SECTION 33 49 23

GUIDE SPECIFICATIONS FOR STORMPRISM PRECAST CONCRETE UNDERGROUND RETENTION, DETENTION, AND INFILTRATION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Drainage & Storm Water
    1. Retention / Detention Systems
        i. StormPrism Module(s)
        ii. Box Culvert Systems
        iii. Dry Wells
        iv. Panel Vaults
B. Environmental
    1. Containment
        i. Storage Tanks

1.2 RELATED SECTIONS

A. 33 00 00 Utilities
B. 35 00 00 Waterway and Marine Construction

1.3 REFERENCES

Where applicable, the latest editions of the following standards shall form a part of this specification to the extent referenced. The publications are referenced to in the text of this guide specification by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

Standard Specifications for Highway Bridges

Standard Specification for Transportation Materials and Methods of Sampling and Testing

ACI INTERNATIONAL (ACI)

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 309R	Consolidation of Concrete
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures and Commentary
ACI 517.2R	Accelerated Curing of Concrete at Atmospheric Pressure

AMERICAN NATIONAL STANDARDS INSTITUTE (ASTM)

ASTM A 36	Specification for Carbon Structural Steel
ASTM A 82	Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184	Specification for Fabricated Deformed Steel Mats for Concrete Reinforcement
ASTM A 185	Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 496	Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706	Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 775	Specification for Epoxy-Coated Reinforcing Steel Bars
ASTM A 884	Specification for Epoxy-Coated Steel and Welded Wire Fabric for Reinforcement

ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Specification for Concrete Aggregates
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C 70	Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C 76	Specification for reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 123	Standard Test Method for Lightweight Particles in Aggregate
ASTM C 125	Standard Terminology Relating to Concrete and Concrete Aggregates
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138	Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143	Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	Specifications for Portland Cement
ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192	Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete

ASTM C 403	Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
ASTM C 566	Test Method for Total Evaporable Moisture content of Aggregate by Drying
ASTM C 595	Specification for Blended Hydraulic Cements
ASTM C 617	Standard Practice for Capping Cylindrical Concrete Specimens
ASTM C 618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 805	Test Method for Rebound Number of Hardened Concrete
ASTM C 857	Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C 858	Specification for Underground Precast Concrete Utility Structures
ASTM C 877	Specification for External Sealing Bands for Concrete Pipe, Manholes and Precast Box Sections
ASTM C 890	Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
ASTM C 891	Practice for Installation of Underground Precast Concrete Utility Structures
ASTM C 913	Specification for Precast Concrete Water and Wastewater Structures
ASTM C 920	Specification for Elastomeric Joint Sealants
ASTM C 923	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
ASTM C 990	Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C 1018	Test method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete

	(Using Beam with Third-Point Loading)
ASTM C 1037	Practice for Inspection of Underground Precast Concrete Utility Structures
ASTM C 1064	Standard Test Method for Temperature of Freshly Mixed Concrete
ASTM C 1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116	Standard Specification for Fiber-Reinforced Concrete
ASTM C 1227	Standard Specification for Precast Concrete Septic Tanks
ASTM C 1231	Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
ASTM C 1240	Standard Specification for Use of Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout
ASTM C 1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 1293	Standard Test Method for Determination of Length Change of Concrete due to Alkali-Silica Reaction
ASTM C 1399	Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete
ASTM C 1550	Standard Test Method for Flexural Toughness of Fiber Reinforced Concrete (Using Centrally Loaded Round Panel)
ASMT C 1582	Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete
ASTM C 1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM C 1611	Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C 1613	Standard Specification for Precast Concrete Grease Interceptors
ASTM G 109	Standard Test Method for Determining the Effects of Chemical Admixtures of the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments

AMERICAN WELDING SOCIETY (AWS)

AWS D 1.1	Structural Welding Code - Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

	Manual of Standard Practice
	Placing Reinforcing Bars

NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual	Quality Control Manual for Precast Concrete Plants

1.4 GENERAL REQUIREMENTS

Precast concrete units shall be designed and fabricated by an experienced and acceptable precast concrete manufacturer certified by the National Precast Concrete Association. The underground precast concrete detention system shall have been produced in the United States for no less than five (5) consecutive years with no record of structural failure due to design or manufacturing deficiencies. In addition, the manufacturer shall employ a registered structural professional engineer.

