INTERNATIONAL DESIGN RESOURCE MANUAL

REDI ROCK®

The information contained in the Design Resource Manual (DRM) has been compiled by Redi-Rock International, LLC to document the performance of the Redi-Rock products contained therein. It is accurate to the best of our knowledge as of the date of its issue. Information included in the DRM has been prepared in accordance with generally recognized engineering principles and practices. This information should not be used without first securing competent advice with respect to its suitability for any general or specific application. Final determination of the suitability of any design information and the appropriateness of this data for a given design purpose is the sole responsibility of the user.

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REGISTER YOUR DESIGN RESOURCE MANUAL

We are committed to always providing you with up-to-date information and cutting-edge engineering. By registering your manual, you will ensure your access to the newest technical updates as they become available.

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Hello!

When Redi-Rock launched in 2000, the introduction of large, wetcast blocks changed the retaining wall industry. Nineteen years later as we publish our latest version of the Design Resource Manual, we're aiming to change more than an industry—we're aiming to reinforce the ways that we, together, are changing the world in concrete ways.

We know that the work you do makes an impact in your community, and we're honored each time you choose Redi-Rock to solve problems and improve people's lives. In recognition of that, we'll continue to strive to be a leader in the industry, providing the design tools and engineering resources you need to do that valuable work.

Within this manual, you'll see the latest innovation of the Redi-Rock system in Redi-Rock XL Hollow-Core Retaining blocks. Standing 914 millimeters tall and available in 1320, 1830, and 2440-millimeter widths, Redi-Rock XL blocks integrate with the rest of the proven system—including Positive Connection, Freestanding, Hollow-core, and our standard Gravity blocks—helping you optimize taller walls in tighter spaces.

Also within these pages, you'll find answers to frequently asked questions, a detailed library of products, detailed design information, specifications, installation instructions, typical details, and much more. The information in this publication is intended to supplement even more information available anytime on our website at **redi-rock.com**.

If you're not finding what you're looking for or if there is anything we can do for you, please let us know how we can help.

Sincerely,

Jamie Johnson, PE
Director of Engineering

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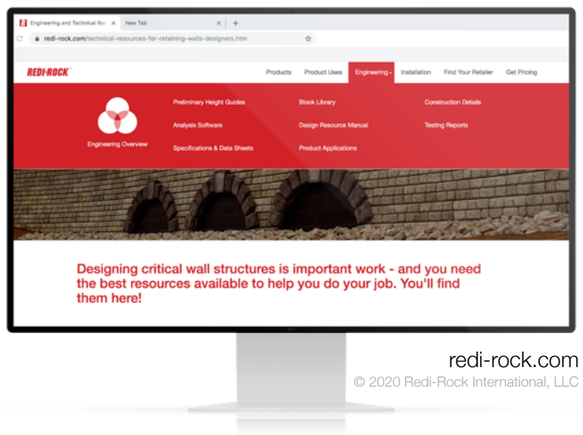
Visit us at Redi-Rock.com!



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Changing the World in Concrete Ways

At Redi-Rock, we believe in helping you change the world in concrete ways by unleashing the possibility of people, products, and technology to create large block retaining wall solutions you can trust for a lifetime. We do that by:

- leading the way with comprehensive, expert-level support and resources,
- never giving up on expanding the solutions possible with our integrated system, and
- making time to care about local communities by partnering with manufacturers, empowering people to contribute to their communities in meaningful ways.

On www.redi-rock.com you'll find hundreds of case studies that illustrate Redi-Rock solutions and these values coming to life in real world applications. We hope they provide the confidence and context you need to design and install Redi-Rock.

We also hope they provide a spark of inspiration about how the work you do can change the lives around you.

View Case Studies
redi-rock.com/changetheworld

One Integrated System of Wall Solutions

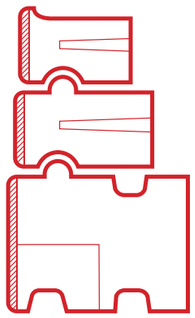
Redi-Rock revolutionized the retaining wall industry in 2000 when they introduced large, wetcast, gravity blocks with interlocking knob and groove technology—think giant, one-ton Lego blocks.

Not only did the walls look better with the texture of natural stone, but the machine-set blocks sped up installation compared to the existing offerings on the market. Since then, the scope of Redi-Rock's product line has evolved into one integrated system of wall solutions.

Whether you're looking for a tall gravity wall, an even taller reinforced wall, a freestanding solution, accessories to polish off your project, or a combination of all of the above, the solution you're after is available with Redi-Rock.

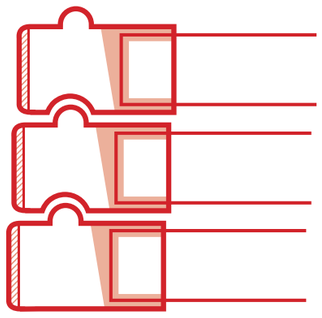
TALL GRAVITY WALLS

It's where it all started. The sheer size and weight of each block utilizes the power of gravity to create strong, beautiful walls. Available in solid or hollow core options, these blocks minimize excavation and feature multiple batter options to allow for taller walls in tighter spaces.



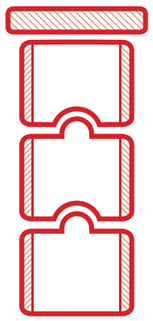
EVEN TALLER REINFORCED WALLS

There's virtually no chance of a connection failure with Positive Connection (PC) blocks because the geogrid wraps through a vertical core slot is cast in each block. Not only does this allow for really tall walls, but it also means massive live loads have met their match.



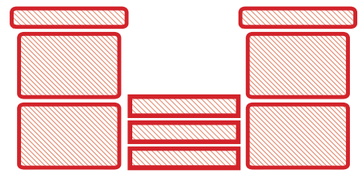
FREESTANDING WALLS

Textured on two or more sides, freestanding blocks help create great looking above-grade finishes or stand alone walls. Whether solid or hollow-core, these blocks are great for solving a number of frequent design challenges like attaching a fence to the top of a wall or cantilever solutions.



COORDINATING ACCESSORIES

One of the best things about Redi-Rock is that all of the different products work together to form seamless solutions. Plus, with accessories like columns, steps, and caps to coordinate perfectly with the rest of the system, so your seamless solution is also a great looking solution.

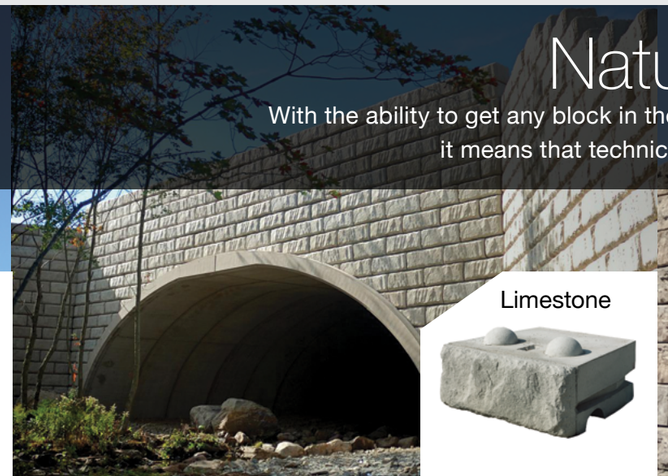


Optimize Your Solution for Any Market

- ARCHITECTURAL
- DEVELOPMENTS
- RESIDENTIAL
- GOVERNMENT
- TRANSPORTATION
- RAIL
- PORTS & HARBORS

Mix and match blocks from the various families of products to optimize your solution for any market.

- FLOOD & STORMWATER
- EROSION CONTROL
- SHORELINE RESTORATION
- UTILITIES
- MINING



Natural Stone Textures

With the ability to get any block in the Redi-Rock arsenal in four natural stone textures, it means that technical agility comes with just the right aesthetic touch.

Frequently Asked Questions

WHAT IS REDI-ROCK?

Redi-Rock is a line of precast products made from durable, first-purpose, air-entrained, wetcast concrete. The most common Redi-Rock products are large retaining wall blocks.

Often referred to as one-ton Lego blocks, Redi-Rock blocks vary in width from 710 millimeters to 2.44 meters and in weight from 544 kilograms to 1588 kilograms. In many instances, the Redi-Rock retaining wall blocks are big enough that they can be simply stacked on top of each other to construct a “gravity” wall. For even taller and/or more heavily loaded retaining walls, the Redi-Rock Positive Connection (PC) System can be used to construct a Mechanically Stabilized Earth (MSE) wall.

However, Redi-Rock is much more than simply large retaining wall blocks. Redi-Rock freestanding blocks have the same great look as the retaining blocks, with texture on two or more sides. These freestanding blocks are perfect for perimeter walls, entrance monuments, or parapet walls. Redi-Rock accessory products include column blocks, steps, and caps. These accessories are perfect for completing your project. We even have products like Pole Base® concrete foundations for light poles, driveway monuments, and signs.

WHO MAKES REDI-ROCK PRODUCTS?

Redi-Rock products are produced by over 130 independently-owned manufacturers located all over the globe. Contact information for the Redi-Rock manufacturer in your area is available anytime at **redi-rock.com**.

WHO DESIGNS REDI-ROCK RETAINING WALLS?

The answer to this question depends on what you are trying to accomplish. If you want to get a good idea of how Redi-Rock products can work for your project, the preliminary height guides in this *Design Resource Manual* are a great place to start. These guides show Redi-Rock wall sections in different assumed soil and loading conditions, and they can quickly help you determine what sections will likely work for your particular project.

When you want to build a wall, there simply is no substitute for detailed plans prepared by a licensed engineer who routinely designs retaining walls. Licensed professionals have proven themselves with years of study and practice, and they are uniquely qualified to create an optimal design for the specific conditions of your project. In addition, a seal of the calculations and design drawings by a “Design Professional of Responsible Charge” is generally required by the International Building Code (Section 105.2) for all walls over four feet (1219 millimeters) in height.

WHO INSTALLS REDI-ROCK RETAINING WALLS?

Redi-Rock walls are typically constructed by earth excavating contractors or landscaping contractors using large pieces of earth-moving equipment. General contractors that have experience building Redi-Rock walls can be excellent resources for your project. Your local Redi-Rock manufacturer will often have close working relationships with the wall installers in your area and can be a great source of information.

Wondering how to install Redi-Rock? We can help there, too. Redi-Rock has a detailed *Installation Manual* that covers the basic installation steps. We also have several typical construction details showing how to build common things like 90-degree corners, curves, barriers, or other features in your wall. These resources are available in this *Design Resource Manual* and online at **redi-rock.com**.

HOW MUCH DO REDI-ROCK WALLS COST?

Since every project is different, there is no single price for a Redi-Rock wall. Several things must be accounted for, including material, labor, and shipping costs. Materials include Redi-Rock blocks, drainage aggregates, geotextiles, drain pipes, and possibly even select fill; however, project costs are much more than just the sum of material costs. Although Redi-Rock blocks may have a higher price per unit than smaller, dry-cast retaining wall products or blocks made from inferior materials like return concrete, they provide significant savings due to installation speed and product longevity.

The true cost of a Redi-Rock wall must be evaluated on the cost per area of wall face (dollars per square foot or square meter) of the completed structure over the full life of the structure. For taller mechanically stabilized earth walls, part of the cost per square unit area of the retaining wall includes the factory cut geogrid strips that are used with the PC blocks. These strips are specifically manufactured and certified for width and strength, providing construction efficiencies and design reliability that add value to your project.

The real value in Redi-Rock retaining walls comes from superior engineering, high-quality products, and unbeatable face textures that lead to extremely robust and attractive structures that will last for a lifetime. It is because of the intricacies and complexities of each unique project that the very best source for pricing is typically from the Redi-Rock manufacturer located closest to your project site. Find the closest manufacturer at **redi-rock.com**.

WILL REDI-ROCK WORK FOR MY PROJECT?

Redi-Rock has been used with outstanding success on a myriad of different retaining wall applications. Some examples are retaining walls in water applications (seawalls, bank stabilization, channelization, and detention ponds), bridge abutments, parks, residential projects, commercial projects, highway walls, GRS-IBS structures, and even rail applications. Chances are, someone has already figured out a way to use Redi-Rock on a project just like yours. There are hundreds of case studies available at **redi-rock.com** that will help you visualize how Redi-Rock can be used to make your project a reality.

I HAVE MORE QUESTIONS...WHAT SHOULD I DO?

Quite simply, ask. Your local Redi-Rock manufacturer is a great place to start. Often they have working relationships with wall design engineers and local installers. You can also contact Redi-Rock International, either through your local manufacturer or directly by calling **(866) 222-8400** or by email at **engineering@redi-rock.com**. We have engineers on staff who can help answer general design questions, provide specific information about our products, and point you in the right direction to successfully design and install your own outstanding Redi-Rock retaining wall.

BLOCK LIBRARY

RETAINING BLOCKS
(FINISHED TEXTURE ON ONE FACE)

The Redi-Rock Retaining wall blocks come in multiple widths and configurations. The defining characteristic is that Retaining blocks have an aesthetic texture cast into only ONE face, and the textured face is the only side exposed to view in the finished wall. These blocks are machine-placed, wet-cast, precast modular block units manufactured from first purpose, non-reconstituted concrete and intended for constructing dry-stacked modular retaining wall systems. The block units are manufactured from structural-grade concrete mixes in accordance with ASTM C94 or ASTM C685 that produce a finished unit with excellent resistance to freeze-thaw, deicing chemical exposure, and submerged conditions in both fresh water and salt water applications. All Redi-Rock blocks are manufactured and distributed through an international network of individually-owned, licensed precast concrete manufacturers.

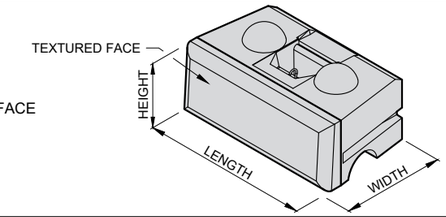
CONCRETE MIX PROPERTIES (1)

FREEZE THAW EXPOSURE CLASS (2)	MINIMUM 28 DAY COMPRESSIVE STRENGTH (3)	MAXIMUM WATER CEMENT RATIO	NOMINAL MAXIMUM AGGREGATE SIZE (10)	AGGREGATE CLASS DESIGNATION (4)	AIR CONTENT (5)
MODERATE	27.6 MPa	0.45	25	3M	4.5% ± 1.5%
SEVERE	27.6 MPa	0.45	25	3S	6.0% ± 1.5%
VERY SEVERE	30.0 MPa	0.40	25	4S	6.0% ± 1.5%
MAXIMUM WATER-SOLUBLE CHLORIDE ION (Cl^-) CONTENT IN CONCRETE, PERCENT BY WEIGHT OF CEMENT (6,7)					0.15
MAXIMUM CHLORIDE AS Cl^- CONCENTRATION IN MIXING WATER, PARTS PER MILLION					1000

MAXIMUM PERCENTAGE OF TOTAL CEMENTITIOUS MATERIALS BY WEIGHT (8,10) (VERY SEVERE EXPOSURE CLASS ONLY)			
FLY ASH OR OTHER POZZOLANS PER ASTM C618	25	TOTAL ASH, POZZOLANS, SLAG, AND SILICA FUME (9)	50
SLAG CONFORMING TO ASTM C989	50	TOTAL ASH, POZZOLANS, SLAG, AND SILICA FUME (9)	35
SILICA FUME CONFORMING TO ASTM C1240	10	ALKALI-AGGREGATE REACTIVITY MITIGATION PER ACI 201	

REFERENCE DIMENSIONS:

HEIGHT = VERTICAL DIMENSION OF TEXTURED FACE
LENGTH = HORIZONTAL DIMENSION PARALLEL TO TEXTURED FACE
WIDTH = HORIZONTAL DIMENSION PERPENDICULAR TO TEXTURED FACE



DIMENSIONAL TOLERANCES (11) (12)

HEIGHT	ALL BLOCKS	457 ± 5 or 3914 ± 5
LENGTH	FULL BLOCKS	1172 ± 13
	HALF BLOCKS	579 ± 13
WIDTH	710mm BLOCKS	575 ± 13 FORM LINE TO BACK OF BLOCK, PLUS APPROXIMATELY 136 FACE TEXTURE
	1030mm BLOCKS	892 ± 13 FORM LINE TO BACK OF BLOCK, PLUS APPROXIMATELY 136 FACE TEXTURE
	1520mm BLOCKS	1387 ± 13 FORM LINE TO BACK OF BLOCK, PLUS APPROXIMATELY 136 FACE TEXTURE
	1320mm XL BLOCKS	1184 ± 13 FORM LINE TO BACK OF BLOCK, PLUS APPROXIMATELY 136 FACE TEXTURE
	1830mm XL BLOCKS	1692 ± 13 FORM LINE TO BACK OF BLOCK, PLUS APPROXIMATELY 136 FACE TEXTURE
	2440mm XL BLOCKS	2302 ± 13 FORM LINE TO BACK OF BLOCK, PLUS APPROXIMATELY 136 FACE TEXTURE

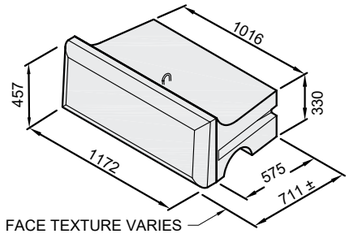
(1) Concrete mix properties are in general accordance with ACI 318 durability requirements. Research has shown that concrete manufactured to these standards demonstrates good durability and performance. When these requirements are followed, specific freeze-thaw testing of the concrete is typically NOT required.
(2) Exposure class is as described in ACI 318.
(3) Test method ASTM C39.
(4) Defined in ASTM C33 Table 3 *Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregate for Concrete.*
(5) Test method ASTM C231.
(6) Test method ASTM C1218 at age between 28 and 42 days.
(7) Where used in high sulfate environments or where alkali-silica reactivity is and issue, water soluble chloride shall be limited to no more than trace amounts (from impurities in concrete-making components, not intended constituents.)
(8) The total cementitious material also includes ASTM C150, C595, C845, and C1157 cement. The maximum percentages shall include:
(a) Fly ash or other pozzolans in type IP, blended cement, ASTM C595, or ASTM C1157.
(b) Slag used in the manufacture of an IS blended cement, ASTM C595, or ASTM C1157.
(c) Silica fume, ASTM C1240, present in a blended cement.
(9) Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.
(10) Prescriptive limits shown may be waived for concrete mixes that demonstrate excellent freeze-thaw durability in a detailed and current testing program.
(11) All dimensions are shown in units of *mm*.
(12) Permissible defects: Chips smaller than 38mm in its largest dimension and cracks not wider than 0.305mm and not longer than 25% of the nominal height of the block; bug holes in the architectural face smaller than 19mm; and bug holes, water marks, and color variation on non-architectural faces.

