



Field Construction Manual

Stone Strong Systems Precast Modular Unit Retaining Wall System

2020

Stone Strong, LLC

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INTRODUCTION

This manual is designed to provide general information and assist in the proper techniques required to build Stone Strong walls. The manual covers the basics of wall construction, and contains many of the details encountered in site work. Look to our web site stonestrong.com or the local Stone Strong Producer for more information.

CONSTRUCTION RESPONSIBILITIES

Stone Strong Dealer

Stone Strong representatives may assist the owner, contractor and inspectors in scheduling of materials, construction procedures, contract documents, plans and specifications. The representatives are available to assist and train the contractor and inspectors as requested and necessary.

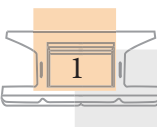
Engineer or Owner's Representative

Owner representative or engineer is responsible for the enforcement of the contract documents, plans and specifications. Owner shall employ services of a material engineering firm to provide quality control testing during embankment construction. Owner and engineer shall not be responsible for means or methods of construction or for safety of workers or of the public.

Contractor

The contractor will be responsible for:

- Checking the materials upon delivery to assure that proper materials have been received.
- Protecting the materials from damage. Damaged material shall not be incorporated into the wall or the reinforced soil embankments.
- Preventing excessive mud, concrete, adhesives and other substances that may adhere from coming in contact with the materials.
- Furnishing and installing Stone Strong unit to the lines and grades shown on the plans and as specified herein.
- The contractor is solely responsible for safety.



MATERIALS, DELIVERY STORAGE AND HANDLING

Precast modular unit will be manufactured under license from Stone Strong, LLC.

Dimension tolerances for precast modular unit shall be +/- 1/8 inch for horizontal and vertical dimensions of the face and 1/2 inch to -1/4 inch for the face-to-tail width.

Concrete for precast modular unit shall have a minimum 28-day compressive strength of 4,000psi. Entrained air content shall be between 5 and 7%.

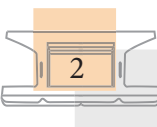
Reinforcing steel (if used) shall be Grade 60. Minimum clear cover to reinforcement shall be 1½ inches.

Check the materials upon delivery to assure that proper material has been received. Remove damaged or otherwise unsuitable material from the site.

Exposed faces of Stone Strong unit shall be free of chips, cracks, bug holes, stains, and other imperfections distracting from their appearance when viewed from a distance of 10 feet.

Prevent mud, concrete, adhesives and other substances that may harm appearance of unit from coming in contact with the system components.

Geogrid filter, prefabricated drainage composite shall be delivered, stored, and handled in accordance with ASTM D 4873.

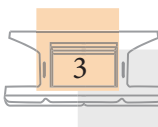




1/4/2019

Unit Type	Description	Conc. Wt. (lbs)	Void Vol (ft3)	Length (ft)	Height (ft)	Unit Width (in)
Standard units (verify availability - not all units available from every producer)						
24	24SF unit (24 square feet)	6,000	43.21	8.00	3.00	44.0
24-ME	24SF Mass Extender unit	10,000	44.94	8.00	3.00	56.0
24-62	24-62 unit (extended 24SF)	6,800	76.05	8.00	3.00	62.0
24-86	24-86 unit (extended 24SF)	7,600	117.90	8.00	3.00	86.0
6	6SF unit (6 square feet)	1,500	10.95	4.00	1.50	44.0
3	3SF unit (3 square feet)	750	5.48	2.00	1.50	44.0
6-28	Mini 6SF unit	950	6.65	4.00	1.50	28.0
3-28	Mini 3SF unit	475	3.33	2.00	1.50	28.0
Alternate top units (not typically used - regular 24SF top unit is used in most applications, analyzed as regular 24SF unit)						
Cap	Cap unit	1,600	0.00	8.00	0.58	32.0
DF	Dual Face unit	3,500	0.00	8.00	1.50	28.0
Vertical stack units (modified recess and face to permit construction of a vertical face)						
V24	24SF unit (24 square feet)	6,000	43.21	8.00	3.00	43.0
V24-ME	24SF Mass Extender unit	10,000	44.94	8.00	3.00	55.0
V24-62	24-62 unit (extended 24SF)	6,800	76.05	8.00	3.00	61.0
V24-86	24-86 unit (extended 24SF)	7,600	117.90	8.00	3.00	85.0
V6	6SF unit (6 square feet)	1,500	10.95	4.00	1.50	44.0
V3	3SF unit (3 square feet)	750	5.48	2.00	1.50	44.0
V6-28	Mini 6SF unit	950	6.65	4.00	1.50	28.0
V3-28	Mini 3SF unit	475	3.33	2.00	1.50	28.0

Note: Check on availability of all units w/ local Producer/Dealer. Some units may have limited availability.



EQUIPMENT AND SUPPLIES

Contractor Supplied Materials and Tools

The following tools are recommended, but should not be limited to this list. Site conditions may require other equipment, tools and materials.

Tools and Equipment

Excavator	Laser Level
Skid Steer	4 foot Level
Front Loader	Shovels
Compactor	Brooms
Spreader Bar (48")	Pry Bars
Chains	Labor

Materials

Wall Base Material	Off Site Borrow (if required)
Unit Fill Material	Filter Fabric (if required)
Drain Tile (if required)	Hand Rail (if required)

Geosynthetic strap reinforcement shall be Paraweb 2D-50 manufactured by Maccaferri, Inc.

Geogrid reinforcement shall be SF55 or SF110 manufactured by Synteen Technical Fabrics, Inc.

Substitution of a different type of geosynthetic shall not be allowed unless approved by the Architect/Engineer or Owner after submittal of shop drawings and test data.

SITE PREPARATION

- Review the approved site plan to confirm lot lines, wall location, length and elevations.
- Schedule preconstruction meeting.
- Verify the on-site soil conditions.
- Call the local utility companies to confirm the location of underground utilities.
- Obtain all necessary building permits.
- Confirm drainage to avoid erosion or buildup of water behind the wall.

EXCAVATION

Lay out the location and length of the wall. If possible, start the wall base as the lowest elevation of the wall. Set wall elevations using a laser level and stakes prior to excavating; due to the size of the Stone Strong unit this method will increase efficiency.

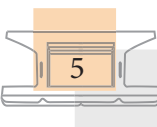
Excavate as required for installation of the retaining wall system. Use caution not to over-excavate beyond depth needed for the foundation.

Slope or shore excavation as necessary for safety and for conformance with applicable OSHA requirements.

FOUNDATION PREPARATION

Foundation soils shall be excavated as required for wall base to the dimensions shown on the plans. Foundation soil shall be observed by the Geotechnical Engineer to confirm that the bearing soils are similar to the design conditions or assumptions.

Foundation soil shall be proof rolled and compacted a minimum of 95 percent of the maximum dry density (ASTM D 698, Standard Proctor) and inspected by the Owner's engineer prior to placement of leveling pad materials. The contractor shall replace any unsuitable soils discovered during excavation at the direction of the engineer.