The completed retention/detention/infiltration structure shall not have walls that protrude from the floor which limit free flow in all directions. Additionally, the system may not feature walls protruding from the floor creating opportunities for debris to become trapped and creating limitations to regular maintenance. Additionally, the system may not feature walls protruding from the floor which limit safe access in unlit emergency situations..

The supplier of the retention/detention/infiltration structure shall also be the manufacturer. The system supplier may not subcontract casting to a second party precaster.

1.5 SUBMITTALS

The following items shall be submitted unless specified otherwise herein.

A. Preconstruction Submittals
    1. The precast manufacturer shall submit a copy of their quality control/assurance manual, which establishes quality control procedures.

B. Drawings
    1. The drawings for precast concrete units shall be furnished by the precast concrete producer for approval. These drawings shall show the design loads and standards have been met. Installation and construction information shall be included on shop drawings upon request. Details of steel reinforcing size and placement shall be submitted if a professional engineering stamp and calculations are required by the customer. It is the responsibility of the project's engineer-of-record to verify that the

design assumptions are suitable for the proposed application.

2. For custom made precast concrete units, in addition to the requirements in B.1, the drawing for submittal shall show locations and dimensions to all penetrations and special embed items. Product dimensions and thicknesses shall be shown, and the drawing shall be to a common architectural scale with the precast producer's information in the title block.

C. Precast Concrete Unit Data

1. Anchorage, Lifting Inserts and Devices

   i. For anchors, lifting inserts and other devices, the precast concrete producer shall provide product data sheets and proper installation instructions upon request.

2. Accessory Items

   i. For items including, but not limited to sealants, gaskets, pipe entry connectors, steps, racks, and other items installed before or after delivery, the precast concrete producer shall include proper installation instructions and relevant product data upon request.

D. Design Data

1. The precast concrete producer shall supply submittals showing design loading and material specifications for supplied products. At a minimum, the following shall be shown on the submittals:

   i. Live load used in design

   ii. Vertical and lateral earth loads used in design

   iii. Depth of soil fill on the structure

   iv. Water table depth used in calculations

2. Upon request, the precast concrete producer shall supply precast concrete unit design calculations and concrete mix design proportions and appropriate mix design test data. Structural design calculations shall be sealed by a licensed professional engineer.

E. Test Reports

1. Upon request, the precast concrete producer shall supply copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for Portland cement, blended cement, pozzolans, ground granulated blast-furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project

2. Upon request, the precast concrete producer shall submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, plastic air content, temperature of freshly mixed concrete, and slump of freshly mixed concrete. Special tests for precast concrete items shall be clearly detailed in the specifications

3. Upon request, the precast concrete producer shall supply copies of in-plant QA/QC inspection reports.

1.6 DESIGN

The following items shall be accounted for in the precast unit design.

A. Precast Concrete Unit Design

1. Design standard precast concrete units to withstand design load conditions in accordance with the applicable industry design standards. Design must also consider stresses induced during handling, shipping, and installation in order to avoid product cracking or other handling damage. Design loads for precast concrete units shall be indicated on the shop drawings, and designed by a licensed professional engineer.
2. At least one (1) maintenance module shall be provided by the precast manufacturer.

B. Joints and Sealants

1. Joints and sealants between adjacent units shall be of the type and configuration indicated on the shop drawings meeting specified design and performance requirements.

