DOUBLEWAL®

INTERLOCKING PRECAST RETAINING WALL SYSTEM

FIELD MANUAL

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FIELD PREPARATION

FIELD OPERATIONS

INTRODUCTION

This manual is intended to be a guide to the rapid, economical and safe erection of Doublewal structures. For ease of use, it is divided into two principal sections:

Field Preparations - Things to know and do before construction;
Field Operations - Including suggestions to make construction as easy as possible.

Each project that utilizes Doublewal is individually designed; therefore, if there is a variation between the instructions in this manual and those of your approved project drawings and specifications, then your approved project drawings and specifications must be followed.

Doublewal structures are simple to install if the approved drawings, specifications and this manual are reviewed by the contractor, superintendent and foreman, before work is started.

APPLICATIONS

The Doublewal precast wall system uses specially designed interlocking modules. These modules are manufactured to close tolerances, which enables them to be rapidly and economically erected.

Doublewal applications include various forms of retaining walls along highways and railroads, retaining structures for building sites, bridge abutments, wing walls, flood control channels, check dams, canal walls, sea walls, blast walls, tank farms, dikes, transfer stations, sound barriers and many others.

In addition to permanent construction, Doublewal is also practical for temporary use. Because it is an interlocking component system, it does not require fastening and may be disassembled, transported, and reused easily and economically.

CONSTRUCTION BENEFITS

- Fast, simple and safe wall erection to save you money. Up to 2,000 sq. feet per day is achievable.
- Cost savings over traditional cast-in-place designs. No formwork to set up and tear down, no reinforcing to bend and tie, no waiting for the concrete to reach strength, no waiting for the right weather conditions.
- The use of temporary sheet piling can be minimized or eliminated.
- No geogrid required which minimizes the cut depth and labor costs.
- All weather construction.
- 32 sq. feet nominal face size means fewer picks. Modules interlock so no temporary bracing is required.
- Easy to backfill and compact as the wall modules are erected.
- Designed to suit existing soil conditions.

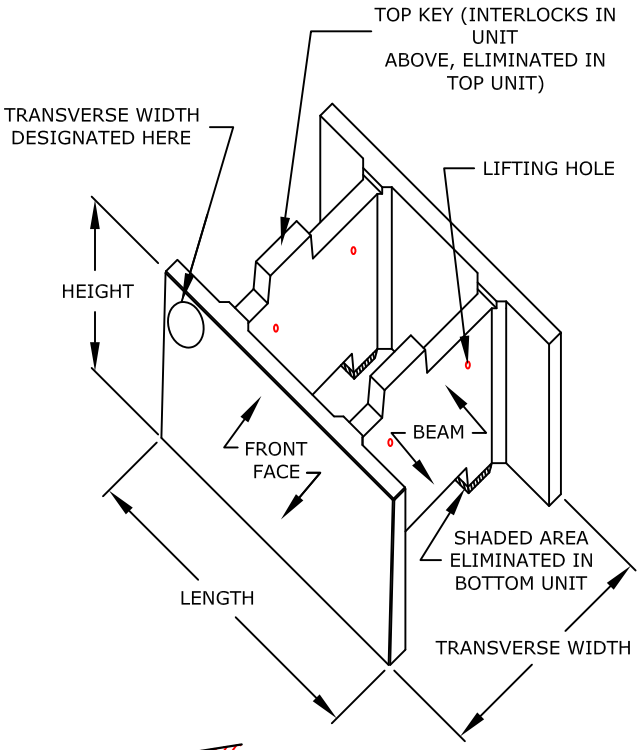
PRODUCT

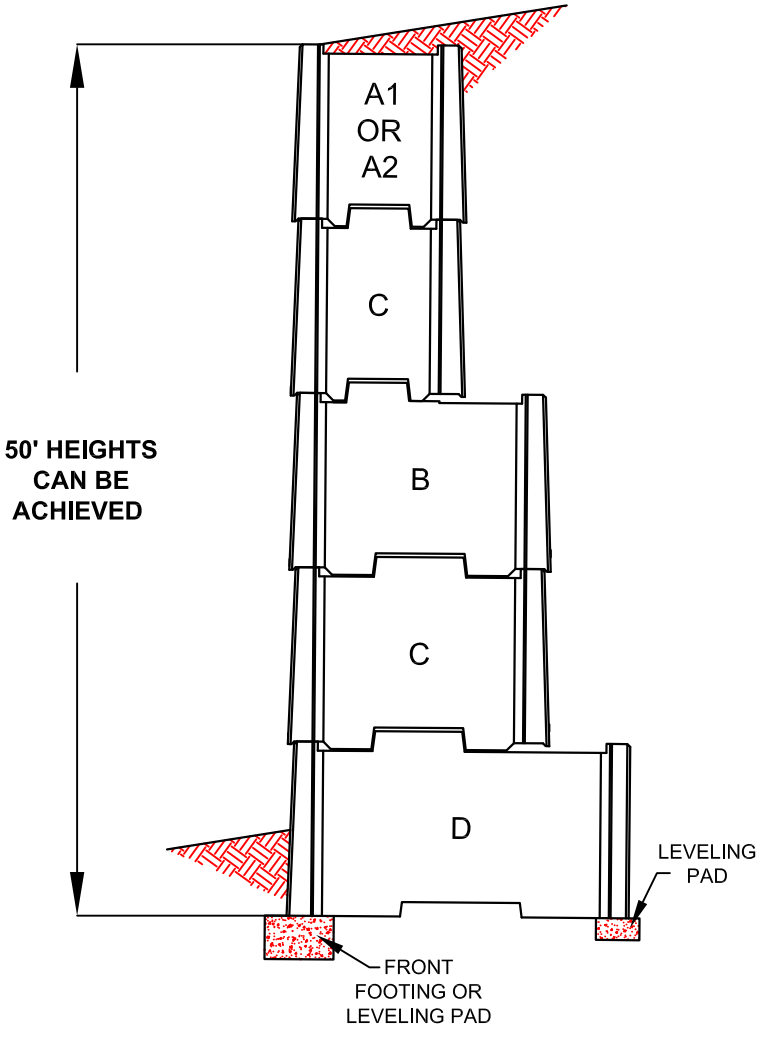
- Quality precast reinforced concrete modules are custom built to the customers specifications in a plant controlled environment.
- Advanced engineering is done for each individual wall design in-house, allowing a quick turn around of your project.
- The versatility of design allows use in many conditions where other wall systems are not practical.
- Optional precast parapet/ traffic barrier/ coping along the top of the wall can be fabricated to follow grade or site conditions.
- Many surface treatments are available and can be customized to the customers requirements.
- Wall heights in excess of 50 feet are possible.