WALL BASE CONSTRUCTION

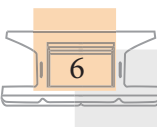
Construct base to the material and dimensions shown on the plans. Over excavated areas shall be filled with additional concrete or granular base material. Wall base shall consist of concrete with a minimum 28-day compressive strength of 3,000 psi, or a dense graded crushed aggregate. A minimum of 75% of coarse material shall have 2 or more fractured faces. Wall base material shall meet the following gradation:

Us Standard Sieve Size	Percent Passing
1-1/2"	100
3/4"	50-75
#4	0-10
#8	0-5

WALL BASE CONSTRUCTION

Compact the wall base to provide a hard and level surface to support the Stone Strong unit. Base material shall be compacted to a minimum of 95 percent of the maximum dry density (ASTM D 698, Standard Proctor).

Prepare and smooth the granular material to ensure complete contact of the first course with the wall base. The surface of granular base may be dressed with finer aggregate to aid leveling, provided that the thickness of dressing layer should not exceed 3 times the maximum particle size used OR 1/2 inch, whichever is greater.

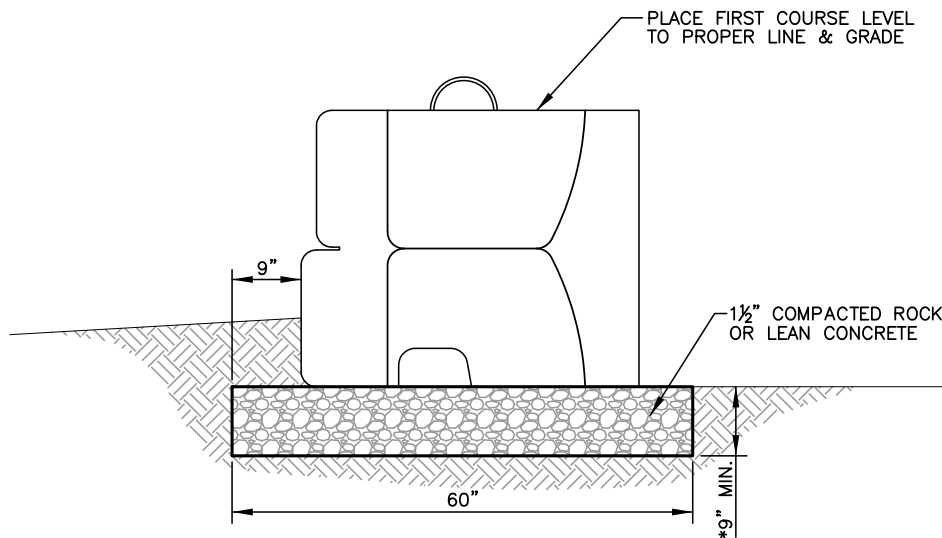


WALL UNIT INSTALLATION

First Course

Place the first course of Stone Strong unit directly on the wall base (see detail 1). If possible, begin placing Stone Strong unit at the lowest section of the wall. The unit shall be leveled side-to-side, front-to-rear and with adjacent unit. Ensure Stone Strong units are in full contact with the compacted base. Adjacent unit should be in contact.

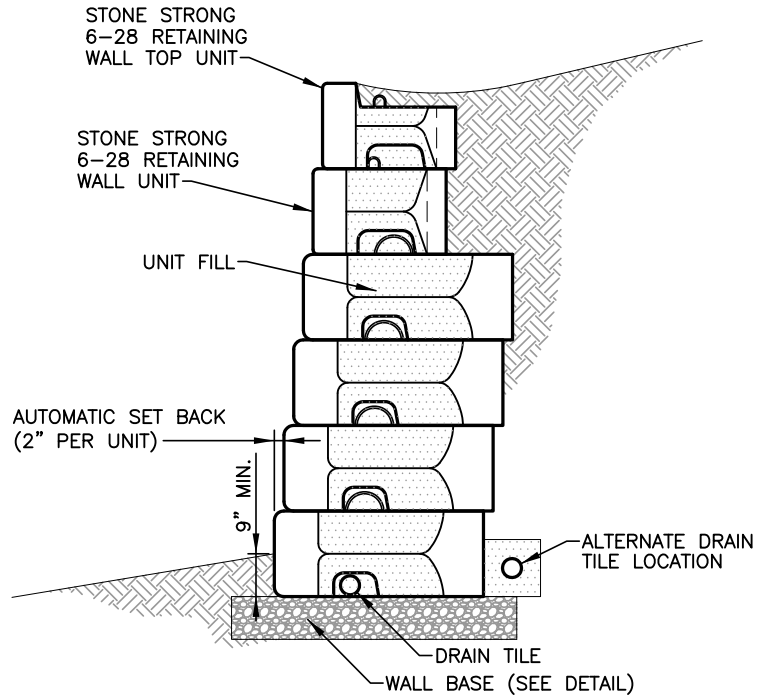
The first course is the most important to ensure accurate and acceptable results. Leveling should be done by means of a 4 foot level across the top of the unit.



NOTE: BEARING CONDITIONS SHALL BE OBSERVED BY THE SITE GEOTECHNICAL ENGINEER. BASE DIMENSIONS MAY BE INCREASED TO ADDRESS DEFICIENT SOIL BEARING CONDITIONS.

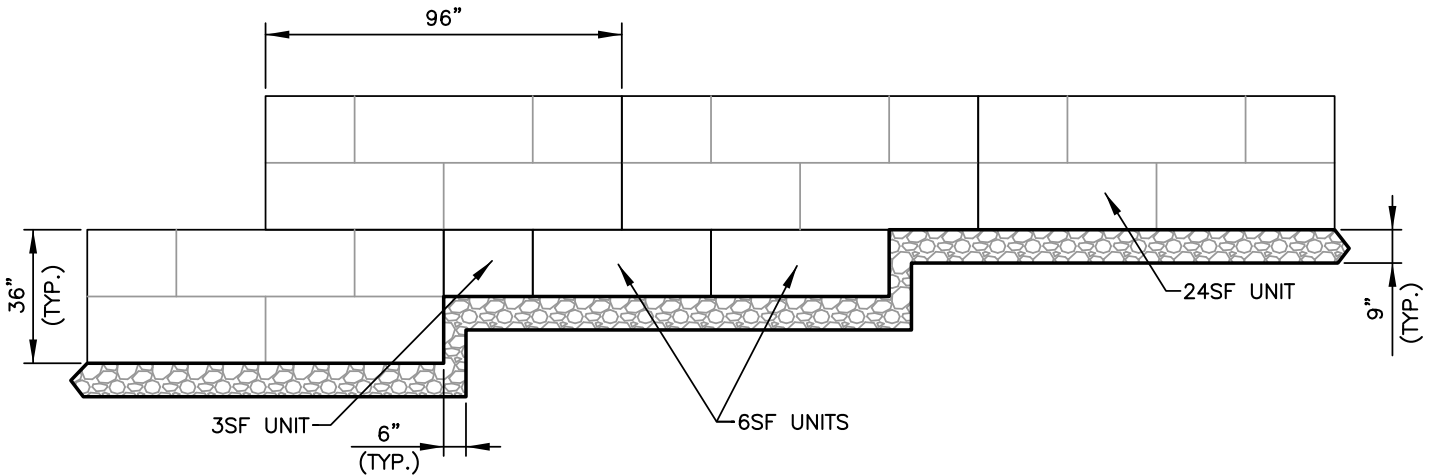
*FOR WALL HEIGHTS OF 6' OR LESS, BASE THICKNESS MAY BE REDUCED TO 6".

