



Field Construction Manual

Stone Strong Systems
Precast Modular Unit Retaining Wall System

Stone Strong, LLC

2023

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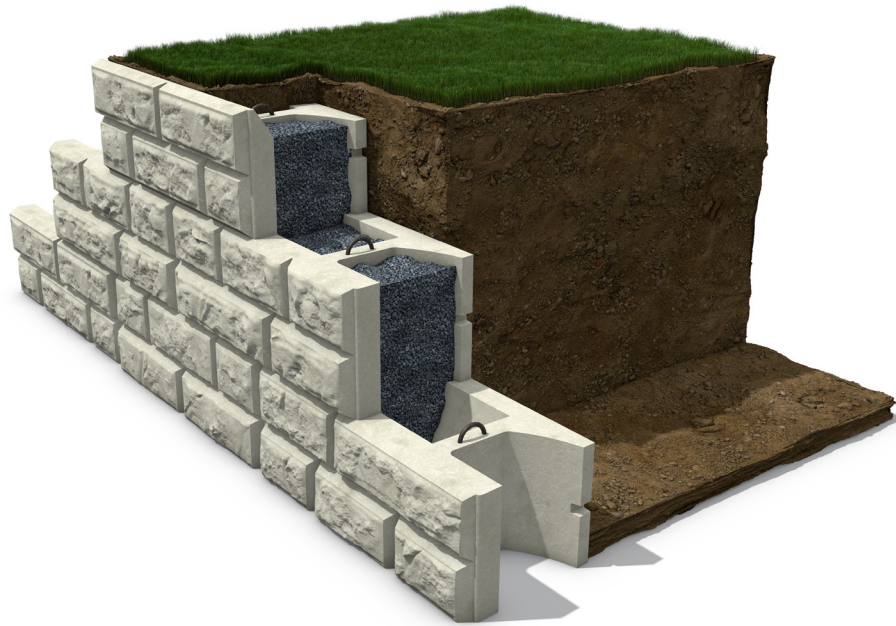
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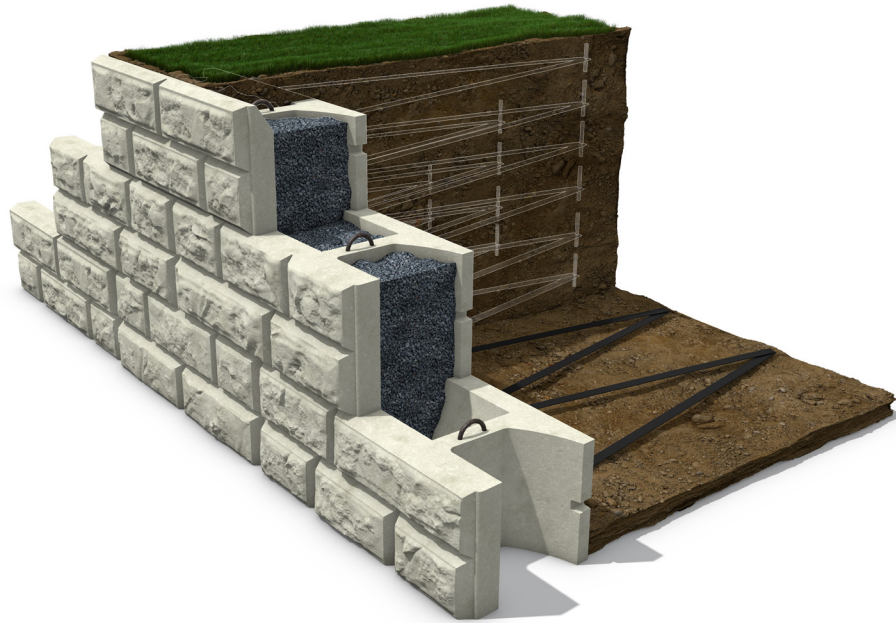
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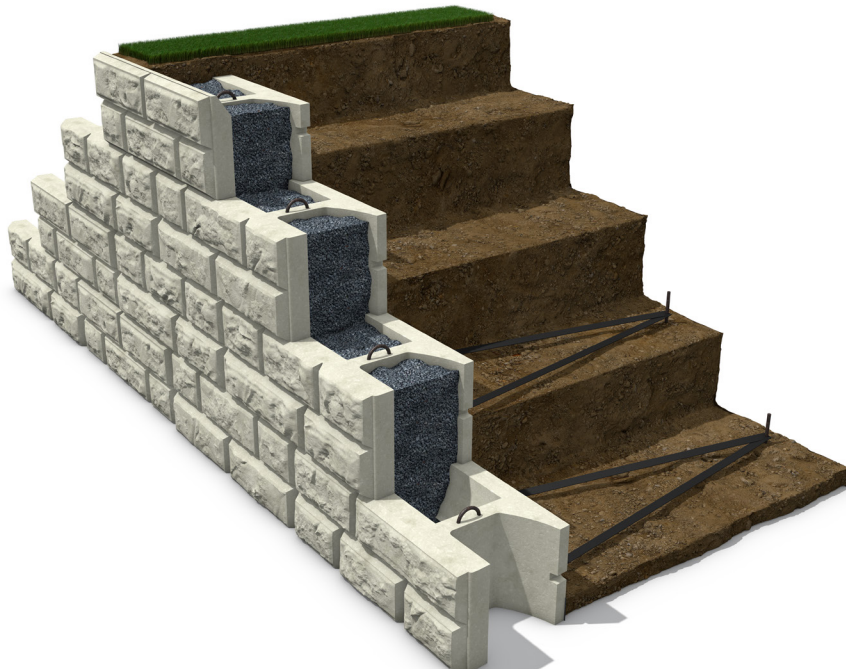
Gravity



MSE



Hybrid



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.

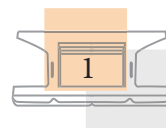
Engineer or owner's representative

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

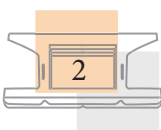
The contractor will be responsible for:

- 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 $\pm 1/8$ 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%.
- When reinforcing steel is used, rebar shall be Grade 60 (metric Grade 400) and mesh shall be Grade 70 (metric Grade 485).
- 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 D698.

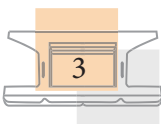




Unit Properties (Imperial)

Unit Type	Unit Description	Conc. Wt. (lbs)	Void Vol (ft ³)	Length (ft)	Height (ft)	Unit Width (in)
Standard units						
24-44	24-44 unit	6,000	43.21	8	3.00	44
24-62	24-62 unit	6,800	76.05	8	3.00	62
24-86	24-86 unit	7,600	117.90	8	3.00	86
D150	D150 Assembly	12,650	210.32	8	3.00	150
6-44	6-44 unit	1,500	10.95	4	1.50	44
3-44	3-44 unit	750	5.48	2	1.50	44
6-28	6-28 unit	950	6.65	4	1.50	28
3-28	3-28 unit	475	3.33	2	1.50	28
24-ME	24SF Mass Extender unit	10,000	44.82	8	3.00	56
Alternate top units						
Cap	Cap unit	1,600		8	0.58	32.0
DF	Dual Face unit	3,500		8	1.50	28.0
Vertical stack units (modified recess and face to permit construction of a vertical face)						
V24-44	Vertical 24-44 Unit	6,000	43.21	8	3.00	43
V24-62	Vertical 24-62 unit	6,800	76.05	8	3.00	61
V24-86	Vertical 24-86 unit	7,600	117.90	8	3.00	85
VD150	Vertical D150 Assembly	12,650	210.32	8	3.00	149
V6-44	Vertical 6-44 unit	1,500	10.95	4	1.50	44
V3-44	Vertical 3-44 unit	750	5.48	2	1.50	44
V6-28	Vertical 6-28 unit	950	6.75	4	1.50	28
V3-28	Vertical 3-28 unit	475	3.38	2	1.50	28
V24-ME	Vertical 24SF Mass Extender unit	10,000	44.82	8	3.00	55

5/3/23



Unit Properties (metric)

Unit Type	Unit Description	Conc. Wt. (kg)	Void Vol (m ³)	Length (m)	Height (m)	Unit Width (mm)
Standard units						
24-44	24-44 unit	2,720	1.22	2.44	0.91	1118
24-62	24-62 unit	3,080	2.16	2.44	0.91	1575
24-86	24-86 unit	3,445	3.35	2.44	0.91	2184
D150	D150 Assembly	5,736	5.96	2.44	0.91	3785
6-44	6-44 unit	680	0.31	1.22	0.46	1118
3-44	3-44 unit	340	0.16	0.61	0.46	1118
6-28	6-28 unit	430	0.19	1.22	0.46	711
3-28	3-28 unit	215	0.10	0.61	0.46	711
24-ME	24SF Mass Extender unit	4,535	1.28	2.44	0.91	1422
Alternate top units						
Cap	Cap unit	730		2.44	0.18	813.00
DF	Dual Face unit	1,590		2.44	0.46	711.00
Vertical stack units (modified recess and face to permit construction of a vertical face)						
V24-44	Vertical 24-44 Unit	2,720	1.22	2.44	0.91	1093
V24-62	Vertical 24-62 unit	3,080	2.16	2.44	0.91	1550
V24-86	Vertical 24-86 unit	3,445	3.35	2.44	0.91	2159
VD150	Vertical D150 Assembly	5,736	5.96	2.44	0.91	3760
V6-44	Vertical 6-44 unit	680	0.31	1.22	0.46	1118
V3-44	Vertical 3-44 unit	340	0.16	0.61	0.46	1118
V6-28	Vertical 6-28 unit	430	0.19	1.22	0.46	711
V3-28	Vertical 3-28 unit	215	0.10	0.61	0.46	711
V24-ME	Vertical 24SF Mass Extender unit	4,535	1.28	2.44	0.91	1397

5/3/23

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 Syntee 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.