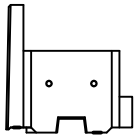
REPAIRS

- Repairs to Doublewal modules and related precast units at the job site should be done by the manufacturer's personnel or, if this is impractical, done under their direction. The material and methods used must be as specified by the manufacturers.
- Repairs must conform to the balance of the work with respect to appearance, strength, and durability.

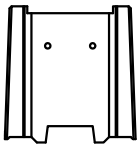
TYPICAL WALL MODULE



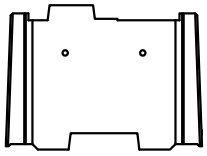




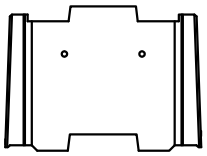
TYPICAL CHOP TOP MODULE - A1



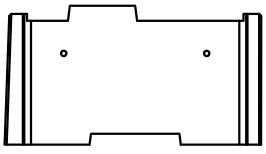
TYPICAL STANDARD TOP MODULE - A2



TYPICAL TRANSITION MODULE - B



TYPICAL STANDARD MODULE - C



TYPICAL BOTTOM MODULE - D

FIGURE 1

NOMENCLATURE

Modules generally are described by their width; on the erection drawings, width is shown in the upper left corner of each module. The typical face dimension is 4' high x 8' long. Generally, the base course of modules may include 6' high and 8' long units; the top course of modules may include 2' high x 8' long units.

BATTERED WALL..... Wall on an incline from a vertical plane.
BEAM..... Connecting elements between the two face panels of a module.
BOTTOM KEY..... Female key at the bottom of the beam.
BOTTOM MODULE..... Module designed for the base course of the wall.
END PANEL..... Concrete slab cast into the end of a module.
FACE PANEL..... Exposed finished panel of a module.
FULL MODULE..... Eight-foot long module with two beams.
HALF MODULE..... Four-foot long module with one beam, typically positioned at the end of the wall or at an angle point.
JOINT MATERIALS..... Cork strips, ethafoam rod, filter fabric, masonite shims, and rubber pads.
LIP..... Exterior bottom edge of a face panel.
MODULE..... Basic precast unit used to build the wall structure.
PARAPET..... Vertical precast panel above the top course of modules, typically 16' long, 2' to 7' high, manufactured to follow grade, secured by a cast-in-place concrete slab.
PLUMB WALL..... Wall that is on vertical plane.
TOP KEY..... Male key at the top of the beam.
TOP MODULE..... Module, designed without a top key, for the top course of the wall.
TRANSITION MODULE..... Module that can accommodate a module of a different width above; therefore, its top key is in a different position than that of a standard module.

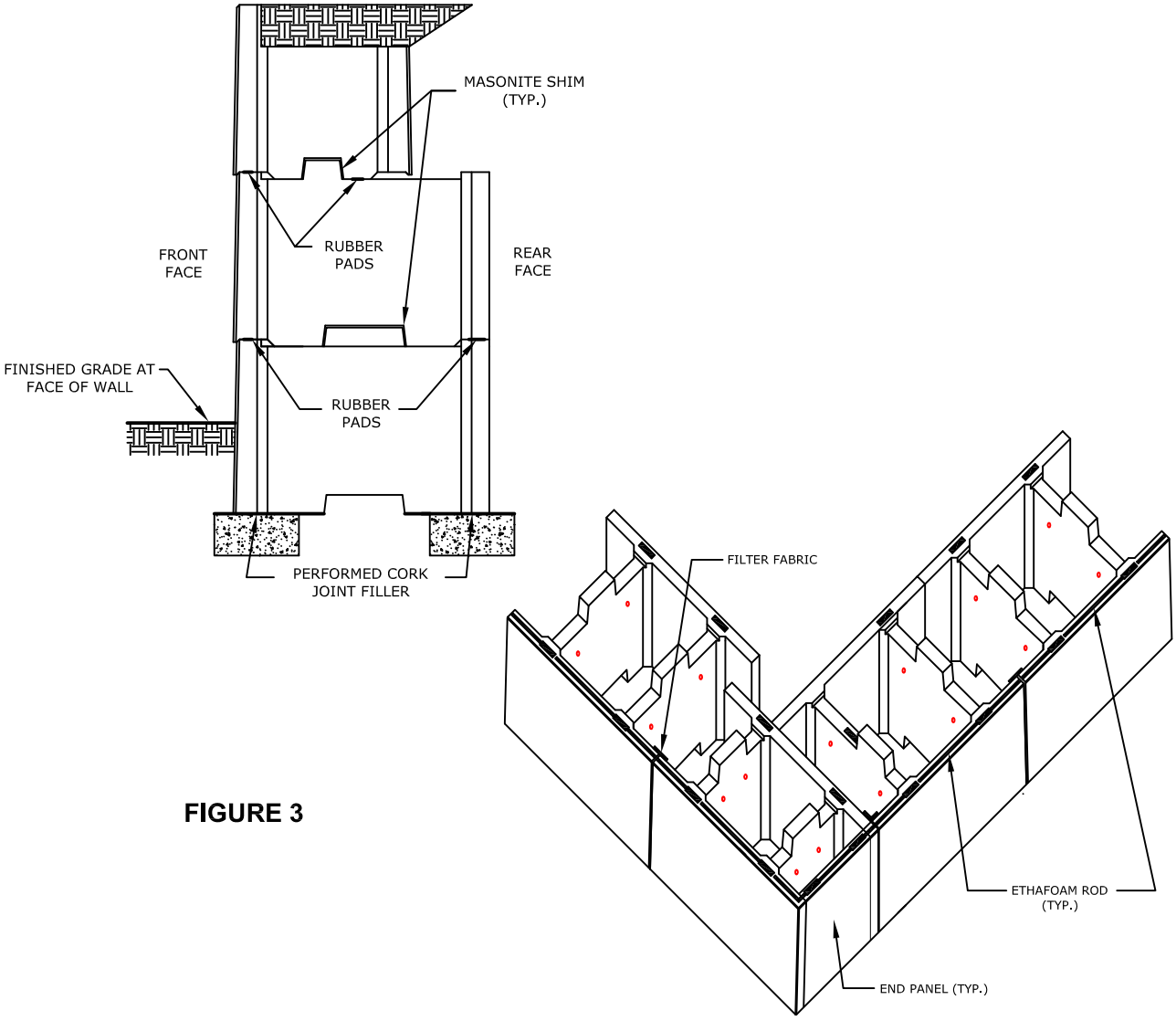


FIGURE 3

MATERIALS

ALL THE MATERIALS BELOW ARE PROVIDED BY THE PRECASTER.