If the wall base elevation varies refer to detail for wall base steps.

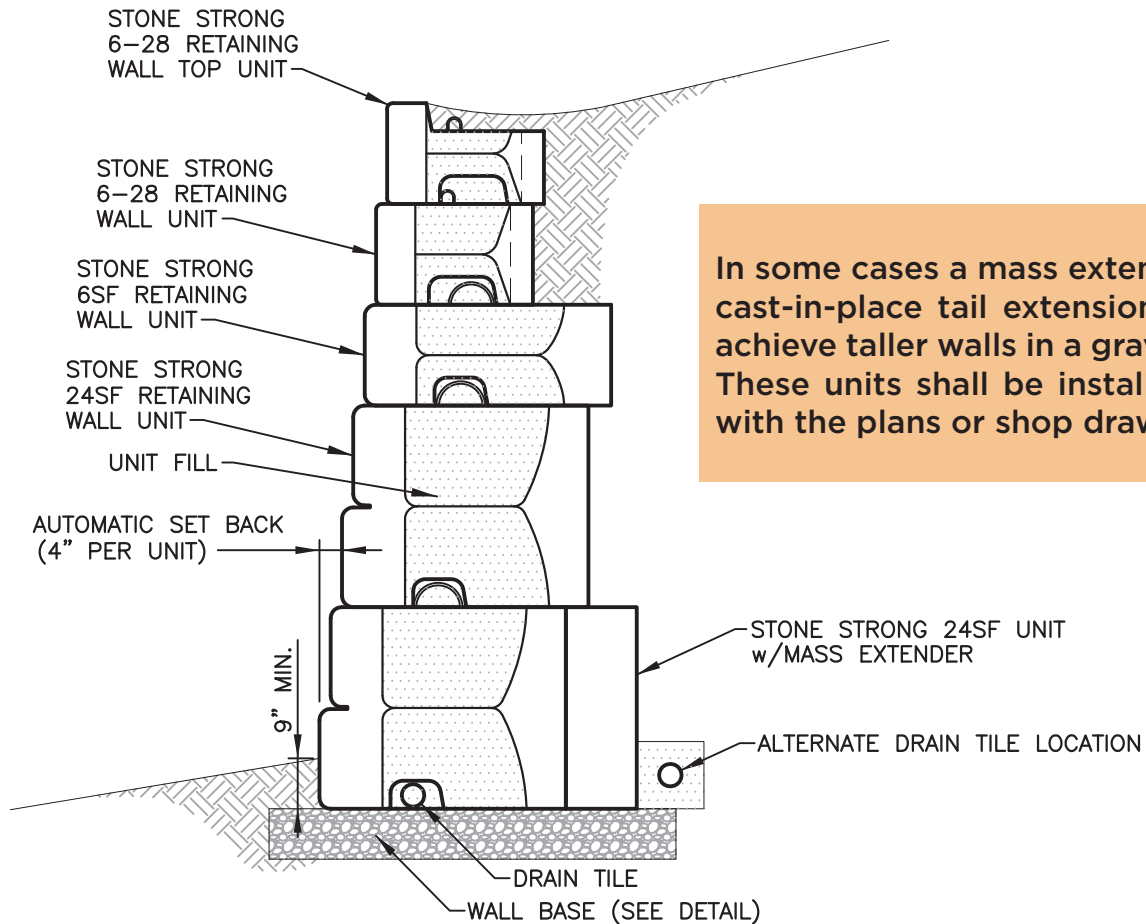


6SF GRAVITY WALL CROSS SECTION

NOT TO SCALE

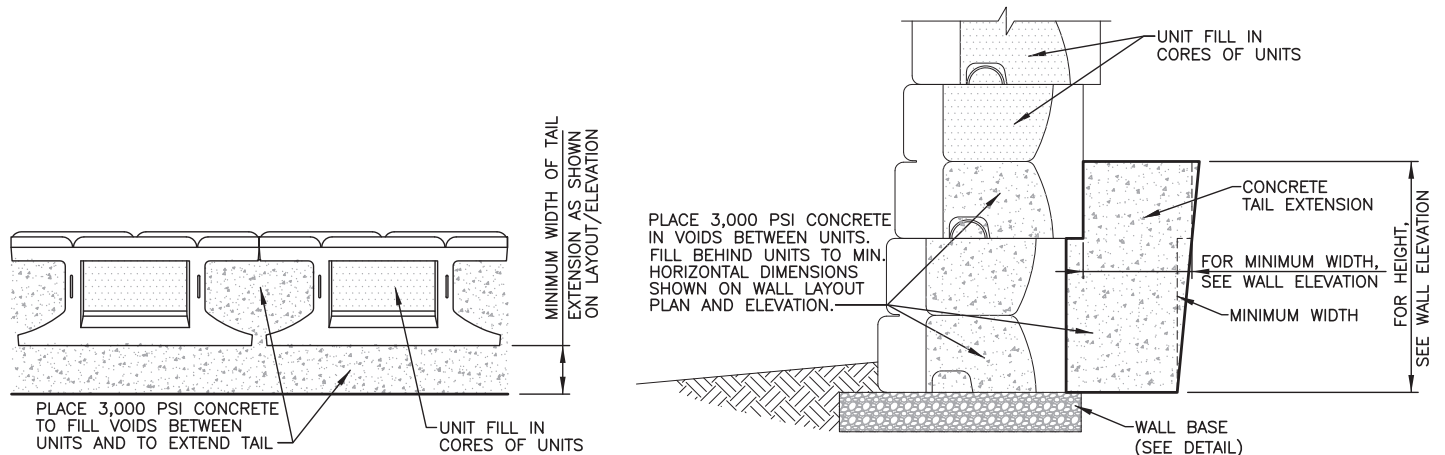


WALL BASE STEP



In some cases a mass extension unit or cast-in-place tail extension may be used to achieve taller walls in a gravity configuration. These units shall be installed in accordance with the plans or shop drawings.