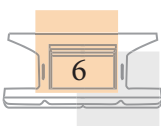
Excavate as required for installation of the retaining wall system. Use caution not to over-excavate beyond depth needed for the foundation.

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 D698, 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 granular base material or concrete if specified. 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	Metric Standard Sieve Size	Percent Passing
1-1/2"	37.5 mm	80-100
3/4"	19 mm	50-90
#4	4.75 mm	0-40
#200	75 µm	0-10

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 D698, 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.



Refer to pg.13 for compaction details

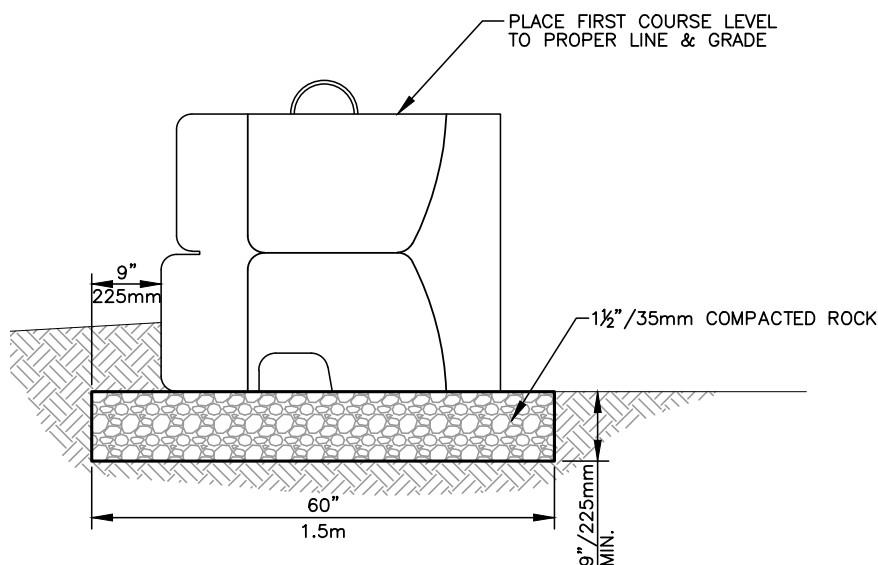


WALL UNIT INSTALLATION - First Course

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.

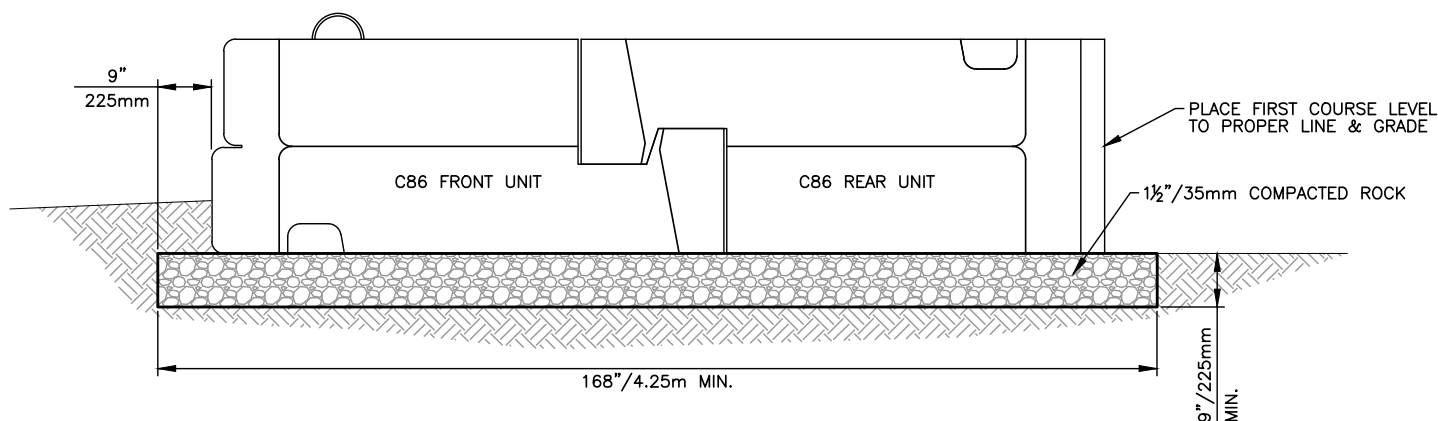
Leveling should be done by means of a 4 foot level across the top of the unit.



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

24-44 WALL BASE

NOT TO SCALE

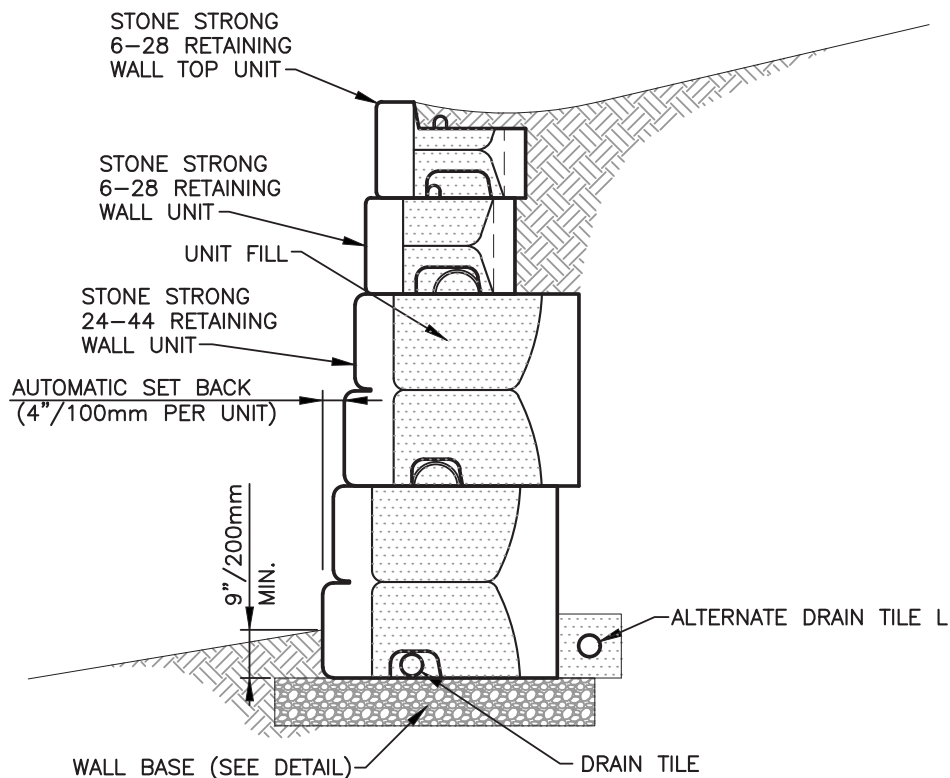


NOTE: BEARING CONDITIONS SHALL BE OBSERVED BY THE SITE GEOTECHNICAL ENGINEER. BASE DIMENSIONS MAY BE INCREASED TO ADDRESS DEFICIENT SOIL BEARING CONDITIONS.

D150 ASSEMBLY WALL BASE

NOT TO SCALE

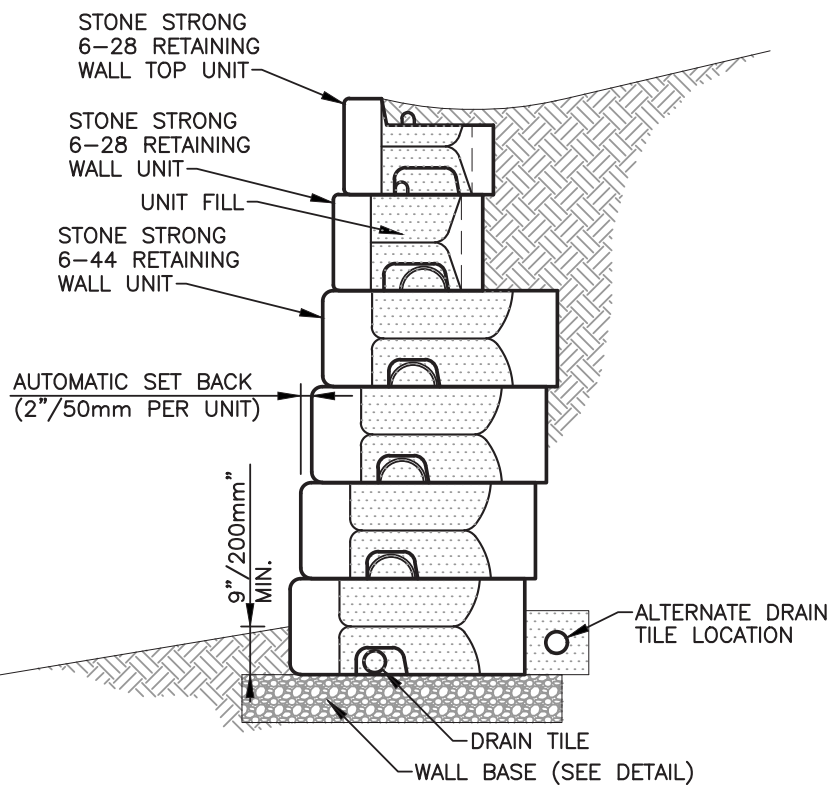
WALL UNIT INSTALLATION - Subsequent Courses