C. Concrete Mix Design

1. Concrete type
    i. For non machine cast products, the concrete shall be self-consolidating concrete which produces minimal bugholes and does not segregate.
2. Concrete Proportions
    i. Selection of proportions for concrete shall be based on current self-consolidating concrete mix design techniques. At a minimum, ACI 211.1 shall be used.
    ii. Upon request the precast concrete producer shall submit a mix design for each strength and type of concrete that will be used. Submitted mix designs shall include the quantity, type, brand and applicable data sheets for all design constituents as well as documentation indicating conformance with applicable reference specifications.
3. Durability and Performance Requirements
    i. Concrete Compressive Strength
        1. Precast concrete units shall have a 28-day compressive strength of 5000 psi for SCC.
    ii. Water-Cementitious Ratio
        1. Concrete that will be exposed to freezing and thawing shall contain air and shall have a water-cementitious ratio of 0.45 or less. Concrete which will not be exposed to freezing, but which is required to be leak resistant, shall have a water-cementitious ratio of 0.48 or less. For corrosion protection, reinforced concrete exposed to deicer salts, brackish water or seawater shall have a water-cementitious ratio of 0.40 or less.
    iii. Air Content
        1. The air content of concrete that will be exposed to freezing conditions shall be within the limits given below

Nominal Maximum Aggregate size (in)	Air Content %	
	Severe Exposure	Moderate Exposure
3/8	6.0 to 9.0	4.5 to 7.5
½	5.5 to 8.5	4.0 to 7.0

¾	4.5 to 7.5	3.5 to 6.5
1	4.5 to 7.5	3.0 to 6.0
1-1/2	4.5 to 7.0	3.0 to 6.0
* For specified compressive strengths greater than 5000 psi, air content may be reduced 1%		

1.7 QUALITY ASSURANCE

The precast concrete producer shall demonstrate adherence to the standards set forth in the plant Quality Control Manual. The precast concrete producer shall meet the requirements written in subparagraph 1.7.A. The precast concrete producer shall provide a limited warranty for their product of at least 2 years in length.

A. Qualifications, Quality Control and Inspection

1. The precast producer shall maintain a permanent quality control department.
2. The precast concrete producer shall have a quality control program which is audited for compliance annually by persons outside that plant's employee structure.
3. Upon request, the precast concrete producer shall supply a copy of their quality control manual.

B. Quality Control

1. The precast concrete producer shall show that the following quality control tests are performed as required and in accordance with the ASTM International standards indicated
    i. Concrete Testing
        1. Slump: A slump test shall be performed at least once per day per mix design used. Slump tests shall be performed in accordance with ASTM C 1611 for self-consolidating concrete.
        2. Temperature: The temperature of fresh concrete shall be measured each time a slump, air content, or compressive strength tests are made. Temperature shall be measured in accordance with ASTM C 1064.
        3. Compressive Strength: At least four compressive strength specimens shall be made each day for each mix design unless otherwise specified. In accordance with ASTM C 31, C 39, C 192.
        4. Air Content: Tests for air content shall be performed if the mix design specifies air entrainment. The air content will be measured in accordance with ASTM C 231. The Air Content shall be measured once per day per mix design.
        5. Density (Unit Weight): Tests for Density (Unit Weight) shall be performed monthly for each mix design used at a minimum. Tests shall be in accordance with ASTM C 138
    ii. Aggregate Testing
        1. A full set of aggregate tests shall be performed on each aggregate at

least annually by an independent testing agency or an in house test lab. These tests will include gradations (ASTM C136), Soundness (ASTM C 88), Organic Impurities (ASTM C 40), Sand Equivalent for fine aggregates only (ASTM D 2419)

2. Potential reactivity shall be performed once per each aggregate source, and when aggregate sources change (ASTM C 1260 or C 1293)
3. Monthly, at a minimum, gradations shall be performed per ASTM C 33.
4. Aggregate Moisture tests: Moisture tests on aggregates shall be performed in accordance with ASTM C 70 or ASTM C 566. Fine aggregate moisture content tests shall be performed at least once per day if there are no moisture meters, otherwise it shall be performed once per month. Alternatively the speedy moisture test is acceptable (ASTM D 4944).

iii. Preplacement Check

1. All products shall be inspected for accuracy prior to placing concrete. Checks shall include, but not be limited to, form condition and cleanliness, form dimensions, joints, release agent, blockouts, inserts and locations, lifting devices, reinforcing steel size, spacing, clearances and proper placement.
2. Preplacement checks shall be documented and initialed by the inspector. A drawing with verifications of the above criteria can be used as documentation.

iv. Post placement Check

1. All products shall be inspected for accuracy after the concrete forms have been removed. Checks shall include, but not be limited to, dimensional checks, finishing, insert locations, squareness, honeycombing, cracking, marking, coatings, racking, hole size and location. Postplacement checks may require a corrective action report.
2. Postplacement checks shall be documented and initialed by the inspector. A drawing with verifications of the above criteria can be used as documentation.

