test Method B shall meet the requirements of Test Methods C 497.

8.2.2.3 Each specimen tested by Test Method A shall have a minimum mass of 0.1 kg.

8.2.2.4 When the initial absorption specimen from a concrete product fails to conform to this specification, the absorption test shall be made on another specimen from the same product and the results of the retest shall be substituted for the original test results.

8.2.3 *Retests*—When not more than 20 % of the concrete test specimens tested under either 8.2.2.1 or 8.2.2.2 fail to pass the requirements of this specification, the manufacturer may cull his stock and may eliminate whatever quantity of product he desires and shall so mark the culled product that they will not be shipped for the order. The required tests shall be made on the balance of the order and the products shall be accepted if in conformance with the requirements of this specification.

8.3 *Test Equipment*—Every manufacturer furnishing manhole products under this specification shall furnish all facilities and personnel necessary to carry out the tests required for acceptance.

9. Repairs

9.1 Manhole products may be repaired, if necessary, because of imperfections in manufacture or damage during handling, and will be acceptable if, in the opinion of the owner, the repaired products conform to the requirements of this specification.

10. Inspection

10.1 The quality of materials, the process of manufacture, and the finished manhole products shall be subject to inspection and approval by the owner.

11. Product Marking

11.1 The following information shall be legibly marked on each precast concrete product:

11.1.1 Specification and product designation: MH for manhole base, riser, conical tops, and grade rings,

11.1.2 Date of manufacture, and

11.1.3 Name or trademark of the manufacturer.

11.2 Marking shall be indented into the concrete or shall be painted thereon with waterproof paint.

PART II—PRODUCTS

12. Grade Rings

12.1 *Scope*—This section covers precast reinforced concrete grade rings used for final adjustment of manholes to grade.

12.2 *Acceptance*—Acceptability of grade rings covered by this specification shall be determined by the results of such tests of materials as are required by Section 4; by compressive strength tests on concrete cores or concrete cylinders required by Section 8; and by inspection of the finished product, including amount and placement of reinforcement as prescribed by 12.4, 12.5, and 12.6, to determine its conformance with the design prescribed under this specification and its freedom from defects.

12.3 *Design*—The minimum wall thickness shall be one twelfth of the internal diameter of the grade ring or 4 in., whichever is greater.

12.3.1 *Joints*—Grade rings are not required to have the joint formed with male and female ends.

12.4 *Circumferential Reinforcement*:

12.4.1 The circumferential reinforcement shall have an equivalent area of not less than 0.07 $in.^2$/vertical ft, but not less than 0.024 $in.^2$ in any one grade ring.

12.4.2 The circumferential reinforcement shall be one line in the center third of the wall of the grade ring.

12.5 *Permissible Variations*:

12.5.1 *Internal Diameter*—The internal diameter of grade rings shall not vary more than ± 1 %.

12.5.2 *Wall Thickness*—The wall thickness of grade rings shall be not less than that prescribed in the design by more than 5 % or ± 3⁄16 in., whichever is greater. A wall thickness greater than that prescribed in the design shall not be cause for rejection.

12.5.3 *Height of Two Opposite Sides*—Variations in laying height of two opposite sides of grade rings shall be not more than ¼in.

12.5.4 *Height of Grade Ring*—The underrun in height of a grade ring shall be not more than ⅛ in./ft of height.

12.5.5 *Position of Reinforcement*—For grade rings with a 4-in. wall thickness, the maximum variation in the design position of circumferential reinforcement from that described in 12.4.1 shall be ±10 % of the wall thickness or ±¼ in., whichever is greater. For grade rings with a wall thickness greater than 4-in., the maximum variation from the design position of reinforcement shall be ±10 % of the wall thickness or ±⅝in., whichever is the lesser. In no case, however, shall the cover over the reinforcement be less than ¾ in. The preceding minimum cover limitation does not apply to the mating surfaces of the joint.

12.5.6 *Area of Reinforcement*—Steel reinforcement areas that are 0.005 $in.^2$/linear ft less than called for by design shall be considered as meeting the required steel reinforcement area.

12.6 *Rejection*:

12.6.1 Grade rings shall be subject to rejection for failure to conform to any of the specification requirements. In addition, an individual grade ring may be rejected because of any of the following:

12.6.1.1 Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.