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

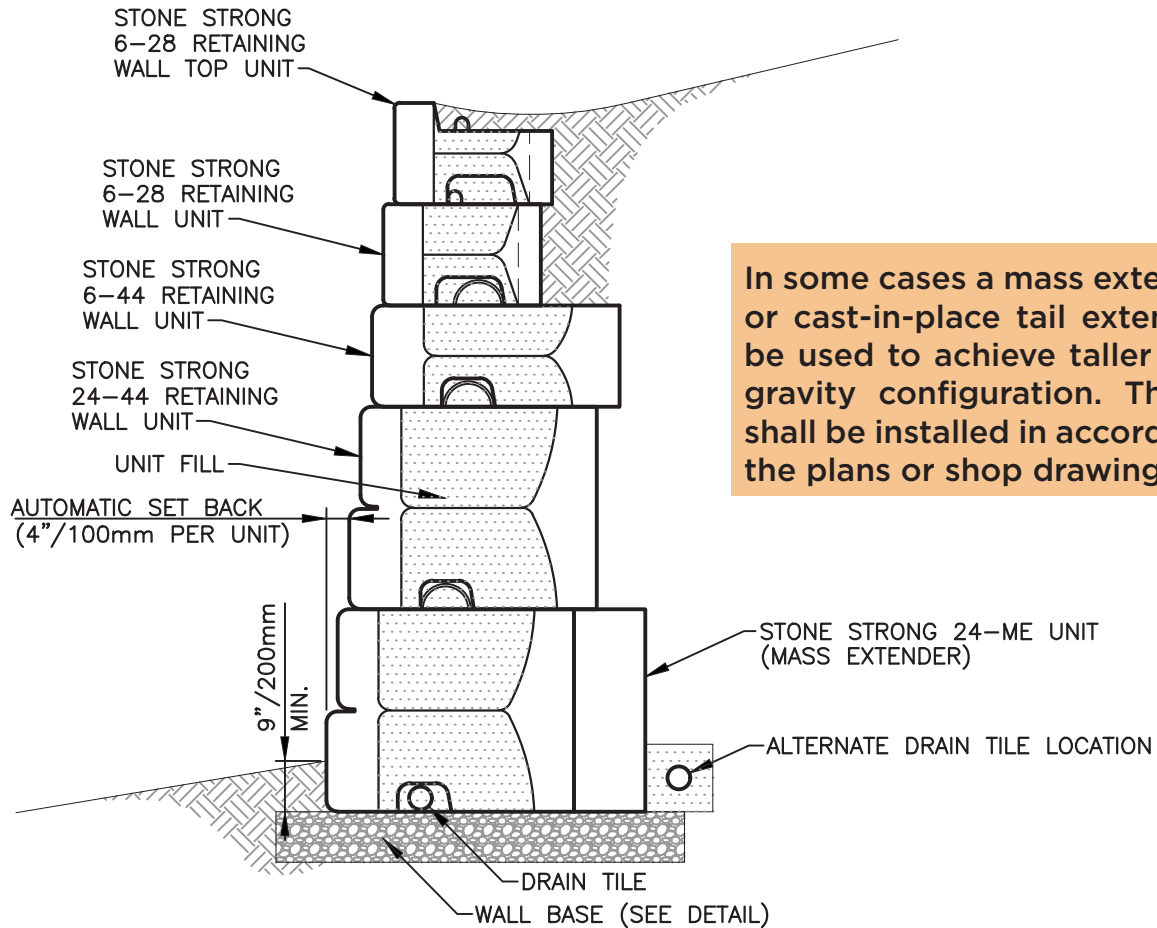
GRAVITY WALL CROSS SECTION

NOT TO SCALE



6-44 GRAVITY WALL CROSS SECTION

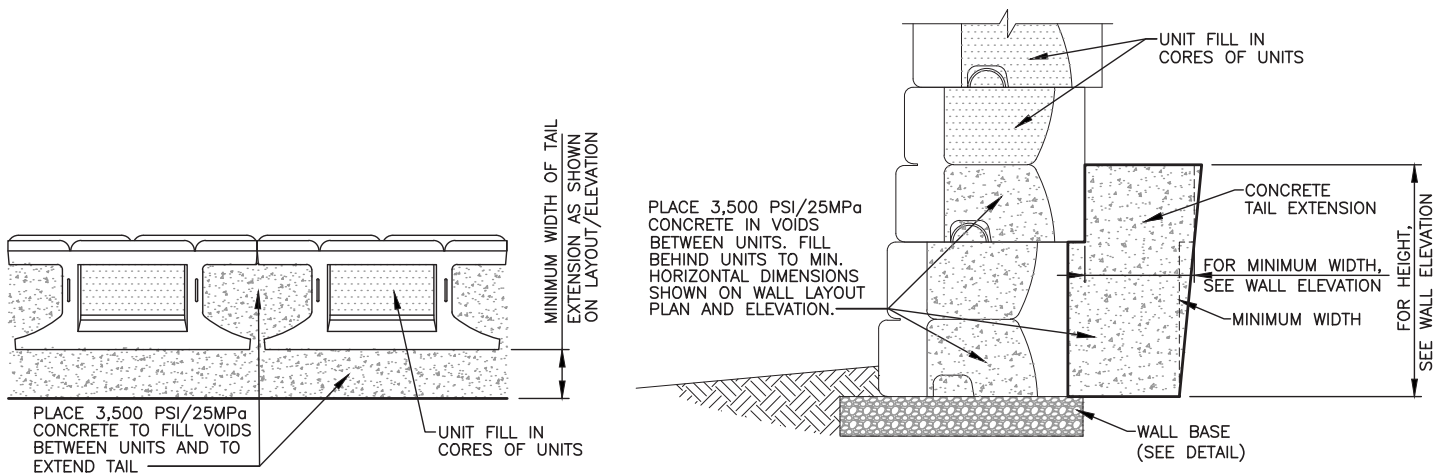
NOT TO SCALE



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



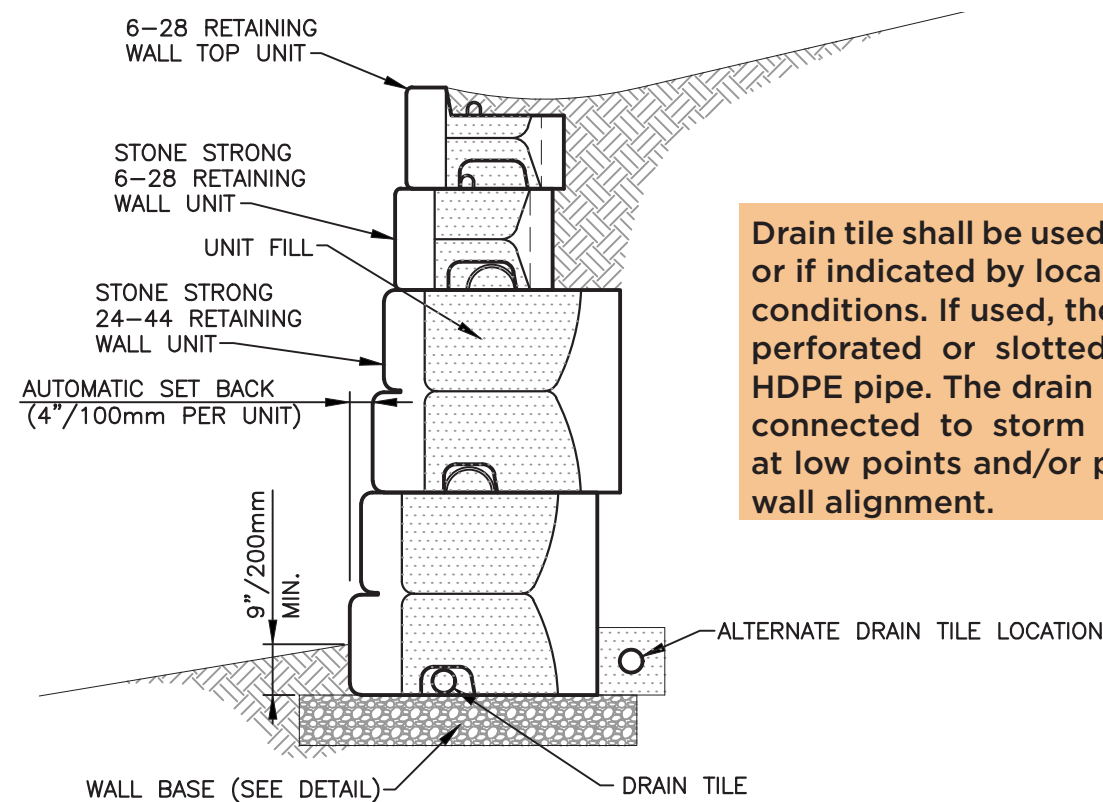
24-44 CONCRETE TAIL EXTENSION DETAIL (CAST-IN-PLACE)

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:

U.S. Standard Sieve Size	Metric Standard Sieve Size	Percent Passing
1-1/2"	37.5mm	100
3/4"	19mm	50-90
#4	4.75mm	0-10
#8	2.36mm	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 D698. 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.