RETAINING BLOCKS

Block Library

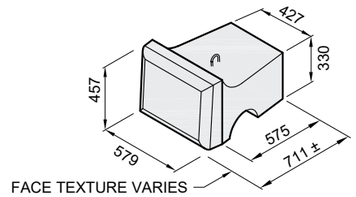
R-28T 710mm TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	557 kg	530 kg
Block Volume:	0.243 m^3	0.229 m^3
Center of Gravity:	378 mm	362 mm



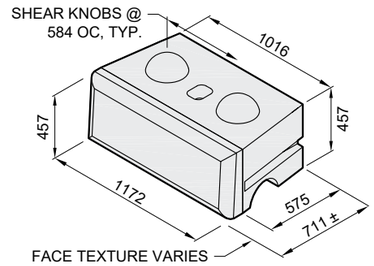
R-28HT 710mm HALF TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	260 kg	240 kg
Block Volume:	0.113 m^3	0.106 m^3
Center of Gravity:	389 mm	373 mm



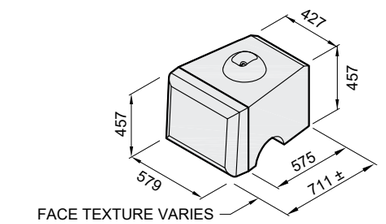
R-28M 710mm MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	730 kg	700 kg
Block Volume:	0.319 m^3	0.305 m^3
Center of Gravity:	354 mm	340 mm



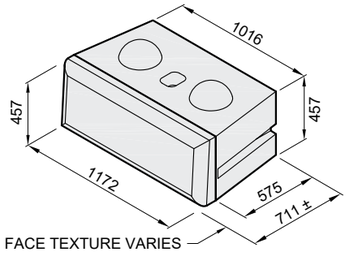
R-28HM 710mm HALF MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	340 kg	320 kg
Block Volume:	0.148 m^3	0.141 m^3
Center of Gravity:	364 mm	350 mm



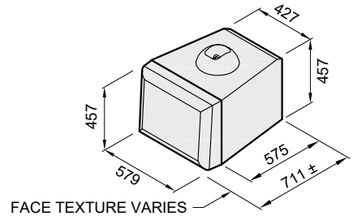
R-28B 710mm BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	790 kg	760 kg
Block Volume:	0.345 m^3	0.331 m^3
Center of Gravity:	355 mm	343 mm



R-28HB 710mm HALF BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	370 kg	350 kg
Block Volume:	0.160 m^3	0.153 m^3
Center of Gravity:	364 mm	352 mm



1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Half blocks contain a fork slot on only one side of the block.
7. Interface Shear knobs are typically 254 mm diameter by 102 mm tall. Smaller knob diameters are available.

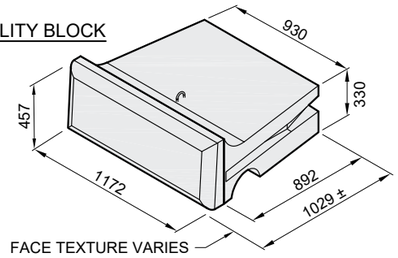
RETAINING BLOCKS

Block Library

R-41T 1030mm TOP *

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	790 kg	760 kg
Block Volume:	0.346 m^3	0.332 m^3
Center of Gravity:	540 mm	522 mm

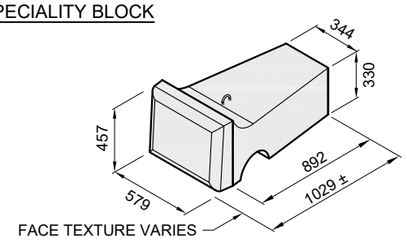
SPECIALITY BLOCK



R-41HT 1030mm HALF TOP *

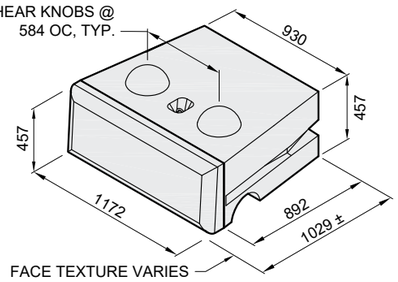
Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	350 kg	330 kg
Block Volume:	0.15 m^3	0.15 m^3
Center of Gravity:	568 mm	550 mm

SPECIALITY BLOCK



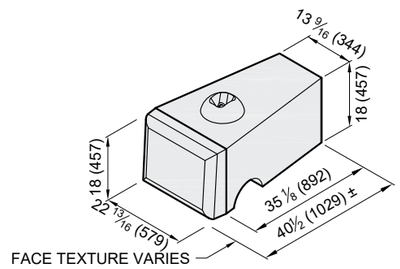
R-41M 1030mm MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1050 kg	1020 kg
Block Volume:	0.457 m^3	0.443 m^3
Center of Gravity:	518 mm	504 mm



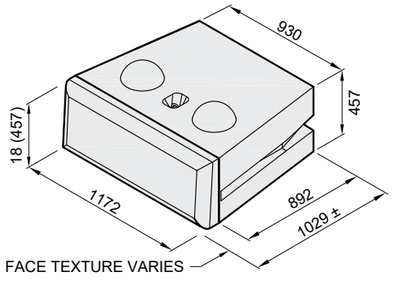
R-41HM 1030mm HALF MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	460 kg	450 kg
Block Volume:	0.20 m^3	0.20 m^3
Center of Gravity:	543 mm	528 mm



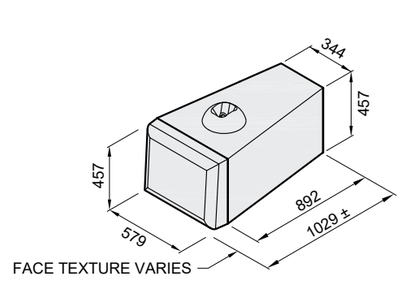
R-41B 1030mm BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1110 kg	1070 kg
Block Volume:	0.483 m^3	0.469 m^3
Center of Gravity:	527 mm	514 mm



R-41HB 1030mm HALF BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	490 kg	480 kg
Block Volume:	0.21 m^3	0.21 m^3
Center of Gravity:	551 mm	538 mm



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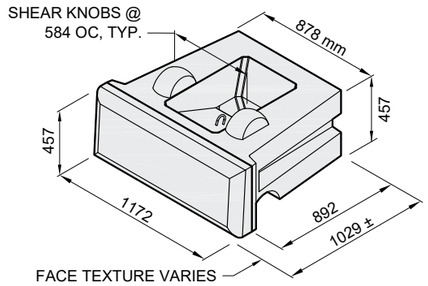
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Half blocks contain a fork slot on only one side of the block.
7. Interface Shear knobs are typically 254 mm diameter by 102 mm tall. Smaller knob diameters are available.
8. *1030mm Top blocks are not typical and used in limited applications.

RETAINING BLOCKS

Block Library

R-41HC 1030mm HOLLOW-CORE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	780 kg	735 kg
Block Volume:	0.33 m^3	0.32 m^3
Center of Gravity:	558 mm	540 mm
Infill Volume	0.18 m^3	



1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before Specifying or Ordering.
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291kg/m^3.
6. Half blocks contain a fork slot on only one side of the block.
7. Interface Shear knobs are typically 254mm diameter by 102mm tall. Smaller knob diameters are available.

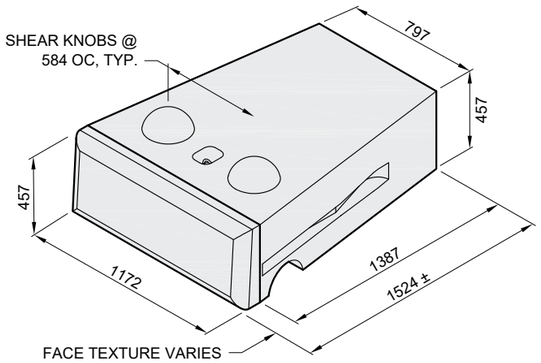
redi-rock.com

RETAINING BLOCKS

Block Library

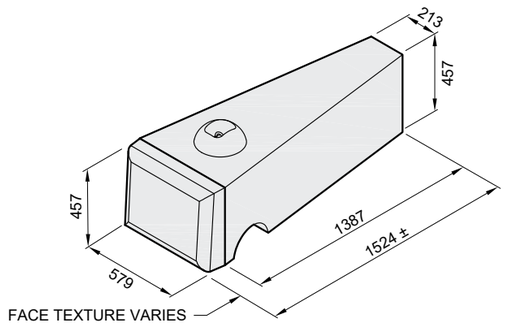
R-60M 1520mm MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1490 kg	1460 kg
Block Volume:	0.651 m^3	0.637 m^3
Center of Gravity:	786 mm	772 mm



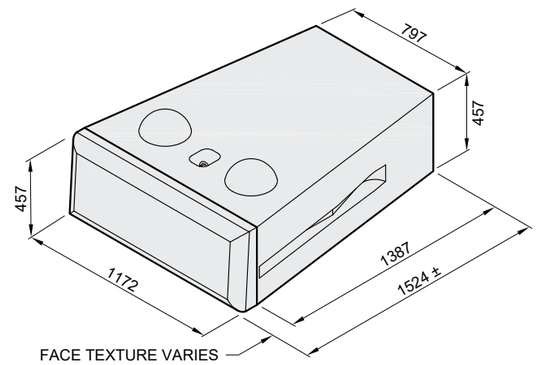
R-60HM 1520mm HALF MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	610 kg	590 kg
Block Volume:	0.264 m^3	0.258 m^3
Center of Gravity:	856 mm	840 mm



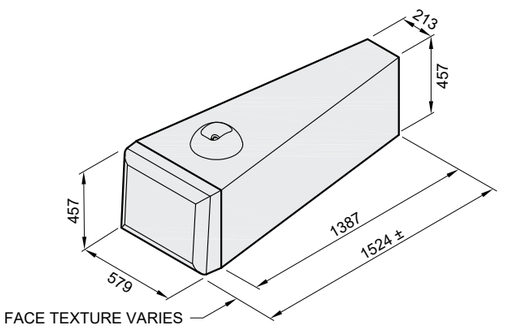
R-60B 1520mm BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1550 kg	1520 kg
Block Volume:	0.677 m^3	0.663 m^3
Center of Gravity:	802 mm	788 mm



R-60HB 1520mm HALF BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	630 kg	620 kg
Block Volume:	0.277 m^3	0.270 m^3
Center of Gravity:	871 mm	856 mm



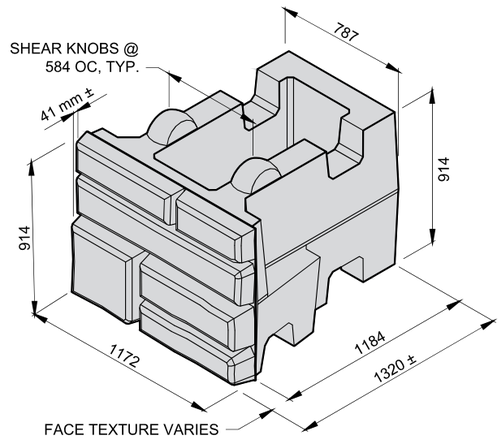
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. 1520 mm blocks are typically used at the bottom of taller walls.
7. Half blocks contain a fork slot on only one side of the block.
8. Interface Shear knobs are typically 254 mm diameter by 102 mm tall. Smaller knob diameters are available.

RETAINING BLOCKS

Block Library

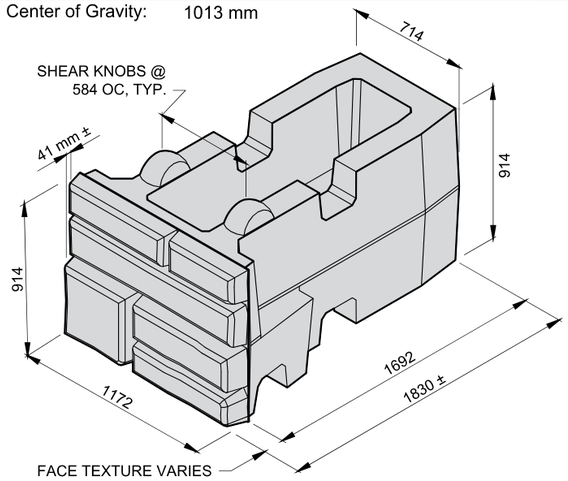
R-5236HC 1320 mm XL Hollow-Core

Face Texture:	Ledgestone
Block Weight:	1510 kg
Block Volume:	0.660 m^3
Infill Volume:	0.648 m^3
Center of Gravity:	737 mm



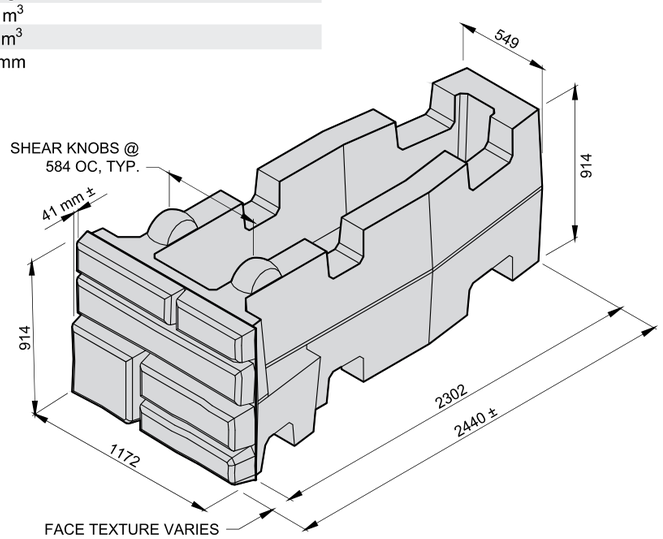
R-7236HC 1830 mm XL Hollow-Core

Face Texture:	Ledgestone
Block Weight:	1890 kg
Block Volume:	0.824 m^3
Infill Volume:	1.028 m^3
Center of Gravity:	1013 mm



R-9636HC 2440 mm XL Hollow-Core

Face Texture:	Ledgestone
Block Weight:	2190 kg
Block Volume:	0.958 m^3
Infill Volume:	1.547 m^3
Center of Gravity:	1405 mm

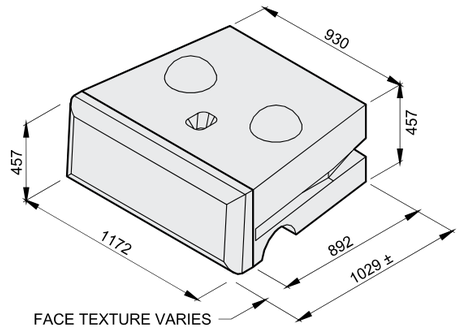


1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Center of Gravity is measured from the back of block, excluding stone infill.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Interface Shear knobs are nominally 254 mm diameter by 102 mm tall.

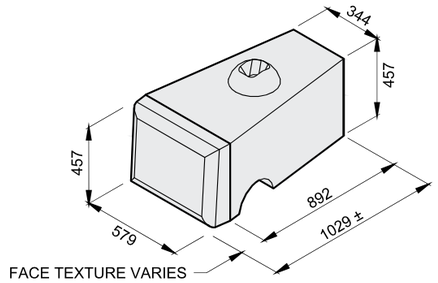
RETAINING BLOCKS

Block Library

R-419M	1030mm MIDDLE 230mm SETBACK		R-419HM	
Face Texture:	Cobble / Limestone	Kingstone / Ledgestone	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1050 kg	1020 kg	470 kg	450 kg
Block Volume:	0.46 m^3	0.44 m^3	0.20 m^3	0.20 m^3
Center of Gravity:	514 mm	500 mm	540 mm	525 mm

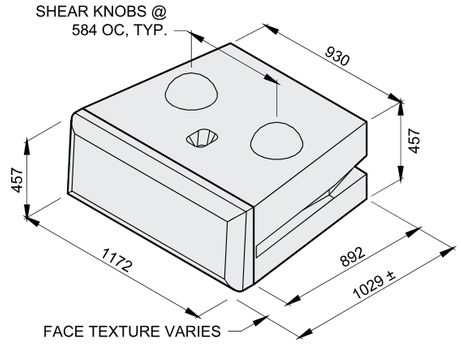


FULL MIDDLE

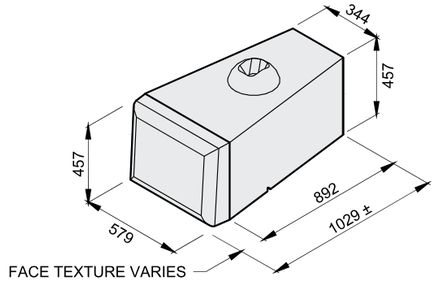


HALF MIDDLE

R-419B	1030mm BOTTOM 230mm SETBACK		R-419HB	
Face Texture:	Cobble / Limestone	Kingstone / Ledgestone	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1110 kg	1080 kg	500 kg	480 kg
Block Volume:	0.48 m^3	0.47 m^3	0.22 m^3	0.21 m^3
Center of Gravity:	523 mm	510 mm	548 mm	534 mm



FULL BOTTOM



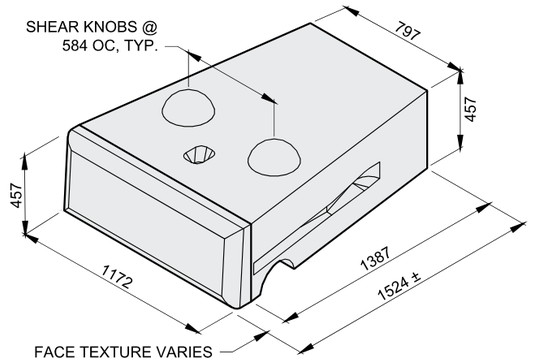
HALF BOTTOM

1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Half blocks contain a fork slot on only one side of the block.
7. Interface Shear knobs are typically 254 mm diameter by 102 mm tall.

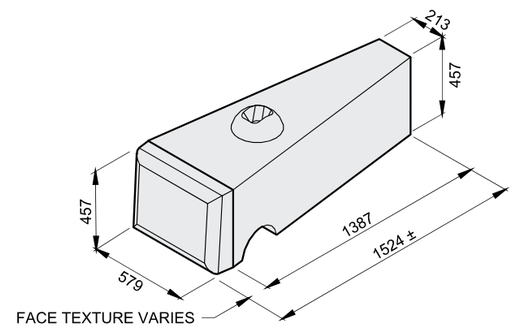
RETAINING BLOCKS

Block Library

R-609M	1520mm MIDDLE 230mm SETBACK		R-609HM	
Face Texture:	Cobble / Limestone	Kingstone / Ledgestone	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1500 kg	1460 kg	610 kg	590 kg
Block Volume:	0.65 m^3	0.64 m^3	0.26 m^3	0.26 m^3
Center of Gravity:	785 mm	770 mm	855 mm	839 mm

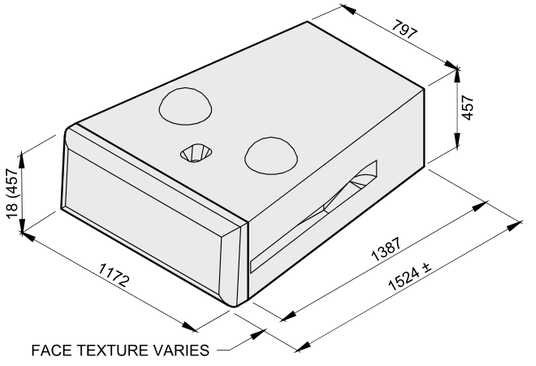


FULL MIDDLE

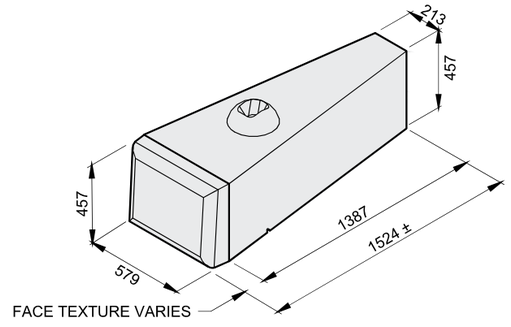


HALF MIDDLE

R-609B	1520mm BOTTOM 230mm SETBACK		R-609HB	
Face Texture:	Cobble / Limestone	Kingstone / Ledgestone	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1550 kg	1520 kg	640 kg	620 kg
Block Volume:	0.68 m^3	0.66 m^3	0.28 m^3	0.27 m^3
Center of Gravity:	800 mm	786 mm	869 mm	854 mm



FULL BOTTOM



HALF BOTTOM

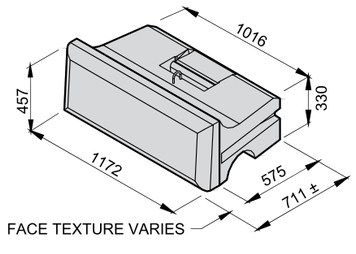
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Half blocks contain a fork slot on only one side of the block.
7. Interface Shear knobs are typically 254 mm diameter by 102 mm tall.
8. 1520 mm Blocks are typically used at the bottom of taller walls.