**GRAVITY WALL
CROSS SECTION w/MASS EXTENDER**
NOT TO SCALE

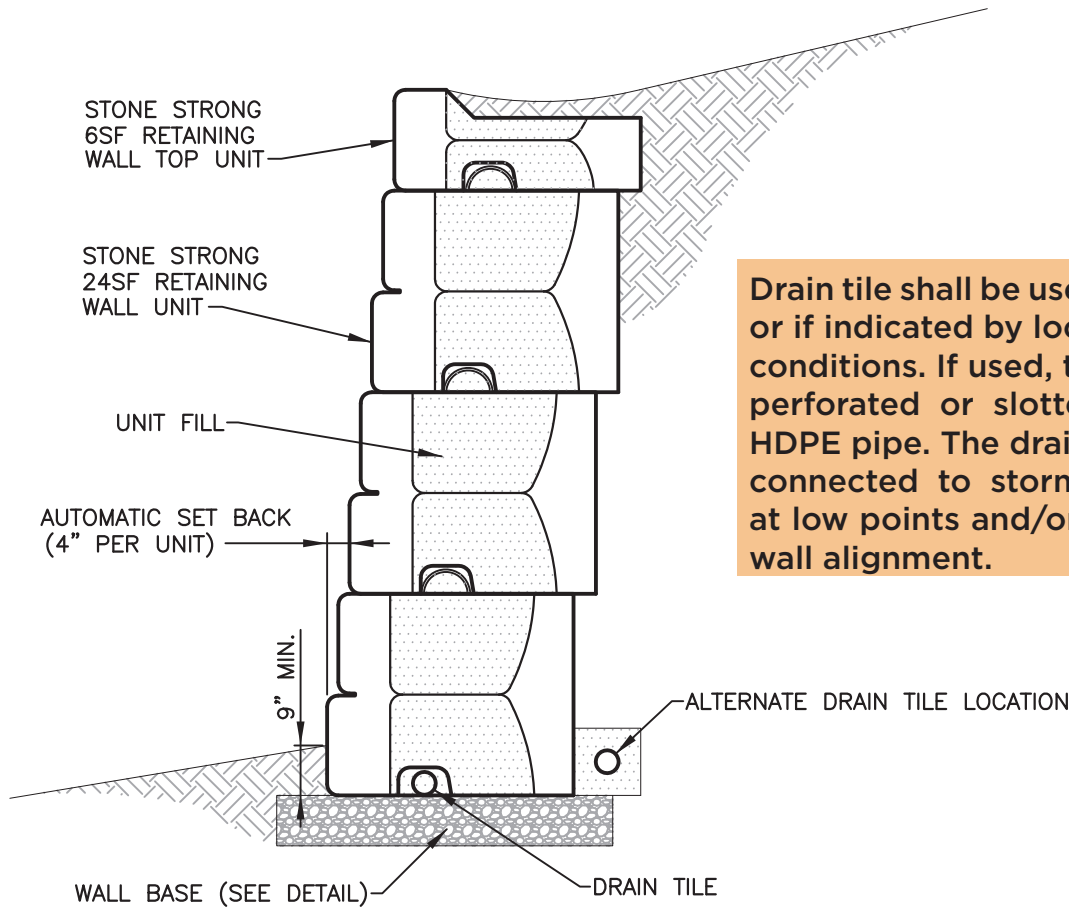


24SF CONCRETE TAIL EXTENSION DETAIL (CAST-IN-PLACE)
NOT TO SCALE

Fill all voids between and within the unit with granular unit fill. Unit fill shall consist of a screened crushed aggregate. A minimum of 75% of coarse material shall have 2 or more fractured faces. Wall base material shall meet the following gradation:

Us Standard Sieve Size	Percent Passing
1-1/2"	100
3/4"	50-75
#4	0-10
#8	0-5

If shown on the plans or the shop drawings, provide a geotextile filter for separation from backfill at the tails of the unit. The geotextile shall be a needle punched non-woven fabric with a minimum grab tensile strength of 120 pounds according to ASTM D 4632. If used, the geotextile may cover the entire back face of the unit or may be cut in strips to cover the gaps between tail unit with a minimum of 6 inches of overlap over the concrete tail on both sides.



Drain tile shall be used if shown on the plans or if indicated by local practices and conditions. If used, the drain tile should be perforated or slotted PVC or corrugated HDPE pipe. The drain tile should be connected to storm drains or daylighted at low points and/or periodically along the wall alignment.

GRAVITY WALL CROSS SECTION

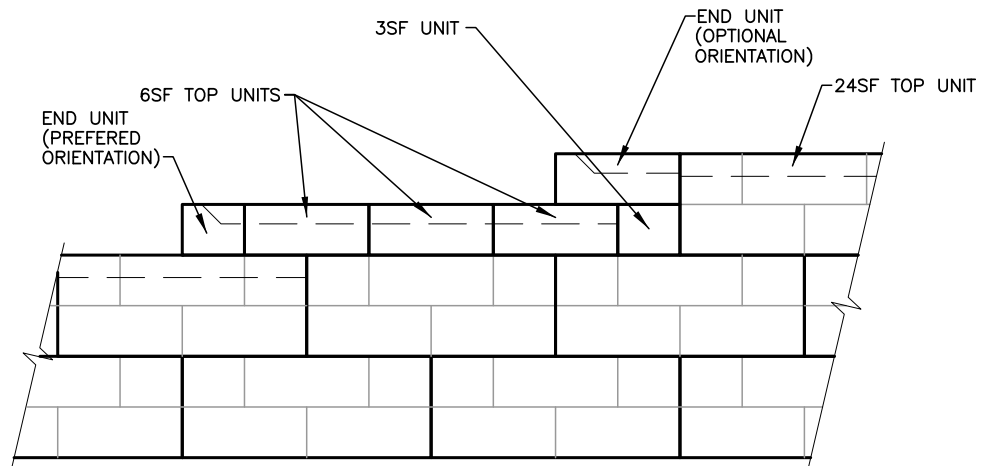
NOT TO SCALE

Subsequent Courses

Remove all excess aggregate and other materials from the top of the unit before laying up the next course. Place the next course of segmental unit in running bond with the previous course. Place the web recess over the alignment loop from the unit below, and pull the unit forward to contact the loop. This alignment will produce a batter of 2 inches for every 18 inches of vertical wall height. Check the unit for level and alignment.