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.

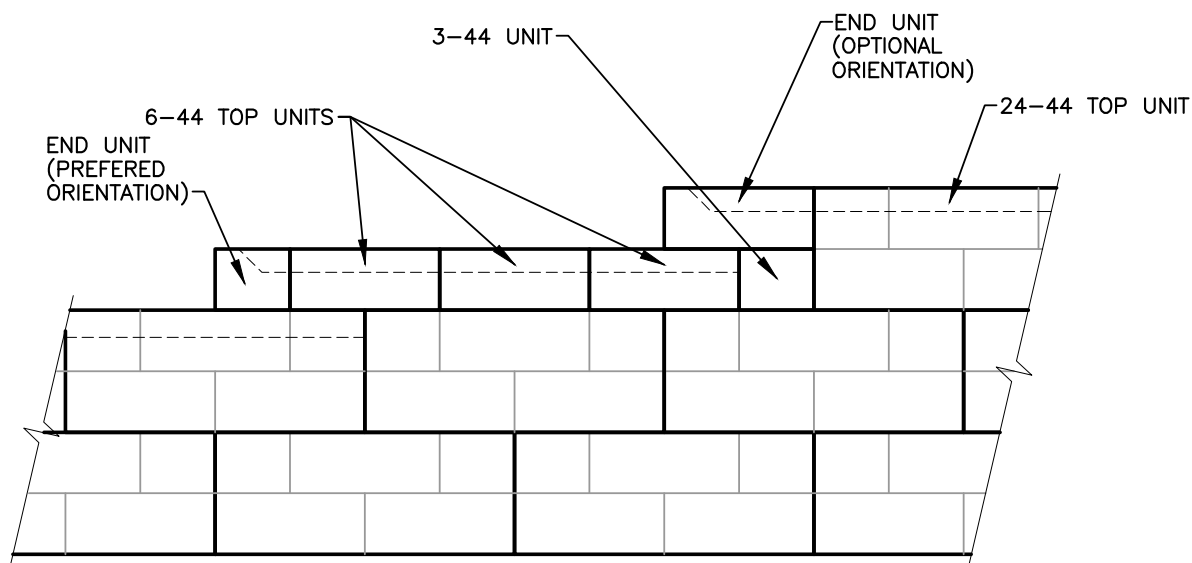
The layout of radius and corners shall be installed in accordance with the plans or shop drawings. See radius tables included at the end of this manual.

1] Continue placing successive courses to the elevations shown on the plans.

2] 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.

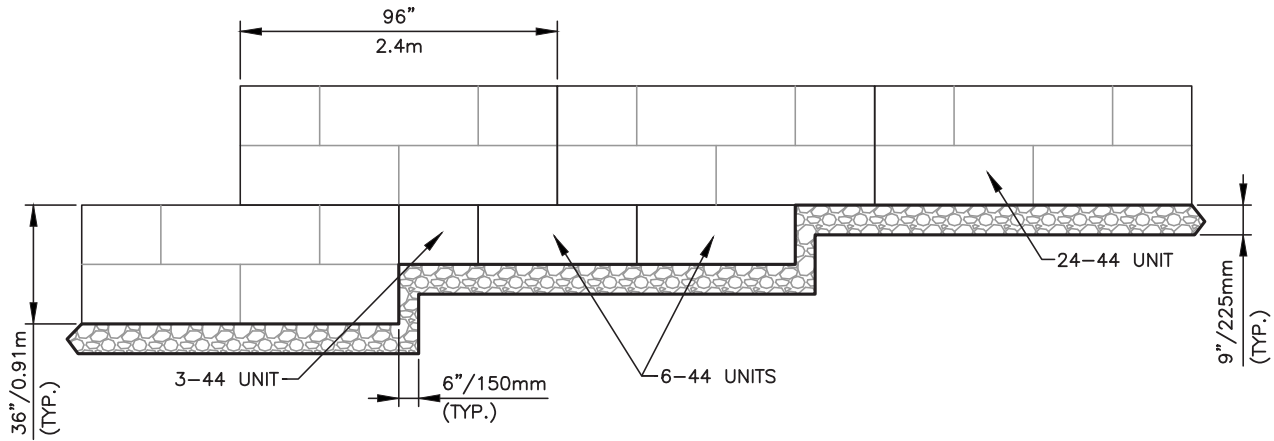
3] Provide temporary swales to divert runoff away from wall excavation and away from face during the construction phase.

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



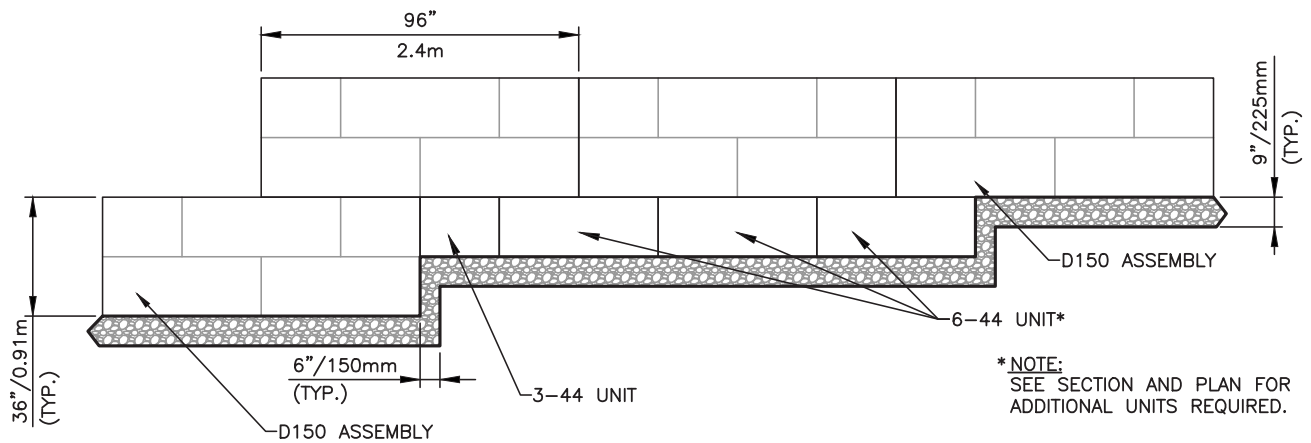
TOP OF WALL STEPS

NOT TO SCALE



24-44 WALL BASE STEP

NOT TO SCALE



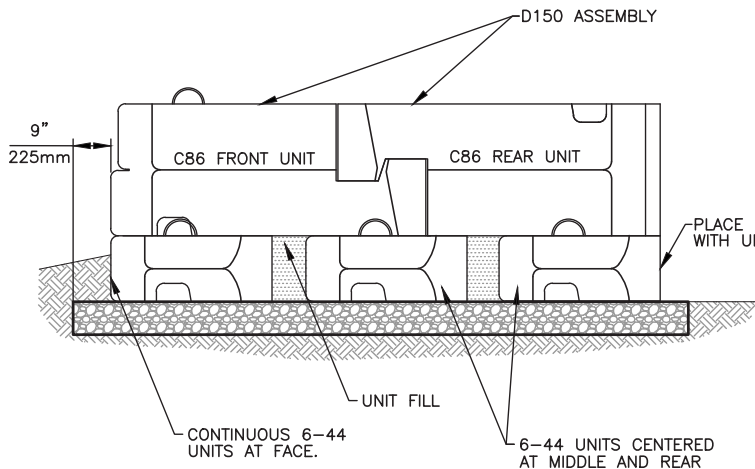
*NOTE:
SEE SECTION AND PLAN FOR
ADDITIONAL UNITS REQUIRED.

ELEVATION

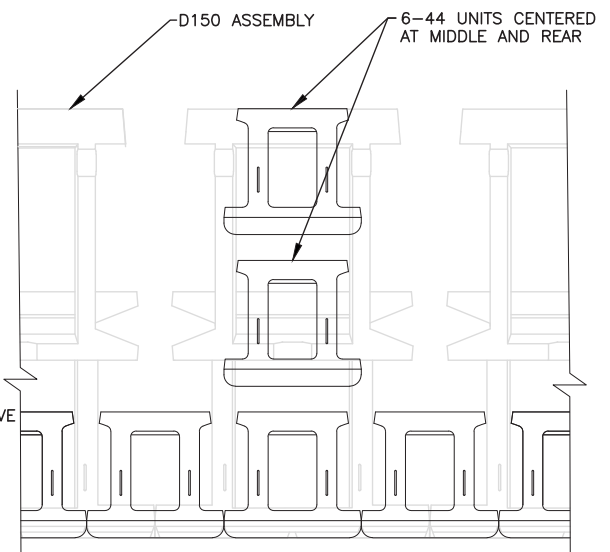
WALL BASE STEP w/D150 ASSEMBLY

NOT TO SCALE

Verify assembly is plane & level -
Clean interlock lift-loop void to assure
components fully mate.