RETAINING BLOCKS

Block Library

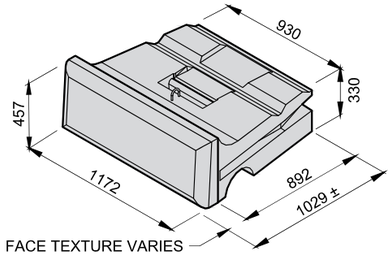
R-28PCT 710mm PC TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	530 kg	500 kg
Block Volume:	0.231 m^3	0.217 m^3
Center of Gravity:	388 mm	372 mm



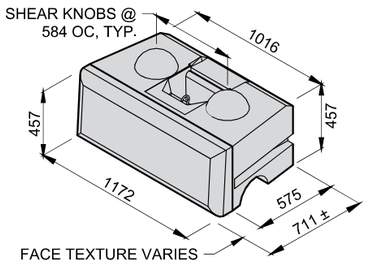
R-41PCT 1030mm PC TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	740 kg	710 kg
Block Volume:	0.32 m^3	0.31 m^3
Center of Gravity:	554 mm	536 mm



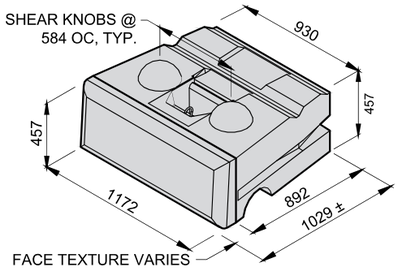
R-28PCM 710mm PC MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	690 kg	660 kg
Block Volume:	0.301 m^3	0.287 m^3
Center of Gravity:	360 mm	346 mm



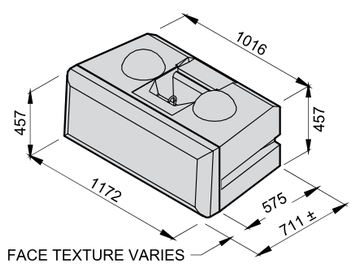
R-41PCM 1030mm PC MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	990 kg	950 kg
Block Volume:	0.43 m^3	0.42 m^3
Center of Gravity:	522 mm	508 mm



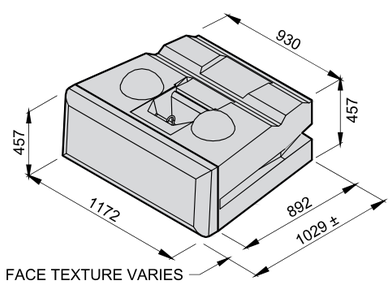
R-28PCB 710mm PC BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	740 kg	700 kg
Block Volume:	0.321 m^3	0.307 m^3
Center of Gravity:	362 mm	349 mm



R-41PCB 1030mm PC BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1030 kg	1000 kg
Block Volume:	0.45 m^3	0.44 m^3
Center of Gravity:	514mm	501mm



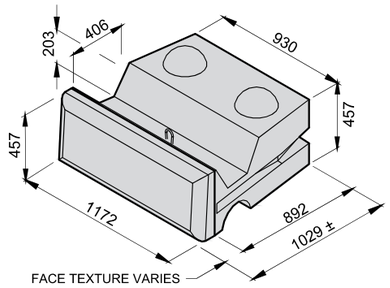
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Blocks contain a vertical slot for a 300 mm strip of geogrid soil reinforcement.
7. Interface Shear knobs are typically 254 mm diameter by 102 mm tall. Smaller knob diameters are available.

RETAINING BLOCKS

Block Library

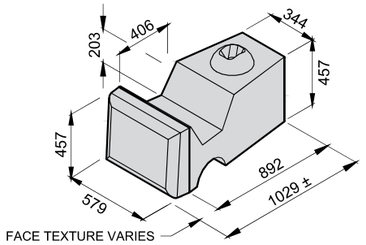
R-41PL 1030mm PLANTER

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	910 kg	880 kg
Block Volume:	0.40 m^3	0.38 m^3
Center of Gravity:	485 mm	468 mm



R-41HPL 1030mm HALF PLANTER

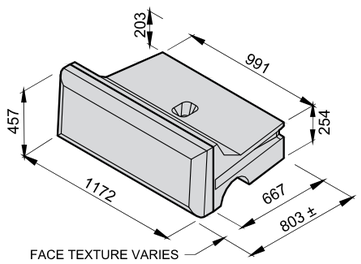
Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	400 kg	380 kg
Block Volume:	0.17 m^3	0.17 m^3
Center of Gravity:	513 mm	495 mm



R-MT MODIFIED TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	540 kg	510 kg
Block Volume:	0.24 m^3	0.22 m^3
Center of Gravity:	455 mm	438 mm

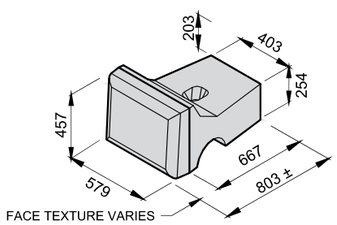
SPECIALITY BLOCK



R-MHT MODIFIED HALF TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	320 kg	290 kg
Block Volume:	0.14 m^3	0.13 m^3
Center of Gravity:	527 mm	504 mm

SPECIALITY BLOCK



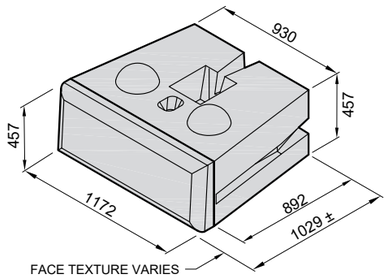
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Half blocks contain a fork slot on only one side of the block.
7. Interface Shear knobs are typically 254 mm diameter by 102 mm tall.

RETAINING BLOCKS

Block Library

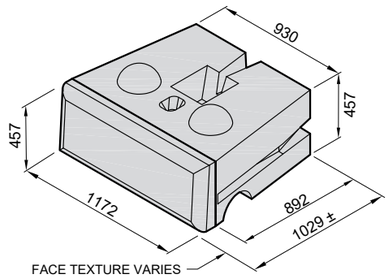
R-AB ANCHOR BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1070 kg	1040 kg
Block Volume:	0.47 m^3	0.45 m^3
Center of Gravity:	533 mm	519 mm



R-AM ANCHOR MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	1010 kg	980 kg
Block Volume:	0.44 m^3	0.43 m^3
Center of Gravity:	523 mm	509 mm

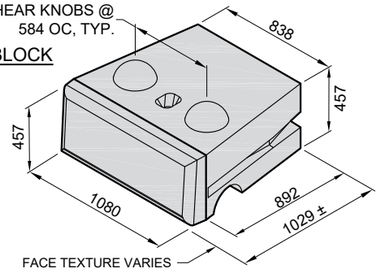


R-SM SHORT MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	970 kg	940 kg
Block Volume:	0.42 m^3	0.41 m^3
Center of Gravity:	499mm	487mm

SHEAR KNOBS @ 584 OC, TYP.

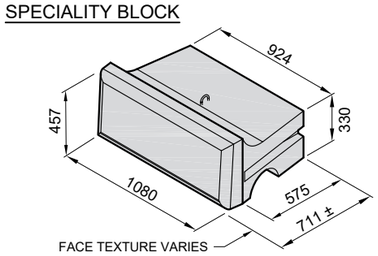
SPECIALITY BLOCK



R-ST SHORT TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	500 kg	480 kg
Block Volume:	0.22 m^3	0.21 m^3
Center of Gravity:	349mm	336mm

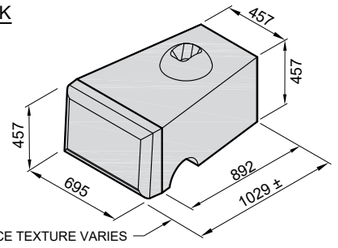
SPECIALITY BLOCK



R-419SM 230mm SETBACK SHORT MID

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	580 kg	560 kg
Block Volume:	0.25 m^3	0.24 m^3
Center of Gravity:	507mm	494mm

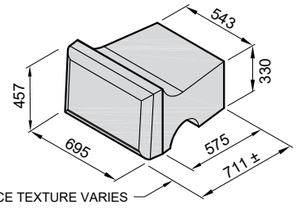
SPECIALITY BLOCK



R-419ST 230mm SETBACK SHORT TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	320 kg	300 kg
Block Volume:	0.14 m^3	0.13 m^3
Center of Gravity:	352mm	339mm

SPECIALITY BLOCK



1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Center of Gravity is measured from the back of block.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. 695mm wide blocks contain a fork slot on only one side of the block. These are speciality blocks and may have limited availability and is only used in double 90-degree corner applications.
7. Interface Shear knobs are typically 254 mm diameter by 102 mm tall. Smaller knob diameters are available.

FREESTANDING BLOCKS
(FINISHED TEXTURE ON MORE THAN ONE FACE)

The Redi-Rock Freestanding blocks come in one width and stack in a vertical manner. The defining characteristic is that freestanding blocks have an aesthetic texture cast into multiple faces; the textured face is on at least the two longitudinal vertical faces, and also as required on one end or the top of the blocks. These blocks are machine-placed, wet-cast, precast modular block units manufactured from first purpose, non-reconstituted concrete and intended for constructing dry-stacked modular retaining wall systems. The block units are manufactured from structural-grade concrete mixes in accordance with ASTM C94 or ASTM C685 that produce a finished unit with excellent resistance to freeze-thaw, deicing chemical exposure, and submerged conditions in both fresh water and salt water applications. All Redi-Rock blocks are manufactured and distributed through an international network of individually-owned, licensed precast concrete manufacturers.

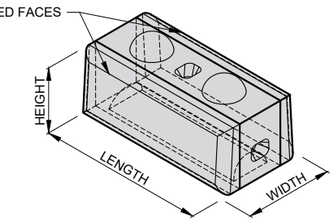
CONCRETE MIX PROPERTIES (1)

FREEZE THAW EXPOSURE CLASS (2)	MINIMUM 28 DAY COMPRESSIVE STRENGTH (3)	MAXIMUM WATER CEMENT RATIO	NOMINAL MAXIMUM AGGREGATE SIZE (10)	AGGREGATE CLASS DESIGNATION (4)	AIR CONTENT (5)
MODERATE	27.6 MPa	0.45	25	3M	4.5% ± 1.5%
SEVERE	27.6 MPa	0.45	25	3S	6.0% ± 1.5%
VERY SEVERE	30.0 MPa	0.40	25	4S	6.0% ± 1.5%
MAXIMUM WATER-SOLUBLE CHLORIDE ION (Cl^-) CONTENT IN CONCRETE, PERCENT BY WEIGHT OF CEMENT (6,7)					0.15
MAXIMUM CHLORIDE AS Cl^- CONCENTRATION IN MIXING WATER, PARTS PER MILLION					1000

MAXIMUM PERCENTAGE OF TOTAL CEMENTITIOUS MATERIALS BY WEIGHT (8,10) (VERY SEVERE EXPOSURE CLASS ONLY)			
FLY ASH OR OTHER POZZOLANS PER ASTM C618	25	TOTAL ASH, POZZOLANS, SLAG, AND SILICA FUME (9)	50
SLAG CONFORMING TO ASTM C989	50	TOTAL ASH, POZZOLANS, AND SILICA FUME (9)	35
SILICA FUME CONFORMING TO ASTM C1240	10	ALKALI-AGGREGATE REACTIVITY MITIGATION PER ACI 201	

REFERENCE DIMENSIONS:

HEIGHT = VERTICAL DIMENSION OF TEXTURED FACE
LENGTH = LONGER HORIZONTAL DIMENSION PARALLEL TO TEXTURED FACES
WIDTH = HORIZONTAL DIMENSION PERPENDICULAR TO LONGER TEXTURED FACES



DIMENSIONAL TOLERANCES (11) (12)

HEIGHT	ALL BLOCKS	457 ± 5
LENGTH	FULL BLOCKS	1172 ± 13
	HALF BLOCKS	579 ± 13
WIDTH	584-610	330 ± 13 FORM LINE TO FORM LINE, PLUS APPROX. 136 FACE TEXTURE ON LONG SIDES

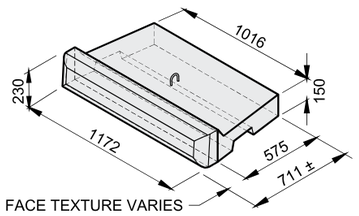
(1) Concrete mix properties are in general accordance with ACI 318 durability requirements. Research has shown that concrete manufactured to these standards demonstrates good durability and performance. When these requirements are followed, specific freeze-thaw testing of the concrete is typically NOT required.
(2) Exposure class is as described in ACI 318.
(3) Test method ASTM C39.
(4) Defined in ASTM C33 Table 3 *Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregate for Concrete*.
(5) Test method ASTM C231.
(6) Test method ASTM C1218 at age between 28 and 42 days.
(7) Where used in high sulfate environments or where alkali-silica reactivity is and issue, water soluble chloride shall be limited to no more than trace amounts (from impurities in concrete-making components, not intended constituents.)
(8) The total cementitious material also includes ASTM C150, C595, C845, and C1157 cement. The maximum percentages shall include:
(a) Fly ash or other pozzolans in type IP, blended cement, ASTM C595, or ASTM C1157.
(b) Slag used in the manufacture of an IS blended cement, ASTM C595, or ASTM C1157.
(c) Silica fume, ASTM C1240, present in a blended cement.
(9) Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.
(10) Prescriptive limits shown may be waived for concrete mixes that demonstrate excellent freeze-thaw durability in a detailed and current testing program.
(11) All dimensions are shown in units of *mm*.
(12) Permissible defects: Chips smaller than 38mm in its largest dimension and cracks not wider than 0.305mm and not longer than 25% of the nominal height of the block; bug holes in the architectural face smaller than 19mm; and bug holes, water marks, and color variation on non-architectural faces.

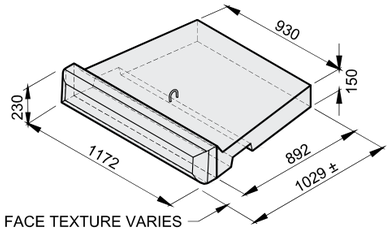
FREESTANDING BLOCKS

Block Library

R-28SDT 230 mm STEPDOWN TOP R-41SDT

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone	Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	270 kg	230 kg	Block Weight:	380 kg	340 kg
Block Volume:	0.12 m^3	0.10 m^3	Block Volume:	0.17 m^3	0.14 m^3





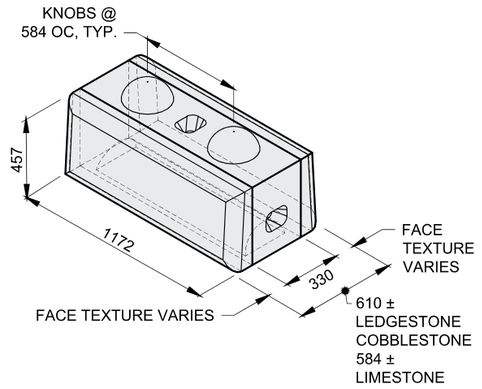
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Architectural faces on the blocks have varying texture.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.

FREESTANDING BLOCKS

Block Library

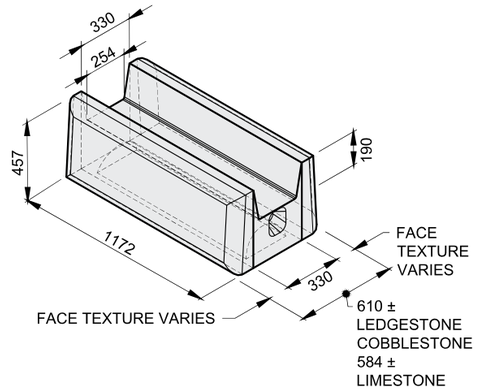
F-SM STRAIGHT MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	640 kg	570 kg
Block Volume:	0.279 m^3	0.250 m^3



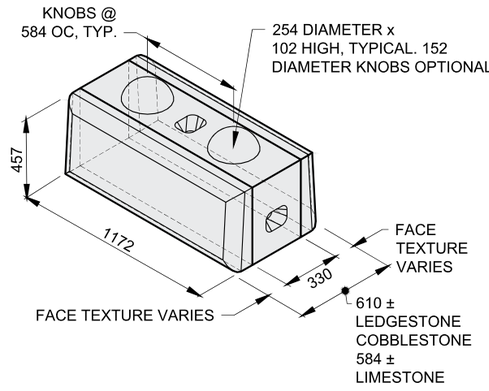
F-SG STRAIGHT GARDEN TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	480 kg	410 kg
Block Volume:	0.208 m^3	0.180 m^3



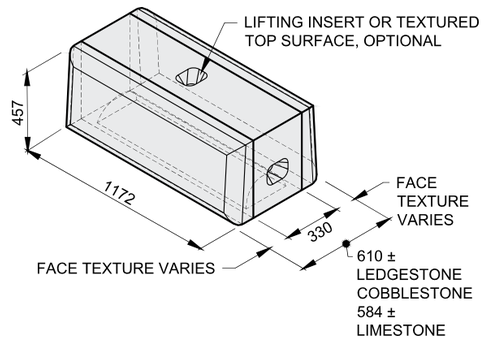
F-SB STRAIGHT BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	690 kg	630 kg
Block Volume:	0.302 m^3	0.273 m^3



F-ST STRAIGHT TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	620 kg	560 kg
Block Volume:	0.272 m^3	0.244 m^3



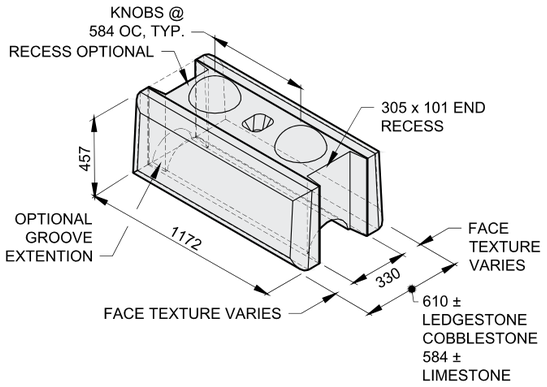
1. Units for dimensions are mm typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Architectural faces on the blocks have varying texture.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. 152 mm diameter vertical semi-cylindrical voids at the ends of the block for mechanical tie-down are available, refer to Force Protection blocks for additional information.
7. Knobs are typically 254mm diameter by 102 mm tall. Smaller knobs are available.