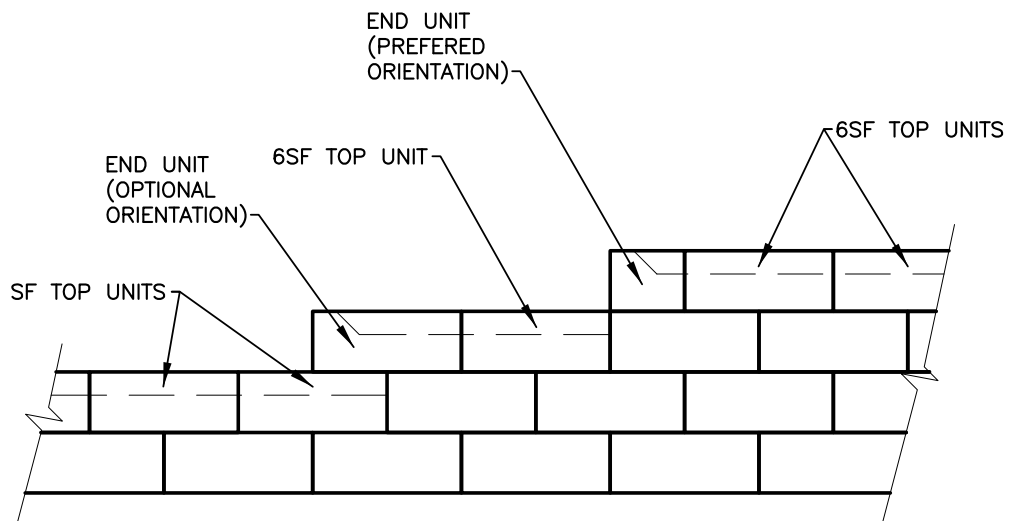
The layout of radius and corners shall be installed in accordance with the plans or shop drawings. See radius tables included at the end of this manual.

Continue placing successive courses to the elevations shown on the plans. Construct wall in level stages, placing the unit at each course for the entire length of the wall, if possible. Unit fill and backfill should be placed to the level of the top of the facing unit before placing the next course to step the top of the wall.



Provide temporary swales to divert runoff away from wall excavation and away from face during the construction phase.

Install the Stone Strong top unit. Place unit fill and backfill level with the back face of the unit.



TOP OF WALL STEPS

NOT TO SCALE

BACKFILL PLACEMENT AND COMPACTION

Place backfill behind the unit in maximum loose lifts of 8 inches and compact. Backfill and compact behind the first course before installing other courses. If select granular fill is required, it shall consist of fill sand or other clean aggregate.

Compact all backfill to a minimum of 95 percent of the maximum dry density (ASTM D 698, Standard Proctor). For cohesive soils, the moisture content at the time of compaction should be adjusted to within -3 and +4 percent of optimum. Place backfill in successive lifts until level with the top of the facing unit. Additional unit fill is not required behind the unit, but may be placed for the convenience of the contractor.

All other backfill behind and in front of the wall shall consist of suitable on-site soil or imported borrow approved by the Geotechnical Engineer. Backfill shall consist of sands, silts, or lean clays with a liquid limit less than 45 and a plasticity index less than 20. Fat clay soils, cobbles, and large rock should be avoided unless approved by the Geotechnical Engineer based on local practices. Frozen soils, excessively wet or dry soils, debris, and harmful materials should not be used.

Final grade above and below the retaining wall shall provide for positive drainage and prevent ponding. Protect completed wall from other construction. Do not operate large equipment or store materials above the wall that exceed the design surcharge loads.



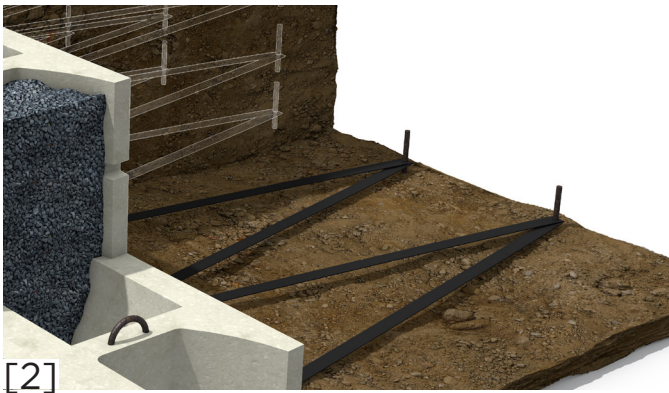
Paraweb Strap Installation

Paraweb straps can be cut or continuously wound through the Macbox inserts. Paraweb strap shall extend to the length specified by the site engineer.

Strap is inserted through box as shown (image 1)
Pull strap tight, a pin can be used (image 2) to hold straps taut until buried. Alternatively, weight put on the end of the strap (image 3) is an acceptable way to hold straps taut until buried.
This process is repeated every subsequent half course.



Note: cutting Paraweb strap at angle as shown (image 4) helps reduce friction when inserting strap through box.



Paraweb straps can be driven over with equipment after covering with minimum 3 inches of backfill.

CLEANUP

Remove any damaged or unused Stone Strong unit.

Remove any unit fill or backfill material.

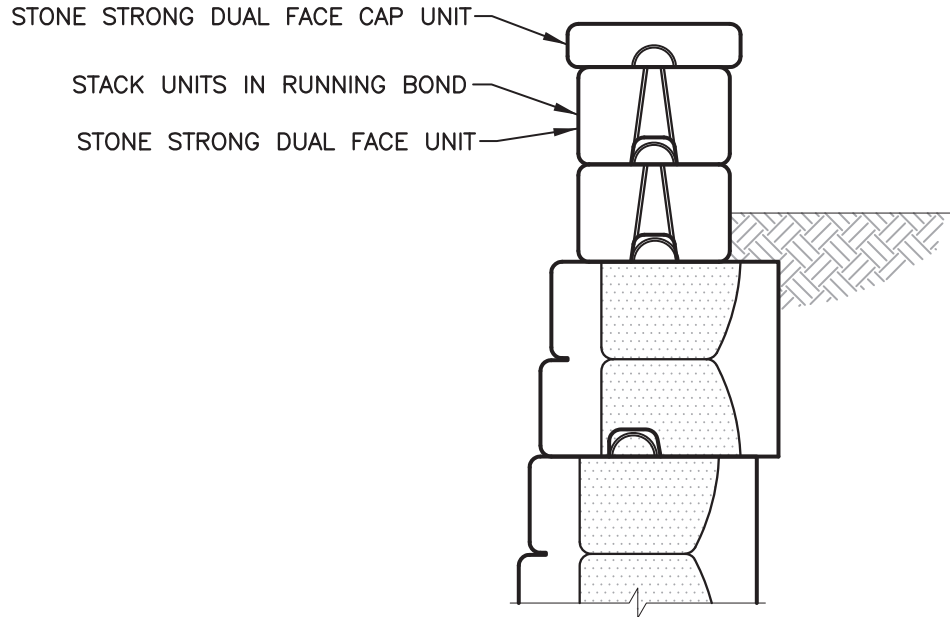
Remove debris caused by wall construction.

TROUBLESHOOTING

First course not level.	Wall base not level. Unit does not meet manufacturing specifications.
Wall leaning in.	Alignment loops not engaged. Unit not level.
Wall leaning out.	Alignment loops not engaged. Unit not level.
Wall has a dip.	Wall base not level. Wall base not properly compacted.
Unit will not stack flat.	Wall base not level. Unit does not meet manufacturing specifications. Excess aggregate or other material on top of unit.

