

Evergreen Maxi Detailed Technical Specifications

SPECIFICATIONS FOR THE EVERGREEN® MAXI WALL

A prefabricated concrete retaining wall

Content

1. Scope
2. Design of wall System
3. Materials
4. Construction
5. Basis (for payment)

Section 1: SCOPE

- 1.1 This specification sets up requirements for the design, materials, manufacture, and construction of precast, reinforced concrete retaining Wall System.
Contract work consists of furnishing materials and installing retaining Wall in accordance with details shown on project plans.
- 1.2 Bidders attention is called to the fact that EVERGREEN retaining Wall units are the basis for this specification.

Section 2: Design of Wall System

- 2.1 Evergreen Units: The wall consists of precast concrete elements with a face vertical or battered 3 to 5 vertical to 1 horizontal. Wall components are all monolithic and do not consist of individual elements, except for board units near top of wall.
Such monolithic type elements are of variable width, wider elements used at the bottom, and smaller elements at the top.
In case of high vertical walls, a wide base of wall is needed made with two side-by-side units.
- 2.2 Resets: Using smaller elements on top of wider elements produces offsets, which will be either on the front side or on the rear, depending on specific wall design. This configuration contributes to improve structural integrity and safety at each joint. In cases, planting is desirable at intermediate levels; such horizontal resets at the outer surface provide rooms for plants and improve plant growth.
- 2.3 Topsoil: In case of planting such resets are to be filled with 8 to 10 inches of topsoil, preferably enriched with nutrients to expedite plant growth.
- 2.4 Design of Units: Evergreen wall components are specifically designed and manufactured for each individual application. Site-specific soil design parameters and traffic loads directly affect the size of Evergreen Maxi units and required steel reinforcement.
The Evergreen franchise includes in-depth Evergreen computer design software and trained staff engineers for specific design of each wall section.
- 2.5 Specific Location of Units: Each type of units is reinforced for resisting a certain range of loading conditions and position of unit beneath the crest of the wall, to be verified by the designer. In most cases, these units are reversible. However, in case of specific design, heavier steel reinforcement may be necessary. In case of wall corners or turns in the alignment of the wall, front panels must be shortened to fit. These units are to be marked individually at the time of manufacture indicating number of stack and number of layer to fit.
- 2.6 Fill Requirement: Units are designed to withstand pressures created by a certain type of backfill within the wall. Wall fill material to be utilized within precast units can be ordinary borrow material, provided water content is

within plus minus 2% of optimum water content and friction angle $\phi' =$ minimum 32° at cohesion $c' = 0$ (zero), and moist density after compaction, $\gamma = \text{min. } 18 \text{ kN/m}^3$.

A standard relative compaction is not a requirement, since this is not a pavement, but a gravity wall in which density is the key issue. Do not over compact to avoid over stress on units.

Fill material shall have 10 to 25% fines passing sieve #200, (0.074 mm); if fill contains 15 to 25% fines, then PL must be below 6 and fraction below 15 microns shall not exceed 15%. This means silt and clay material are not suited for filling.

- 2.7 Engineering Review and Stamp: These specifications are intended in conjunction with the Evergreen computer design program, used by a designer familiar with the specific soil qualities in dry climate conditions, such as saturation collapse and dissolving of chemicals in the fill and sub-ground materials.

Any design calculation including Evergreen software plots and prints must have final approval by the responsible design engineer before construction starts for evaluating the actual situation on site and incorporate any changes beforehand. These checks must include actual values of: soil parameters, height of fill behind wall, backfill slope, and surcharge loads.

Section 3: Materials

- 3.1 Unit materials: Materials shall meet the requirements specified in the following subsections:
- 3.2 Fill: Fill materials shall conform to the material requirements as specified in 4.10
- 3.3. Backfill: Backfill material shall conform to the material requirements as specified in 4.11
- 3.4 Concrete Units: Concrete elements shall be Evergreen monolithic type fabricated according to standard concrete specifications with the following exceptions and additions:
- (1) The Concrete shall have a compressive strength of 5000 psi = 35 kg/cm² = 35 MN/m² at 28 days.
 - (2) The units shall be fully supported until the concrete reaches a minimum compressive strength of 1.500 psi = 105 kg/cm² = 10 MN/m². The units may be shipped and installed after reaching a compressive strength of 4000 psi = 280 kg/cm² = 28 MN/m² within 14 days
 - (3) Concrete surface at the front of the elements shall be smooth as resulting from steel forms and for rear face or inner faces, no special requirements are requested. Rear or inner faces of elements shall be screened to eliminate open pockets of aggregate and surface distortions in excess of 1/4 in. The panels shall be cast in steel forms.
 - (4) Concrete should cover steel reinforcing by 1 1/4 in. = 38mm from reinforced surface. Concrete cover of reinforcement shall be maintained by positive mechanical control.
 - (5) Marking: The date of manufacture and piece mark shall be clearly scribed on an unexposed face of each unit.
 - (6) Handling, Storage and shipping. All units shall be handled, stored, and shipped in such a manner as to minimize the danger of chipping, discoloration, cracks, fractures, and excessive bending stresses. Elements in storage shall be supported on firm blocking, to protect the exposed exterior finish, and to prevent distortions.
 - (7) Tolerances all units shall be manufactured within the following tolerances:
 - a) General dimensions, position of suspending devices within 1 inch =

26mm; all other dimensions within 3/16 inch = 5mm.

b) Element dimensions: Dimensions as determined by length and transverse width near the legs shall not exceed 1/2 inch = 13mm.

c) Element surface finish: Surface defects on smooth formed surface measured over a length of 5 ft=1.50m shall not exceed 1/4 inch = 6mm.

