

**ITEM 17203.280502 M - "DOUBLEWAL" STRUCTURES**  
**ITEM 17203.280602 M - EXCAVATION AND DISPOSAL OF EXCAVATED MATERIAL**  
**FOR THE INSTALLATION OF DOUBLEWAL STRUCTURES**

**DESCRIPTION**

The work shall consist of constructing a "DOUBLEWAL" structure at the locations indicated on the plans.

"DOUBLEWAL" construction is patented system of the  
Doublewal Corporation  
59 East Main Street  
Plainville, Connecticut 06062  
(203) 793-0295

All necessary materials except backfill and cast-in-place concrete shall be obtained through a licensee of the Doublewal Corporation.

Doublewal Corporation shall supply a qualified, experience technical representative to advise the Engineer and Contractor concerning proper installation procedures. All instructions will be delivered to the Engineer.

Two weeks prior to the beginning of any construction, the Contractor shall supply the Engineer with two copies of the Doublewal Corporation Field Manual. In addition, he shall satisfy the Engineer that he is also in possession of two copies of the Doublewal Corporation Field Manual.

A. Definitions. The following definitions shall apply:

1. Module. A precast concrete unit used as a part of the Doublewal system. Modules may include precast parapets or traffic barriers.
2. Joint Fillers. Materials necessary to occupy the joints required for unit separation.
3. Doublewal Structure. A combination of modules and backfill which when properly placed together, forms a single contiguous structural element, generally a wall.
4. Unit Backfill. Material which is placed within the modules.

**MATERIALS**

A. Modules. These shall be fabricated in accordance with the requirements of Subsection 718-31 - Precast Concrete Modular Units (Doublewal Structure). The Contractor shall notify the Deputy Chief Engineer (Structures), (D.C.E.S.), of the name and address of the unit fabricator. Notification shall be given within 14 days after the award of Contract.

Precast concrete end panels, filler panels, and other incidental precast units shall be fabricated in accordance with the requirements of Subsection 718-31.

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**ITEM 17203.280602 M - EXCAVATION AND DISPOSAL OF EXCAVATED MATERIAL  
FOR THE INSTALLATION OF DOUBLEWAL STRUCTURES**

- B. Joint Fillers. No filler is required between vertical joints. Horizontal joint filler shall be preformed cork conforming to AASHTO M 153, Type II, and a premium grade closed cell polyethylene foam backer rod, and shall be placed as detailed on the shop drawings.
- C. Cast-in-Place Concrete.
1. Footings and Leveling Pads. This shall meet the requirements contained in the Special Note entitled, Modified Class F Concrete for Footings and Leveling Beams (Doublewal).
  2. Bar Reinforcement. Bar reinforcement for cast-in-place concrete shall meet the requirements of Subsection 709-01 - Bar Reinforcement, Grade 40.
- D. Unit Backfill. Material for Unit Backfill shall conform to the requirements specified in Subsection 703-02 - Coarse Aggregate. The size designation shall be 2, 3 or 4 as defined by Table 703-4.
- E. Geotextiles. The geotextile shall be on the Approved List for Bedding issued by the Department's Materials Bureau.
- F. Basis of Acceptance.
1. Modules. Acceptance shall be in accordance with the requirements of Subsection 718-31.
  2. Other Materials Except Unit Backfill. Acceptance shall be by certification of the supplier that the terms of this specification have been met. The Department reserves the right to sample material for testing for information purposes. Results of these tests will be applied according to written Departmental instructions. Samples will not be returned.

**CONSTRUCTION DETAILS**

- A. Excavation. Excavation shall be conducted in accordance with the applicable requirements of Section 206 Trench, Culvert and Structure Excavation, and the details specified in the contract documents.
- B. Foundations. At each unit foundation level, cast-in-place footings or leveling pads shall be provided where shown on the plans. Cast-in-place concrete shall be placed in the manner required by Subsection 555-3 Construction Details. The footings shall be given a wood float finish. The completed surface shall be constructed in accordance with grades and cross slopes shown on the shop drawings. When tested with a 3 m straight edge, the surface shall not vary more than 3 mm in 3 m.