Top of Wall Treatments:

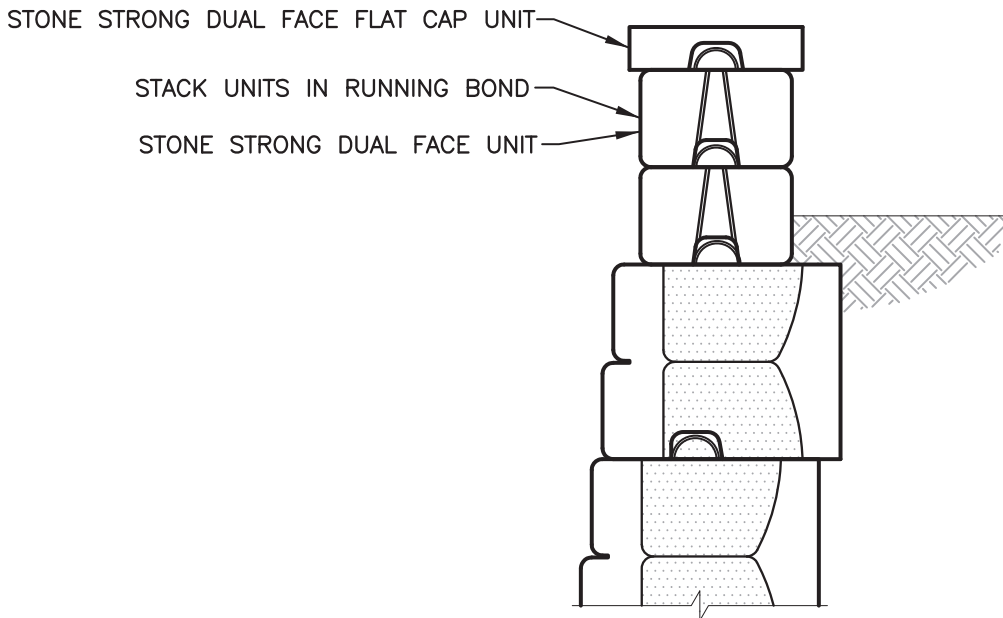
Wall Capping



DUAL FACE PARAPET

WALL w/CAP

NOT TO SCALE



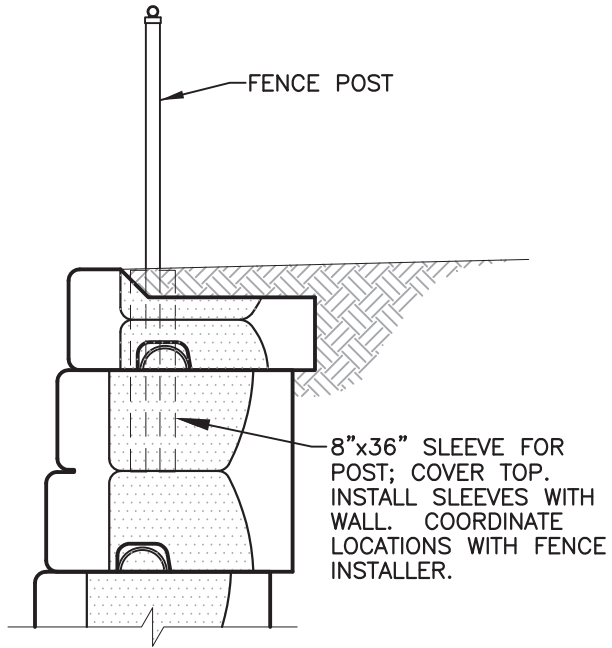
DUAL FACE PARAPET

WALL w/FLAT CAP

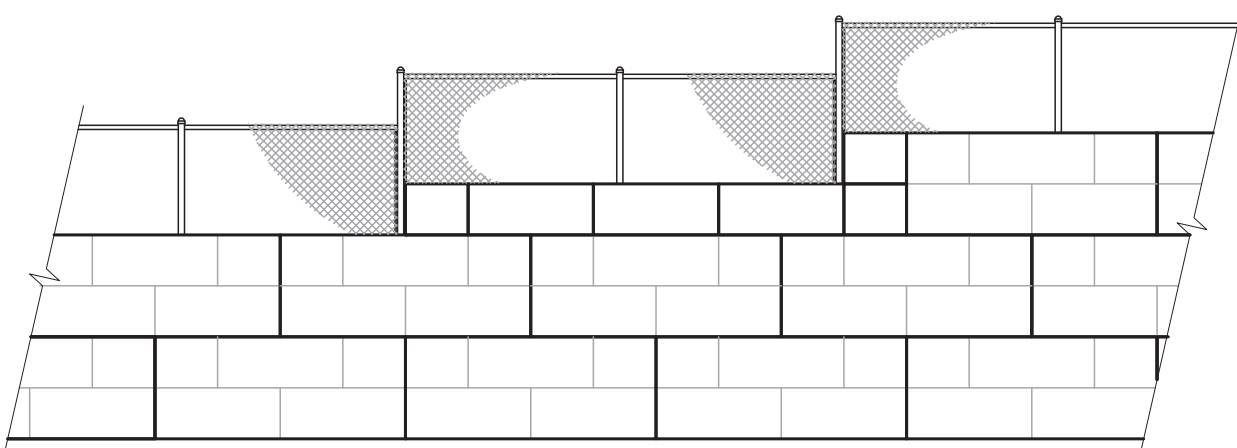
NOT TO SCALE

Top of Wall Treatments:
Fencing

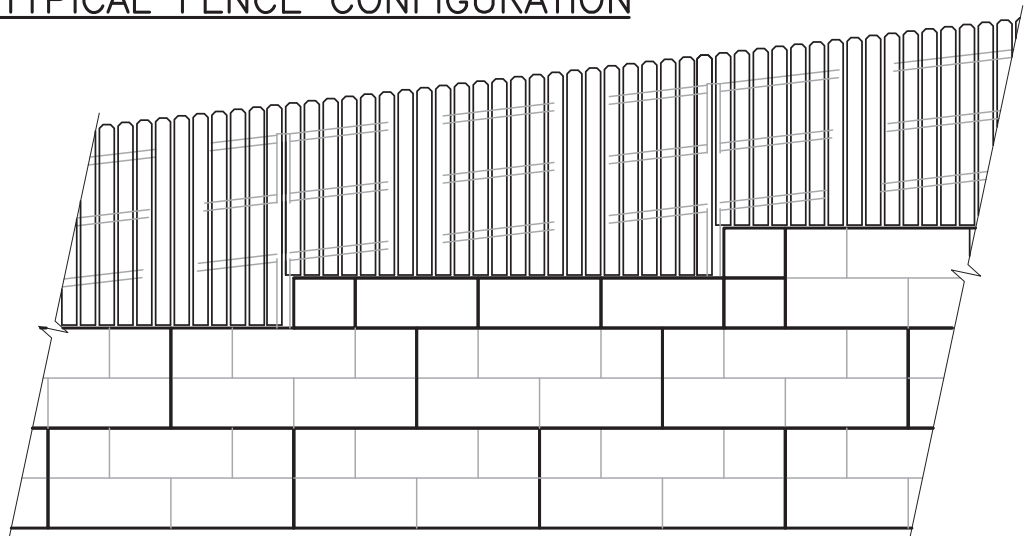
Top of Wall Treatments:
Fencing



FENCE SLEEVE
NOT TO SCALE



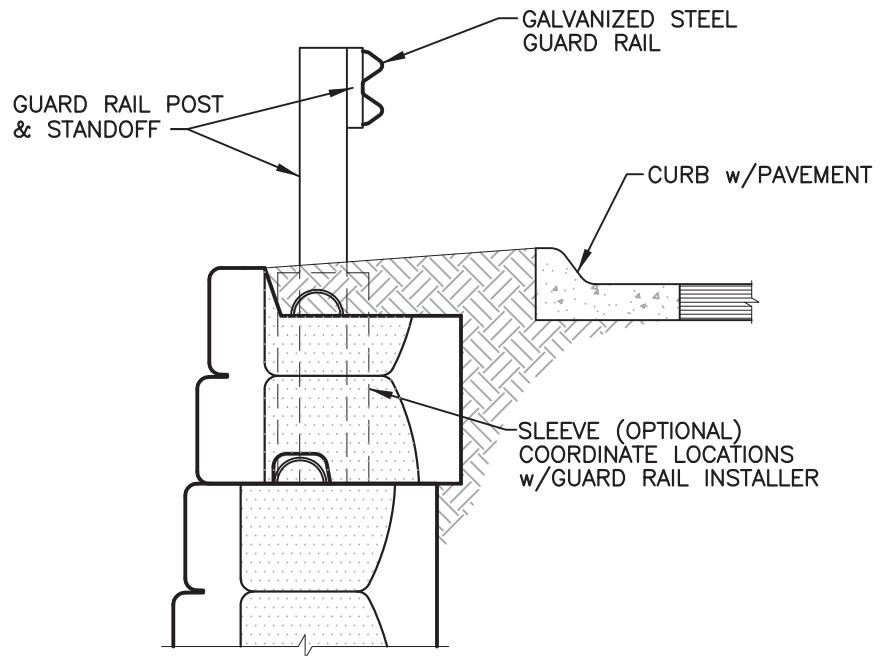
TYPICAL FENCE CONFIGURATION



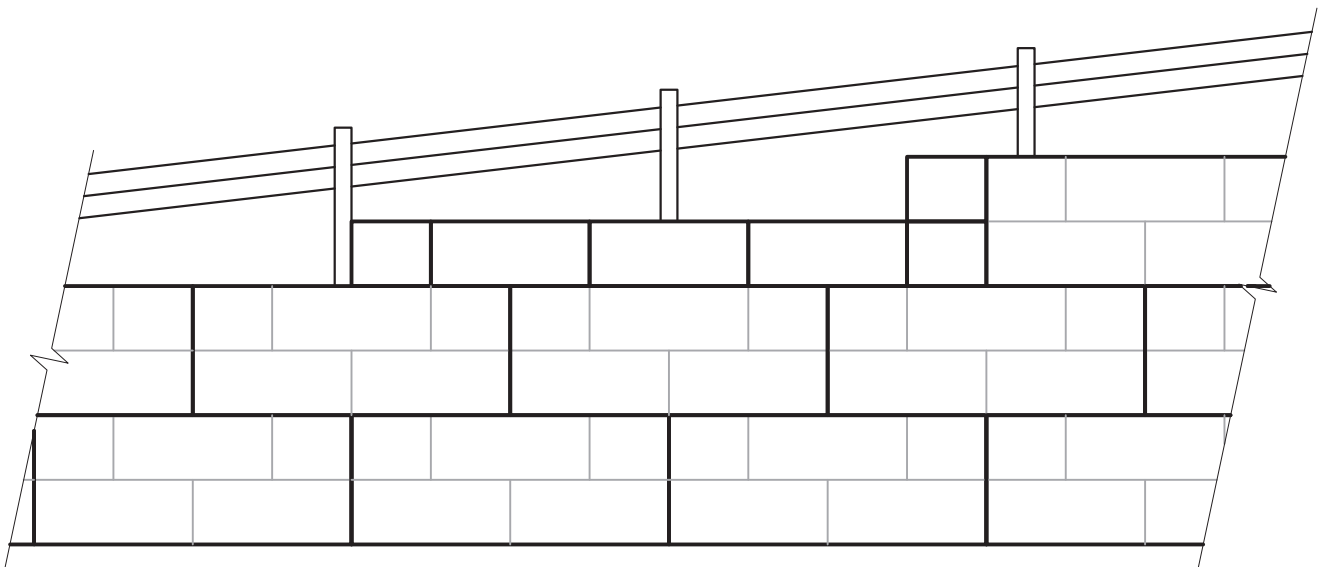