FREESTANDING BLOCKS

Block Library

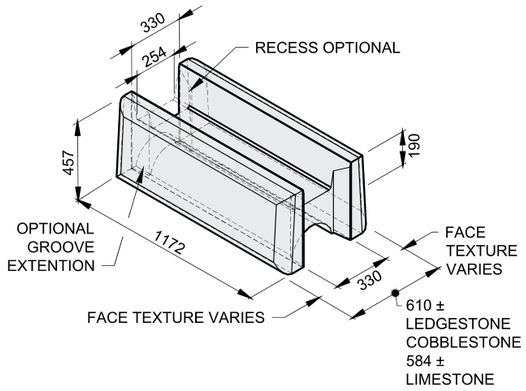
F-VM VARIABLE RADIUS MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	570 kg	510 kg
Block Volume:	0.251 m^3	0.223 m^3



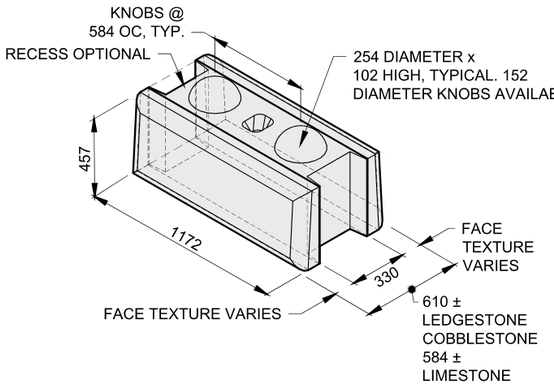
F-VG VARIABLE RADIUS GARDEN TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	440 kg	370 kg
Block Volume:	0.191 m^3	0.163 m^3



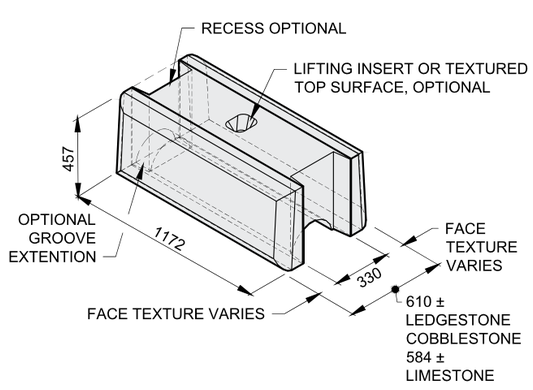
F-VB VARIABLE RADIUS BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	630 kg	560 kg
Block Volume:	0.273 m^3	0.245 m^3



F-VT VARIABLE RADIUS TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	560 kg	500 kg
Block Volume:	0.244 m^3	0.216 m^3



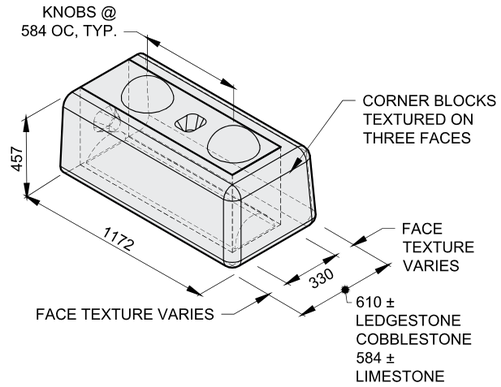
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Variable radius feature can be cast on only one end, coordinate.
4. Architectural faces on the blocks have varying texture.
5. Actual block volumes and weights may vary.
6. Weights are based upon a concrete density of 2291 kg/m^3.
7. Knobs are typically 254 mm diameter by 102 mm tall. Smaller knobs are available.

FREESTANDING BLOCKS

Block Library

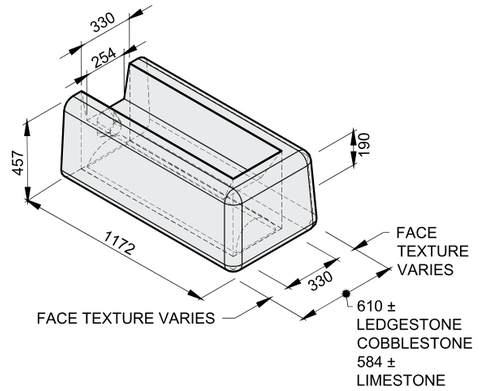
F-CM CORNER MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	620 kg	620 kg
Block Volume:	0.27m^3	0.27m^3



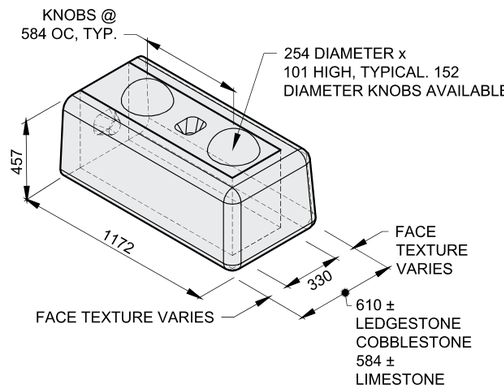
F-CG CORNER GARDEN TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	480 kg	480 kg
Block Volume:	0.21m^3	0.21m^3



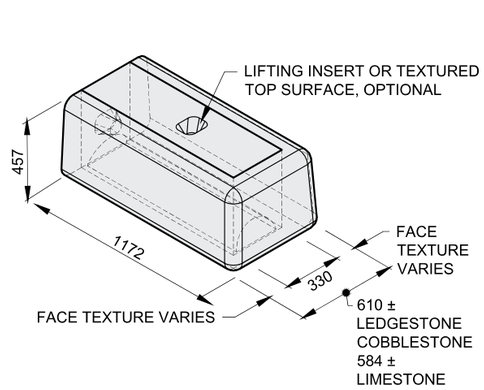
F-CB CORNER BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	680 kg	670 kg
Block Volume:	0.30m^3	0.29m^3



F-CT CORNER TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	610 kg	600 kg
Block Volume:	0.26m^3	0.26m^3



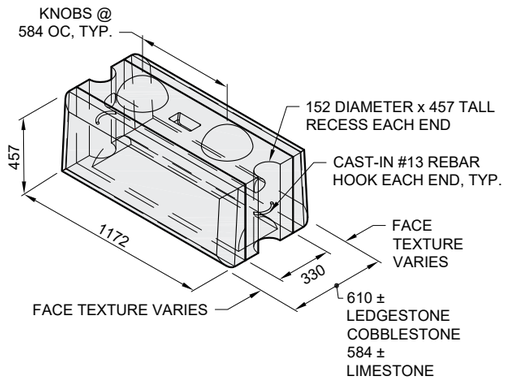
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Architectural faces on the blocks have varying texture.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Knobs are typically 254mm diameter by 102 mm tall. Smaller knobs are available.

FREESTANDING BLOCKS

Block Library

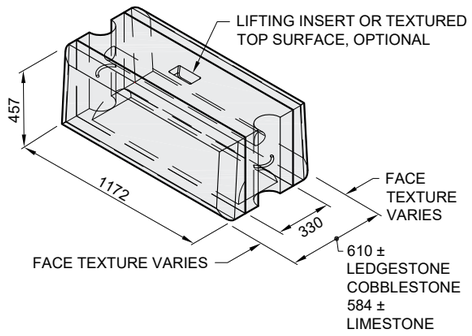
F-FM FORCE PROTECTION MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	610 kg	550 kg
Block Volume:	0.267 m^3	0.238 m^3



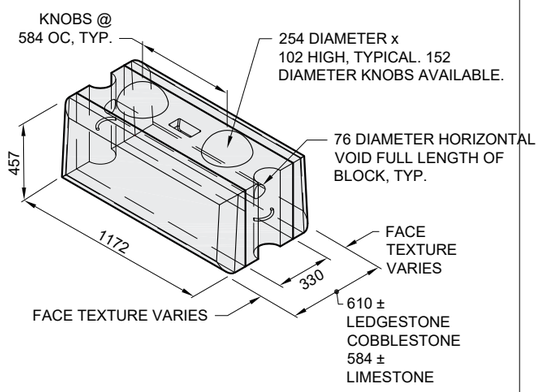
F-FT FORCE PROTECTION TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	600 kg	530 kg
Block Volume:	0.260 m^3	0.232 m^3



F-FB FORCE PROTECTION BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	660 kg	600 kg
Block Volume:	0.290 m^3	0.261 m^3



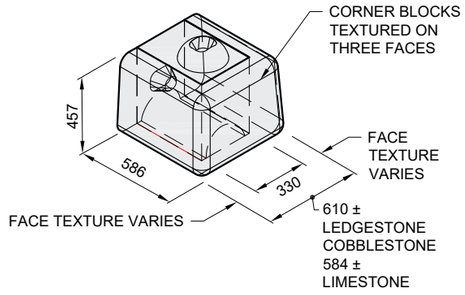
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Architectural faces on the blocks have varying texture.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Knobs are typically 254mm diameter by 102 mm tall. Smaller knobs are available.

FREESTANDING BLOCKS

Block Library

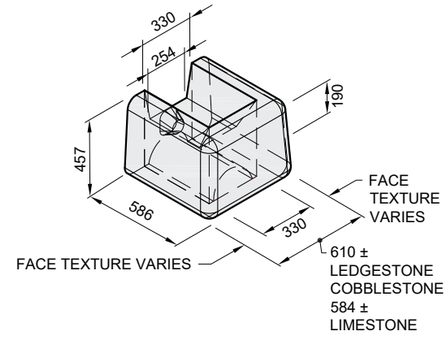
F-HCM HALF CORNER MIDDLE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	300 kg	300 kg
Block Volume:	0.13m^3	0.13m^3



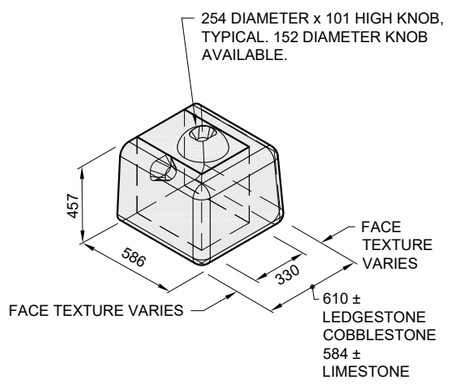
F-HCG HALF CORNER GARDEN TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	240 kg	240 kg
Block Volume:	0.11m^3	0.10m^3



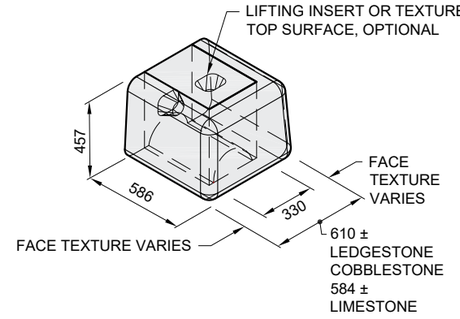
F-HCB HALF CORNER BOTTOM

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	320 kg	320 kg
Block Volume:	0.14m^3	0.14m^3



F-HCT HALF CORNER TOP

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	290 kg	290 kg
Block Volume:	0.13m^3	0.13m^3



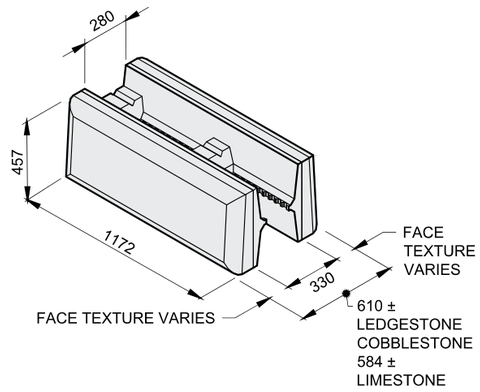
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Architectural faces on the blocks have varying texture.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.
6. Knobs are typically 254mm diameter by 102 mm tall. Smaller knobs are available.

FREESTANDING BLOCKS

Block Library

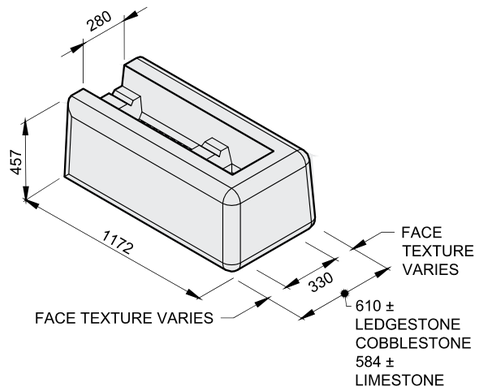
F-HC HOLLOW-CORE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	410 kg	350 kg
Block Volume:	0.181 m^3	0.152 m^3
Infill Volume:	0.116 m^3	



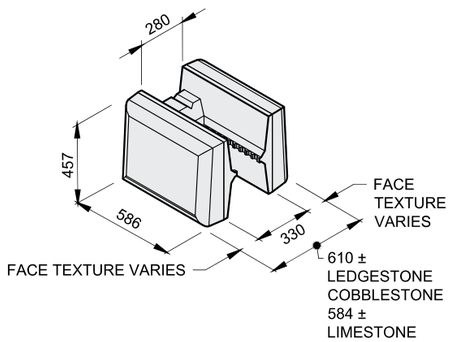
F-CHC CORNER HOLLOW-CORE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	460 kg	440 kg
Block Volume:	0.198 m^3	0.192 m^3
Infill Volume:	0.095 m^3	



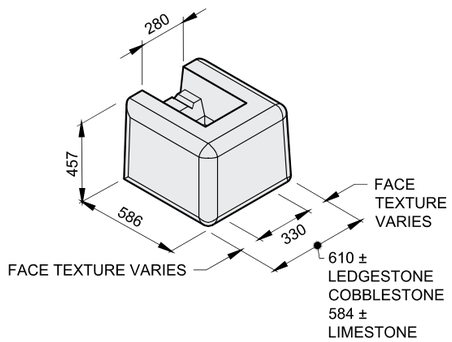
F-HHC HALF HOLLOW-CORE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	210 kg	180 kg
Block Volume:	0.090 m^3	0.076 m^3
Infill Volume:	0.058 m^3	



F-HCHC HALF CORNER HOLLOW-CORE

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	250 kg	230 kg
Block Volume:	0.108 m^3	0.100 m^3
Infill Volume:	0.037 m^3	



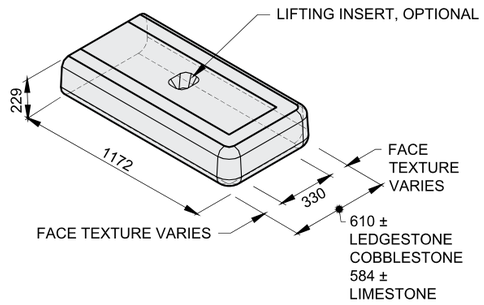
1. Units for dimensions are mm, typical unless noted otherwise.
2. Confirm block production with licensed Redi-Rock manufacturer.
3. Architectural faces on the blocks have varying texture.
4. Average block weights shown. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.

FREESTANDING BLOCKS

Block Library

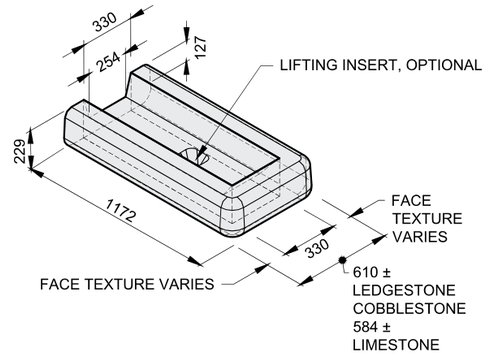
F-9SC 9" (230) STEPDOWN CORNER

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	340 kg	300 kg
Block Volume:	0.146 m^3	0.130 m^3



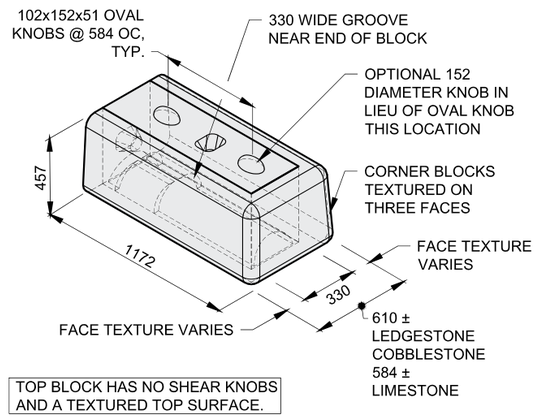
F-9SG 9" (230) STEPDOWN GARDEN

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	250 kg	210 kg
Block Volume:	0.109 m^3	0.093 m^3



F-90C 90 DEGREE CORNER

Face Texture:	Cobble / Limestone	Kingstone / Ledgestone
Block Weight:	600 kg	600 kg
Block Volume:	0.26m^3	0.26m^3



1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Architectural faces on the blocks have varying texture.
4. Actual block volumes and weights may vary.
5. Weights are based upon a concrete density of 2291 kg/m^3.

ACCESSORY BLOCKS
(COLUMNS, STEPS, AND CAPS)

The Redi-Rock Column and Accessory blocks come in multiple widths and configurations. The defining characteristic is that these blocks have an aesthetic texture cast into two or more faces, and create columns, caps, and steps that complement both Retaining and Freestanding blocks. These blocks are machine-placed, wet-cast, precast modular block units manufactured from first purpose, non-reconstituted concrete and intended for constructing dry-stacked modular features that coordinate with retaining walls. The block units are manufactured from structural-grade concrete mixes in accordance with ASTM C94 or ASTM C685 that produce a finished unit with excellent resistance to freeze-thaw, deicing chemical exposure, and submerged conditions in both fresh water and salt water applications. All Redi-Rock blocks are manufactured and distributed through an international network of individually-owned, licensed precast concrete manufacturers.

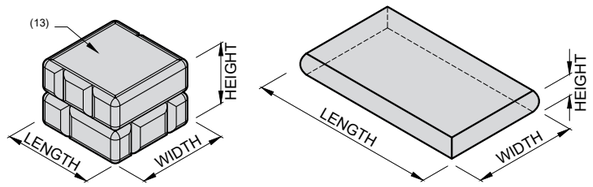
CONCRETE MIX PROPERTIES (1)

FREEZE THAW EXPOSURE CLASS (2)	MINIMUM 28 DAY COMPRESSIVE STRENGTH (3)	MAXIMUM WATER CEMENT RATIO	NOMINAL MAXIMUM AGGREGATE SIZE (10)	AGGREGATE CLASS DESIGNATION (4)	AIR CONTENT (5)
MODERATE	27.6 MPa	0.45	25	3M	4.5% ± 1.5%
SEVERE	27.6 MPa	0.45	25	3S	6.0% ± 1.5%
VERY SEVERE	30.0 MPa	0.40	25	4S	6.0% ± 1.5%
MAXIMUM WATER-SOLUBLE CHLORIDE ION (Cl^-) CONTENT IN CONCRETE, PERCENT BY WEIGHT OF CEMENT (6,7)					0.15
MAXIMUM CHLORIDE AS Cl^- CONCENTRATION IN MIXING WATER, PARTS PER MILLION					1000

MAXIMUM PERCENTAGE OF TOTAL CEMENTITIOUS MATERIALS BY WEIGHT (8,10) (VERY SEVERE EXPOSURE CLASS ONLY)			
FLY ASH OR OTHER POZZOLANS PER ASTM C618	25	TOTAL ASH, POZZOLANS, SLAG, AND SILICA FUME (9)	50
SLAG CONFORMING TO ASTM C989	50	TOTAL ASH, POZZOLANS, AND SILICA FUME (9)	35
SILICA FUME CONFORMING TO ASTM C1240	10	ALKALI-AGGREGATE REACTIVITY MITIGATION PER ACI 201	

REFERENCE DIMENSIONS:

HEIGHT = VERTICAL DIMENSION OF TEXTURED FACE
LENGTH = LONGER HORIZONTAL DIMENSION OF TEXTURED FACE
WIDTH = SHORTER HORIZONTAL DIMENSION



DIMENSIONAL TOLERANCES (11)(12)

	COLUMN BLOCK	CAP/ STEP BLOCK
	COLUMN BLOCKS	CAP/ STEP BLOCKS
HEIGHT	457 ± 5	152 ± 5
LENGTH	610 ± 13	VARIES ± 13
WIDTH	610 ± 13	724 ± 13

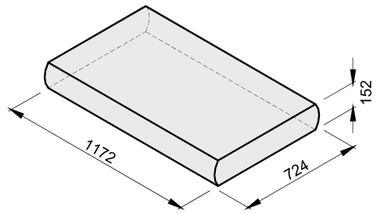
(1) Concrete mix properties are in general accordance with ACI 318 durability requirements. Research has shown that concrete manufactured to these standards demonstrates good durability and performance. When these requirements are followed, specific freeze-thaw testing of the concrete is typically NOT required.
(2) Exposure class is as described in ACI 318.
(3) Test method ASTM C39.
(4) Defined in ASTM C33 Table 3 *Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregate for Concrete.*
(5) Test method ASTM C231.
(6) Test method ASTM C1218 at age between 28 and 42 days.
(7) Where used in high sulfate environments or where alkali-silica reactivity is and issue, water soluble chloride shall be limited to no more than trace amounts (from impurities in concrete-making components, not intended constituents.)
(8) The total cementitious material also includes ASTM C150, C595, C845, and C1157 cement. The maximum percentages shall include:
(a) Fly ash or other pozzolans in type IP, blended cement, ASTM C595, or ASTM C1157.
(b) Slag used in the manufacture of an IS blended cement, ASTM C595, or ASTM C1157.
(c) Silica fume, ASTM C1240, present in a blended cement.
(9) Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.
(10) Prescriptive limits shown may be waived for concrete mixes that demonstrate excellent freeze-thaw durability in a detailed and current testing program.
(11) All dimensions are shown in units of *mm*.
(12) Permissible defects: Chips smaller than 38mm in its largest dimension and cracks not wider than 0.305mm and not longer than 25% of the nominal height of the block; bug holes in the architectural face smaller than 19mm; and bug holes, water marks, and color variation on non-architectural faces.
(13) Column blocks have a smooth troweled finish on horizontal faces.