SECTION



PLAN

WALL BASE STEP w/D150 ASSEMBLY

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.

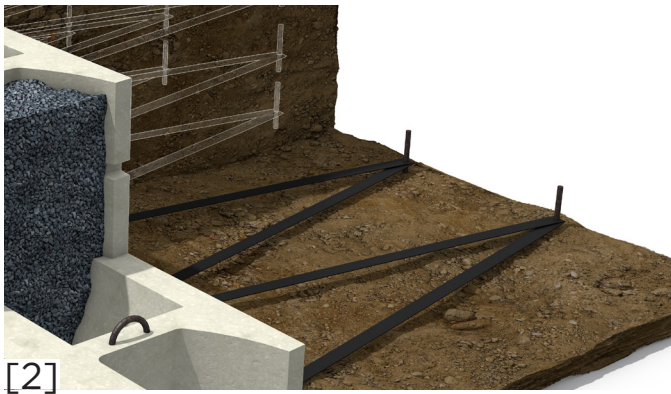
Strap is inserted through box as shown (image 1)

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.



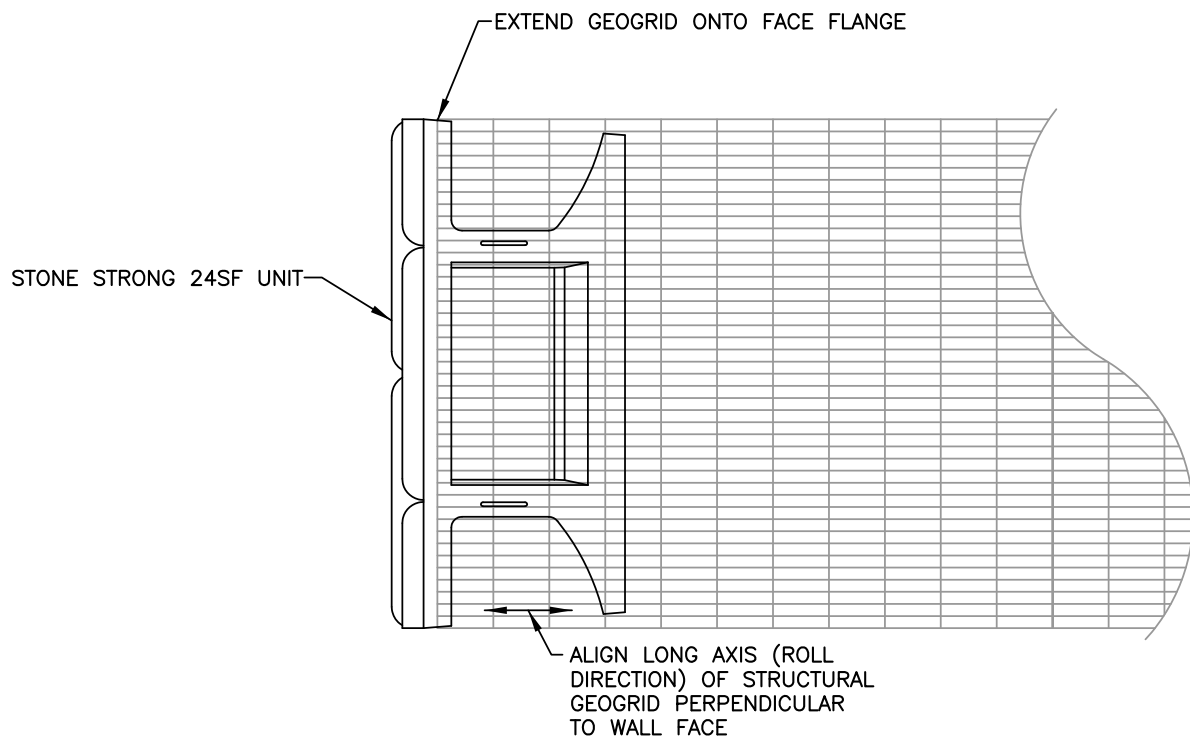
Equipment can be used over straps after covering with minimum 3 inches of backfill.

Geogrid Installation



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.



CLEANUP

Remove any damaged or unused Stone Strong unit.

Remove any unit fill or backfill material.

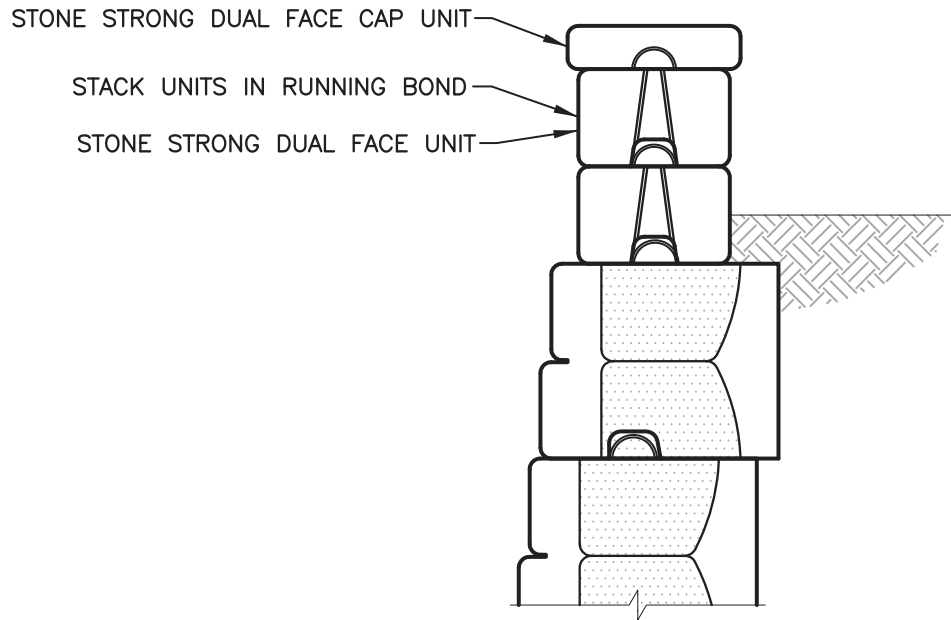
Remove debris caused by wall construction.

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:

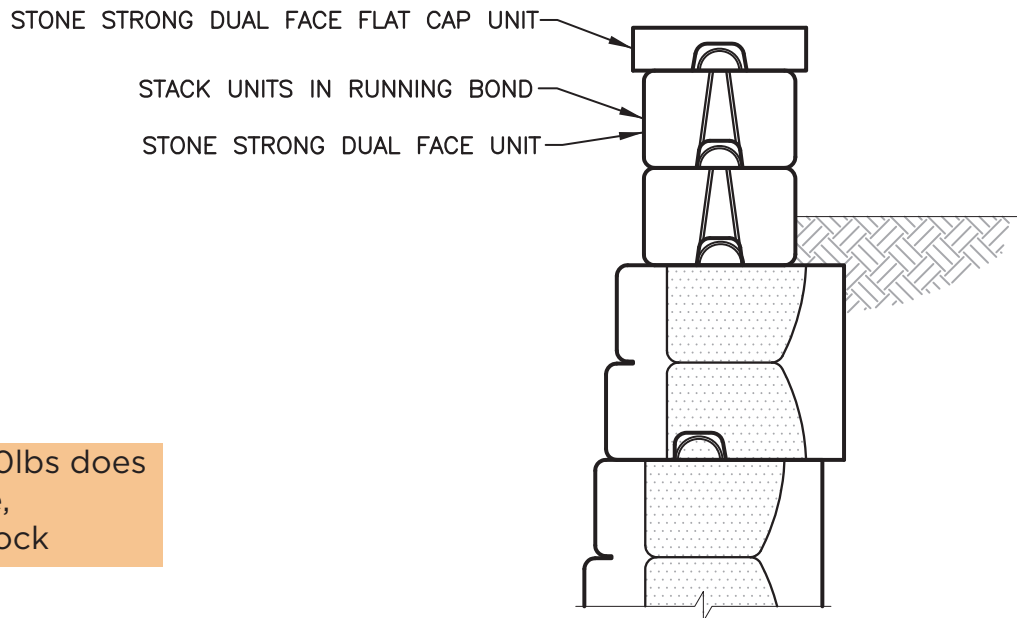
Wall Capping



DUAL FACE PARAPET

WALL w/CAP

NOT TO SCALE



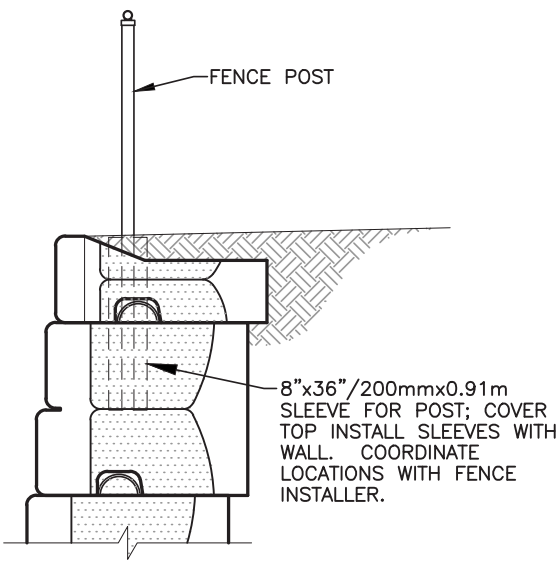
Any block over 1,000lbs does not require adhesive, including the cap block