OPTIONAL FENCE CONFIGURATION
NOT TO SCALE

Top of Wall Treatments:

Guardrail



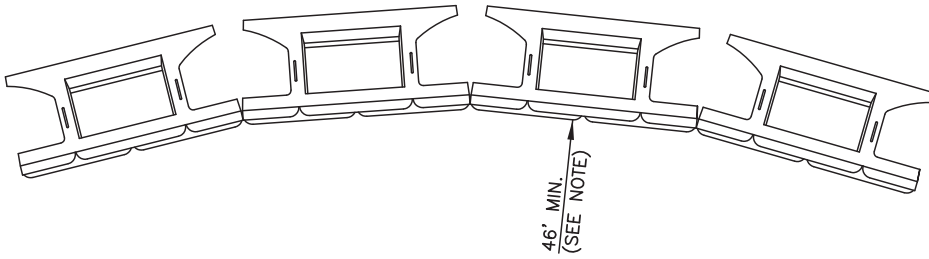
WALL w/GUARD RAIL
NOT TO SCALE



TYPICAL GUARDRAIL CONFIGURATION
NOT TO SCALE

Radius:

24SF

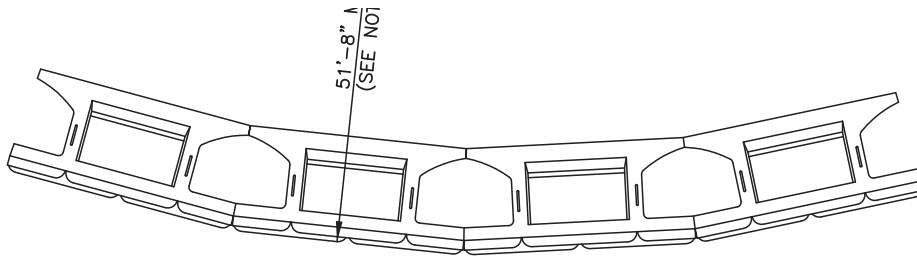


Minimum Concave Radius		
Wall Height (ft)	Total # of Courses	Reqd. Radius at Top Course
6	2	46' 4"
9	3	46' 8"
12	4	47' 0"
15	5	47' 4"
18	6	47' 8"
21	7	48' 0"
24	8	48' 4"

NOTE:
 MINIMUM RADIUS OCCURS AT LOWEST COURSE.
 RADIUS INCREASES 4" PER COURSE ABOVE,
 AS SHOWN ON TABLE.