(8) Compressive Strength: Acceptance of concrete elements with respect to compressive strength will be determined on the bases of production lots. A production lot is defined us a group of elements that will be represented by a single compressive strength sample and will consist of a single day production.

During the production of the concrete elements, the manufacturer will randomly sample the concrete in accordance with AASHTO T-141.

A Single compressive strength sample consisting of a minimum of 4 cylinders will be randomly selected for every production lot of every 20 cu yards.

Compression tests shall be made using standard 6" x 12" or 4" x 8" test specimen prepared in accordance with AASHTO T-23.

Compressive strength testing shall he conducted in accordance with AASHTO T-22.

If air entrained concrete is required, air content testing will be performed in accordance with AASHTO-T-196. Air content samples will be taken at the beginning of each day's production and at the same time as compressive samples are taken to ensure compliance.

The slump test will be performed in accordance with AASHTO T119. The slump will be determined at the beginning of each day's production and at the same time as the compressive samples are taken.

For every compressive strength, sample O minimum of two cylinders shall be cured in accordance with AASHTO T-23 and tested at 28 days.

The average compressive strength of these cylinders, when tested in accordance with AASHTO T-22, will provide a compressive strength test result, which will determine the compressive strength of the production lot.

The average compressive strength of these cylinders when tested in accordance with AASHTO T-22 will determine whether the forms can be removed or the elements shipped in accordance to 3.4.

Acceptance of a production lot will be made if the compressive strength test result is in accordance to AASHTO T-20, and then the acceptance of the production lot will be based on its meeting the following acceptance criteria in its entirety:

a) Ninety percent (90%) of the compressive strength test results for the overall production shall exceed 5200 psi = 365 kgjcm² = 36MN/m². b) The average of any six consecutive compressive strength test results shall exceed 5300 pounds per square inch.

c) No individual compressive strength test result shall fall below 4500 psi =316 kg/cm² = 32 MN/m².

d) Units shall be considered acceptable for placement in the wall when 7-day strength exceeds 65 percent of 28-day requirements.

Rejection: Units may be rejected for replacement or repair because of failure to meet any of the requirements specified above.

(9) Corrosion protection: Special consideration shall be given where the wall will be exposed to seawater, maritime atmosphere, and or sulphate.

(10) Curing:

a) All units will be covered with a moisture barrier membrane covering immediately after pouring to hold in heat and moisture, and will remain covered until a stripping strength of 1500 psi = 105 kgjcm² = 10 MNjm² has been attained.

b) All units shall be protected from frost and from direct rays of the sun and from drying for 72 hours or until the units reach 90% of their design

strength (5000 psi = 350 kg/cm² = 35MN/m²). This protection shall be either by a totally enclosed building or by the use of insulated heavy plastic covering adequately secured to avoid movement and or drying of green concrete created by wind and severe gain on hot days or 1055 of temperature or freezing.

- c) Should steam curing be used, at a minimum two hours elapse time is required after casting until the steam is applied. Thereafter, the rate of temperature rise shall not exceed 20 degrees Fahrenheit = 11°C per hour. The temperature of the steam enclosure shall not exceed 165 degrees F = 74°C. In temperatures below 50 degrees F = 10°C, allow four hours cool down inside to prevent thermo cracks.

Section 4: Construction

- 4.1 **Acceptance of Units on Site:** All units shall be subject to final acceptance on site. It shall be the contractor's responsibility to ensure that all units are erected in an undamaged condition.

The Project Engineer's representative may carry out such tests or measurements as he thinks fit to satisfy himself that the units delivered to the site are equal in quality to the units specified and are in accordance with the approved design. Where these tests are of a destructive nature and units prove acceptable, the cost of the units as delivered to the site of testing will be at charge to the contract.

Units that do not satisfy the material requirements or the dimensions and tolerances of this specification will be liable to rejection. Units with structural cracks are unacceptable shall not be placed in the Wall.

Rejected units shall immediately be removed from the site and shall be replaced with acceptable units at no extra cost to the contract.

- 4.2 **Wall Layout:** Crib wall construction shall be in reasonably close conformity to the lines, grades, design and dimensions shown on the Plans and as established by the Project Engineer by means of surveyed staking.

The Contractor shall obtain the Engineer's approval of alignment before casting any concrete or placing any Evergreen elements.

- 4.3 **Excavation and Foundation Preparation** - A bench excavation to sound material shall be made for the base of the retaining wall. Except for vertical walls, the benches shall be slanted in accordance with the wall batter, horizontal in the line of the wall and have a fall of 1 in 4 (or as specified for the wall batter), from the front to the back of the excavation.