2. Copies of the test results and Inspections above shall be available upon request.

C. Outside Inspection

1. The customer or customer's agent (specifier) may place an inspector in the plant when the units covered by this specification are being manufactured. The precast concrete producer shall give notice of 3 days prior to the time the precast concrete units will be available for plant inspection

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling

1. Precast concrete units shall be handled and transported in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Lifting shall be accomplished with methods or devices intended for this purpose as indicated

on the shop drawings. Upon request, the precast concrete producer shall provide documentation on acceptable handling methods for the product.

B. Storage

1. Precast concrete units shall be stored in a manner that will minimize potential damage.

C. Delivery

1. Precast concrete units shall be delivered to the site in accordance with the delivery schedule. Upon delivery to the jobsite, all precast concrete units shall be inspected by the customer's agent for quality and final acceptance.

D. Final Acceptance

1. Upon final acceptance, the customer's agent acknowledges and understands the appropriate methods for handling the accepted precast concrete unit(s). Upon acceptance by the customer or customer's agent, the precast concrete manufacturer is not responsible for replacing damaged product resulting from improper handling practices on the job site.

1.9 PLANT CONDITIONS

Any plant producing precast concrete units for this specification shall have a written, implemented, comprehensive safety and environmental program. Upon request, documentation shall be provided to show the safety program meets the following minimum requirements.

A. Safety Program Requirements

The safety program shall include the following written and documented parts as a minimum.

1. Housekeeping
2. Lock-Out Tag-Out
3. Machine Guarding
4. Risk Assessment
5. Personal Protective Equipment
6. Contractor and Visitor Safety
7. Cranes and Lifting Equipment Safety
8. Ergonomics and handling Safety
9. Fall Protection

B. Health and Safety Management System Requirements

The health and safety management system shall be used to manage the safety program and all measureable aspects.

C. Environmental Management System Requirements

The Environmental Management System shall encompass the following:

1. Air Pollution Control
2. Water and Wastewater Management

D. Recordable rate

1. The recordable rate shall be below the industry average. If the industry average is not readily available, assume a value of 6 recordable injuries per 200,000 hours worked as the industry average.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Foley Products Inc.

B. Substitutions: Alternative systems must be preapproved by the engineer 30 days prior to the project bid date.

2.2 MATERIALS

Except as otherwise specified, material shall conform to the following section.

A. Materials

Cement	Standard Specification for Admixtures to Inhibit ASTM C 150 (Type I, II, III, or V) ASTM C 595 (for Blended Cements)
Silica Fume	ASTM C 1240
Fly Ash and Pozzolans	ASTM C 618
Ground Granulated Blast-Furnace Slag	ASTM C 989
Water	ASTM C 1602 (the use of reclaimed/recycled water shall be permitted)
Aggregates	ASTM C 33 (and aggregate specifications)
Air Entraining Admixtures	ASTM C 260
Accelerating, Retarding, Water Reducing Admixtures	ASTM C 494
Corrosion Inhibitors	ASTM C 1582
Reinforcing Bars	ASTM A 615 or ASTM A 706
Plain, Welded Wire Reinforcement	ASTM A 185
Deformed, Welded Wire Reinforcement	ASTM A 497
Epoxy Coated Reinforcing Bars	ASTM A 775

Epoxy Coated Welded Wire Reinforcement	ASTM A 884
Hot-Dipped Galvanizing for Inserts	ASTM A 152
External Sealing Bands for Pipe	ASTM C 877
Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections	ASTM C 990
Elastomeric Joint Sealants	ASTM C 920
Pipe Entry Connectors	ASTM C 923, ASTM C 1478
Nonshrink Grout	ASTM C 1107

2.3 MANUFACTURING

Manufacturing shall conform to the producer's acceptable quality control manual

A. Forms

1. Forms for manufacturing precast concrete units shall be of the type and design consistent with the precast concrete industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Forms shall be constructed so that the forces and vibrations to which the forms will be subjected cause no damage to the precast concrete unit.
2. Forms shall be cleaned of concrete build-up after each use.
3. Form release agents shall be applied according to the manufacturer's recommendations and shall not be allowed to build up on the form casting surface.