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**ITEM 17203.280602 M - EXCAVATION AND DISPOSAL OF EXCAVATED MATERIAL  
FOR THE INSTALLATION OF DOUBLEWAL STRUCTURES**

C. Unit Inspection, Storage, Repair and Rejection. All Doublewal units shall arrive at the jobsite produced in accordance with all provisions of Subsection 718-31. The precast Doublewal units shall be inspected by the Engineer prior to installation to determine if any were damaged during shipment or storage. The decision to repair a unit or reject it shall require the concurrence of the D.C.E.S. Damaged Precast Doublewal Units shall be repaired in a manner approved by the Engineer. Precast Doublewal Units which the Engineer determines cannot be repaired shall be replaced by the Contractor with Precast Doublewal Units acceptable to the Engineer. If the Contractor stores units on the site, they shall be handled and stored in a manner acceptable to the Engineer. All repair and replacement work shall be done at no additional cost to the State.

D. Structure Installation.

1. Methods and Equipment. Units shall be erected in accordance with the Doublewal Corporation's instruction manual. Prior to installation of the units, the Contractor shall furnish the Engineer with detailed information concerning the proposed construction method, as well as the specific construction equipment he plans to use. No work shall be done without the Engineer's approval.
2. Construction. The precast concrete modular units shall be installed in accordance with the contract plans.

All modular units above the first course shall interlock with lower courses. Vertical joints shall be staggered with each successive course as shown on the plans. The vertical joint opening on the front face of the wall shall be between 6 mm and 13 mm. Joint filler and rubber pads shall be installed as detailed on the plans.

Exposed Unit Backfill material shall be covered by a layer of geotextile as shown on the contract documents to prevent migration of soil fines into the Unit Backfill.

Dumping of Unit Backfill from a height greater than 1 m above the top of wall unit will not be permitted.

The bottom 2 m of wall units shall be filled with Unit Backfill placed in lifts no greater than 300 mm thick and compacted to the satisfaction of the Engineer. Above 2 m, units 1.2 m in height shall be filled in one layer and thoroughly compacted, and units which are greater than 1.2 m in height shall be filled in two approximately equal layers, each compacted to the satisfaction of the Engineer.

Placement of backfill behind the wall shall closely follow installation of successive courses of units. At no time shall the difference in elevation between the backfill and the top of the last installed course exceed 2.1 m. At no time shall

**ITEM 17203.280502 M - "DOUBLEWAL" STRUCTURES**

**ITEM 17203.280602 M - EXCAVATION AND DISPOSAL OF EXCAVATED MATERIAL FOR THE INSTALLATION OF DOUBLEWAL STRUCTURES**

the elevation of the backfill behind the wall exceed the elevation of the Unit Backfill within the units.

The Contractor shall govern his operations and procedures so as to prevent misalignment of the units. Any misalignment which occurs in excess of the construction tolerances specified herein, shall be corrected by the Contractor in a manner acceptable to the Engineer, at no additional cost.

Underdrain, if required, shall be placed in accordance with the details shown on the plans and in accordance with applicable standard specifications.

3. Tolerances. The structure shall be constructed to the following tolerances:

Vertical alignment	20 mm per any 3 m segment
Horizontal alignment	20 mm per 3 m
Overall vertical alignment (top to bottom of structure)	20 mm per 3 m of wall height

**METHOD OF MEASUREMENT**

- A. Doublewal Structure Modules and Parapet Units (when required). The quantity will be determined as the total number of square meters of face area computed from the payment lines shown on the plans or between payment lines established, in writing, by the Engineer.

The computed face area will be obtained from the product of the height of the wall (as measured, parallel to the front face, from the top of wall to the bottom of the footing) and the horizontal length of the wall (as measured along the bottom of wall).

The computations shall take into consideration the possible variation in the elevations of the footing and top of facing units. No field measurements will be made unless the Engineer specifies, in writing, a change in the lines indicated on the Contract Plans.

- B. Excavation and Disposal of Excavated Material for the Installation of Doublewal Structures. The quantity shall be determined as the number of cubic meters of material computed in its original position between the payment lines shown on the Contract Plans or between revised payment lines established in writing by the Engineer.

**BASIS OF PAYMENT**

- A. "Doublewal" Structure. The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including

**ITEM 17203.280502 M - "DOUBLEWAL" STRUCTURES**

**ITEM 17203.280602 M - EXCAVATION AND DISPOSAL OF EXCAVATED MATERIAL FOR THE INSTALLATION OF DOUBLEWAL STRUCTURES**

the footings and leveling beams, joint filler and coping, parapets, geotextile and Unit Backfill.

No payment will be made for any damaged units, or for units which do not meet dimensional tolerances. Such units shall be repaired or replaced at no additional cost to the State.

- B. Excavation and Disposal of Excavated Material for the Installation of Doublewal Structures. The unit price bid shall include the cost of all labor, material and equipment necessary to complete the work, including the cost of grading and compacting all foundation soils.