The depth of the excavation shall be a minimum of 1.0 foot = 0.30m below the proposed finished ground level at the front face of the wall, or as shown on the project plans.

Contractor shall call for and obtain the Engineer's inspection and approval of the excavated foundation prior to casting any concrete or placing any Evergreen units.

Any soft, wet, organic, or other deleterious material evident at the footing area shall be sub-excavated a minimum of 2 ft and backfilled with clean Sand or gravel and compacted in lifts of 1 ft = 0.30m maximum.

Bulk excavation to bring grade within 0.5 feet = 0.15m of base excavation is not a part of the retaining wall contract.

Finished base excavation to within 0.5 inches = 13mm of base excavation shall include vertical Steps where plans indicate base of wall is to Step.

Prior to wall construction, except where built on the rock, the foundation shall be compacted with mechanical compaction equipment.

Minimum requirement for foundation material beneath foundation is as shown on drawings.

- 4.4 **Foundations:** Remove any soft, wet, organic, or otherwise unsuited material in the footing area and replace it with a minimum of 0.3m of clean gravel placed and compacted in max. 0.3m lifts.

Minimum requirement material beneath foundation depends on

individual project design as shown on drawings: friction angle $\phi = \min. 35^\circ$, cohesion $c = \text{zero}$, $\gamma = \min. 20 \text{ kN/m}^3$.

Should there be material beneath foundation of lower quality, wider Evergreen will be required according to the required redesign.

Should such local observation be the case immediate measures are needed for redesign, exchange of foundation materials and possible change of base units.

Provide concrete foundation $\min. 25 \text{ MN/m}^2$ and grade 500 MN/m^2 rebars.

Concrete cast against excavation with finished top to ensure proper grade and elevation at zero to minus 25 mm tolerance.

4.5 Drainage: any retaining wall needs a complete drainage concept and drainage system, such as:

Surface drains and culverts are needed for collecting any surface water runoff and direct it away from the wall crest and away from the wall foundation to avoid any erosion.

Provide a vertical 'layer' of free draining material, $\min. 0.30\text{m}$ thickness directly behind the wall facing for collecting and diverting any water to the bottom of the wall or to drain through joints.

However, at the top of the wall cover the free draining 'layer' with non-draining material, $\min. 0.30\text{m}$ thick, to prevent clogging of vertical drain.

Horizontal and vertical joints are to be covered with a strip of geotextile to prevent any fill erosion from inside the units.

At the heel of the wall a drainage pipe $\min. \text{dia } 100\text{mm}$, with provisions for servicing and cleaning, shall be placed to collect any infiltrated water and bring it toward the low points in the surroundings.

Such drainpipe shall be covered with $\min. 0.3\text{m}$ of free draining material and then covered with a geotextile to prevent clogging.

4.6 Joints: before erecting any unit place mortar on the foundation pad to ensure well bearing contact surfaces for distributing wall loads.

Use mortar pads on each contact surface between units (under legs AND under front panels), except for joints between regular units less than 3m from the top of the wall.

Carefully use mortar pads under the center portion of board units and girder beams and parapets at any place to prevent spalling of unit below while backfilling.

Leave openings in mortar pads at any level near ends of face panels and at midspan between legs for drainage.

Inside of joints shall be covered with a strip of geotextile as mentioned above.

4.7 Base Slab for Individual Footing - The footing designs are varied according to the specific job site conditions. They are to be built as per the detail on the approved construction plans.

4.8 Wall Erection - From time to time, an Evergreen field representative shall be available during the erection on the wall site at no additional cost to the project.

Precast concrete elements shall be handled and placed in such a manner that they are not severely cracked or chipped and so that no damage is caused at seating areas.

Precast concrete elements shall be placed in such a way that final position is vertical or battered, as shown on the plans. Lifting devices or excavators have to handle the units with long belts for erection. Such belts or cables shall be long enough to support elements at an angle of 45° or steeper. Cables shall not be used nor forklifts because of potential damage and discoloring.

All elements shall be placed on mortar beds and elements shall be adjusted by means of temporary wedges. After positioning of the elements, the mortar bed shall be completed using dry-pack as necessary.

Do NOT put mortar beds under the front panel for a length of about 0.30m next to the outer ends of panels and at mid-span for facilitate drainage and prevent water pressure build-up behind the panels.

An engineer's level is to be used to adjust the first layer of elements with an accuracy of plus or minus 2mm in the first row.

Wooden wedges to be used to check proper batter at top of each element. Use wooden wedges for adjustment of neighboring units as needed.

Do NOT use mortar beds in joints closer than 3.0m to the crest of the wall. However, use careful mortar beds at center of front panel for board units to prevent spalling of unit below while backfilling board units.

Section 5: Basis for payment

- 5.1 Payment for retaining wall shall be made from top of foundation to crest of wall including board units, parapets or bridge abutment wall, measured parallel to facing, thus nominal unit height and length, i.e. the nominal number of units.
- 5.2 Payment for foundation excavation, foundation work including leveling pads, concrete and reinforcing are paid under separate provisions.

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