CORK STRIPS..... 1/4", 3/8", and 1/2" thick; to provide bearing between the base course and footings.

FILTER FABRIC..... 12" wide, unless otherwise specified; placed behind the vertical joints in the front face of the wall (typically held in place with duct tape).

RUBBER PADS..... Generally 5" x 8" x 1/8", 1/4", and 3/8" thick; placed at proper bearing areas above the base course.

ETHAFOAM ROD....1" diameter; used in horizontal joints above the base course.

MASONITE SHIMS.. 5" x 6" x $\frac{1}{8}$" and $\frac{1}{4}$" thick; placed in the keyway of the modules.

HARDWOOD WEDGES.....1 1/4" to 2" wide, 2 1/4" to 2 1/2" high tapered to 3/8", approximately 8" long; used only in setting parapet.

EQUIPMENT

Equipment and tools necessary to install Doublewal modules include the following:

CRANE ..... With swivel hook and adequate capacity.
(see back cover for module and parapet weights)
SLING ..... Used with 4 lifting pins (to set module a).
Used with 2 lifting pins (to set module b).
Used with ring clutches (to lift top caps c).
Special adjustable sling (to set parapets d).
COMPACTOR ..... Hand - controlled plate type vibrator and/or vibratory compactor on a backhoe or excavator.
CROWBARS &
STRIPPING BARS ..... Heavy duty.
CUTTING TOOL .....To trim the filter fabric.
LEVEL & ADAPTERS. Carpenter level - 4' long.
Plumb wall level adapter.
Battered wall level adapter.
LADDER(S) ..... Minimum 6' high.
SLEDGE HAMMER ... For driving wedges under parapet.
CONSTRUCTION
ADHESIVE ..... For positioning ethafoam rod at parapet.

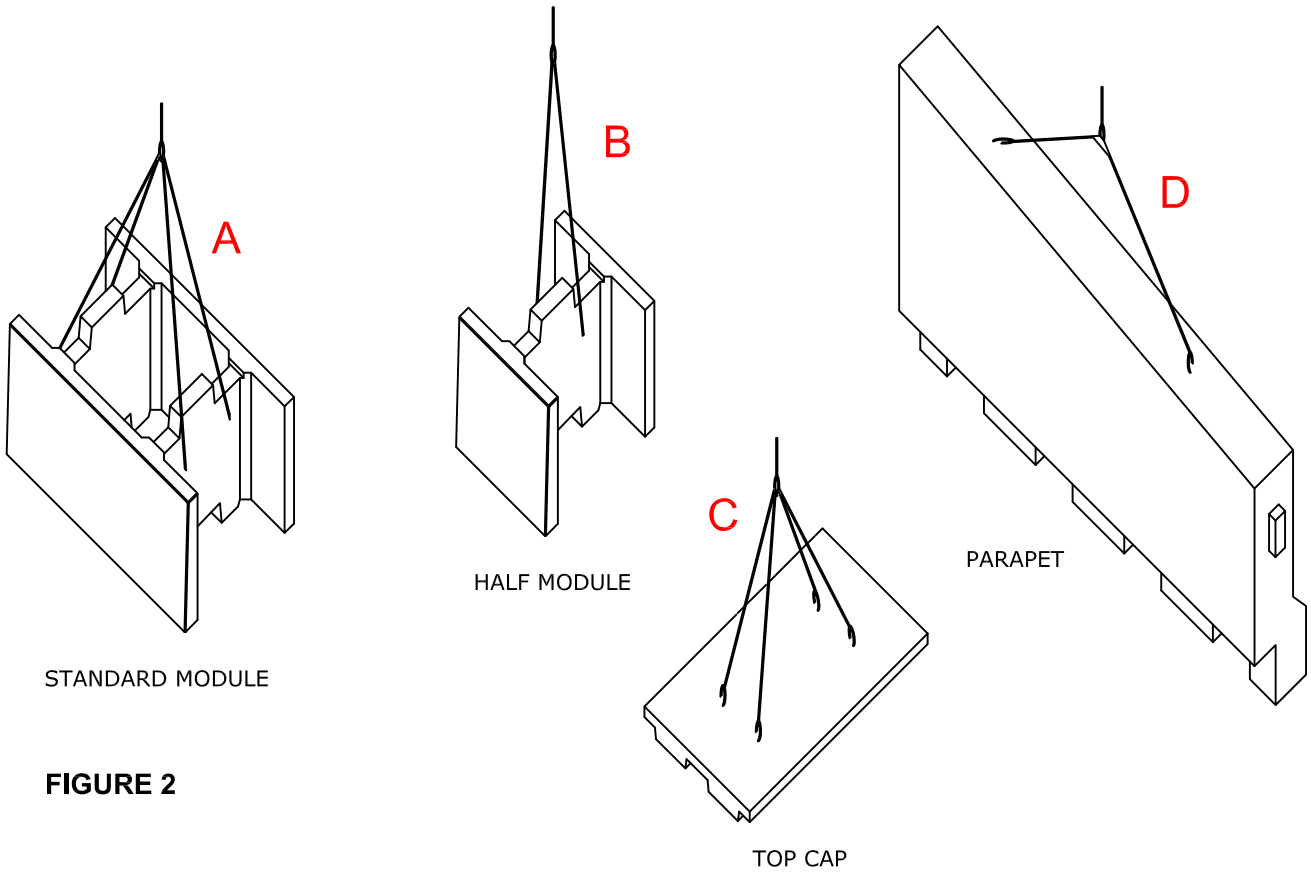


FIGURE 2

RECEIVING PROCEDURE

Make certain that the module marking system shown on the plans is understood by all who work with it. In order to avoid damage, modules and other precast units must be handled with the appropriate handling devices and slings as specified.

The most economical method of erection is to erect the modules directly from the trailers. When this is not possible, the following is suggested.

- The modules and other concrete units should be stored on blocking, placed on level ground at a location that will not require reloading on a vehicle.
- They should be stored in a sequence that will allow removal in the order required to erect the wall.
- Protect the concrete faces of the modules from mud or other materials that might stain or otherwise damage their appearance. If the exposed face becomes soiled, it should be immediately washed with water.