ACCESSORIES (CAP AND STEP BLOCKS)

Block Library

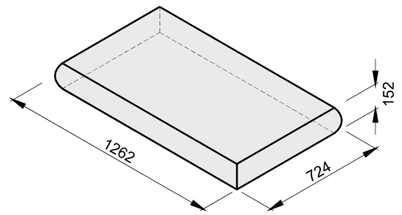
A-2SC TWO-SIDED

Block Weight: 290 kg
Block Volume: 0.125 m^3



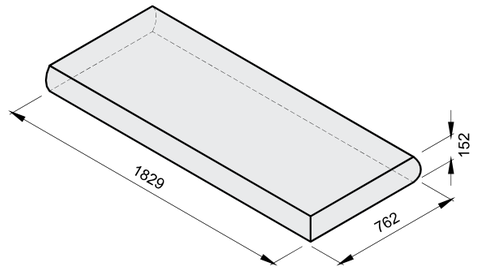
A-4SC FOUR-SIDED

Block Weight: 300 kg
Block Volume: 0.132 m^3



A-3SC72 THREE-SIDED 1830mm

Block Weight: 470 kg
Block Volume: 0.21 m^3



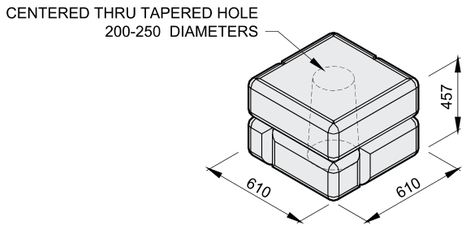
1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Actual block volumes and weights may vary.
4. Weights are based upon a concrete density of 2291 kg/m^3.

ACCESSORIES (COLUMN BLOCKS)

Block Library

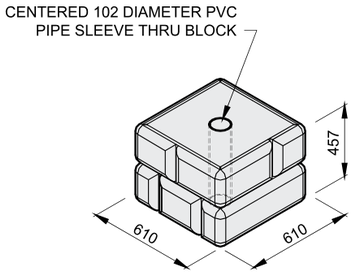
A-COL8 COLUMN - 203mm CORE

Block Weight:	330 kg
Block Volume:	0.14 m^3



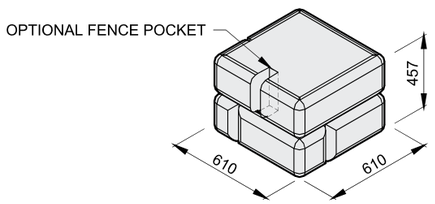
A-COL4 COLUMN - 102mm CORE

Block Weight:	370 kg
Block Volume:	0.16 m^3



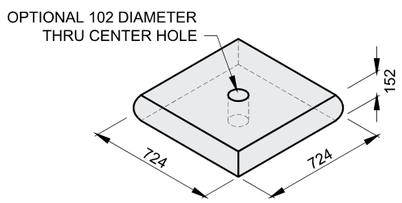
A-COLS COLUMN - SOLID CORE

Block Weight:	380 kg
Block Volume:	0.16 m^3



A-CC COLUMN CAP

Block Weight:	180 kg
Block Volume:	0.08 m^3



1. Units for dimensions are mm, typical unless noted otherwise.
2. Block production varies with each licensed Redi-Rock manufacturer. Confirm availability before specifying or ordering.
3. Actual block volumes and weights may vary.
4. Weights are based upon a concrete density of 2291 kg/m^3.
5. Weight and volume ranges represents the blocks with the maximum hole size shown and with no hole.
6. Optional fence rail pockets available upon request. Typical pocket size is: 50 wide x 130 deep x 230 tall.

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DESIGN INFORMATION

PROVEN, ENGINEERED SOLUTIONS

"The Worcester State site was sloping with a pretty good drop off, and they chose to build the wall with terraces of about 10 feet each. For aesthetic reasons, they used the Ledgestone product—it looks really nice."

Eric Merluzzi, PE
Project Engineer
Watch the video at redi-rock.com/worcester

Designing critical wall structures is important work—and Redi-Rock has the best resources available to make your job easier.
These include:

- Wall Analysis Software
- Preliminary Height Guides
- MSE Design Details

And so much more...

EASY INSTALLATION

Remember how fun it was to play with Lego blocks as a kid? Well installing Redi-Rock retaining walls is like that ... on a much larger scale. And to make it even easier, Redi-Rock has a ton of resources available to help you out:

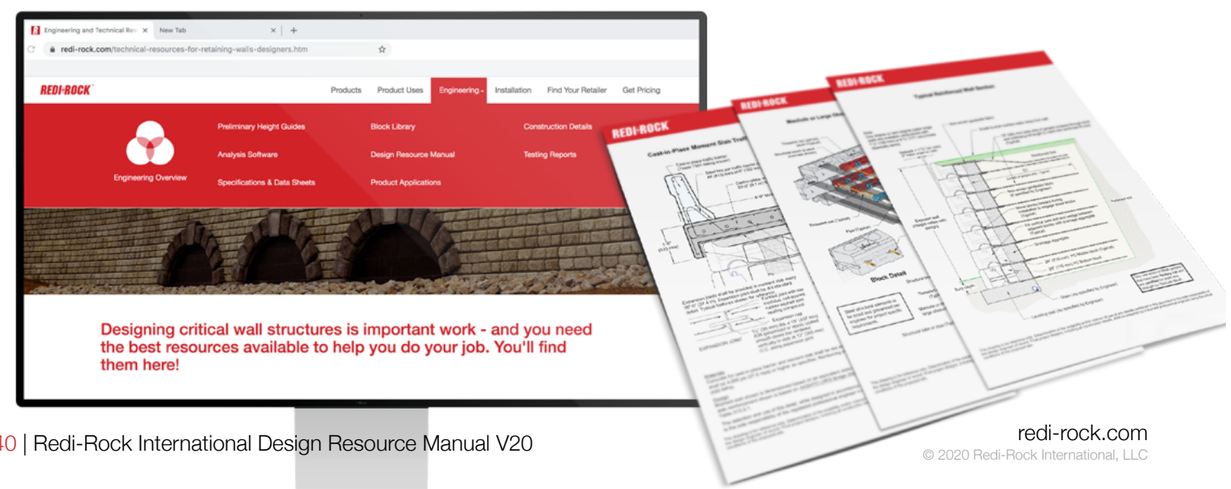
- The Installation Guide
- Typical Construction Details
- The Block Library

And multiple other resources...

"We prefer to install a Redi-Rock wall due to the size of the block. There's more machine work involved, they go quicker, and in a given day you can install more square footage as compared to a smaller, more labor-intensive block."

Matt Guigli
Vice President of
Guigli & Sons, Inc.
Watch the video at redi-rock.com/worcester

On Demand Resources Available at Redi-Rock.com



Redi-Rock Wall+ Software (RRWall+)

Build Confidence In Your Retaining Wall Designs

RRWALL+ FREE DOWNLOAD

Design and Analyze Redi-Rock Gravity & MSE Walls

Tackle your toughest design challenges with this free software program for the design and analysis of Redi-Rock gravity and MSE wall cross sections. Developed in partnership with FINE Software, the experts behind the GEO5 geotechnical suite of software, this robust engineering tool allows users to:

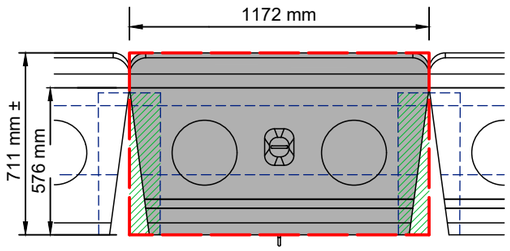
- Select specific design standards like Eurocodes, ASD, LRFD (US) and many other international or custom standards
- Model various site conditions including soil layers, load types & locations, water conditions, and seismic
- Analyze for slope stability and bearing capacity
- Create customized reports

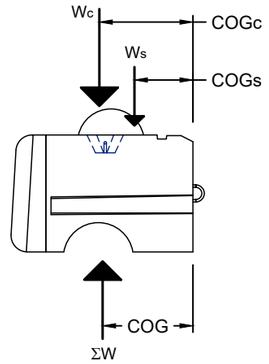
Robust and simple to use, RRWall+ is available in six languages (English, French, German, Italian, Portuguese, and Spanish) and includes step-by-step tutorials. Join the thousands of engineers utilizing the software **by downloading your free copy today at:**
https://rr.direct/get-rrwall

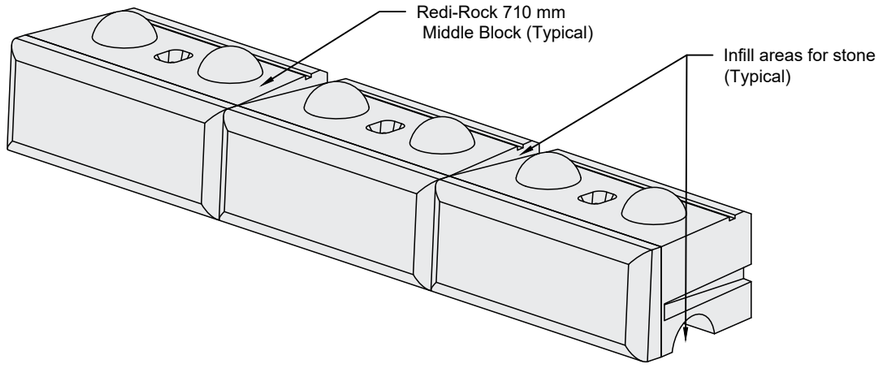
RETAINING BLOCKS

Infill Weight Calculations

R-28M 710 mm MIDDLE BLOCK WITH SOIL INFILL







INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 143 pcf (2291 kg/m^3)

LIMESTONE AND COBBLESTONE FACE TEXTURE

Average Volume (Vc)	0.319 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.319 m^3 x 2291 kg/m^3 = 731 kg

KINGSTONE AND LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.305 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.305 m^3 x 2291 kg/m^3 = 699 kg
Average Center of Gravity (COGc)	353 mm (From CAD Model)

INFILL SOIL

Design Unit Weight = 1602 kg/m^3

Soil considered as infill includes the soil between adjacent blocks and at the ends of the bottom groove in the block.

Volume (Vs)	0.0297 m^3 (From CAD Model)
Infill Soil Weight (Ws)	Ws = 0.0297 cft x 1602 kg/m^3 = 47.6 kg
Center of Gravity (COGs)	345 mm (Data from CAD Model)

DESIGN VOLUME

0.711 m x 1.172 m x 0.457 m = 0.381m^3

INFILLED UNIT WEIGHT

LIMESTONE AND COBBLESTONE FACE TEXTURE

γ_{INFILL} = (731 kg + 48 kg) / 0.381 m^3 = **2045 kg/m^3**

KINGSTONE AND LEDGESTONE FACE TEXTURE

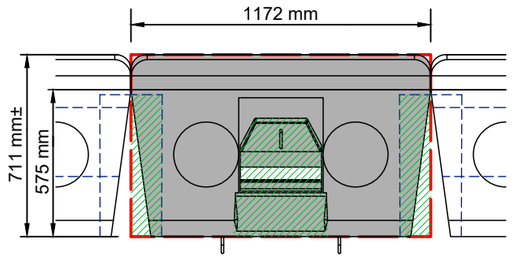
γ_{INFILL} = (699 kg + 48 kg) / 0.381 m^3 = **1961 kg/m^3**

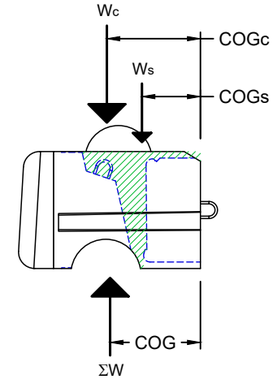
NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis.

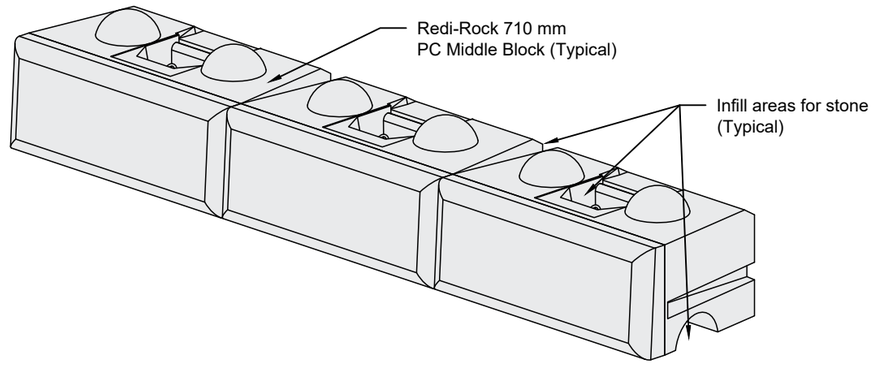
RETAINING BLOCKS

Infill Weight Calculations

R-28PCM 710 mm POSITIVE CONNECTION (PC) MIDDLE BLOCK WITH SOIL INFILL







INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 2291 kg/m^3

LIMESTONE AND COBBLESTONE FACE TEXTURE

Average Volume (Vc)	0.301 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.301 m^3 x 2291 kg/m^3 = 690 kg

KINGSTONE AND LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.287 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.287 m^3 x 2291 kg/m^3 = 658 kg
Average Center of Gravity (COGc)	356 mm (From CAD Model)

INFILL SOIL

Design Unit Weight = 1602 kg/m^3

Soil considered as infill includes the soil between adjacent blocks, in the geogrid slot, and at the ends of the bottom groove in the block.

Volume (Vs)	0.049 m^3 (From CAD Model)
Infill Soil Weight (Ws)	Ws = 0.049 m^3 x 1602 kg/m^3 = 78 kg
Center of Gravity (COGs)	251 mm (Data from CAD Model)

DESIGN VOLUME

0.711 m x 1.172 m x 0.457 m = 0.381m^3

INFILLED UNIT WEIGHT

LIMESTONE AND COBBLESTONE FACE TEXTURE

γ_{INFILL} = (690 kg + 78 kg) / 0.381 m^3 = **2016 kg/m^3**

KINGSTONE AND LEDGESTONE FACE TEXTURE

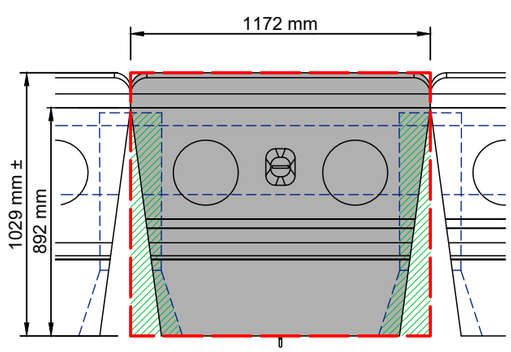
γ_{INFILL} = (658 kg + 78 kg) / 0.381 m^3 = **1932 kg/m^3**

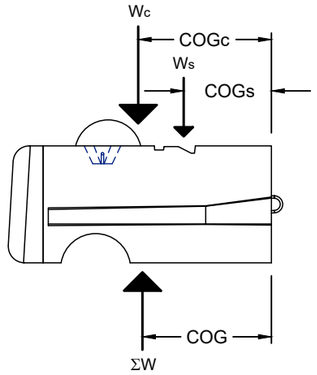
NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis.

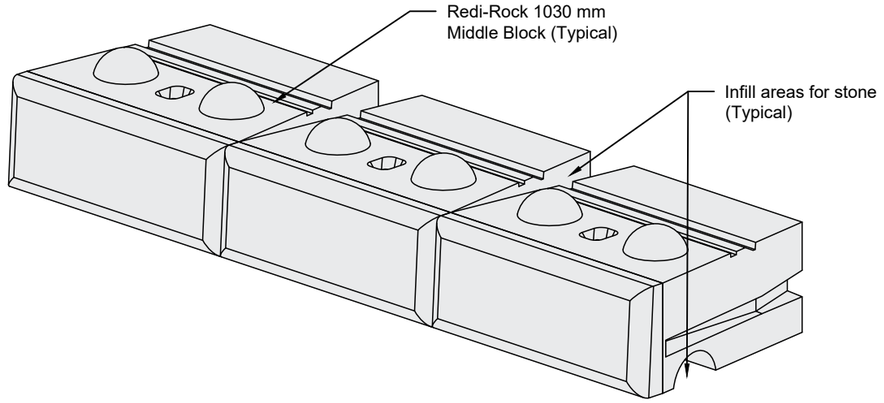
RETAINING BLOCKS

Infill Weight Calculations

R-41M 1030 mm MIDDLE BLOCK WITH SOIL INFILL







INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 2291 kg/m^3

LIMESTONE AND COBBLESTONE FACE TEXTURE

Average Volume (Vc)	0.457 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.457 m^3 x 2291 kg/m^3 = 1047 kg

KINGSTONE AND LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.443 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.443 m^3 x 2291 kg/m^3 = 1015 kg
Average Center of Gravity (COGc)	521 mm (From CAD Model)

INFILL SOIL

Design Unit Weight = 1602 kg/m^3

Soil considered as infill includes the soil between adjacent blocks and at the ends of the bottom groove in the block.

Volume (Vs)	0.0617 m^3 (From CAD Model)
Infill Soil Weight (Ws)	Ws = 0.0617 m^3 x 1602 kg/m^3 = 98.8 kg
Center of Gravity (COGs)	342 mm (Data from CAD Model)

DESIGN VOLUME

1.03 m x 1.172 m x 0.457 m = 0.552 m^3

INFILLED UNIT WEIGHT

LIMESTONE AND COBBLESTONE FACE TEXTURE

γ_{INFILL} = (1047 kg + 99 kg) / 0.552 m^3 = **2076 kg/m^3**

KINGSTONE AND LEDGESTONE FACE TEXTURE

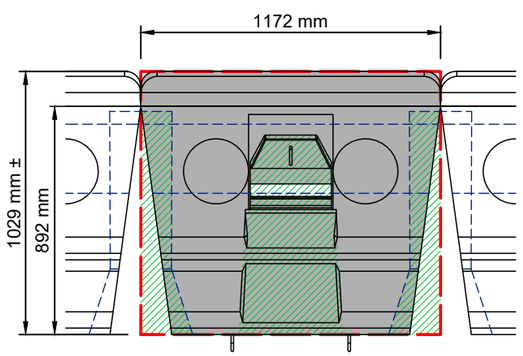
γ_{INFILL} = (1015 kg + 99 kg) / 0.552 m^3 = **2018 kg/m^3**

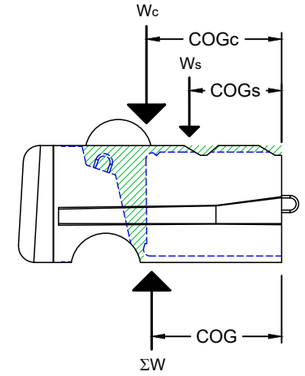
NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis.