B. Reinforcement

1. Cages of reinforcement shall be fabricated by tying the bars, wires or welded wire reinforcement. The tolerances for concrete cover shall be 3/8 in. or as specified in the design. Welding shall be allowed only for ASTM A 706 rebar.
2. Positive means shall be taken to assure that the reinforcement does not move significantly during the casting operations

C. Embedded Items

1. Embedded items shall be positioned at locations specified in the design documents. Inserts and other embeds shall be held rigidly in place so that they do not move significantly during casting operations.

D. Concrete

1. Concrete Mixing
    i. Mixing operations shall produce batch-to-batch uniformity of strength, consistency and appearance
2. Concrete placing
    i. Concrete shall be placed in a manner in which it flows and consolidates without segregation or air entrapment. The freefall of concrete shall be kept to a minimum.

ii. Cold Weather Concreting

1. Recommendations for cold weather concreting are given in detail in ACI 306 R. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing temperatures. All concrete materials, reinforcement, and forms shall be free from frost. In cold weather, the temperature of the concrete at the time of placement shall not be below 45 degrees F. Concrete that freezes before it reaches a compressive strength of 500 psi shall be discarded.

iii. Hot Weather Concreting

1. Recommendations for hot weather concreting are given in detail in ACI 305 R. During hot weather excessive concrete temperatures and water evaporation shall be minimized. The temperature of concrete at the time of placing shall not exceed 95 degrees F.

3. Concrete Curing

i. Curing operations shall commence immediately following the initial set of the concrete and completion of surface finishing.

ii. Curing by moisture retention

1. Precast products shall be protected from drafts and wind to prevent plastic shrinkage cracking.
2. Moisture shall be prevented from excessively evaporating from exposed surfaces until adequate strength for stripping the precast concrete unit from the form is reached.

iii. Curing with Heat and Moisture

1. Concrete shall not be subjected to steam or hot air until after the concrete has attained its initial set. If hot air is used, precautions shall be taken to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed 150 degrees F. The temperature gain shall not exceed 40 degrees F per hour.

4. Surface Finish

i. The surface finish shall be as specified on the contract documents and/or approved shop drawings.

5. Stripping Precast Concrete Units from Forms

Precast concrete units shall not be removed from the forms until the concrete reaches the compressive strength for stripping required by design. Stripping strengths shall be routinely measured to ensure product has attained sufficient strength for safe handling.

6. Patching and Repair

i. Repairing Minor Defects

1. Defects that will not impair the functional use or expected life of the precast concrete unit may be repaired by any method that does not impair the product

ii. Repairing Honeycombed Areas

1. When honeycombed areas are to be repaired, all loose material shall be removed and the areas cut back into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Proprietary repair

materials shall be used in accordance with the manufacturer's instructions. Otherwise, the area shall be saturated with water. Immediately prior to repair, the area should be damp, but free of excess water. A cement-sand grout or an approved bonding agent shall be applied to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

iii. Repairing Major Defects

1. Defects in precast concrete products which impair the functional use or the expected life of products shall be evaluated by qualified personnel to determine if repairs are feasible and, if so, to establish the repair procedure.

7. Shipping Precast Concrete Units

i. Precast concrete units shall not be shipped until they have reached at least 70% of their specified 28-day design strength, unless damage will not result, impairing the performance of the product.

PART 3 EXECUTION

3.1 SURVEY

A. The installation area shall be surveyed using the work print and a checklist to identify the work to be done and to determine that the plans are correct

B. All underground facilities and structures such as gas, water, sewer, power, telephone cable, and so forth shall be located and identified. Location markings shall be placed by the affected utilities before construction

C. The survey shall identify and obstacles such as overhead wires, building structures that will interfere with crane operations, work progress, or create a safety hazard.