12.6.1.2 Defects that indicate mixing and molding not in compliance with 7.1 or surface defects indicating honeycombed or open texture that would adversely affect the function of the grade ring.

12.6.1.3 The planes of the ends are not perpendicular to the longitudinal axis of the grade ring, within the limits of permissible variations prescribed in 12.5.

12.6.1.4 Damaged or cracked ends, where such damage would prevent making a satisfactory joint.

12.6.1.5 Any continuous crack having a surface width of 0.01 in., or more and extending for a length of 12 in. or more, regardless of position in the wall.

13. Flat Slab Tops

13.1 *Scope*—This section covers precast reinforced concrete flat slab tops used in the construction of manholes for use in sewer and water works.

13.2 *Acceptance*:

13.2.1 Acceptability of flat slab tops shall be determined by the results of such tests of materials as are required by Section 4; by compressive strength tests on concrete cores or concrete cylinders required by Section 8; and by inspection of the finished product, including amount and placement of reinforcement as prescribed by 13.4 and 13.6, to determine its conformance with the design prescribed under this specification and its freedom from defects.

13.2.2 Unless otherwise designated by the owner at the time of, or before, placing an order, two separate and alternative methods of acceptance are permitted for flat slab top manufacturer designs, in addition to tests of materials and inspection required in 13.2.1.

13.2.2.1 *Acceptance on the Basis of Proof-of-Design Test*—Acceptance of flat slab tops on the basis of the results of a proof-of-design test performed in accordance with 13.5 in lieu of submission of design calculations and detailed drawings.

13.2.2.2 *Acceptance on the Basis of Rational Design*—Acceptance of flat slab tops on the basis of design calculations by a rational method and detailed drawings.

13.3 *Design*:

13.3.1 The basis of flat slab top designs shall be the appropriate sections of the latest edition of ACI 318.

13.3.2 Flat slab tops shall have a minimum thickness of 6 in. or risers up to and including 48 in. in diameter and 8 in. for larger diameters.

13.3.3 The flat slab top access opening shall be a minimum of 24 in. in diameter.

13.3.4 *Joint*—The reinforced concrete flat slab top may be

formed with or without a male or female end so that when the manhole base, riser and top section are assembled, they will make a continuous and uniform manhole compatible with the tolerances given in 13.6.

13.4 *Reinforcement*:

13.4.1 Flat slab tops manufactured with a joint or with other indication of the top or bottom of the slab shall be manufactured with one layer of reinforcement shall be placed near the bottom surface so that the protective cover over the reinforcement shall be 1 in.

13.4.2 Flat slab tops manufactured without a joint or without other indication of the top or bottom of the slab shall be manufactured with two layers of steel reinforcement, one located near the bottom surface and one near the top surface so that the protective cover over each layer is 1 in.

13.4.3 A layer of reinforcement shall have a minimum area of 0.12 $in.^2$/linear foot in both directions.

13.4.4 Openings in flat slab tops shall be additionally reinforced with a minimum of the equivalent of 0.20 $in.^2$ of steel at 90°. Straight rods used to reinforce openings shall have a minimum length equal to the diameter of the opening plus 2 in.

13.5 *Physical Requirements*—Physical requirements for tests shall conform to the requirements of Section 8.

13.5.1 *Proof-of-Design Test*:

13.5.1.1 If 13.2.2.2 has been designated as the basis of acceptance, one flat slab top for each design shall be tested unless the owner has indicated otherwise.

13.5.1.2 The flat slab top proof-of-design test procedures shall be in accordance with Test Methods C 497.

13.5.1.3 The ultimate test load shall be the sum of at least 130 % of the dead load on the slab plus at lest 217 % of the live-plus impact load on the slab. Dead load is the weight of the column of earth over the slab plus the weight of the riser supported by the slab. Live load is the maximum anticipated wheel load that may be transmitted through the riser to the slab.

13.5.1.4 The flat slab top shall be acceptable if it supports the required ultimate test load without failure. Ultimate strength failure is defined as the inability of the slab to resist an increase in the applied load.

13.5.1.5 When agreed upon by the owner and manufacturer, the flat slab top shall be acceptable based on certified copies of the results of tests performed on identical flat slab tops instead of requiring new proof-of-design acceptance tests.