MINIMUM CONCAVE RADIUS-24SF UNITS

NOT TO SCALE



Minimum Convex Radius		
Wall Height (ft)	Total # of Courses	Reqd. Radius at First Course
6	2	52' 0"
9	3	52' 4"
12	4	52' 8"
15	5	53' 0"
18	6	53' 4"
21	7	53' 8"
24	8	54' 0"

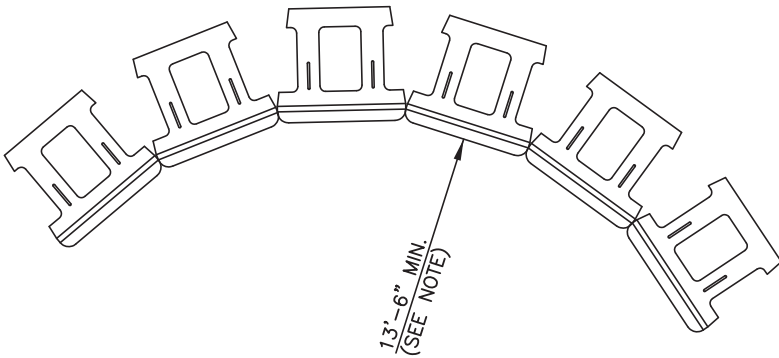
NOTE:
 MINIMUM RADIUS OCCURS AT TOP COURSE.
 REQUIRED RADIUS INCREASES 4" PER COURSE
 BELOW, AS SHOWN ON TABLE.

MINIMUM CONVEX RADIUS-24SF UNITS

NOT TO SCALE

Radius:

6SF



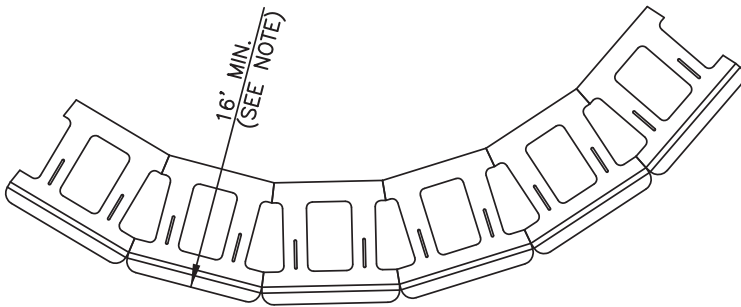
Minimum Concave Radius		
Wall Height (ft)	Total # of Courses	Reqd. Radius at Top Course
3	2	13' 8"
4 1/2	3	13' 10"
6	4	14' 0"
7 1/2	5	14' 2"
9	6	14' 4"
10 1/2	7	14' 6"
12	8	14' 8"

NOTE:

MINIMUM RADIUS OCCURS AT LOWEST COURSE.
RADIUS INCREASES 2" PER COURSE ABOVE, AS SHOWN ON TABLE.

MINIMUM CONCAVE RADIUS—6SF UNITS

NOT TO SCALE



Minimum Convex Radius		
Wall Height (ft)	Total # of Courses	Reqd. Radius at First Course
3	2	16' 2"
4 1/2	3	16' 4"
6	4	16' 6"
7 1/2	5	16' 8"
9	6	16' 10"
10 1/2	7	17' 0"
12	8	17' 2"

NOTE:

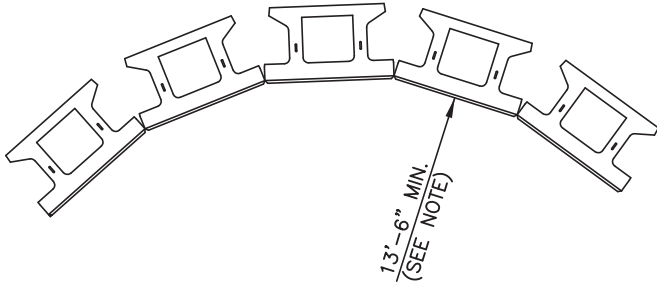
NOTE: MINIMUM RADIUS OCCURS AT TOP COURSE.
REQUIRED RADIUS INCREASES 2" PER COURSE BELOW, AS SHOWN ON TABLE.

MINIMUM CONVEX RADIUS—6SF UNITS

NOT TO SCALE

Radius:

6-28

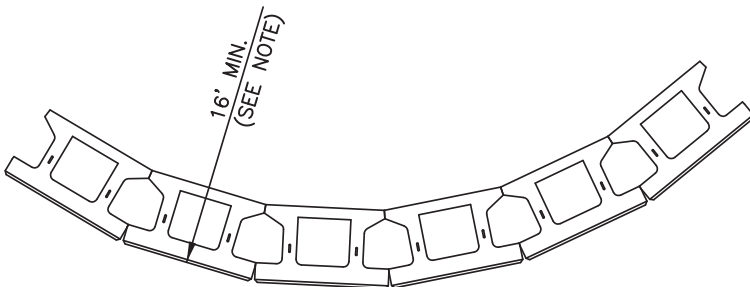


NOTE:
 MINIMUM RADIUS OCCURS AT LOWEST COURSE.
 RADIUS INCREASES 2" PER COURSE
 ABOVE, AS SHOWN ON TABLE.

Minimum Concave Radius		
Wall Height (ft)	Total # of Courses	Reqd. Radius at Top Course
3	2	13' 8"
4 1/2	3	13' 10"
6	4	14' 0"
7 1/2	5	14' 2"
9	6	14' 4"
10 1/2	7	14' 6"
12	8	14' 8"

MINIMUM CONCAVE RADIUS—6—28 UNITS

NOT TO SCALE



NOTE:
 NOTE: MINIMUM RADIUS OCCURS AT TOP COURSE.
 REQUIRED RADIUS INCREASES 2" PER COURSE
 BELOW, AS SHOWN ON TABLE.

Minimum Convex Radius		
Wall Height (ft)	Total # of Courses	Reqd. Radius at First Course
3	2	16' 2"
4 1/2	3	16' 4"
6	4	16' 6"
7 1/2	5	16' 8"
9	6	16' 10"
10 1/2	7	17' 0"
12	8	17' 2"

MINIMUM CONVEX RADIUS—6—28 UNITS

NOT TO SCALE



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