D. The survey shall give consideration to the soil structure so that proper shoring, sloping, or both may be planned in advance of the excavation work

3.2 PLANNING

A. Permits required to do work in accordance with the detail plans shall be secured before starting the job. All permits or a record of the permits shall be retained on the job for immediate reference

B. All utilities and owners of surface and subsurface facilities and structures in the area shall be given advance notification of proposed excavation. Every effort shall be made to avoid damage to the facilities of others. If any damage occurs, the owner of the damaged facility shall be notified immediately.

C. Planning shall include the coordination of all responsible parties to ensure that arrangements for removal of excess and damaged material have been made.

D. Should it appear that a structure location will interfere with traffic, review the situation with the engineer and notify appropriate authorities.

E. Provide for access to call boxes, fire hydrants, etc.

3.3 SAFETY REQUIREMENTS

A. Safety requirements for construction shall be in accordance with all federal, state, and local regulations.

3.4 EXCAVATING

A. If unforeseen facilities or obstructions are encountered, stop excavation operations immediately. Expose the obstruction with wood handled digging tools and investigate them with caution. If there is any doubt as to the type of obstruction exposed, request positive identification from those suspected of owning the facility and then proceed as circumstances dictate.
B. Inspect excavations after every rain storm or other hazard-increasing occurrence, and increase the protection against slides and cave-ins, if necessary
C. In dewatering excavations, make certain that the discharge is carried to a suitable runoff point
D. Excavation size shall be large enough to allow access around the structure after it is installed.

3.5 SHORING

A. Shoring for construction shall be in accordance with all federal, state, and local regulations

3.6 INSTALLATION

- Follow all manufacturer's instructions.
- Conduct preconstruction meeting with manufacturer / supplier.

  Include Civil Engineer, Installing Contractor and subcontractors (if applicable), manufacturer and state or local government as required.

A. Site Access

   The general contractor shall be responsible for providing adequate access to the site to facilitate cranes, delivery trucks, unit storage, and proper handling of the precast concrete units.

B. Installation
C. Vertical deviations of bedding materials must remain under .25" (3.175 cm) versus specified elevation. Bedding shall be placed according to manufacturer's recommendations.

   Precast concrete units shall be installed: to the lines and grades shown on the contract documents or otherwise specified; be lifted by suitable lifting devices at points provided by the precast concrete producer; in accordance with applicable industry standards. Upon request, the precast concrete producer shall provide installation instructions.

   Field modifications to the product shall relieve the precast producer of liability and warranty regardless if such modifications result in the failure of the precast concrete unit.

D. Leak Resistance

   Where leak resistance is a necessary performance characteristic of the precast concrete unit's end use, joint sealant, pipe-entry connectors and other penetrations shall be sealed according to manufacturers requirements to ensure the integrity of the system.

   - Engineer to specify whether system is to be "soil-tight" or "water tight". Water tight

requirements and related sealing requirements should be detailed by the Engineer of Record on project plans and in project specification.

3.7 BACKFILLING AND RESTORATION

- Follow manufacturer's instructions for backfilling structure.

A. Perform backfilling as soon as possible after the structure has been placed.

B. Backfill material may be native soils but must be free from organic materials, large stones, rocks, and waste building materials. Expansive soil material shall not be used as backfill around the structure

C. Backfilling shall be achieved by lifts (layers) to the required compaction.

D. Follow up inspections for settlements are required. Should settlement occur, the contractor shall be responsible for all necessary repairs.

E. Operation and Maintenance shall be performed per the Operation/Maintenance Manual provided by the precast manufacturer. Operation/Maintenance responsibilities shall be established prior to construction.

3.8 FIELD QUALITY CONTROL

A. Job Site Tests

Job Site testing shall be performed per the contract documents and drawings.

B. Inspection

1. Final field elevations and compaction properties shall be verified and documented.

END OF SECTION