13.6 *Permissible Variations*:

13.6.1 *Internal Diameter*—The internal diameter of the flat slab tops entrance hole shall not vary more than ±1 %.

13.6.2 *Thickness*—The thickness of flat slab tops shall be not less than that prescribed in the design by more than 5 % or ±3⁄16 in., whichever is greater. A thickness greater than that prescribed in the design shall not be cause for rejection.

13.6.3 *Length of Two Opposite Sides*—Variations in lengths of two opposite sides of flat slab tops shall be not more than ¼ in.

13.6.4 *Length*—The underrun in length of a flat slab top shall be not more than ⅛ in./ft of length.

13.6.5 *Position of Reinforcement*—For flat slab tops with a less than a 6-in. thickness, the maximum variation in the position of reinforcement from that prescribed in 13.5 shall be ±10 % of the thickness or ±¼ in., whichever is greater. For flat slab tops with a thickness greater than 6-in., the maximum variation shall be ±10 % of the thickness or ±⅝in., whichever is the lesser. In no case, however, shall the cover over the reinforcement be less than ¾ in.

13.6.6 *Area of Reinforcement*—Steel reinforcement areas that are 0.005 $in.^2$/linear ft less than called for by design shall be considered as meeting the required steel reinforcement area.

13.7 *Rejection*:

13.7.1 Flat slab tops shall be subject to rejection for failure to conform to any of the specification requirements. In addition, an individual flat slab top of may be rejected because of any of the following:

13.7.1.1 Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.

13.7.1.2 Defects that indicate mixing and molding not in compliance with 7.1 or surface defects indicating honeycombed or open texture that would adversely affect the function of the flat slab top.

13.7.1.3 The planes of the ends are not perpendicular to the longitudinal axis of the flat slab top, within the limits of permissible variations prescribed in 13.6.

13.7.1.4 Damaged or cracked ends, where such damage would prevent making a satisfactory joint.

13.7.1.5 Any continuous crack having a surface width of 0.01 in, or more and extending for a length of 12 in. or more, regardless of position in the slab.

14. Risers and Conical Tops

14.1 *Scope*—This section covers precast reinforced concrete risers and conical tops used for in construction of manholes for use in sewer and water works.

14.2 *Acceptance*—Acceptability of risers and conical tops covered by this specification shall be determined by the results of such tests of materials as are required by Section 4; by compressive strength tests on concrete cores or concrete cylinders required by Section 8; and by inspection of the finished product, including amount and placement of reinforcement as prescribed by 14.4, 14.5, and 14.7, to determine its conformance with the design prescribed under this specification and its freedom from defects.

14.3 *Design*—The minimum wall thickness shall be one twelfth of the largest internal diameter of the riser or conical top.

14.4 *Welded Steel Cage Reinforcement*:

14.4.1 *Riser Circumferential Reinforcement*:

14.4.1.1 Circumferential reinforcement may consist of either one or two lines of steel. The total area of reinforcement per vertical foot shall be not less than 0.0025 times the internal diameter in inches.

14.4.1.2 A line of circumferential reinforcement for any given total area may be composed of two layers if the layers are not separated by more than the thickness of one cross member plus ¼ in. The two layers shall be tied together to form a single cage. All other specification requirements such as laps, welds, and tolerances of placement in the wall of the riser or conical

top shall apply to this method of fabricating a line of reinforcement.

14.4.1.3 Where one line of circumferential reinforcement is used, it shall be placed in the center third of the wall. The protective cover over the circumferential reinforcement in the wall shall be no less than ¾ in. in accordance with 14.7.

14.4.1.4 Where two lines of circumferential reinforcement are used, each line shall be so placed that the protective covering over the circumferential reinforcement in the wall shall be 1 in.

14.4.1.5 The location of the reinforcement shall be subject to the permissible variations in dimensions prescribed in 14.7.

14.4.1.6 The spacing center to center of circumferential reinforcement in a cage shall not exceed 6 in.

14.4.2 *Longitudinal Members*—Each line of circumferential reinforcement shall be assembled into a cage that shall contain sufficient longitudinal bars or members to maintain the reinforcement in shape and position within the form to comply with permissible variations in 14.7.