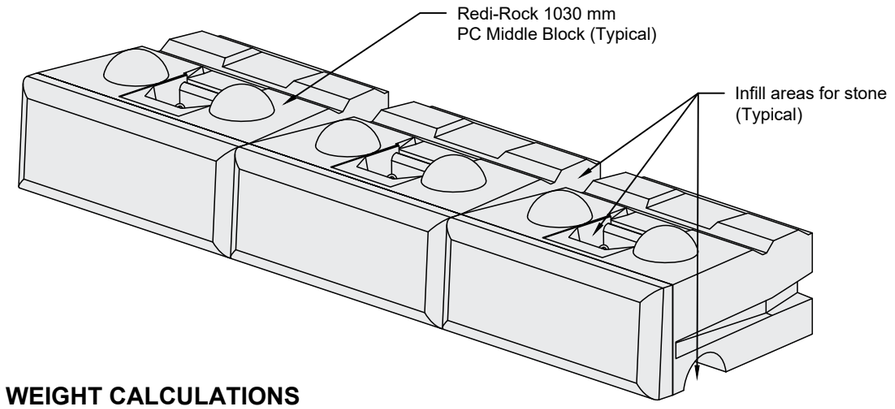
RETAINING BLOCKS

Infill Weight Calculations

R-41PCM 1030 mm POSITIVE CONNECTION (PC) MIDDLE BLOCK WITH SOIL INFILL







INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 2291 kg/m^3

LIMESTONE AND COBBLESTONE FACE TEXTURE

Average Volume (Vc)	0.430 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.430 m^3 x 2291 kg/m^3 = 985 kg

KINGSTONE AND LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.416 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.416 m^3 x 2291 kg/m^3 = 953 kg
Average Center of Gravity (COGc)	518 mm (From CAD Model)

INFILL SOIL

Design Unit Weight = 1602 kg/m^3

Soil considered as infill includes the soil between adjacent blocks, in the geogrid slot, and at the ends of the bottom groove in the block.

Volume (Vs)	0.0827 m^3 (From CAD Model)
Infill Soil Weight (Ws)	Ws = 0.0827 m^3 x 1602 kg/m^3 = 132 kg
Center of Gravity (COGs)	396 mm (Data from CAD Model)

DESIGN VOLUME

1.03 m x 1.172 m x 0.457 m = 0.552 m^3

INFILLED UNIT WEIGHT

LIMESTONE AND COBBLESTONE FACE TEXTURE

γ_{INFILL} = (985 kg + 132 kg) / 0.552 m^3 = **2024 kg/m^3**

KINGSTONE AND LEDGESTONE FACE TEXTURE

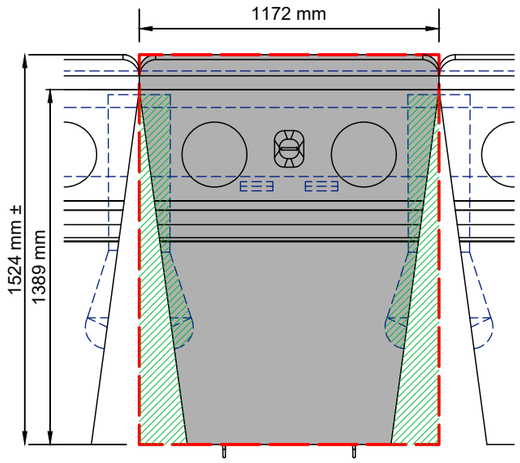
γ_{INFILL} = (953 kg + 132 kg) / 0.552 m^3 = **1966 kg/m^3**

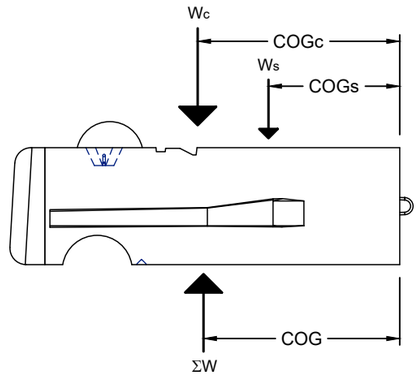
NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis.

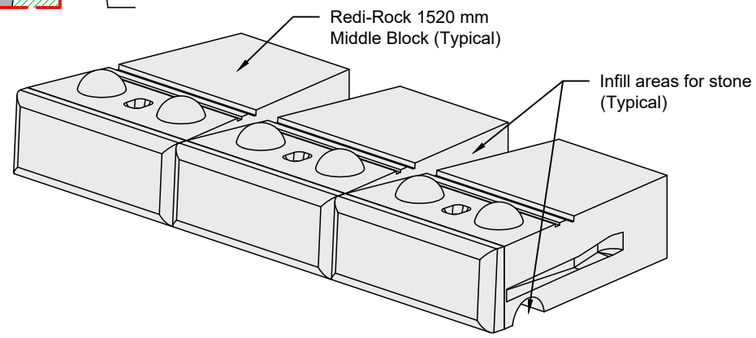
RETAINING BLOCKS

Infill Weight Calculations

R-60M 1520 mm MIDDLE BLOCK WITH SOIL INFILL







INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 2291 kg/m^3

LIMESTONE AND COBBLESTONE FACE TEXTURE

Average Volume (Vc)	0.651m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.651m^3 x 2291 kg/m^3 = 1491 kg

KINGSTONE AND LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.637 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.637 m^3 x 2291 kg/m^3 = 1463 kg
Average Center of Gravity (COGc)	790 mm (From CAD Model)

INFILL SOIL

Design Unit Weight = 1602 kg/m^3

Soil considered as infill includes the soil between adjacent blocks and at the ends of the bottom groove in the block.

Volume (Vs)	0.133 m^3 (From CAD Model)
Infill Soil Weight (Ws)	Ws = 0.133 m^3 x 1602 kg/m^3 = 213 kg
Center of Gravity (COGs)	513mm (Data from CAD Model)

DESIGN VOLUME

1.524 m x 1.172 m x 0.457 m = 0.816 m^3

INFILLED UNIT WEIGHT

LIMESTONE AND COBBLESTONE FACE TEXTURE

γ_{INFILL} = (1491 kg + 213 kg) / 0.816 m^3 = **2088 kg/m^3**

KINGSTONE AND LEDGESTONE FACE TEXTURE

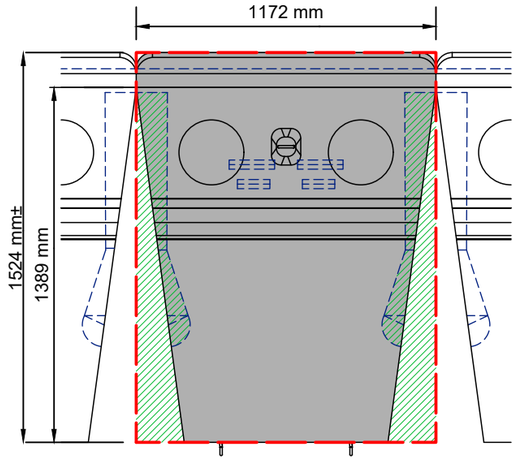
γ_{INFILL} = (1463 kg + 213 kg) / 0.816 m^3 = **2054 kg/m^3**

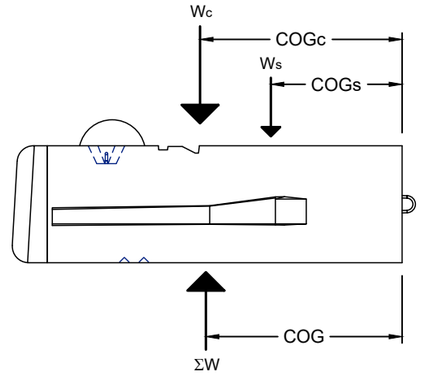
NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis.

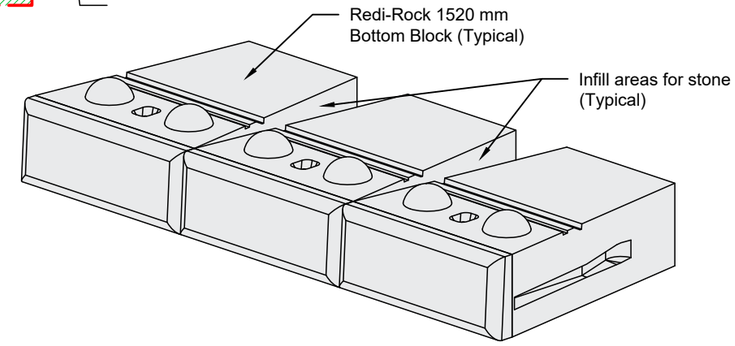
RETAINING BLOCKS

Infill Weight Calculations

R-60B 1520 MM BOTTOM BLOCK WITH SOIL INFILL







INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 2291 kg/m^3

LIMESTONE AND COBBLESTONE FACE TEXTURE

Average Volume (Vc)	0.677 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.677 m^3 x 2291 kg/m^3 = 1,551 kg

KINGSTONE AND LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.663 m^3 (From CAD Model)
Concrete Block Weight (Wc)	Wc = 0.663 m^3 x *2291* kg/m^3 = 1,519 lbs
Average Center of Gravity (COGc)	803mm (From CAD Model)

INFILL SOIL

Design Unit Weight = 1602 kg/m^3

Soil considered as infill includes the soil between adjacent blocks and at the ends of the bottom groove in the block.

Volume (Vs)	0.130 m^3 (From CAD Model)
Infill Soil Weight (Ws)	Ws = 0.130 m^3 x 1602 kg/m^3 = 208 kg
Center of Gravity (COGs)	495 mm (From CAD Model)

DESIGN VOLUME

1.524 m x 1.172 m x 0.457 m = 0.816 m^3

INFILLED UNIT WEIGHT

LIMESTONE AND COBBLESTONE FACE TEXTURE

γ_{INFILL} = **(1551 kg + 208 kg) / 0.816 m^3 = 2156 kg/m^3**

KINGSTONE AND LEDGESTONE FACE TEXTURE

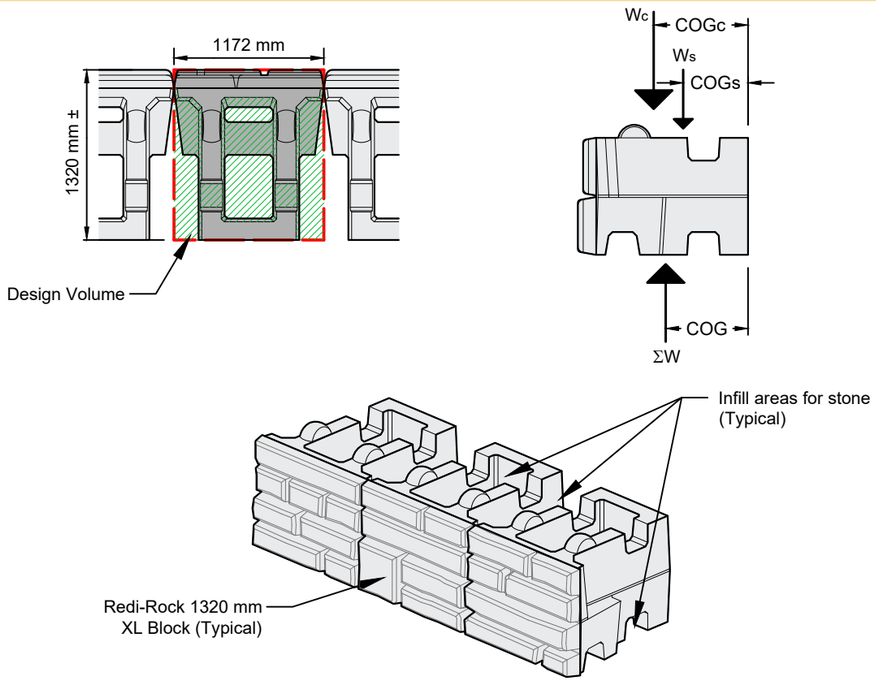
γ_{INFILL} = **(1519 kg + 208 kg) / 0.816 m^3 =2116 kg/m^3**

NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis.

HOLLOW CORE RETAINING BLOCKS

Infill Weight Calculations

R-5236HC 1320 mm XL HOLLOW-CORE RETAINING BLOCK WITH SOIL INFILL



INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 2291 kg/m^3

LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.659 m^3 (From CAD Model)
Concrete Block Weight (Wc)	0.659 m^3 x 2,291 kg/m^3 = 1,510 kg
Average Center of Gravity (COGc)	737 mm (From CAD Model)

INFILL

Design Unit Weight = 1602 kg/m^3

Material considered as infill includes the crushed stone between adjacent blocks and in the hollow cores within the blocks.

Volume (Vs)	0.648 m^3 (From CAD Model)
Infill Soil Weight (Ws)	0.648 m^3 x 1602 kg/m^3 = 1,038 kg
Center of Gravity (COGs)	507 mm (From CAD Model)

DESIGN VOLUME & CENTER OF GRAVITY

1.321 m x 1.172 m x 0.914 m = 1.415 m^3

COG = (737 mm (1510 kg) + 507 mm (1038 kg)) / (1510 kg + 1038 kg) = 643 mm

INFILLED UNIT WEIGHT

LEDGESTONE FACE TEXTURE

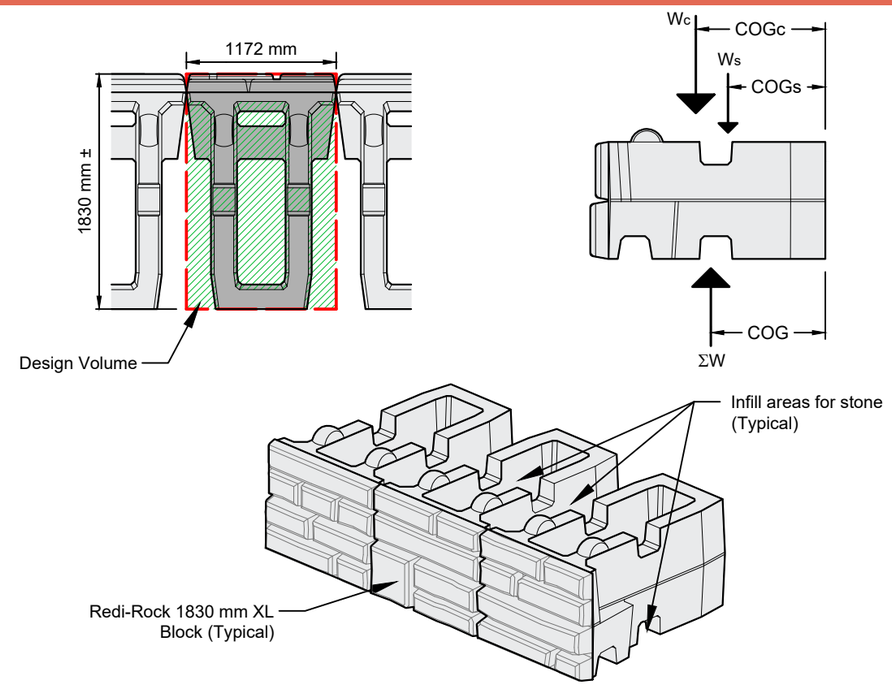
γ_{INFILL} = (1511 kg + 1038 kg) / 1.415 m^3 = **1801 kg/m^3**

NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis. For overturning analyses, AASHTO recommends limiting the infill soil weight to 80% of its theoretical maximum for units without a solid bottom (11.11.4.4).

HOLLOW CORE RETAINING BLOCKS

Infill Weight Calculations

R-7236HC 1830 mm XL HOLLOW-CORE RETAINING BLOCK WITH SOIL INFILL



INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 2291 kg/m^3

LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.824 m^3 (From CAD Model)
Concrete Block Weight (Wc)	0.824 m^3 x 2291 kg/m^3 = 1888 kg
Average Center of Gravity (COGc)	1013 mm (From CAD Model)

INFILL

Design Unit Weight = 1602 kg/m^3

Material considered as infill includes the crushed stone between adjacent blocks and in the hollow cores within the blocks.

Volume (Vs)	1.028 m^3 (From CAD Model)
Infill Soil Weight (Ws)	1.028 m^3 x 1602 kg/m^3 = 1647 kg
Center of Gravity (COGs)	762 mm (From CAD Model)

DESIGN VOLUME & CENTER OF GRAVITY

1.829 m x 1.172 m x 0.914 m = 1.959 m^3

COG = (1013 mm (1888 kg) + 762 mm (1647 kg)) / (1888kg + 1647 kg) = 896 mm

INFILLED UNIT WEIGHT

LEDGESTONE FACE TEXTURE

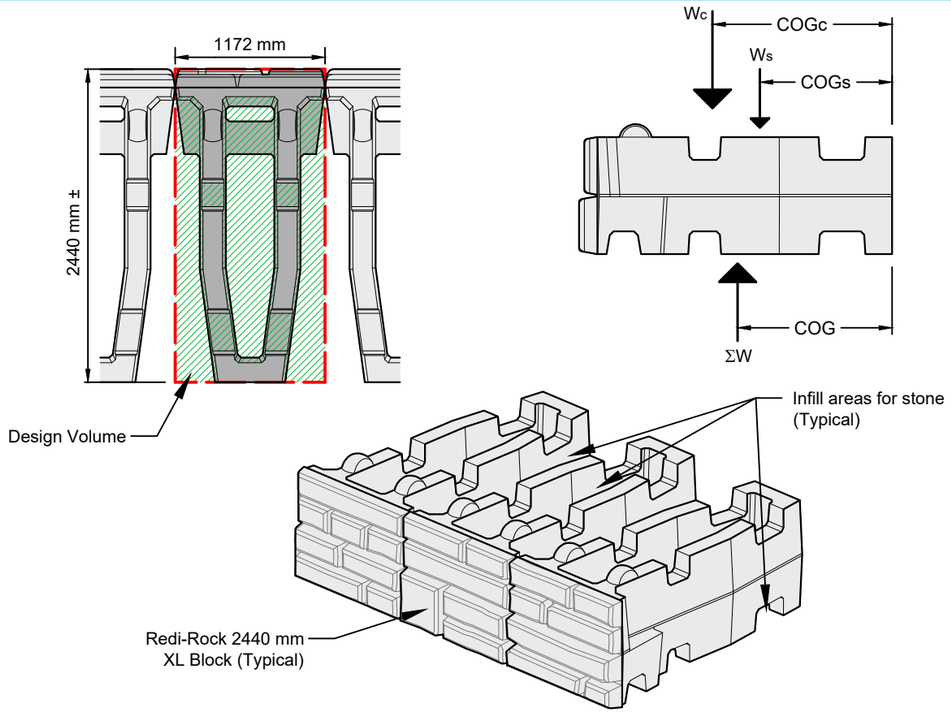
γ_{INFILL} = (1888 kg + 1646 kg) / 1.959 m^3 = **1804 kg/m^3**

NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis. For overturning analyses, AASHTO recommends limiting the infill soil weight to 80% of its theoretical maximum for units without a solid bottom (11.11.4.4).

HOLLOW CORE RETAINING BLOCKS

Infill Weight Calculations

R-9636HC 2440 mm XL HOLLOW-CORE RETAINING BLOCK WITH SOIL INFILL



INFILLED UNIT WEIGHT CALCULATIONS

CONCRETE

Design Unit Weight = 2291 kg/m^3

LEDGESTONE FACE TEXTURE

Average Volume (Vc)	0.958 m^3 (From CAD Model)
Concrete Block Weight (Wc)	0.958 m^3 x 2291 kg/m^3 = 2195 kg
Average Center of Gravity (COGc)	1405 mm (From CAD Model)

INFILL

Design Unit Weight = 1602 kg/m^3

Material considered as infill includes the crushed stone between adjacent blocks and in the hollow cores within the blocks.