If the magnitude of the job or distance from the precast plant warrants a marshalling yard, it should be established to provide a constant supply of modules for the erection crew. The yard should be on site or as close to the job as possible, with sufficient area to park loaded and empty trailers, and secure from the risk of vandalism. This allows for orderly scheduling of operations, permits continuance of the work regardless of temporary delivery interruptions such as traffic delays and truck breakdowns, and prevents demurrage charges for delivery tractors.

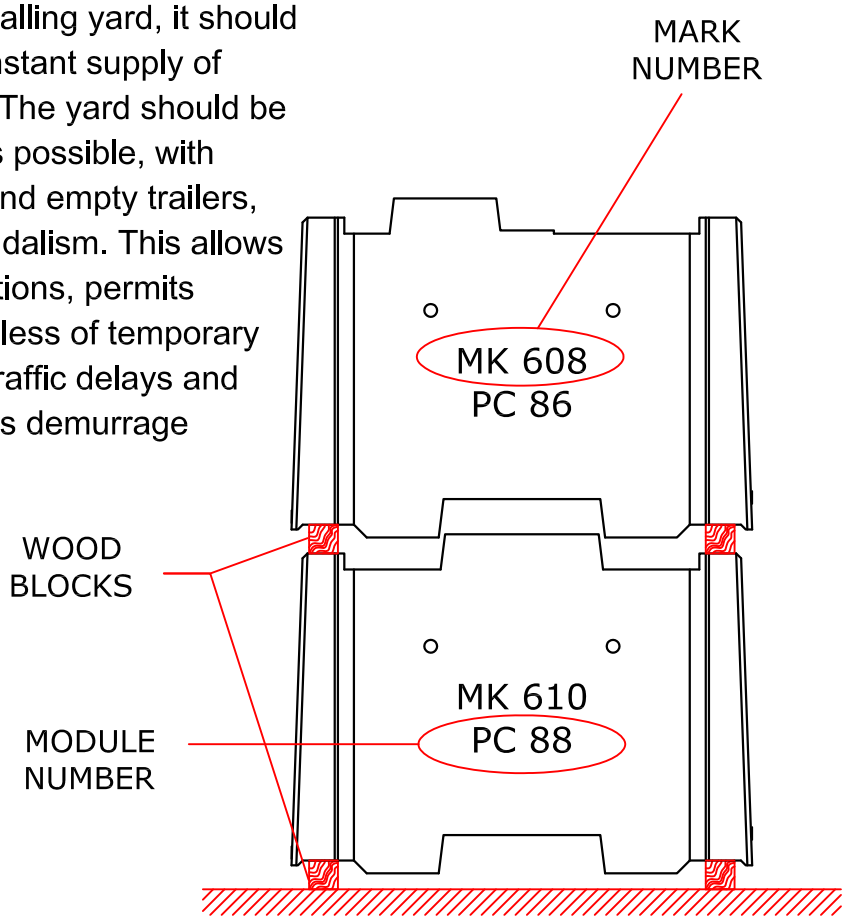


FIGURE 4

FOUNDATION BED AND FOOTINGS

The footing must be constructed to proper line and grade and be level. This is the most critical phase of the entire operation. Proper installation of footings will result in a trouble free installation of the Doublewal structure.

- Refer to the plans for specific dimensions for all footings.
- Prepare a stable foundation bed.
- Use forms the same height as the footing thickness, to assure exact grade at the top of the form.
- Place stakes or metal pins on proper line and at proper intervals to support the forms. Whether using wood or steel, brace forms sufficiently to assure accurate line and grade. The forms should be rechecked prior to placing concrete.
- The leveling pad must be placed on the same plane as the footing.
- The surface of the footings must not vary more than 1/8" in 10 feet when tested with a 10 foot straightedge.
- All the above instructions apply also to a battered wall, but care must be taken to continue the batter from one step to another. As the grade rises with each vertical step, the footing and the face of the wall move toward the rear; this is governed by batter and step elevation.

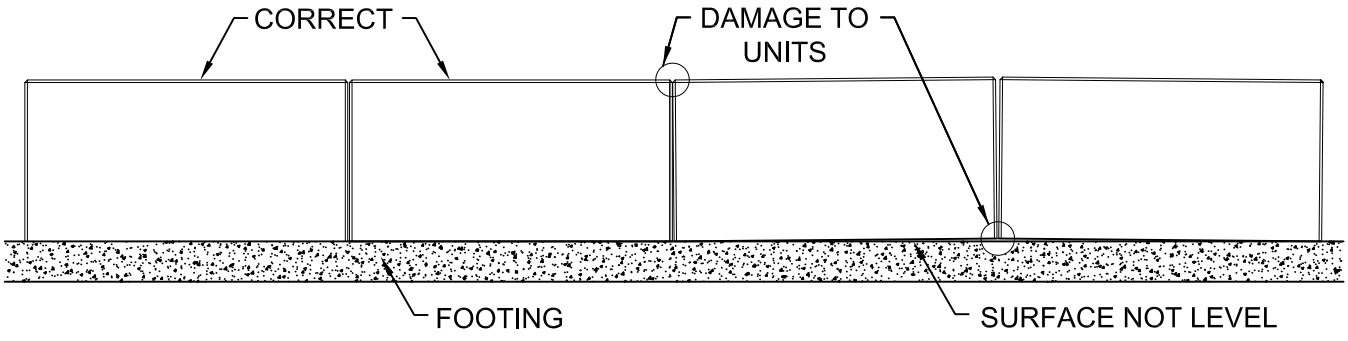


FIGURE 5

If the surface of the footings is not level, it is difficult, if not impossible, to maintain alignment and proper bearing of the module on the footing. This may result in damage to the units as shown above, resulting in costly delays in erection. It is worth the minimal extra effort in the construction of footings to achieve the proper surface.