14.4.3 *Joint Reinforcement*—Either the tongue or groove of the joint shall contain circumferential reinforcement equal in area to that of a single line within the wall of the riser or conical top.

14.5 *Steel Hoop Reinforcement for Risers and Conical Tops Up to and Including 48 in. Diameters*:

14.5.1 *Continuous Circumferential Reinforcement*:

NOTE 3—Care shall be taken to ensure that none of the steel hoop reinforcement is cut prior to installation of the riser or conical top.

14.5.1.1 Circumferential reinforcement for manhole risers and conical tops up to and including 24 in. in height shall consist of no less than two hoops of steel wire or reinforcing bars. The steel hoop shall have a minimum cross-sectional diameter of 0.250 in. and shall be located in each end quarter of the riser or conical top, with a minimum distance of 1 in. from the shoulder of the riser or conical top.

14.5.1.2 Circumferential reinforcement for manhole risers and conical tops greater in height than 24 in. and up to and including 48 in. in height shall consist of no less than three hoops of steel wire or reinforcing bars. The steel hoops shall have a minimum cross-sectional diameter of 0.250 in. and shall have a hoop located in each end quarter of the riser or conical top with a minimum distance of 1 in. from the shoulder of the riser or conical top. The third, or middle, hoop shall be located from the shoulder of the riser or conical top a distance equal to one-half the section height ±6 in.

14.5.1.3 The hoop reinforcement shall be placed in the center third of the riser wall or conical top. The concrete cover over the hoop reinforcement in the wall of the section shall be no less than ¾ in. in accordance with 14.7.

14.5.2 *Joint Reinforcement*—The tongue or groove of the joint need not contain circumferential reinforcement.

14.6 *Joints*—Precast reinforced concrete risers and conical tops shall be designed and manufactured with male and female ends, so that the assembled manhole base, riser and conical top shall make a continuous and uniform manhole, compatible with the tolerances given in 14.7.

14.7 *Permissible Variations*:

14.7.1 *Internal Diameter*—The internal diameter of risers and conical tops shall not vary more than 1 %.

14.7.2 *Wall Thickness*—The wall thickness of risers and conical tops shall be not less than that prescribed in the design by more than 5 % or ±3⁄16 in., whichever is greater. A wall thickness greater than that prescribed in the design shall not be cause for rejection.

14.7.3 *Height of Two Opposite Sides*—Variations in laying heights of two opposite sides of risers or conical tops shall be not more than ⅝ in.

14.7.4 *Height of Section*—The underrun in height of a riser or conical top shall be not more than ¼ in./ft of height with a maximum of ½ in. in any one section.

14.7.5 *Position of Reinforcement*—For risers or conical tops with a 4-in. wall thickness or less, the maximum variation in the position of reinforcement from that prescribed in 14.5 and 14.6 shall be ±10 % of the wall thickness or ±¼in., whichever is greater. For sections with a wall thickness greater than 4 in., the maximum variation in the position of reinforcement shall be ±10 % of the wall thickness or ±⅝in., whichever is the lesser. In no case, however, shall the cover over the reinforcement be less than ¾ in. The preceding minimum cover limitation does not apply to the mating surfaces of the joint.

14.7.6 *Area of Reinforcement*—Steel reinforcement areas that are 0.005 $in.^2$/linear ft less than called for by design shall be considered as meeting the required steel reinforcement area.

14.8 *Rejection*:

14.8.1 Risers and conical tops shall be subject to rejection for failure to conform to any of the specification requirements. In addition, an individual riser or conical top may be rejected because of any of the following:

14.8.1.1 Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.

14.8.1.2 Defects that indicate mixing and molding not in compliance with 7.1 or surface defects indicating honeycombed or open texture that would adversely affect the function of the riser or conical top.

14.8.1.3 The planes of the ends are not perpendicular to the longitudinal axis of the riser or conical top, within the limits of permissible variations prescribed in 14.7.

14.8.1.4 Damaged or cracked ends, where such damage would prevent making a satisfactory joint.

14.8.1.5 Any continuous crack having a surface width of 0.01 in., or more and extending for a length of 12 in. or more, regardless of position in the wall.