Payment will be made under:

<b>PAYMENT ITEM NUMBER</b>	<b>ITEM</b>	<b>UNIT</b>
17203.280502 M	"Doublewal" Structures	Square Meter
17203.280602 M	Excavation and Disposal of Excavated Material for Installation of Doublewal Structures	Cubic Meter

## **718-31 PRECAST CONCRETE MODULAR UNITS (DOUBLEWAL STRUCTURE)**

### **SCOPE**

This specification covers the material and fabrication requirements for the precast concrete modular units as shown on the Contract Drawings. Drawings showing details for the manufacture of the units shall be submitted to the D.C.E.S. for approval. Manufacturing details shall include, but not be limited to, the size and shape of units, and the size and location of reinforcement. Tolerances shall conform to those specified herein. These modules shall be used to construct a Doublewal structure.

A modular unit is one precast concrete unit, whether standard, end or parapet type.

The word "supplier" shall mean a Licensee of the Doublewal Corporation, and all modules shall be obtained through said supplier.

### **MATERIALS**

General. The materials used for the fabrication of these units shall be either Manufacturer certified or Department approved prior to being incorporated in the units. Unless specifically noted as accepted by certification, the materials shall be Department approved through Department quality assurance procedures.

Concrete. Concrete shall meet the requirements of Section 501, Portland Cement Concrete - General, Subsections 501-2 Materials and 501-3 Construction Details, with modifications as noted:

1. Cement shall be Type 1, Type 2 or Type 3. Only one type and brand of cement shall be used for the units required for any one structure. NOTE: The use of Type 3 cement shall be restricted to concrete cured in accordance with Method 1 and 2, under Curing of this specification.
2. Coarse Aggregate gradation shall be N.Y.S., No. 1 size or ASTM Designation D448, No. 67 size.
3. Concrete proportioning requirements for the respective classes of concrete shall not apply.
4. Air content shall be 5.5 % minimum, 7.0% desired, and 9.0% maximum. Test to be performed in accordance with ASTM C-231.
5. Automatic proportioning equipment will not be required.

Reinforcing Bars. Reinforcing bars shall meet with requirements of Subsection 709-04 Epoxy - Coated Bar Reinforcement, Grade 40.

Lifting Sleeves. Lifting sleeves (PVC pipe) shall meet the requirements of the supplier.

Lifting Device. The type and adequacy of lifting devices shall be in accordance with the directives of the supplier.

## **FABRICATION**

Inspection. Fabrication of the units shall be inspected by an Inspector designated by the State. The Contractor shall inform the D.C.E.S. seventy-two (72) hours prior to:

1. Commencement of work.
2. Commencement of work after a work suspension of forty-eight (48) hours or more except for weekends.
3. Unit shipping.

The Contractor shall keep the Inspector informed of day-to-day fabrication scheduling operations. The Inspector shall have free access to the fabrication plant in order to satisfy himself that the work being done is in conformance with the Contract Documents. The Inspector shall be present when any test is made.

Work done at any time the Inspector has been refused or prevented access for inspection purposes shall automatically be rejected.

**PRODUCTION NOTE SHEET.** The Contractor shall submit the in-process production information required below. Except as noted, this information shall require the approval of the D.C.E.S., prior to the beginning of any fabrication. All information shall be noted on a sheet titled: PRODUCTION NOTE SHEET.

1. Size and Type of Sheet. The size and type requirements of Subparagraph 2A-Working Drawings, Size and Type, as given in Subsection 718-01, Prestressed Concrete Units (Structural), under Drawings, shall apply.
2. Information Required. The following information shall be given:
  - a. Description of the fabricating plant, including any backup concrete mixing facilities, original design mix (including name of source of all constituents) and proposed method of concrete placement. Modifications, or deviations, from original design mix, which occur at any time, shall be submitted in writing to the D.C.E.S.
  - b. Schedule of fabricating plant production and size of lot as required under CONCRETE STRENGTH VERIFICATION of this specification.
  - c. Quality Control tests and procedures, including the number of cylinders to be sampled per lot.
  - d. Method and outline of unit and cylinder curing procedures.
  - e. Winter concreting procedures, if need is anticipated.
  - f. Typical piece mark including the lot, number and date.

- g. Precasting tolerances as required under TOLERANCES of this specification.
  - h. Concrete lifting strength established by contractor and 28 day strength.
3. Submission For Approval. The procedures described under SUBMISSION OF WORKING DRAWINGS, of Subsection 718-01, shall apply.