STEPPED FOOTING LAYOUT GUIDE

BATTERED WALL

WALL BATTER 1:12	
Y	X
1' - 11 15/16"	2"
3' - 11 7/8"	4"
5' - 11 3/4"	6"

WALL BATTER 1:6	
Y	X
1' - 11 11/16"	4"
3' - 11 3/8"	7 7/8"
5' - 11"	11 13/16"

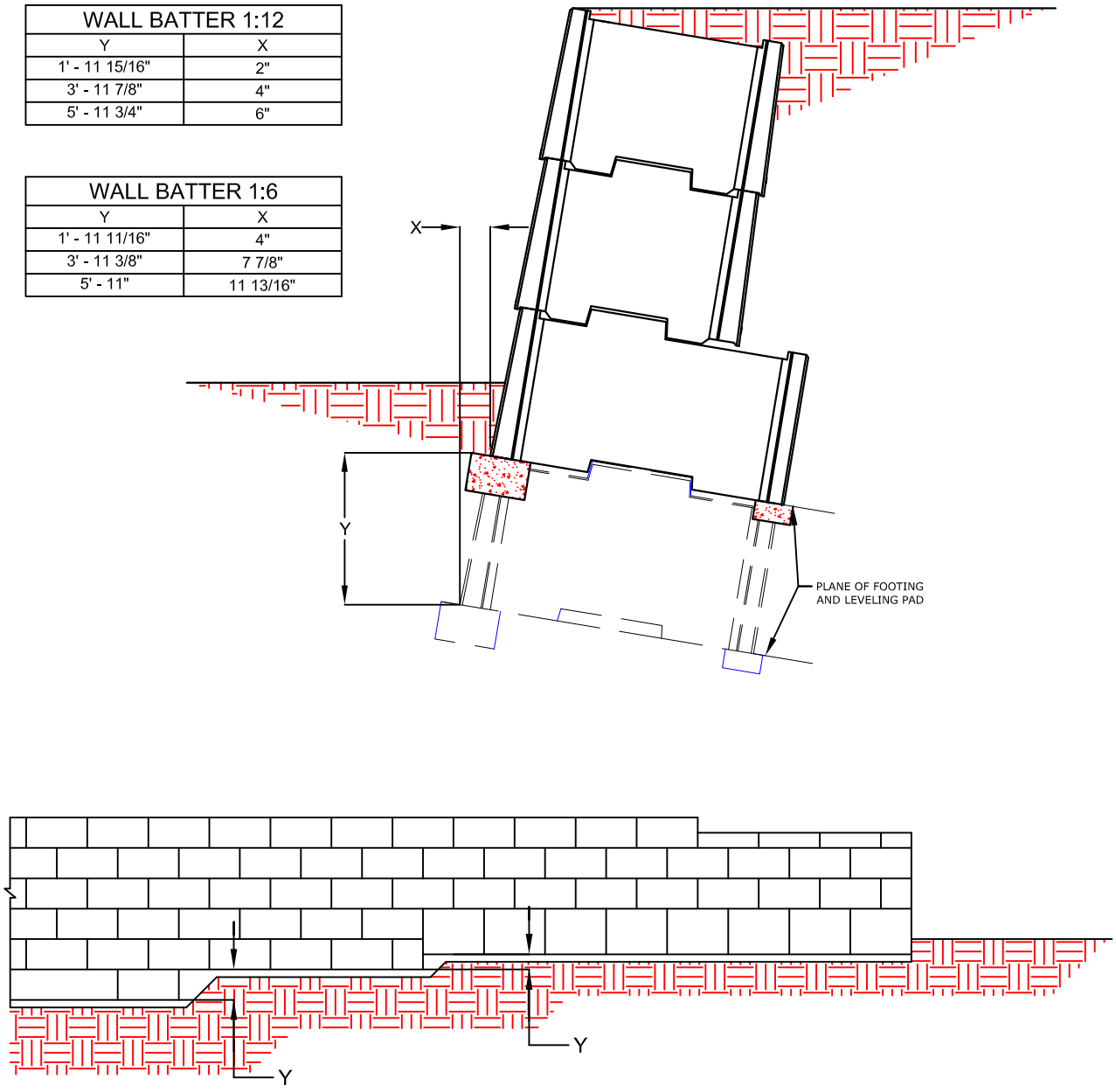


FIGURE 6

The height of the footing step is shown as "Y". The horizontal distance between the front face of the wall at the two steps is shown as "X". As the grade rises with each vertical step, the footings and the face of the wall move toward the rear; this is governed by batter and step elevation.

ERECTION PROCEDURE

The following is the suggested crew required to erect a Doublewal structure.

- Foreman
- Crane operator
- Two laborers to place the modules
- Truck driver (if a marshalling yard is used)

The following erection procedure is to be used along with the erection drawings furnished by the precaster:

- Prior to the day of erection, check the grade of the footings. At the footing, survey and mark (on 2' centers) the elevations 3" behind the plan location of the front face. The same is done on 2' centers along the center of the leveling pad. The difference between the high and low points in a footing run should not exceed 1/2". If the footings are not on proper line and grade, make corrections prior to setting modules. To save time in the overall erection of the wall and avoid subsequent problems, extra care must be taken in placing the bottom row of modules to the proper grade and with the tops of the modules at a constant elevation.
- Keep the precaster's dispatcher informed of your progress, ordering material by the module numbers on the erection drawing, and allowing enough time for loading and delivery of the modules.
- Plan to start construction by placing modules against any permanent vertical structure that may exist and work towards the open end. If there is no vertical structure, start the wall at the lowest elevation.
- Snap a chalk line on the footing to locate the front face of the wall. To provide uniform bearing at the base course, cork strips are placed on both the footings and leveling pads. Once the truck driver attaches the lifting pins to the module, two men guide the module into its final position using a cushion (like a scrap of cork or wood) to prevent striking of the module already in place.
- After setting the module on line, checking the top elevation, bearing, and face alignment; check that the modules are plumb and level on a vertical wall, or true to the batter on a battered wall. Doublewal modules set on footings or leveling pads must bear on a minimum of 1/4" of cork. Adjustments can be made to the modules by adding to the thickness of the cork up to a maximum of 3/4". The front vertical joints are backed with filter fabric, which may be held in place with duct tape. For appearance, the filter fabric should not drape over the front face.