15. Base Sections

15.1 *Scope*—This section covers three types of precast reinforced concrete base sections used in the construction of manholes for use in sewer and water works. The three types of base sections are a precast reinforced concrete flat slab floor upon which a riser section is placed, a riser section monolithically cast with an integral floor, and a riser section monolithically cast with an integral floor and benching. The riser portions of a base section shall meet all the requirements of Section 14.

15.2 *Acceptance*—Acceptability of base sections covered by this specification shall be determined by the results of such tests of materials as are required by Section 4; by compressive

strength tests on concrete cores or concrete cylinders required by Section 8; and by inspection of the finished product, including amount and placement of reinforcement as prescribed by 15.4 and 15.6, to determine conformance with the design prescribed under this specification and its freedom from defects.

15.3 *Design*:

15.3.1 Base flat slab floors or integral floors shall have a minimum thickness of 6 in. for risers up to and including 48 in. in diameter and 8 in. for larger diameters.

15.3.2 Benched inverts cast either monolithically with the base section or as a secondary casting in a cured base section shall have the following minimum dimensions:

15.3.2.1 Minimum slope of ½ in./ft from the channel to the inside diameter (I.D.) of riser wall for the benching.

15.3.2.2 Minimum channel invert depth of one-half the pipe I.D.

15.3.2.3 When a base section is precast monolithically with a benched invert, the minimum concrete thickness from the invert to the bottom of the integral base section shall be 4 in.

15.3.2.4 When a channel is cast in a cured base section, the minimum concrete thickness under the invert shall be 2 in.

15.3.2.5 Width of channel at top of benching shall be a minimum of the pipe I.D.

15.3.2.6 Invert shall provide a positive flow between inlet to outlet pipes.

15.3.2.7 The minimum channel centerline radius shall be the pipe I.D.

15.4 *Reinforcement*:

15.4.1 *Base Section Circumferential Reinforcement*—Circumferential reinforcement shall meet all the requirements of Section 14.

15.4.2 *Base Integral Floor and Flat Slab Floor Reinforcement*:

15.4.2.1 A layer of reinforcement shall be placed above the midpoint, and shall have a minimum area of 0.12 $in.^2$/linear ft in both directions.

15.4.2.2 The minimum protective cover over the reinforcement shall be 1 in.

15.4.3 *Longitudinal Members*—Longitudinal bars or members used to maintain a cage of circumferential reinforcement in shape and position within the form shall meet all the requirements of Section 14.

15.4.4 *Joint Reinforcement*—The mating surface of a base section joint shall contain circumferential reinforcement equal in area to that of a single line within the wall of the base riser.

15.5 *Joints*—Precast reinforced base sections shall be designed and manufactured with a male or female end, so that the assembled manhole base, riser and top will make a continuous and uniform manhole, compatible with the tolerances given in 15.6.

15.6 *Permissible Variations*:

15.6.1 *Internal Diameter*—The internal diameter of base sections shall not vary more than 1 %.

15.6.2 *Thickness*—The thickness of a flat slab floor integral floor or integral floor with benching shall be not less than that prescribed in the design by more than 5 % or ±3⁄16 in., whichever is greater. A thickness greater than that prescribed in the design shall not be cause for rejection.

15.6.3 *Height of Two Opposite Sides*—Variations in laying heights of two opposite sides of base sections shall be not more than ⅝in.

15.6.4 *Height of Sections*—The underrun in height of a base section shall be not more than ¼ in./ft of height with a maximum of ½ in. in any one base section.

15.6.5 *Position of Reinforcement*—For flat slab floors, integral floors or integral floors with benching with a 4-in. thickness or less, the maximum variation in the position of reinforcement from that prescribed in 15.4 shall be ±10 % of the thickness or ±¼in., whichever is greater. For floors with a thickness greater than 4-in., the maximum variation shall be ±10 % of the thickness or ±⅝ in., whichever is the lesser. In no case, however, shall the cover over the reinforcement be less than ¾ in. The preceding minimum cover limitation does not apply to the mating surfaces of base section joints.

15.6.6 *Area of Reinforcement*—Steel reinforcement areas that are 0.005 $in.^2$/linear ft less than called for by design shall be considered as meeting the required steel reinforcement area.