DUAL FACE PARAPET

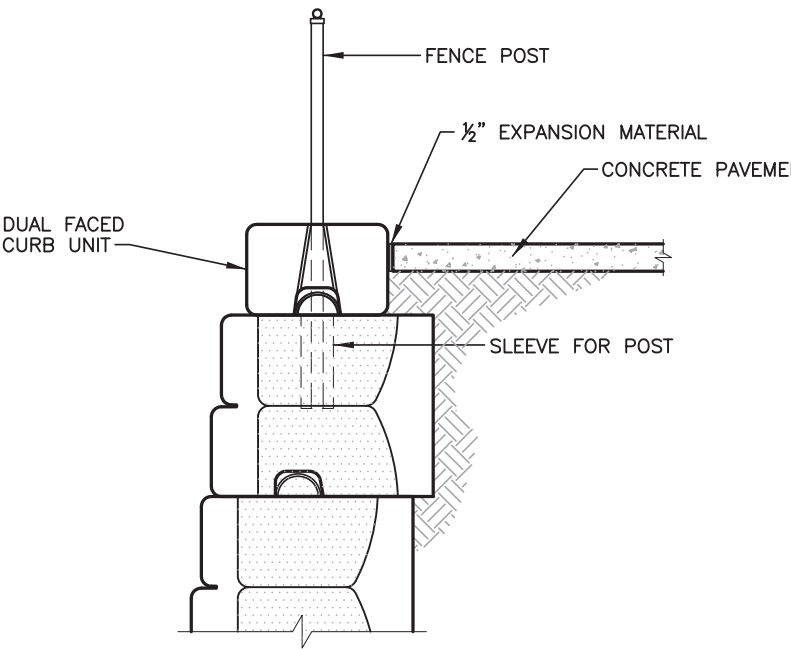
WALL w/FLAT CAP

NOT TO SCALE

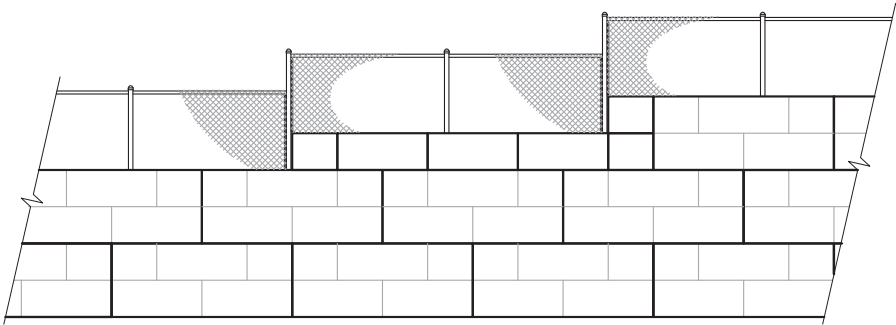
Top of Wall Treatments:
Fencing



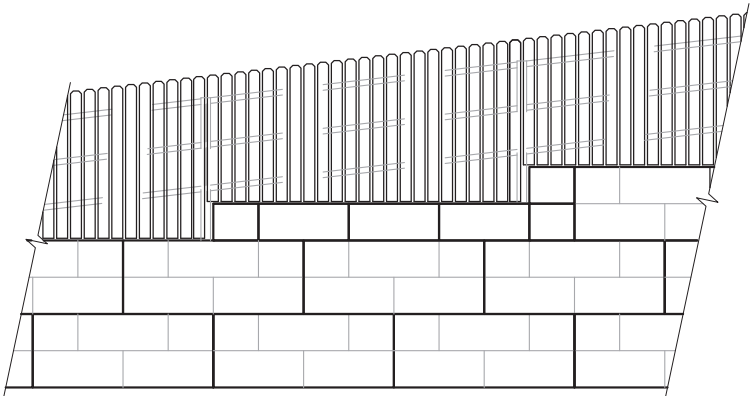
FENCE SLEEVE
NOT TO SCALE



DUAL FACE CURB w/SIDEWALK
NOT TO SCALE

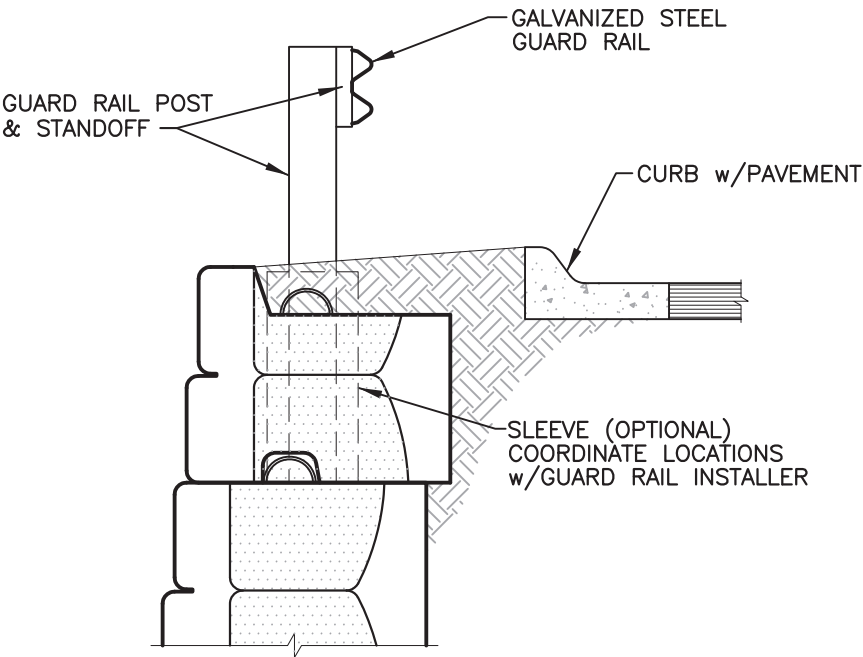


TYPICAL FENCE CONFIGURATION
NOT TO SCALE

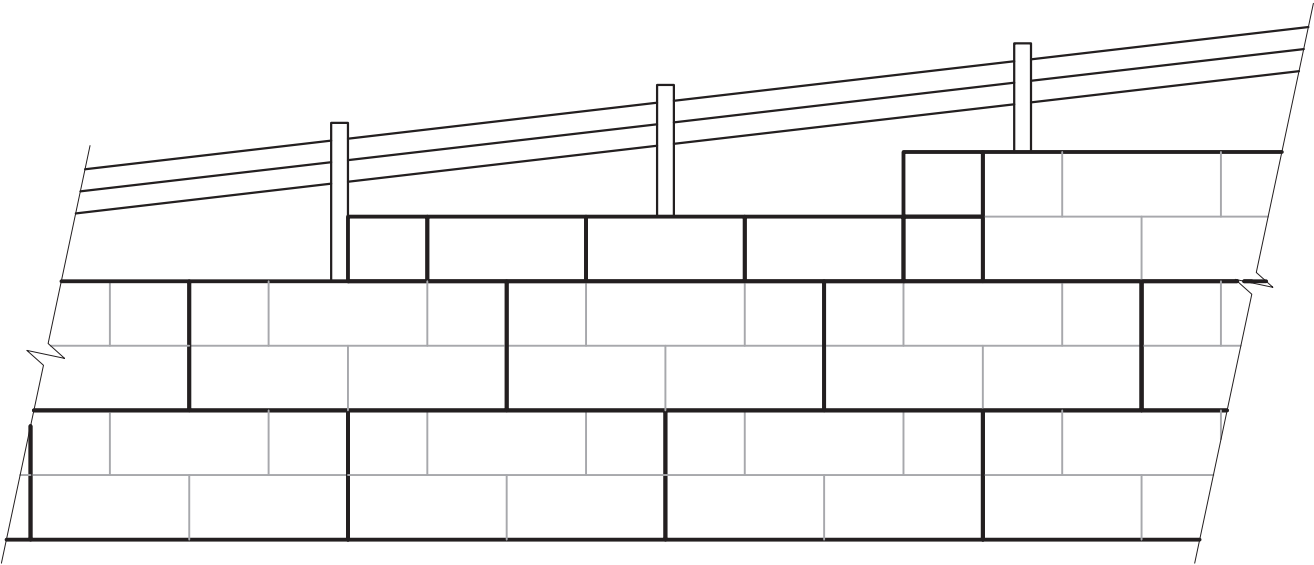


OPTIONAL FENCE CONFIGURATION
NOT TO SCALE

Top of Wall Treatments:
Guardrail

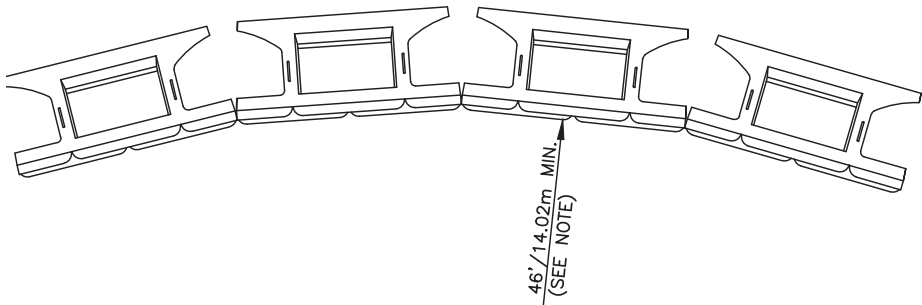


WALL w/GUARD RAIL
NOT TO SCALE



TYPICAL GUARDRAIL CONFIGURATION
NOT TO SCALE

Radius: 24SF Blocks

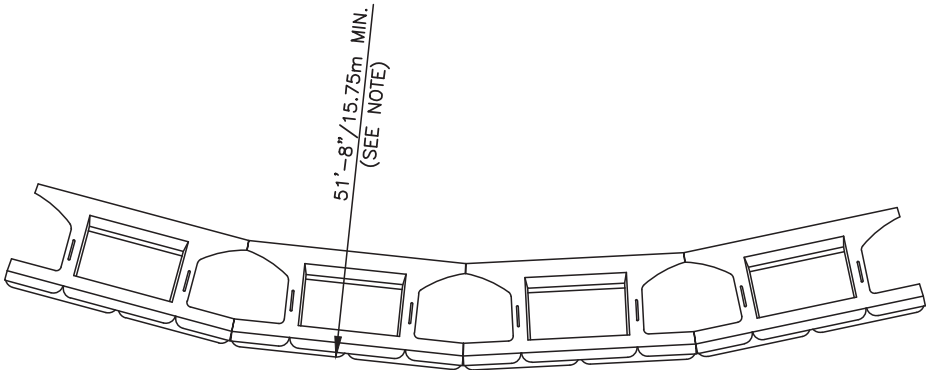


Minimum Concave Radius		
Wall Height (m)	Total # of Courses	Reqd. Radius at Top Course
1.83	2	14.12m
2.74	3	14.22m
3.66	4	14.33m
4.57	5	14.43m
5.49	6	14.53m
6.40	7	14.63m
7.32	8	14.73m

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"/102mm PER COURSE ABOVE,
AS SHOWN ON TABLE.

MINIMUM CONCAVE RADIUS 24–44 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"

Minimum Convex Radius		
Wall Height (m)	Total # of Courses	Reqd. Radius at First Course
1.83	2	15.85m
2.74	3	15.95m
3.66	4	16.05m
4.57	5	16.15m
5.49	6	16.26m
6.40	7	16.36m
7.32	8	16.46m