ERECTION PROCEDURE - (CONTINUED)

- After each course is erected, fill the Doublewal units with the specified pervious backfill. Fill units four feet or less in height in one layer and then thoroughly consolidate the backfill with a vibratory tamping device. Fill units which are more than four feet in height in two approximately equal layers and thoroughly consolidate each layer after it is placed. These specifications may vary from state to state and must be confirmed with the job specifications. After each course is filled, backfill behind the wall. At no time should the difference in elevation between the backfill behind the wall and top of the last erected course exceed seven feet.
- Between courses of Doublewal modules, ethafoam rod is used in the front horizontal joints. The rubber pads, are placed on the beams at proper bearing areas. At no time should the total thickness of rubber pads exceed 3/4". **It is critical that there be full bearing on each pad.**
- All modules above the first course interlock with those on the lower courses. Vertical joints are staggered with each successive course. On each module, the foreman checks for a 4' measurement from the end of the unit just set to the center of the next joint on the course below and if necessary, adjusts the module to attain the 4' measurement; modules should not be in contact at the vertical joints in the front face of the wall; however, the joint opening must not exceed 3/4". The foreman also checks that the module is level or on the correct batter prior to setting the next module. From the outside of the lip of the upper unit to the face of the lower unit, the overlap should be approximately 1 1/2".
- Once the modules are properly set and prior to back filing, place masonite shims at the rear of the keyway to fill any space between the keys. Use of the masonite shims prevents movement of the modules to the front when the backfill is placed. Sometimes, on battered walls, shims are used on both the front and rear of the keyway to prevent movement during backfilling. After the shims are set, place the filter fabric and backfill in the same manner as the lower course.

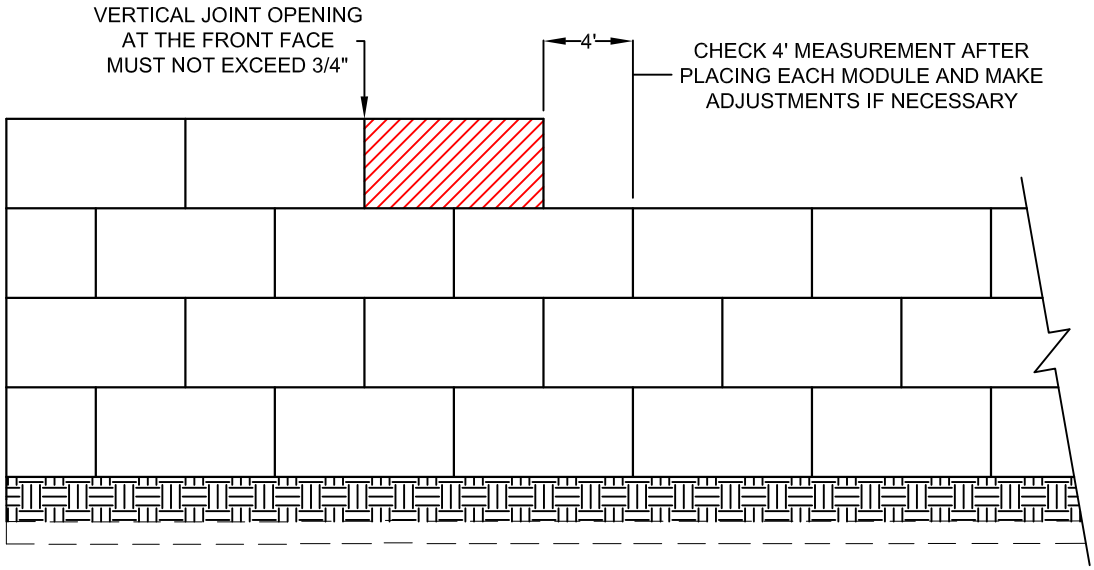
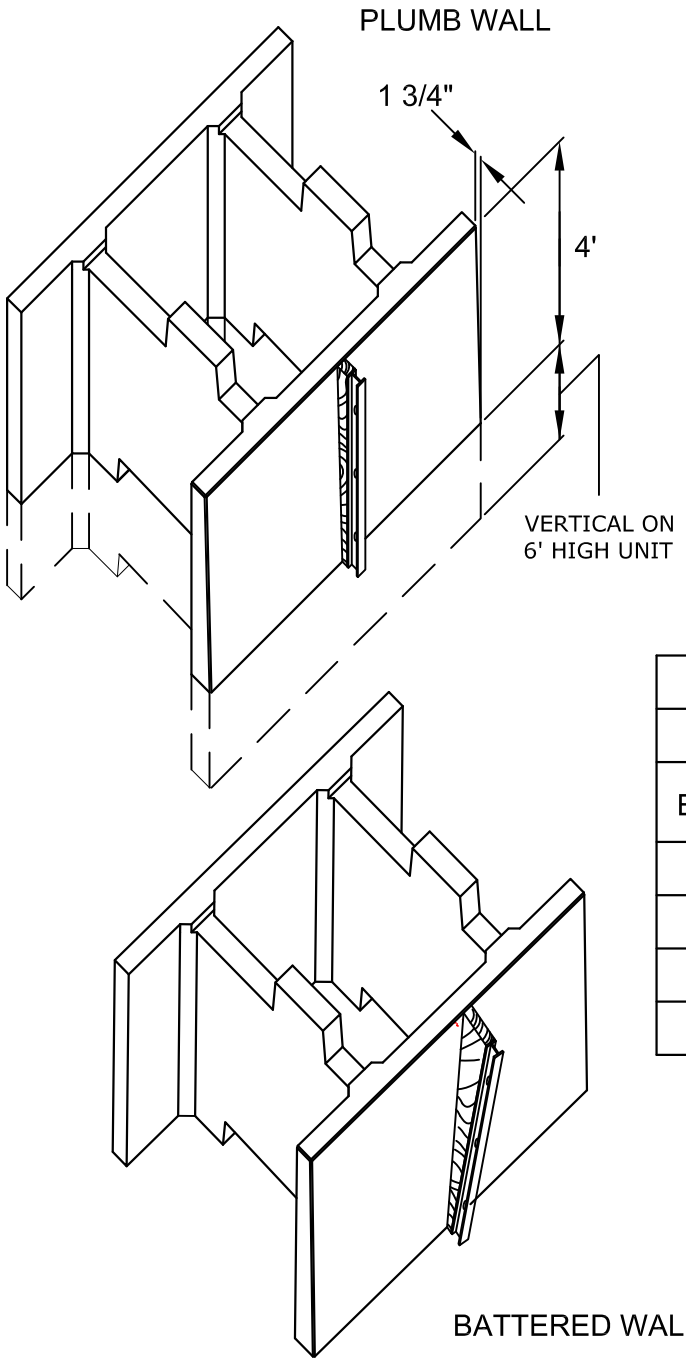
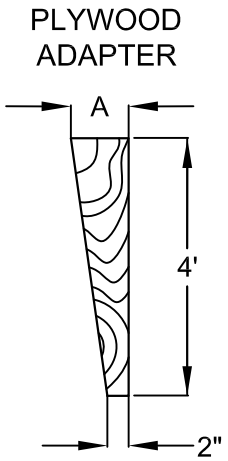


FIGURE 7



PLUMB WALL	
ADAPTER	
A	MODULE HEIGHT
5 ½"	2'
3 ¾"	4'
3 ¾"	6'



BATTERED WALL

BATTERED WALL		
ADAPTER		
BATTER	A	MODULE HEIGHT
1:6	7 13/16"	2'
1:12	5 ¾"	2'
1:6	11 13/16"	4'
1:12	7 ¾"	4'

FIGURE 8

The plumb check for a wall requires the use of an adapter which is cut from plywood to an angle which represents the actual batter of the front face. On a 6' high module, use the adapter and plumb the top 4' of the module. Below that point the face is vertical.