Approval of this sheet shall not constitute approval of the information required under 2a, above. This data is for informational purposes only.

Commencement of Work. No fabrication work shall be started until the PRODUCTION NOTE SHEET has been approved and the Department's Inspector has received official copies.

Data For Inspector Approval. No fabrication work shall be started until the Inspector has received and approved the following data:

1. A calibration certificate attesting to the fact that the concrete cylinder testing machine to be used has been calibrated within the twelve (12) month period immediately prior to the first date of actual use of the machine.
2. Certificates indicating compliance with the requirements of this specification for all materials that are manufacturer certified.

Concrete Forms. Forms shall be well constructed, carefully aligned, and sufficiently tight to prevent leakage of mortar. The forms shall be constructed in a manner to allow exposed faces of the unit to be cast against steel form except where an architectural finish is specified.

All form surfaces that come in contact with the concrete shall be thoroughly treated with a form coating in the manner and at the rate specified by the Manufacturer.

Reinforcement and Appurtenances. Prior to installation in the units, the reinforcement and any other embedded material shall be free of frost, dirt, oil, or any material that may prevent bond between it and the concrete. Tack welding of cages is not permitted.

Concrete Mix Design and Proportioning. The Contractor shall be responsible for designing a concrete mix to produce the required minimum compressive concrete tested in accordance with this specification. If no compressive strength is indicated on the Contract Drawings, the required minimum compressive strength shall be 34.5 MPa at 28 days.

Maximum cement content for the design mix shall be limited to 446 kg per cubic meter.

The Contractor may request permission from the D.C.E.S. to incorporate a High Range Water Reducing (HRWR) admixture into concrete mix. The D.C.E.S. will grant such permission only if he deems it to be the best interests of the State and then only under such conditions as the D.C.E.S. requires.

If the atmospheric temperature is below 7\_ C, fabrication of the units shall only be done in accordance with the Winter Concreting Procedures noted on the PRODUCTION NOTE SHEET.

If Winter Concreting Procedures have not been previously approved, the Contractor shall submit them for approval, in accordance with the Submission For Approval Subsection of this specification. The D.C.E.S. will make every effort to reply in a timely manner. However, the time taken to review the Winter Concrete Procedures shall not be a reason to request an extension of time as provided for by Subsection 108-04 Extension of Time. Further, no additional compensation shall be made if Winter Concreting Procedures are employed.

Plastic concrete shall be consolidated in place by internal or external vibration methods or both. Internal vibrators shall be the "pencil" type. All vibrators shall be approved by the Inspector prior to use. Vibrators shall be used only to consolidate concrete after it has been properly placed. They shall not be used to move concrete within the forms. Internal vibrators shall be slowly inserted and removed from the concrete.

Suitable means shall be used for placing concrete without segregation. Concrete shall not be dropped from a height greater than 1 meter to place of deposition. Special care shall be taken to deposit the concrete in its final position in each part of the form.

The following quality control tests shall be performed and recorded by the Contractor, in the presence of the Inspector, from the same concrete sample as that used to satisfy the CONCRETE STRENGTH VERIFICATION Subsection of this specification:

1. Slump
2. Air Content
3. Concrete Temperature

Additionally, if truck mixed concrete is employed, the Contractor shall perform the above tests on material from each truck.

Curing. The method of curing concrete units shall be one of the following and shall meet the requirements of the Subsection noted:

- |    |                           |        |
|----|---------------------------|--------|
| 1. | Low Pressure Steam        | 718-01 |
| 2. | Radiant Heat and Moisture | 718-01 |
| 3. | Water Spray               | 706-02 |
| 4. | Saturated Cover           | 718-01 |

## **CONCRETE STRENGTH VERIFICATION**

### **General.**

1. Concrete strength shall be determined from concrete test cylinders made in conformance with the requirements of ASTM Designation C31 and cured in the same manner as the units they represent. All cylinders shall be tested in conformance with ASTM Designation C39 on testing machine approved by the Inspector. All cylinders shall be made and tested by the Contractor, in the presence of the Inspector.

Cylinders shall be made from the same batch of concrete actually placed in the units. Cylinders shall be made at the Inspector's discretion. The Inspector shall be the sole judge as to which cylinders are defective or damaged and are not to be included in the determination for the strength acceptance.