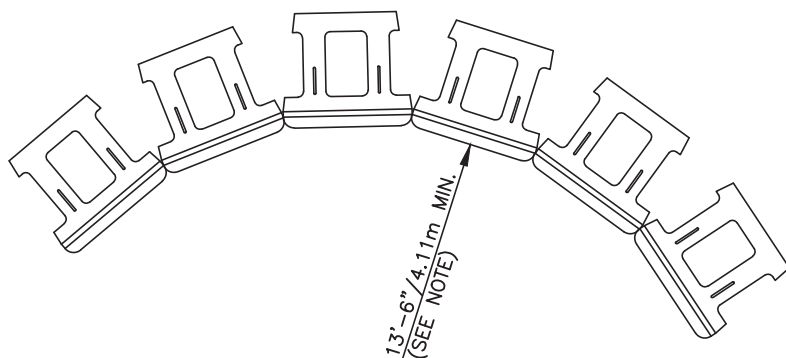
NOTE:
MINIMUM RADIUS OCCURS AT TOP COURSE.
REQUIRED RADIUS INCREASES 4"/102mm PER COURSE
BELOW, AS SHOWN ON TABLE.

MINIMUM CONVEX RADIUS 24–44 UNITS NOT TO SCALE

Note: All 24sf face block have equivalent radius. This applies to 24-62 & 24-86 units.

Radius:

6-44 & 6-28 Block



NOTE:

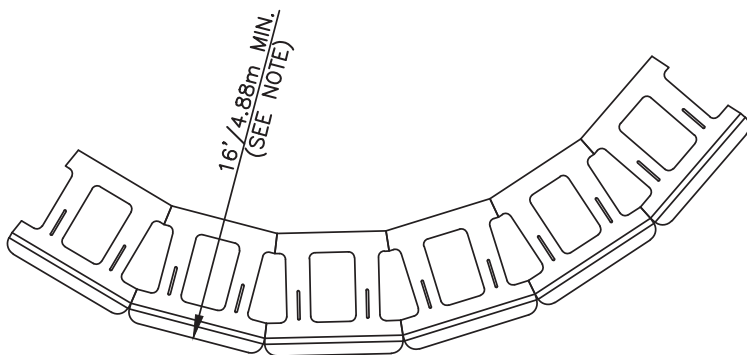
MINIMUM RADIUS OCCURS AT LOWEST COURSE.
RADIUS INCREASES 2"/51mm PER COURSE
ABOVE, AS SHOWN ON TABLE.

MINIMUM CONCAVE RADIUS 6-44 UNITS

NOT TO SCALE

Minimum Concave Radius		
Wall Height (m)	Total # of Courses	Reqd. Radius at First Course
0.91	2	4.17m
1.37	3	4.22m
1.83	4	4.27m
2.29	5	4.32m
2.74	6	4.37m
3.20	7	4.42m
3.66	8	4.47m

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:

NOTE: MINIMUM RADIUS OCCURS AT TOP COURSE.
REQUIRED RADIUS INCREASES 2"/51mm PER COURSE
BELOW, AS SHOWN ON TABLE.

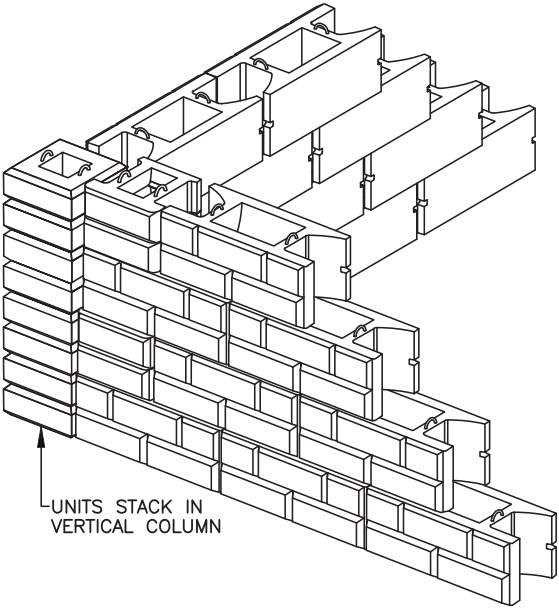
MINIMUM CONVEX RADIUS 6-44 UNITS

NOT TO SCALE

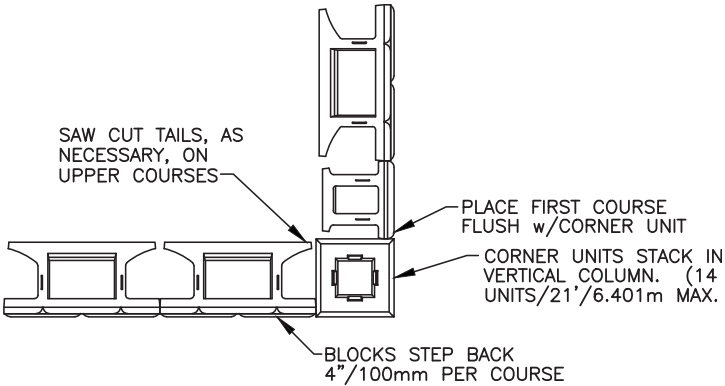
Minimum Convex Radius		
Wall Height (m)	Total # of Courses	Reqd. Radius at First Course
0.91	2	4.93m
1.37	3	4.98m
1.83	4	5.03m
2.29	5	5.08m
2.74	6	5.13m
3.20	7	5.18m
3.66	8	5.23m

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"