The adapter used for a batter of the front wall is cut to an angle which includes the batter of the wall plus the batter of the front face.

Plumb adapters are not to be used to check level or batter on the parapets.

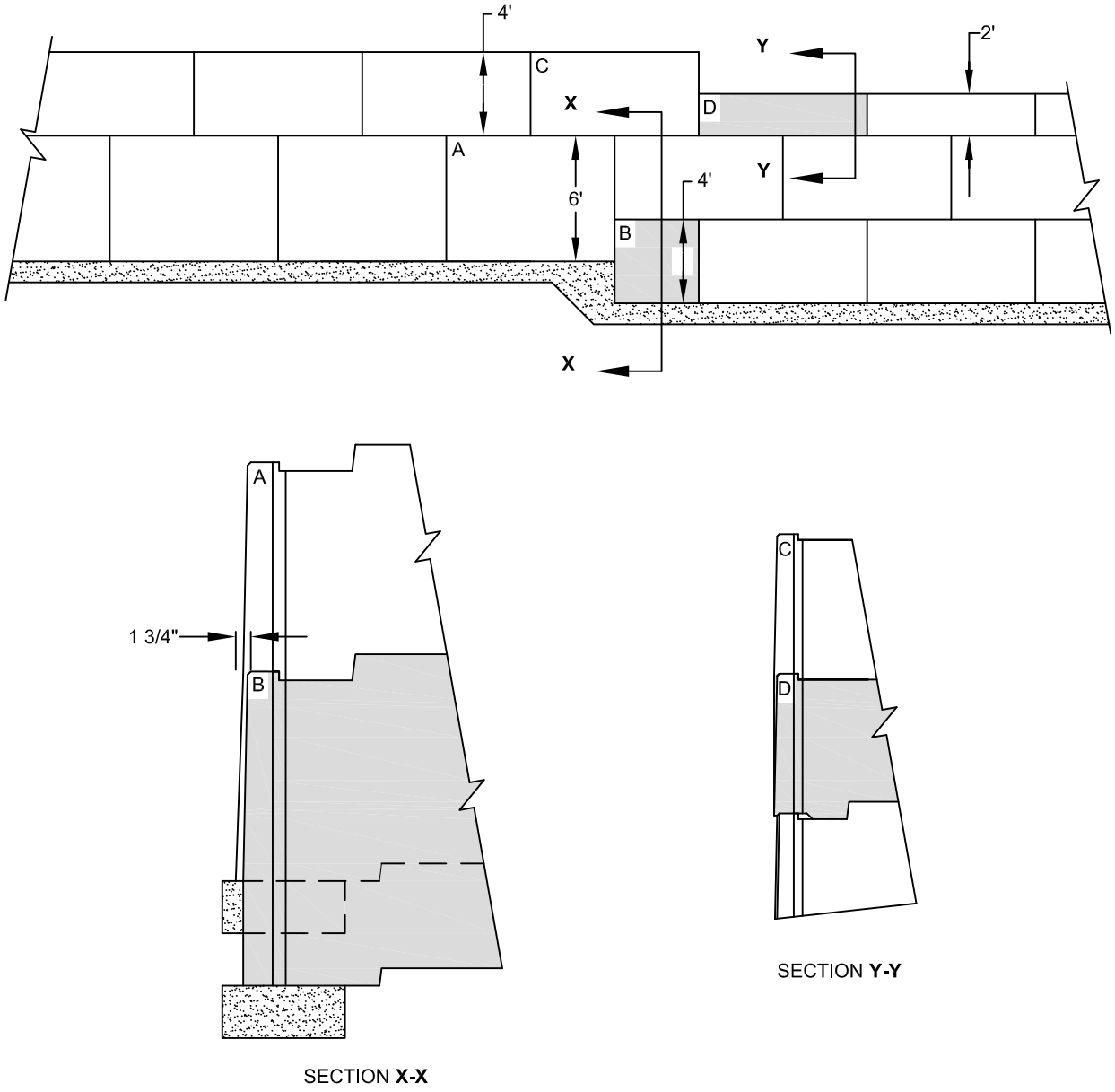


FIGURE 9

There are situations in which the front face of modules will appear not to align. Section **X-X** shows a 4' high module on the lower position of a 2' footing step in contact with a 6' high module in the upper position. Align the modules to the chalk lines on the footings. This will result in a difference of approximately 1 3/4" between the front faces at the top of the 4' high module.

Section **Y-Y** shows a 2' high module in contact with a 4' high module on the same course. Align these at the bottom edge of the face panel.

PARAPET ERECTION

- The parapet crew consists of the standard erection crew with the possible addition, of a man on a ladder at the face of the wall.

- Cast into the top of each parapet are two lifting inserts. Parapets will arrive on the trailer face down or vertical. If the parapet is face down, care must be taken to avoid damage to the face during the lifting process. A special adjustable sling is used to set the parapet. This sling has a lifting eye mechanism that allows the legs to be adjusted to unequal lengths. Although a parapet may have a top surface that slopes, the base may be lifted level by properly adjusting the legs.

- Start at an existing structure or at one end of the wall and work toward the open end, preferably from a higher to a lower elevation. After rubber pads are placed, ethafoam rod is positioned with construction adhesive, and hardwood wedges are placed at the crossbeams, the crew is prepared to set the parapet. If the base of the parapet, when lifted, is not level with the top course, carefully set it down, make an adjustment in the special sling, then lift the parapet again. The foreman, standing at the open end of the wall, directs the crane. The first man, positioned at the closed end of wall, holds a cushioning object at the end of the unit previously set, eliminating risk of damage to either unit.