Volume (Vs)	1.547 m^3 (From CAD Model)
Infill Soil Weight (Ws)	1.547 m^3 x 1602 kg/m^3 = 2478 kg
Center of Gravity (COGs)	1034 mm (From CAD Model)

DESIGN VOLUME

2.438 m x 1.172 m x 0.914 m = 2.612 m^3

COG = (1405 mm (2195 kg) + 1034 mm (2478 kg)) / (2195 kg + 2478 kg) = 1208 mm

INFILLED UNIT WEIGHT

LEDGESTONE FACE TEXTURE

γ_{INFILL} = (2194 kg + 2478 kg) / 2.612 m^3 = **1789 kg/m^3**

NOTE: The infilled unit weights shown here are reference values. Several factors can cause the unit weights of both concrete and infill soil to vary. The designer should use sound engineering judgement when assigning an infilled unit weight value for analysis. For overturning analyses, AASHTO recommends limiting the infill soil weight to 80% of its theoretical maximum for units without a solid bottom (11.11.4.4).

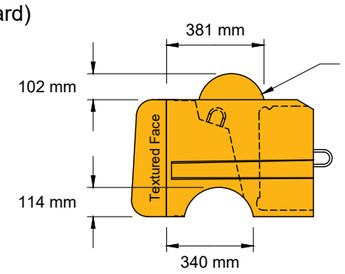
457 mm HIGH RETAINING BLOCKS

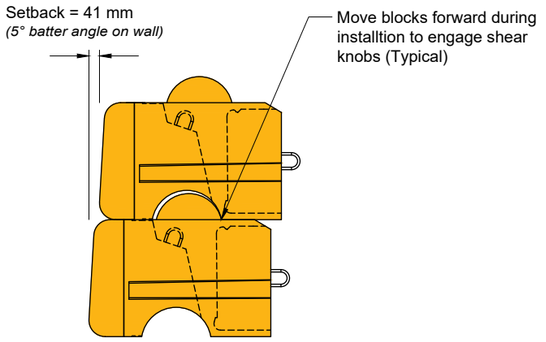
Block Setback Options

The block-to-block setback available with Redi-Rock is controlled by the size and location of the shear knobs (domes) cast into the blocks. While the 254 mm diameter knob and the 41 mm setback position is the most common configuration, Redi-Rock has three different knob sizes and three different locations available.

Five degree (5°) setback

(Standard)



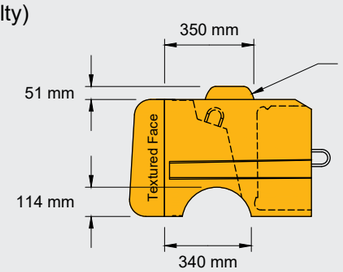


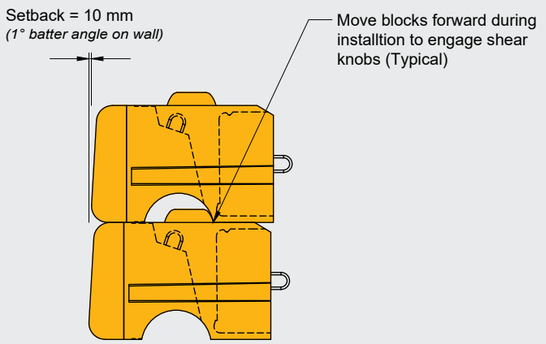
Available with:

- 710 mm blocks, 1030 mm blocks, and 1520 mm blocks
- 710 mm PC blocks (shown here) and 1030 mm PC blocks

One degree (1°) setback

(Specialty)



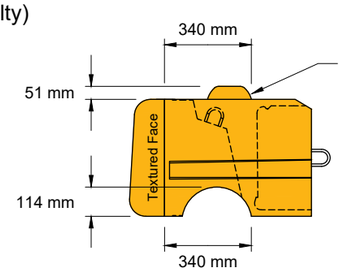


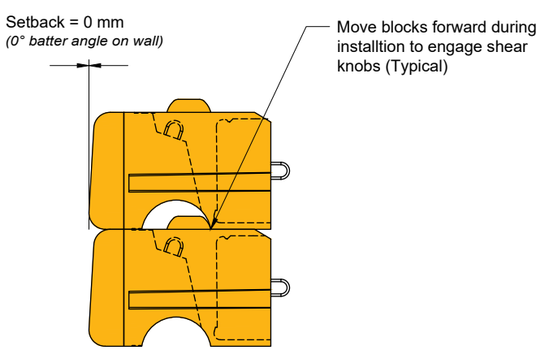
Available with:

- 710 mm blocks, 1030 mm blocks, and 1520 mm blocks
- 710 mm PC blocks (shown here) and 1030 mm PC blocks

Zero (0°) setback

(Specialty)





Available with:

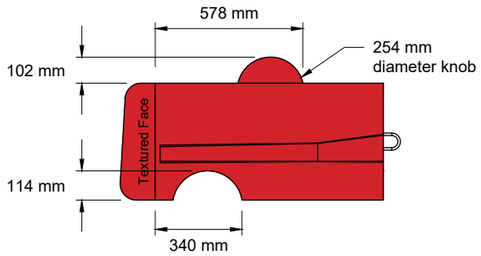
- 710 mm blocks, 1030 mm blocks, and 1520 mm blocks
- 710 mm PC blocks (shown here) and 1030 mm PC blocks

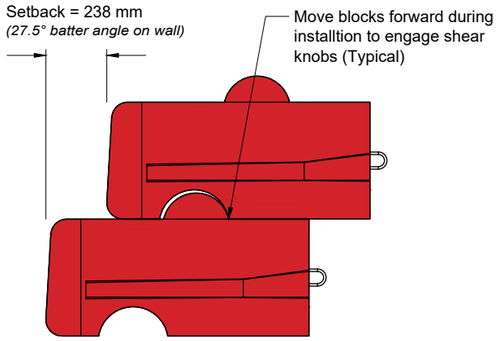
457 mm HIGH RETAINING BLOCKS

Block Setback Options

Redi-Rock has two options for large batter retaining walls. Both options are created by relocating the knob so that it is further back in the Redi-Rock blocks compared to our smaller batter walls (5° and less). There are two knob locations further back in the block which create the 230 mm setback block and the planter block. Blocks made with knobs in either of these locations almost exclusively use 254 mm diameter knobs.

230 mm Setback Blocks

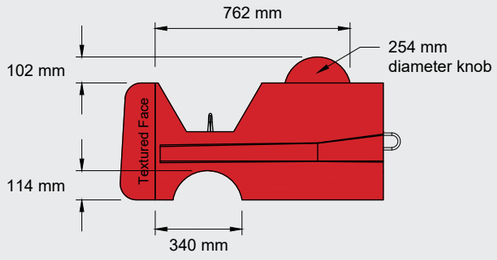


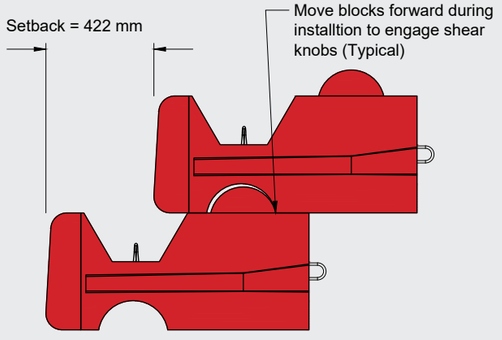


Available with:

- 1030 mm blocks (shown here) and 1520 mm blocks
- Not available in PC blocks

Planter Blocks





Available with:

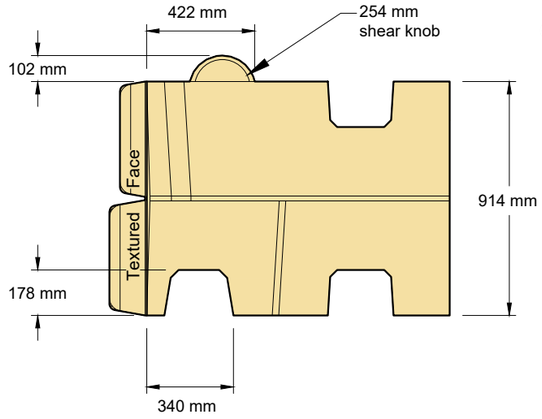
- 1030 mm blocks (shown here) and 1520 mm blocks
- Not available in PC blocks

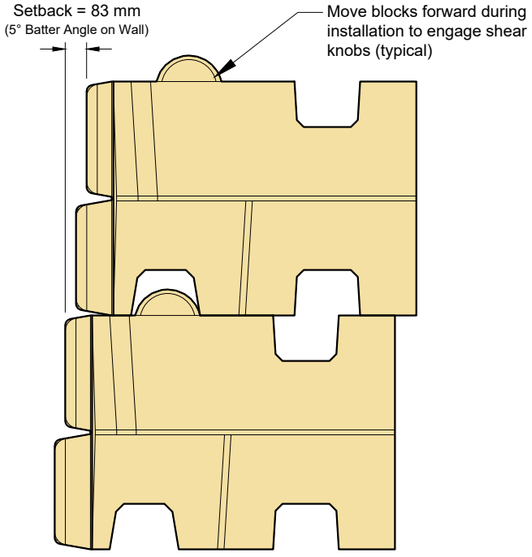
914 mm HIGH RETAINING BLOCKS

Block Setback

The block-to-block setback available with 914 mm high Redi-Rock XL hollow-core retaining blocks is controlled by the location of the shear knobs cast into the blocks. The 83 mm setback between courses creates a 5° batter angle on the back of the wall which is consistent with the batter angle created by 457 mm high Redi-Rock blocks with 254 mm shear knobs.

914 mm High XL Hollow-Core Retaining Blocks





The relative knob and groove configuration, and resulting setback, are consistent between the 1320 mm, 1830 mm, and 2440 mm XL hollow-core retaining blocks.

Interface Shear Report 171 mm

Test Methods: ASTM D6916 & NCMA SRWU-2

Test Facility: Bathurst, Clarabut Geotechnical Testing, Inc.

Block Type: 710 mm Positive Connection (PC) Block

Test Dates: 2011-10-21 - 171 mm Shear Knob Test

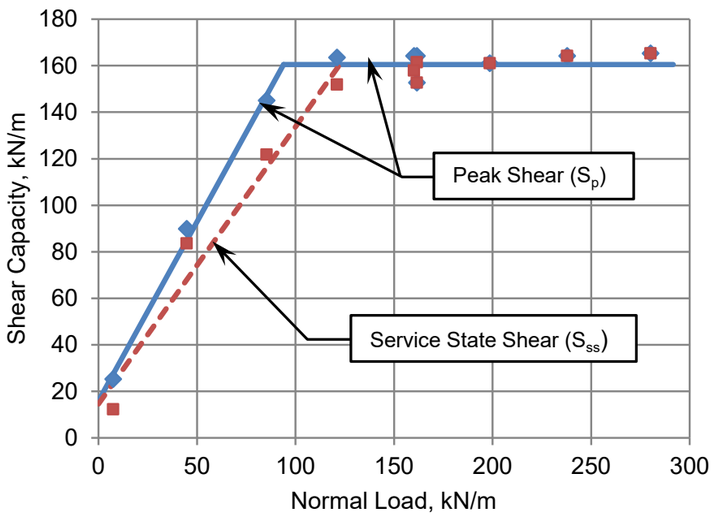
171 mm KNOB INTERFACE SHEAR DATA[a, c, d]

Test No.	Normal Load kN/m	Service State Shear kN/m	Peak Shear kN/m	Observed Failure
1	7.618	12.230	25.160	Test Stopped
2	280.334	165.261	165.261	Test Stopped
3	237.924	164.211	164.211	Test Stopped
4	198.652	161.058	161.058	Test Stopped
5	161.627	152.681	152.681	Test Stopped
6	161.613	161.409	164.211	Knob Shear
7	121.115	151.893	163.510	Test Stopped
8	85.433	121.669	144.990	Knob Shear
9	44.905	83.506	89.796	Knob Shear
10	160.256	157.921	164.211	Knob Shear

Peak Shear: S_p = 15.91 + N tan 57°, $S_{p(max)}$ = 160.50 kN/m

Service State Shear: S_{ss} = 14.59 + N tan 50°, $S_{ss(max)}$ = 160.5 kN/m

171 mm KNOB INTERFACE SHEAR CAPACITY



(a) Minimum 28-day compressive strength of the concrete blocks tested in the 171 mm knob interface shear test exceeded 24.8 MPa.

(b) Service State Shear is measured at a horizontal displacement equal to 2% of the block height. For Redi-Rock blocks, displacement = 9 mm.

(c) In several test cases, the test was stopped before failure of the block occurred to prevent damage to the test apparatus. The shear capacities recorded reflect the limits of the maximum loading that could be safely exerted on the blocks tested..

(d) The recommended design shear capacity at a given normal load for a critical wall structure is the lesser of the peak capacity divided by a minimum factor of safety (not less than 1.5) or the capacity based upon the 9 mm service state displacement criterion. Nevertheless, the design shear capacity envelope inferred from the test data reported herein should be lower (i.e.: increased factor of safety) if the compressive strength of the concrete is less than that of the blocks used in this test.

The information contained in this report has been compiled by Redi-Rock International, LLC as a recommendation of peak interface shear capacity. It is accurate to the best of our knowledge as of the date of its issue. However, final determination of the suitability of any design information and the appropriateness of this data for a given design purpose is the sole responsibility of the user. No warranty of performance is expressed or implied by the publishing of the foregoing laboratory test results. Issue date: 2019-08-14.

Interface Shear Report 254 mm

Test Methods: ASTM D6916 & NCMA SRWU-2

Test Facility: Bathurst, Clarabut Geotechnical Testing, Inc.

Block Type: 710 mm Positive Connection (PC) Block

2011-10-14 - 254 mm Shear Knob Test

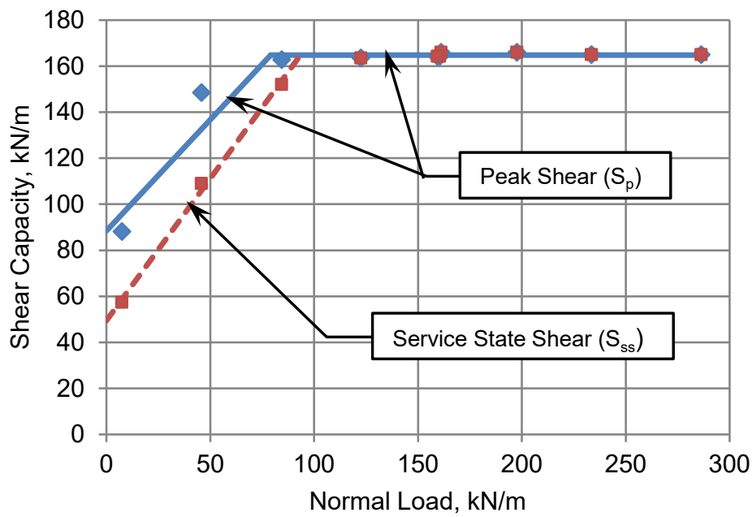
254 mm KNOB INTERFACE SHEAR DATA[b,c,d]

Test No.	Normal Load kN/m	Service State Shear kN/m	Peak Shear kN/m	Observed Failure[c]
1	286.318	164.911	164.911	Test Stopped
2	233.605	164.911	164.911	Test Stopped
3	197.689	165.947	165.947	Test Stopped
4	161.146	165.947	165.947	Test Stopped
5	122.589	163.510	163.510	Test Stopped
6	160.518	164.211	164.211	Test Stopped
7	159.395	164.211	164.211	Test Stopped
8	84.440	151.981	162.810	Test Stopped
9	45.781	109.002	148.478	Test Stopped
10	7.618	57.296	88.045	Test Stopped

Peak Shear: S_p = 88.45 + N tan 44°, $S_{p(max)}$ = 164.8 kN/m

Service State Shear: S_{ss} = 49.47 + N tan 51°, $S_{ss(max)}$ = 164.8 kN/m

254 mm KNOB INTERFACE SHEAR CAPACITY



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(a) Minimum 28-day compressive strength of the concrete blocks tested in the 254 mm knob interface shear test exceeded 30.3 MPa.

(b) Service State Shear is measured at a horizontal displacement equal to 2% of the block height. For Redi-Rock blocks, displacement = 9 mm.

(c) In several test cases, the test was stopped before failure of the block occurred to prevent damage to the test apparatus. The shear capacities recorded reflect the limits of the maximum loading that could be safely exerted on the blocks tested..

(d) The recommended design shear capacity at a given normal load for a critical wall structure is the lesser of the peak capacity divided by a minimum factor of safety (not less than 1.5) or the capacity based upon the 9 mm service state displacement criterion. Nevertheless, the design shear capacity envelope inferred from the test data reported herein should be lower (i.e.: increased factor of safety) if the compressive strength of the concrete is less than that of the blocks used in this test.

The information contained in this report has been compiled by Redi-Rock International, LLC as a recommendation of peak interface shear capacity. It is accurate to the best of our knowledge as of the date of its issue. However, final determination of the suitability of any design information and the appropriateness of this data for a given design purpose is the sole responsibility of the user. No warranty of performance is expressed or implied by the publishing of the foregoing laboratory test results. Issue date: 2019-08-14.

Interface Shear Report XL Hollow-Core Retaining Block

Test Methods: ASTM D6916 & NCMA SRWU-2 | Block Type: R-5236 1320 mm Hollow-Core Retaining Block

INTERFACE SHEAR DATA[a]

Tested By: TRI Environmental | 10-21 December 2017

Test No.	Normal Load kN/m	Peak Shear kN/m	Observed Failure[b]
1	12.7	55.6	Test stopped - uplift
2	73.4	167.9	Knob/face shear
3	12.7	49.4	Test stopped - uplift
4	241.7	247.5	Test stopped - capacity
5	30.1	101.7	Test stopped - uplift
6	51.6	143.8	Test stopped - uplift
7	113.4	163.6	Knob/face shear
8	113.3	154.7	Test stopped - back cracked
9	111.7	181.0	Test stopped - back cracked
10	95.5	176.8	Test stopped - uplift
11	182.4	203.8	Test stopped - back cracked

Tested By: Redi-Rock International | 14-23 March 2018

Test No.	Normal Load kN/m	Peak Shear kN/m	Observed Failure[b]
1	113.2	228.2	Test stopped - back cracked
2	114.4	231.2	Test stopped - back cracked
3	113.3	202.3	Knob/face shear
4	242.5	249.1	Test stopped - back cracked
5	183.7	252.5	Knob/face shear
6	12.3	97.0	Knob/face shear
7	12.5	97.9	Knob/face shear
8	33.9	132.8	Test stopped - back cracked
9	52.7	171.4	Test stopped - back cracked
10	73.8	159.7	Test stopped - back cracked
11	96.5	189.4	Test stopped - back cracked

Peak Shear Envelope:[c]

$S_{p(1)} = 66.4 + N \tan 44°$ (N < 102.4 kN/m)

$S_{p(2)} = 123.9 + N \tan 22°$ (102.4 kN/m ≤ N < 235.2 kN/m)

$S_{p(max)} = 218.9$ kN/m (N ≥ 235.2 kN/m)

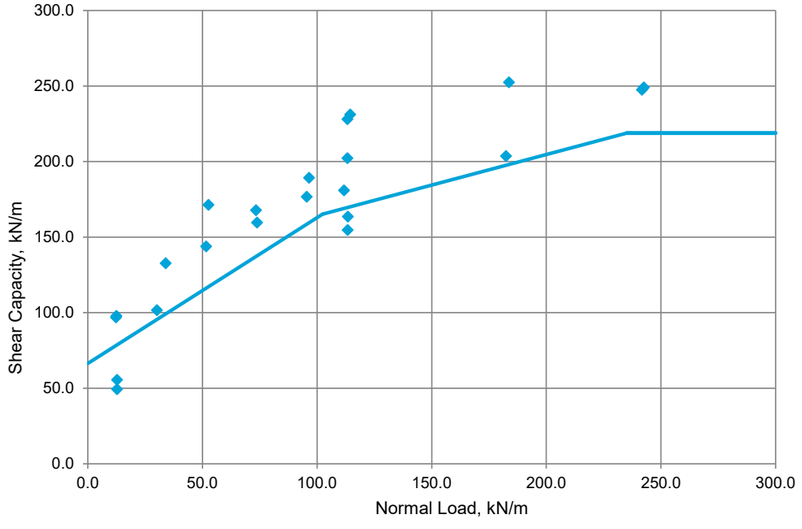
Inflection Points:

$N_1 = 0$ kN/m $S_1 = 66.4$ kN/m

$N_2 = 102.4$ kN/m $S_2 = 165.2$ kN/m

$N_3 = 235.2$ kN/m $S_3 = 218.9$ kN/m

INTERFACE SHEAR CAPACITY



(a) The average compressive strength at the time of testing of all concrete blocks tested in the XL hollow- core retaining block test series was 36.9 MPai.