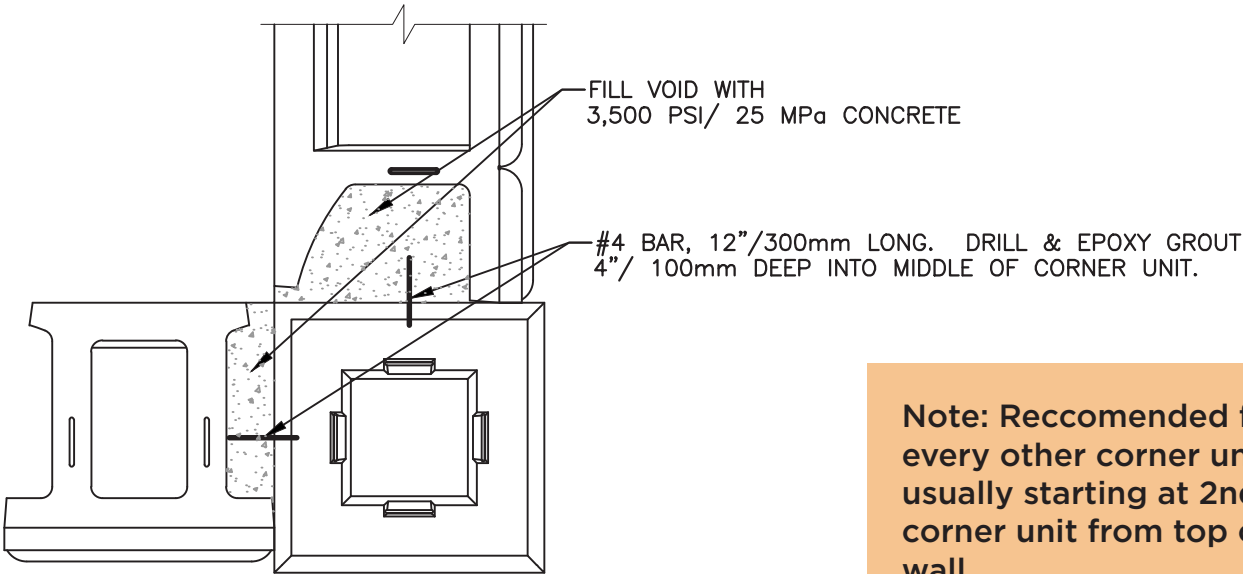
Outside 90 Deg. Corner



NOTE:
TIEBACKS SHALL BE INSTALLED FOR CORNERS 9'/2.74m TALL OR TALLER. INSTALL TIEBACK EVERY OTHER CORNER UNIT USUALLY STARTING AT 2nd CORNER UNIT FROM TOP OF WALL (SEE 90° CORNER TIEBACK DETAIL).



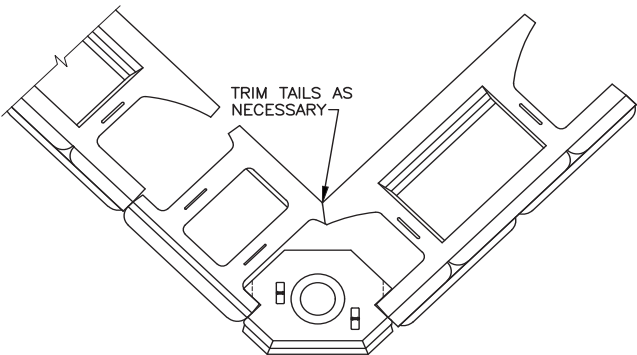
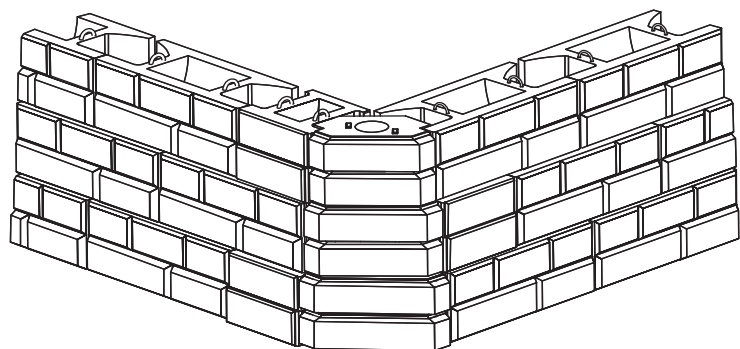
90 Deg. Corner with Tieback



Note: Reccomended for every other corner unit usually starting at 2nd corner unit from top of wall

90° CORNER TIEBACK
NOT TO SCALE

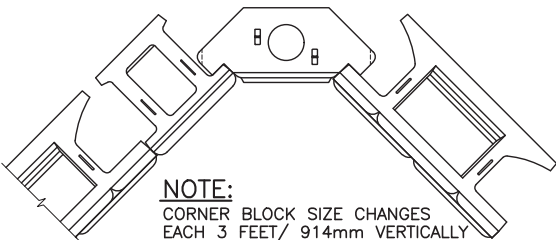
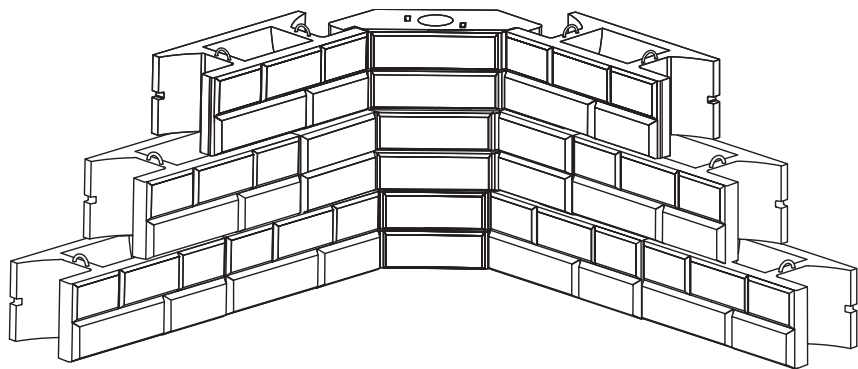
Outside Corner Assembly



NOTE:
CORNER BLOCK SIZE CHANGES
EACH 3 FEET/ 914mm VERTICALLY

STONE STRONG OUTSIDE CORNER BLOCK ASSEMBLY
NOT TO SCALE

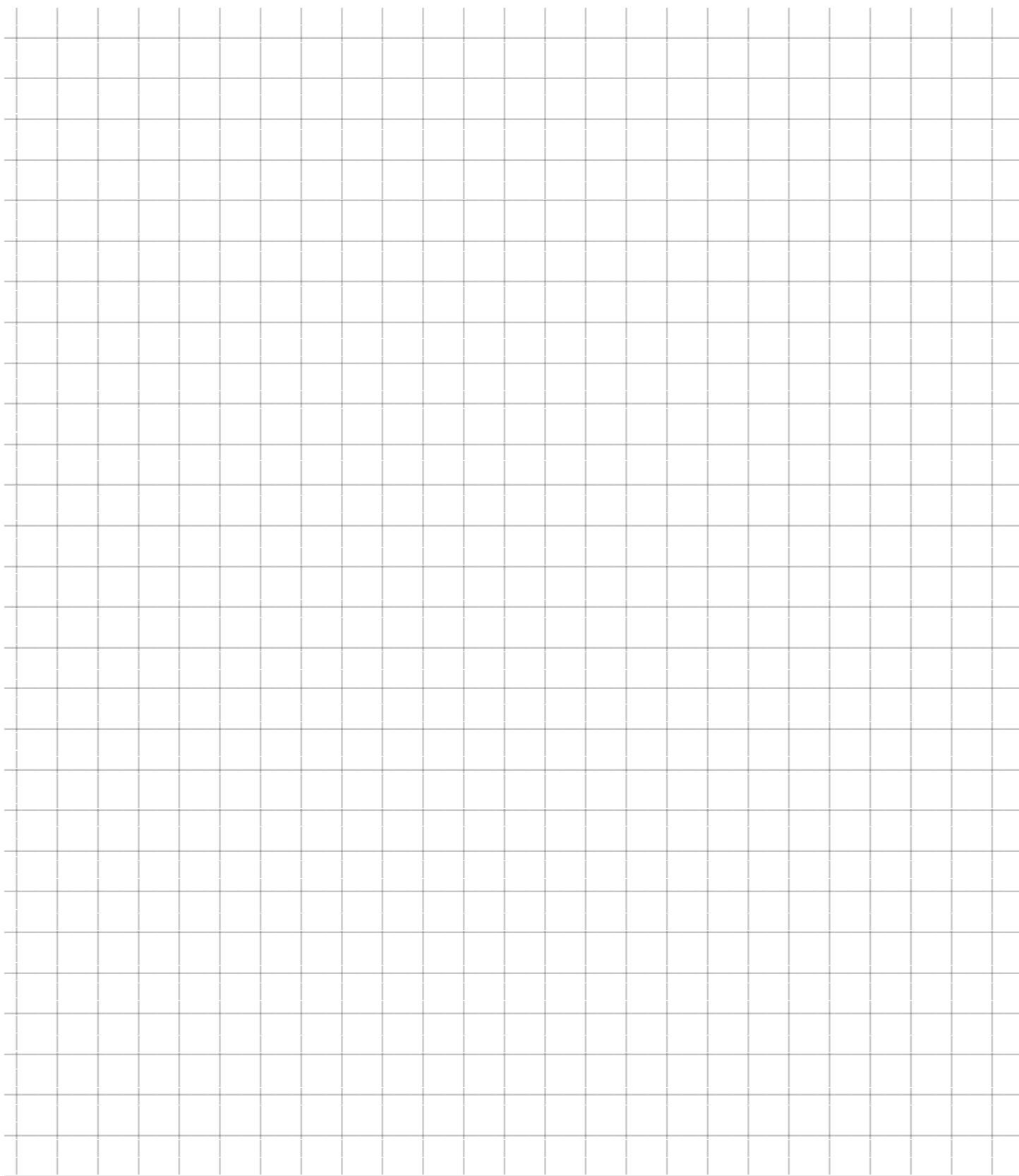
Inside Corner Assembly



STONE STRONG INSIDE CORNER BLOCK ASSEMBLY
NOT TO SCALE

Notes







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