- While a strain is maintained on the cable, the second man, positioned behind the middle of the parapet, forces the unit toward the man holding the cushion. This is done by using a crowbar between the parapet rebar and crossbeam of the top module. If the wall height requires it, position a man on a ladder at the face of the wall. He checks alignment at the closed end, makes height adjustments by reducing or adding rubber pads. At no time should the total thickness of rubber pads exceed 3/4" inch. On a low wall, the foreman may elect to perform the work of the man on the ladder, eliminating the need for the additional man.

- At the open end, the foreman checks the amount of overhang and makes adjustments in the bearing pad at the beam nearest him. He also checks 4' measurement from the end of the unit just set to the center of the next joint on the course below, as he had done in the erection of the modules.

PARAPET ERECTION - (CONTINUED)

- Once the parapet is in place, slightly reduce the strain on the cable. The parapet generally tends to lean inward and must be brought to plumb or to the proper batter. Under the direction of the foreman, the man behind the middle of the parapet makes the adjustment, rocking the parapet with the help of the man previously at the closed end, who drives home a hardwood wedge with a sledge hammer. As the parapet is being rocked, the foreman makes certain that it is not forced outward beyond its final position.

- He then performs a final check with a level to insure that the parapet is plumb or on the required batter as shown on the plans. The man on the ladder (or the foreman, on the low wall) checks that the closed end alignment with the parapet previously set is maintained as shown on the plans. Once proper alignment is attained, the other wedges should be hammered home and the bearing on the rubber pads rechecked.

- Pour the concrete, as shown on the detail sheet of the drawings, as soon as possible after setting the parapet.

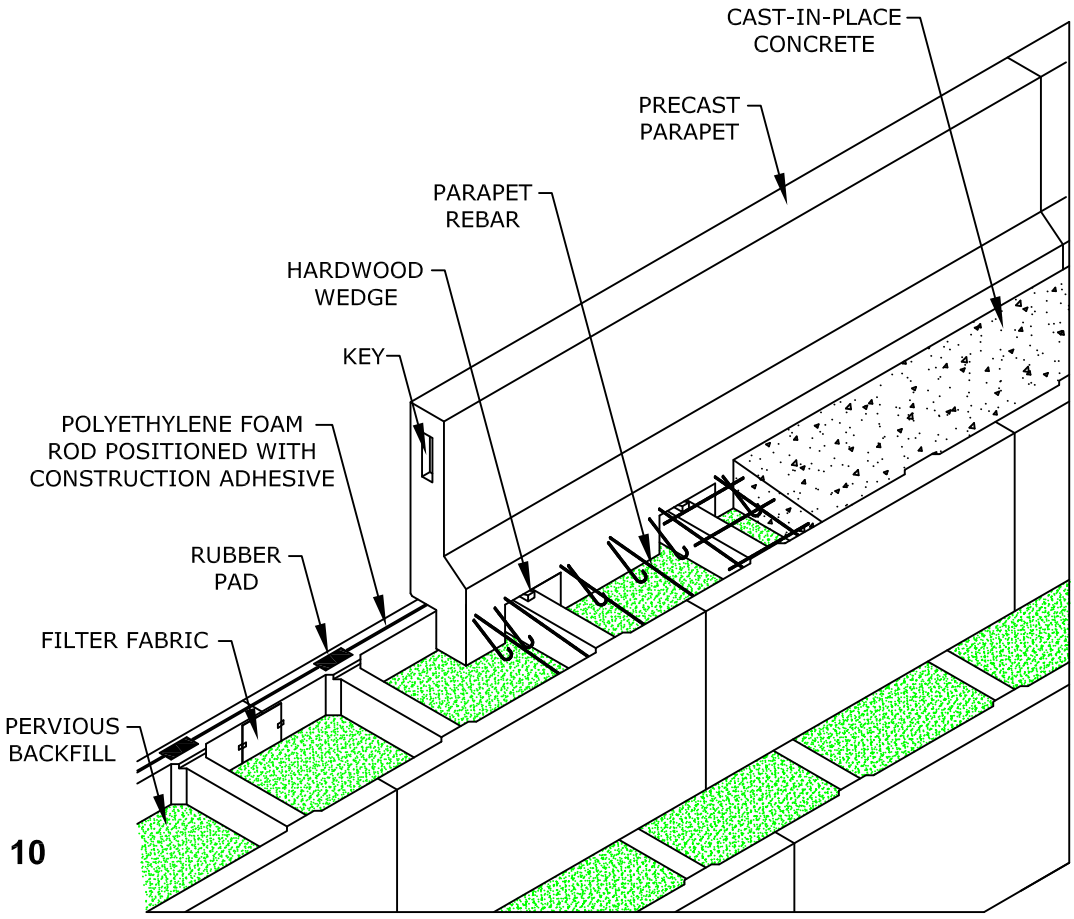


FIGURE 10

FULL MODULE PROPERTIES										
	WIDTH (FT.)	4	6	8	10	12	14	16	18	20
2 FEET HIGH	CONCRETE WEIGHT (Lb.)	3,551	4,178	4,619	-	-	-	-	-	-
	FILL VOLUME (Cu. Ft.)	38.8	66.7	94.5	-	-	-	-	-	-
4 FEET HIGH	CONCRETE WEIGHT (Lb.)	7,114	8,387	9,238	10,802	15,702	17,123	18,951	20,454	22,020
	FILL VOLUME (Cu. Ft.)	77.6	133.4	189.0	243.2	276.3	330.6	385.0	439.3	493.6
6 FEET HIGH	CONCRETE WEIGHT (Lb.)	11,287	13,171	14,194	16,266	22,996	25,039	27,310	29,336	-
	FILL VOLUME (Cu. Ft.)	116.4	200.1	283.6	365.5	419.0	500.9	582.8	664.7	-

PARAPET PROPERTIES			
WEIGHT			
TYPE	MAXIMUM LB./SQ. FT.	WIDTH OF TOP MODULE	CU. YD./LIN. FT.
CONVENTIONAL	200	4 FEET	0.092
		6 FEET	0.175
TRAFFIC BARRIER	260	8 FEET	0.255

*THE ABOVE FIGURES ARE FOR PLAIN FORM FINISH UNITS AND ARE APPROXIMATE. FORMLINER FINISH UNIT WEIGHTS CAN VARY. THE ACTUAL WEIGHTS AND VOLUMES SHOULD BE CONFIRMED WITH THE LOCAL MANUFACTURER.

DOUBLEWAL®

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