2. The Contractor shall cast a sufficient number of concrete test cylinders to fulfill the strength test requirements as stated in Testing For Concrete Strength. The Contractor may submit to the D.C.E.S., for approval, an alternate sampling procedure based on his concreting operation. If the alternate sampling procedure is approved, the Contractor shall indicate it on the PRODUCTION NOTE SHEET.
3. To verify 28-day strength, a minimum of four (4) cylinders shall be cast for each lot. The lot size shall not exceed the lesser of:
  - a. Ten Units **or**
  - b. The number of unit forms available for set-up at the time of casting.  
The Contractor shall indicate, on the PRODUCTION NOTE SHEET, the number of units that shall be defined as a casting lot.

All units within a lot shall be cast without interruption. If an interruption in casting is encountered for a period in excess of one hour, the units cast prior to the interruption shall be defined as a lot, and a new lot shall be established for those units subsequently cast.

Testing For Concrete Strength. The strength requirement for each lot shall be verified by the Contractor before that lot is accepted for strength. Strength determination shall be accomplished as follows:

1. 28-Day Strength. Two cylinders representing each lot shall be tested in immediate succession at twenty-eight days (28) of age to verify the required 28-day strength of the concrete. The average strength of the two cylinders shall be equal to or greater than the required 28-day strength with no cylinder testing below 33 MPa. If these requirements are not met, the remaining cylinders representing the lot shall also be tested at 28 days of age. Subsequently, the average strength of all cylinders representing the 28-day strength of that lot shall be equal to or greater than the required 28-day strength.
2. Option. The Contractor may test two cylinders representing each lot, in immediate succession, prior to the twenty-eight (28) day age limit. The average strength of the two cylinders shall be equal to, or greater than, the required 28-day strength with no cylinder testing below 33 MPa. If these requirements are met, the cylinder test at 28 days of age shall be waived. If the Contractor chooses this option of testing prior to 28 days of curing, additional cylinders shall be made so that a minimum of four cylinders are available for testing at 28 days.

## **FINISHING**

All surfaces of concrete shall be true and even, and free from depressions, projections and rough, open or honeycombed areas.

## **REJECTION OF UNITS**

Any unit not fabricated in accordance with the Contract Documents, or displaying any one of the following defects, shall be rejected:

1. Strength Requirements. All units of a lot represented by cylinders not meeting the required strength of concrete as specified under CONCRETE STRENGTH VERIFICATION.
2. Deleterious Materials. The materials used for the manufacture of concrete shall not contain, or cause concentration of, chemicals or other deleterious materials that are injurious to concrete as determined by the D.C.E.T.S. A total concentration of chloride ions in excess of 0.08% by weight of cement per cubic meter of concrete will be considered injurious. Sampling and testing concrete and materials, in order to determine specification conformance, will be in accordance with Department instructions.
3. Honeycombing. Honeycombing of the concrete to such an extent that chipping away of the honeycomb concrete results in exposed steel.

If chipping of the honeycombed portion causes a hole more than one-half the thickness of the unit to result, the unit will be rejected.

All honeycombed areas shall be chipped until sound concrete is detected. Sound concrete is defined as that point at which chipping causes fracture of the aggregates.

The inspector shall determine whether spalled, honeycombed or otherwise defective concrete shall be repaired or be cause for rejection. The decision to repair a unit or reject it shall require the concurrence of the D.C.E.S. Repair of units, if allowed, shall be done in a manner satisfactory to the Inspector. Regardless of what manner of repair is used, repair to concrete surfaces which will be exposed to view after construction is completed shall be such that the repaired area cannot be distinguished from the non-repaired.

## **TOLERANCES**

All units shall be checked for compliance with the tolerance listed below. Any unit which does not meet the listed tolerances shall be rejected. Responsibility for rejection shall rest solely with the Inspector, except that the total number of rejected units of a day's production may not exceed twenty (20) percent without the concurrence of the D.C.E.S.

Tolerances are as follows:

1. Module Dimensions. Face of module, length, and height shall be 5<sup>±</sup> mm.
2. Squareness. The length difference between the two diagonals shall not exceed 8 mm for modules up to 3 m wide, or 19 mm for larger modules.
3. Warping. Warping of the exposed panel face shall not exceed 5 mm in 2.5 m.

## **SHIPPING**

No unit shall be shipped until the required twenty-eight day strength has been attained.

Each unit shall be clearly marked with its piece mark, lot number, and the date of fabrication. This mark shall be indelible and shall be placed on a surface which will not be exposed to view after installation is completed.

No unit shall be shipped without the Inspector's stamp of approval.

**BASIS OF ACCEPTANCE**

The Inspector's stamp of approval shall constitute basis of acceptance for shipment to the project site.