15.7 *Rejection*:

15.7.1 Base sections be subject to rejection for failure to conform to any of the specification requirements. In addition, an individual base section with a flat slab floor, integral floor or integral floor with benching may be rejected because of any of the following:

15.7.1.1 Fractures or cracks passing through the riser wall, except for a single end crack that does not exceed the depth of the joint.

15.7.1.2 Defects that indicate mixing and molding not in compliance with 7.1 or surface defects indicating honeycombed or open texture that would adversely affect the function of the base section.

15.7.1.3 The planes of the ends are not perpendicular to the longitudinal axis of the base section, within the limits of permissible variations prescribed in 15.6.

15.7.1.4 Damaged or cracked ends, where such damage would prevent making a satisfactory joint.

15.7.1.5 Any continuous crack having a surface width of 0.01 in., or more and extending for a length of 12 in. or more, regardless of position in the base section.

16. Steps and Ladders

16.1 *Scope*:

16.1.1 This section covers manhole steps and ladders used for providing access through manholes for use in sewer and water works.

16.1.2 Access through manholes may be by steps that are cast, mortared, or attached by mechanical means into the walls of base, riser, or conical top sections or by ladder.

16.2 *Acceptance*—Unless otherwise designated by the owner at the time of, or before, placing an order, acceptance of steps and ladders installed in manholes will be on the basis of tests and inspection of the completed product.

16.3 *Materials*:

16.3.1 Except as required by Section 20, manhole steps and ladders shall conform to the requirements of the Occupational Safety and Health Standards, U.S. Department of Labor.

16.3.2 Manhole steps that are cast, mortared, or attached by

mechanical means into the walls of base, riser or conical top sections shall meet the requirements of 16.4 and 16.5 in addition to the following:

16.3.2.1 When dissimilar types of materials are used in the steps, appurtenances and fastenings, the materials shall be treated to prevent deleterious effects.

16.3.2.2 That portion of the step projecting into the base section, riser or conical top opening shall be free of splinters, sharp edges, burrs, or projections which may be a hazard.

16.4 *Design*:

16.4.1 Steps in base section, riser and conical top sections shall be aligned in each section so as to form a continuous ladder with rungs equally spaced vertically in the assembled manhole at a maximum design distance of 16 in. apart.

16.4.2 Steps shall be embedded in the base section, riser or conical top section wall a minimum distance of 3 in.

16.5 *Dimensions*:

16.5.1 Ferrous metal steps not painted or treated to resist corrosion shall have a minimum cross sectional dimension of 1 in.

16.5.2 The minimum width of rungs or cleats shall be 10 in.

16.5.3 The rung or cleat shall project a minimum clear distance of 4 in. from the wall of the base, riser, or conical top section measured from the point of embedment.

16.5.4 The minimum clear distance between the rung or cleat and the opposite wall of the base, riser, or conical top shall be 18 in. measured at the center face of the rung or cleat.

16.6 *Physical Requirements*:

16.6.1 *Testing*:

16.6.1.1 The manufacturer furnishing manhole sections with steps under this specification shall furnish all facilities and personnel necessary to carry out the tests required in the Manhole Step Test section of Test Methods C 497.

16.6.1.2 One installed manhole step of the type to be used on a project shall be tested unless certified test results are available.

16.6.1.3 Vertical and horizontal load test procedures for manhole steps shall be in accordance with Test Methods C 497.

16.6.1.4 The horizontal pull out load shall be 400 lb.

16.6.1.5 The vertical load shall be 800 lb.

16.6.2 *Acceptance*—The step shall be acceptable if the following requirements are met:

16.6.2.1 The step remains solidly embedded after application of the horizontal load test.

16.6.2.2 The step sustains a permanent set of ½ in. or less after application of the vertical load test.

16.6.2.3 No cracking or fracture of the step nor spalling of the concrete is evident.

16.6.2.4 If certified test results are not available and the step selected fails to conform to the test requirements, the manufacturer may select two other steps for retests. If either of these steps fail the retest, the steps shall be rejected.

17. Keywords

17.1 absorption; acceptance criteria; base sections; compressive strength; concrete; cone tops; design; flat slab tops; grade rings; ladders; manhole; manufacture; reinforced; riser sections; sewer; steps; tests; water