(b) In many cases, the test was stopped before peak shear load occurred because of significant uplift of upper block, damage to the back of upper block where horizontal load was applied, or maximum capacity of test apparatus was reached.

(c) Design shear capacity inferred from the test data reported herein should be lowered when test failure results from block rupture or knob shear if the compressive strength of the blocks used in design is less than the blocks used in this test. The data reported represents the actual laboratory test results. The equations for peak shear conditions have been modified to reflect the interface shear performance of concrete with a minimum 28-day compressive strength equal to 27.6 MPa. No further adjustments have been made. Appropriate factors of safety for design should be added.

The information contained in this report has been compiled by Redi-Rock International, LLC as a recommendation of peak interface shear capacity. It is accurate to the best of our knowledge as of the date of its issue. However, final determination of the suitability of any design information and the appropriateness of this data for a given design purpose is the sole responsibility of the user. No warranty of performance is expressed or implied by the publishing of the foregoing laboratory test results.

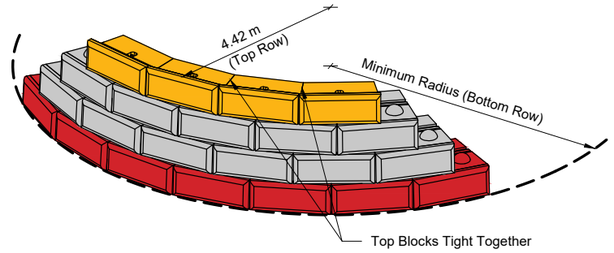
Minimum Turning Radius

Convex curves can easily be incorporated into a Redi-Rock wall. Redi-Rock blocks are tapered 7½° on each side. The smallest radius that can be made with Redi-Rock blocks (without cutting the blocks) occurs when the blocks are placed together with their sides touching. This minimum radius for full size blocks is 4.42 m from the face of the blocks.

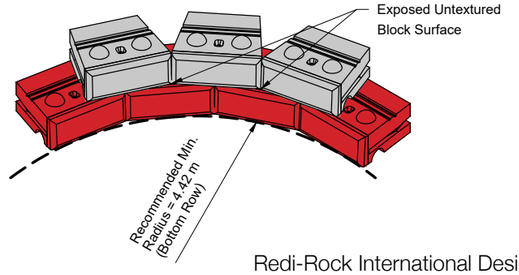
Block to block setback will cause the radius for each succeeding row to be smaller than the row below. To ensure the minimum radius for the top row of blocks in a wall, start with the minimum radius and then add 51 mm per course for each standard set-back block 457-mm high block, 254 mm per course for each 230 mm setback block, and 432 mm per course for each planter block in the wall below the top row of blocks. For 914-mm high XL blocks, add 102 mm per row.

MINIMUM RADIUS FOR BOTTOM ROW OF BLOCKS

	457 mm High Blocks	914 mm High Blocks
HEIGHT OF WALL	RADIUS FROM FACE OF BLOCK	RADIUS FROM FACE OF BLOCK
(0.46 m)	(4.42 m)	
(0.91 m)	(4.47 m)	
(1.37 m)	(4.52 m)	
(1.83 m)	(4.57 m)	(4.57 m)
(2.29 m)	(4.62 m)	(4.62 m)
(2.74 m)	(4.67 m)	(4.67 m)
(3.20 m)	(4.72 m)	(4.72 m)
(3.66 m)	(4.78 m)	(4.78 m)
(4.11 m)	(4.83 m)	(4.83 m)
(4.57 m)	(4.88 m)	(4.88 m)
(5.03 m)		(4.93 m)
(5.49 m)		(4.98 m)
(5.94 m)		(5.03 m)
(6.4 m)		(95.08 m)



Concave curves may be installed at varying radii. The blocks should be placed tight together to make a smooth curve. Although there is no fixed minimum radius, smaller radii lengths of less than 4.42 m will result in exposing more of the untextured top face of the blocks in the underlying layer.



Precast Modular Block Retaining Wall Specification

CSI Format

2019-08-05

The following specification addresses precast modular block walls designed as unreinforced gravity structures or reinforced with geosynthetic reinforcement. This document is a guide specification and should be modified as necessary for your particular project.
An editable version of this document is available for download at **redi-rock.com**.

SECTION 32 32 16
PRECAST MODULAR BLOCK RETAINING WALL

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes furnishing all materials and labor required for the design and construction of a precast concrete modular block (PMB) retaining wall with or without geosynthetic reinforcement. Precast modular block retaining wall blocks under this section shall be cast utilizing a wet-cast concrete mix and exhibit a final handling weight in excess of 450 kg per unit.

B. Scope of Work: The work shall consist of furnishing materials, labor, equipment and supervision for the construction of a precast modular block (PMB) retaining wall structure in accordance with the requirements of this section and in acceptable conformity with the lines, grades, design and dimensions shown in the project site plans.

C. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 31, Division 32 and Division 33 also apply to this Section.

1.02 PRICE AND PAYMENT PROCEDURES

A. Allowances. No allowance shall be made in the price of the retaining wall for excavation beyond the limits required for retaining wall construction as shown on the project plans. The cost of excavation for the purposes of site access shall be the responsibility of the General Contractor. Removal of unsuitable soils and replacement with select fill shall be as directed and approved in writing by the Owner or Owner's representative and shall be paid under separate pay items.

B. Unit Prices. In addition to a lump sum price pursuant to completion of the scope of work described in Part 1.01 of this Section, the General Contractor shall provide a unit price per square meter of vertical wall face that shall be the basis of compensation for up to a ten (10) percent increase or reduction in the overall scope of the retaining wall work.

C. Measurement and Payment.
1. The unit of measurement for furnishing the precast modular block retaining wall system shall be the vertical area of the wall face surface as measured from the top of the leveling pad to the top of the wall including coping. The final measured quantity shall include supply of all material components and the installation of the precast modular block system.
2. The final accepted quantities of the precast modular block retaining wall system will be compensated per the vertical face area as described above. The quantities of the precast modular block retaining wall as shown on the plans and as approved by the Owner shall be the basis for determination of the final payment quantity. Payment shall be made per square meter of vertical wall face.

1.03 REFERENCES

A. Where the specification and reference documents conflict, the Owner's designated representative will make the final determination of the applicable document.

B. Definitions:
1. Precast Modular Block (PMB) Unit – machine-placed, "wet cast" concrete modular block retaining wall facing unit.
2. Geotextile – a geosynthetic fabric manufactured for use as a separation and filtration medium between dissimilar soil materials.
3. Geogrid – a geosynthetic material comprised of a regular network of tensile elements manufactured in a mesh-like configuration of consistent aperture openings. When connected to the PMB facing units and placed in horizontal layers in compacted fill, the geogrid prevents lateral deformation of the retaining wall face and provides effective tensile reinforcement to the contiguous reinforced fill material.
4. Drainage Aggregate – clean, crushed stone placed within and immediately behind the precast modular block units to facilitate drainage and reduce compaction requirements immediately adjacent to and behind the precast modular block units.
5. Unit Core Fill – clean, crushed stone placed within the hollow vertical core of a precast modular block unit. Typically, the same material used for drainage aggregate as defined above.
6. Foundation Zone – soil zone immediately beneath the leveling pad and the reinforced zone.
7. Retained Zone – soil zone immediately behind the drainage aggregate and wall infill for wall sections designed as modular gravity structures. Alternatively, in the case of wall sections designed with geosynthetic soil reinforcement, the retained zone is the soil zone immediately behind the reinforced zone.
8. Reinforced Zone – structural fill zone within which successive horizontal layers of geogrid soil reinforcement have been placed to provide stability for the retaining wall face. The reinforced zone exists only for retaining wall sections that utilize geosynthetic soil reinforcement for stability.
9. Reinforced Fill – structural fill placed within the reinforced zone.
10. Leveling Pad – hard, flat surface upon which the bottom course of precast modular blocks are placed. The leveling pad may be constructed with crushed stone or cast-in-place concrete. A leveling pad is not a structural footing.
11. Wall Infill – the fill material placed and compacted between the drainage aggregate and the excavated soil face in retaining wall sections designed as modular gravity structures.

C. Reference Standards
1. Design
   a. AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014.
   b. Minimum Design Loads for Buildings and Other Structures – ASCE/SEI 7-10.
   c. International Building Code, 2012 Edition.
   d. FHWA-NHI-10-024 Volume I and GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
   e. FHWA-NHI-10-025 Volume II and GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
2. Precast Modular Block Units
   a. ACI 201 – Guide to Durable Concrete

b. ACI 318 – Building Code Requirements for Structural Concrete
c. ASTM C33 – Standard Specification for Concrete Aggregates
d. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
e. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
f. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
g. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.
h. ASTM C150 – Standard Specification for Portland Cement
i. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
j. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
k. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
l. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
m. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
n. ASTM C666 – Standard Test Method for Concrete Resistance to Rapid Freezing and Thawing.
o. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
p. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
q. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
r. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
s. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
t. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
u. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
v. ASTM C1611 – Standard Test Method for Slump Flow of Self-Consolidating Concrete.
w. ASTM C1776 – Standard Specification for Wet-Cast Precast Modular Retaining Wall Units.
x. ASTM D6638 – Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks).
y. ASTM D6916 – Standard Test Method for Determining Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks).

3. Geosynthetics
   a. AASHTO M 288 – Geotextile Specification for Highway Applications.
   b. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics Diaphragm Bursting Strength Tester Method.
   c. ASTM D4354 – Standard Practice for Sampling of Geosynthetics for Testing.
   d. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles
   e. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   f. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   g. ASTM D4595 – Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
   h. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   i. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile.
   j. ASTM D4759 – Standard Practice for Determining Specification Conformance of Geosynthetics.
   k. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.

   l. ASTM D4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
   m. ASTM D5262 – Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics.
   n. ASTM D5321 – Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
   o. ASTM D5818 – Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics.
   p. ASTM D6241 – Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
   q. ASTM D6637 – Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
   r. ASTM D6706 – Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.
   s. ASTM D6992 – Standard Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method.

4. Soils
   a. AASHTO M 145 – AASHTO Soil Classification System.
   b. AASHTO T 104 – Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
   c. AASHTO T 267 – Standard Method of Test for Determination of Organic Content in Soils by Loss of Ignition.
   d. ASTM C33 – Standard Specification for Concrete Aggregates.
   e. ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils.
   f. ASTM D448 – Standard Classification for Sizes of Aggregates for Road and Bridge Construction.
   g. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. (12,400 ft-lbf/ft (2,700 kN-m/m)).
   h. ASTM D1241 – Standard Specification for Materials for Soil-Aggregate Subbase, Base and Surface Courses.
   i. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
   j. ASTM D1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. (56,000 ft-lbf/ft (2,700 kN-m/m)).
   k. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   l. ASTM D2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
   m. ASTM D3080 – Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions.
   n. ASTM D4254 – Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   o. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   p. ASTM D4767- Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils.
   q. ASTM D4972 – Standard Test Method for pH of Soils.

r. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Aggregate by Nuclear Methods (Shallow Depth).
s. ASTM G51 – Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing.
t. ASTM G57 – Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method.

5. Drainage Pipe
   a. ASTM D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   b. ASTM F2648 – Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preconstruction Meeting. As directed by the Owner, the General Contractor shall schedule a preconstruction meeting at the project site prior to commencement of retaining wall construction. Participation in the preconstruction meeting shall be required of the General Contractor, Retaining Wall Design Engineer, Retaining Wall Installation Contractor, Grading Contractor and Inspection Engineer. The General Contractor shall provide notification to all parties at least 10 calendar days prior to the meeting.

   1. Preconstruction Meeting Agenda:
      a. The Retaining Wall Design Engineer shall explain all aspects of the retaining wall construction drawings.
      b. The Retaining Wall Design Engineer shall explain the required bearing capacity of soil below the retaining wall structure and the shear strength of in-situ soils assumed in the retaining wall design to the Inspection Engineer.
      c. The Retaining Wall Design Engineer shall explain the required shear strength of fill soil in the reinforced, retained and foundation zones of the retaining wall to the Inspection Engineer.
      d. The Retaining Wall Design Engineer shall explain any measures required for coordination of the installation of utilities or other obstructions in the reinforced or retained fill zones of the retaining wall.
      e. The Retaining Wall Installation Contractor shall explain all excavation needs, site access and material staging area requirements to the General Contractor and Grading Contractor.

1.05 SUBMITTALS

A. Product Data. At least 14 days prior to construction, the General Contractor shall submit a minimum of six (6) copies of the retaining wall product submittal package to the Owner's Representative for review and approval. The submittal package shall include technical specifications and product data from the manufacturer for the following:
   1. Precast Modular Block System brochure
   2. Precast Modular Block concrete test results specified in paragraph 2.01, subparagraph B of this section as follows:
      a. 28-day compressive strength
      b. Air content
      c. Slump or Slump Flow (as applicable)
   3. Drainage Pipe

   4. Geotextile
   5. Geosynthetic Soil Reinforcement (if required by the retaining wall design). The contractor shall provide certified manufacturer test reports for the geosynthetic soil reinforcement material in the manufactured roll width specified. The test report shall list the individual roll numbers for which the certified material properties are valid.

B. Installer Qualification Data. At least 14 days prior to construction, the General Contractor shall submit the qualifications of the business entity responsible for installation of the retaining wall, the Retaining Wall Installation Contractor, per paragraph 1.07, subparagraph A of this section.

C. Retaining Wall Design Calculations and Construction Shop Drawings. At least 14 days prior to construction, the General Contractor shall furnish six (6) sets of construction shop drawings and six (6) copies of the supporting structural calculations report to the Owner for review and approval. This submittal shall include the following:
   1. Signed, sealed and dated drawings and engineering calculations prepared in accordance with these specifications.
   2. Qualifications Statement of Experience of the Retaining Wall Design Engineer as specified in paragraph 1.07, subparagraph B of this section.
   3. Certificate of Insurance of the Retaining Wall Design Engineer as specified in paragraph 1.06, subparagraph B of this section.

1.06 CONSTRUCTION SHOP DRAWING PREPARATION

A. The Retaining Wall Design Engineer shall coordinate the retaining wall construction shop drawing preparation with the project Civil Engineer, project Geotechnical Engineer and Owner's Representatives. The General Contractor shall furnish the Retaining Wall Design Engineer the following project information required to prepare the construction shop drawings. This information shall include, but is not limited to, the following:
   1. Current versions of the site, grading, drainage, utility, erosion control, landscape, and irrigation plans;
   2. electronic CAD file of the civil site plans listed in (1);
   3. report of geotechnical investigation and all addenda and supplemental reports;
   4. recommendations of the project Geotechnical Engineer regarding effective stress shear strength and total stress shear strength (when applicable) parameters for in-situ soils in the vicinity of the proposed retaining wall(s) and for any fill soil that may potentially be used as backfill in retained and/or foundation zones of the retaining wall.

B. The Retaining Wall Design Engineer shall provide the Owner with a certificate of professional liability insurance verifying the minimum coverage limits of $1 million USD per claim and $1 million USD aggregate.

C. Design of the precast modular block retaining wall shall satisfy the requirements of this section. Where local design or building code requirements exceed these specifications, the local requirements shall also be satisfied.

D. The Retaining Wall Design Engineer shall note any exceptions to the requirements of this section by listing them at the bottom right corner of the first page of the construction shop drawings.

E. Approval or rejection of the exceptions taken by the Retaining Wall Engineer will be made in writing as directed by the Owner.

F. The precast modular block design, except as noted herein, shall be based upon AASHTO Load and Resistance Factor Design (LRFD) methodology as referenced in paragraph 1.03, subparagraph C.1.

G. In the event that a conflict is discovered between these specifications and a reasonable interpretation of the design specifications and methods referenced in paragraph F above, these specifications shall prevail. If a reasonable interpretation is not possible, the conflict shall be resolved per the requirements in paragraph 1.03, subparagraph A of this section.

H. Soil Shear Parameters. The Retaining Wall Design Engineer shall prepare the construction shop drawings based upon soil shear strength parameters from the available project data and the recommendations of the project Geotechnical Engineer. If insufficient data exists to develop the retaining wall design, the Retaining Wall Design Engineer shall communicate the specific deficiency of the project information or data to the Owner in writing.

I. Allowable bearing pressure requirements for each retaining wall shall be clearly shown on the construction drawings.

J. Global Stability. Overall (global) stability shall be evaluated in accordance with the principals of limit equilibrium analysis as set forth in FHWA-NHI-10-024 Volume I and FHWA-NHI-10-025 Volume II GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes as referenced in paragraph 1.03, subparagraph C.1. The minimum factors of safety shall be as follows:

Normal Service (Static)	1.4
Seismic	1.1
Rapid Drawdown (if applicable)	1.2

K. Seismic Stability. Seismic loading shall be evaluated in accordance with AASHTO Load and Resistance Factor Design (LRFD) methodology as referenced in paragraph 1.03, subparagraph C.1.

1.07 QUALITY ASSURANCE

A. Retaining Wall Installation Contractor Qualifications. In order to demonstrate basic competence in the construction of precast modular block walls, the Retaining Wall Installation Contractor shall document compliance with the following:
   1. Experience.
      a. Construction experience with a minimum of 2,800 square meters of the proposed precast modular block retaining wall system.
      b. Construction of at least ten (10) precast modular block (large block) retaining wall structures within the past three (3) years.
      c. Construction of at least 4,650 square meters of precast modular block (large block) retaining walls within the past three (3) years.
   2. Retaining Wall Installation Contractor experience documentation for each qualifying project shall include:
      a. Project name and location

      b. Date (month and year) of construction completion
      c. Contact information of Owner or General Contractor
      d. Type (trade name) of precast modular block system built
      e. Maximum height of the wall constructed
      f. Face area of the wall constructed
   3. In lieu of the requirements set forth in items 1 and 2 above, the Retaining Wall Installation Contractor must be a certified Precast Modular Block Retaining Wall Installation Contractor as demonstrated by satisfactory completion of a certified precast modular block retaining wall installation training program administered by the precast modular block manufacturer.

B. Retaining Wall Design Engineer Qualifications and Statement of Experience. The Retaining Wall Design Engineer shall submit a written statement affirming that he or she has the following minimum qualifications and experience.
   1. The Retaining Wall Design Engineer shall be licensed to practice in the jurisdiction of the project location.
   2. The Retaining Wall Design Engineer shall be independently capable of performing all internal and external stability analyses, including those for seismic loading, compound stability, rapid draw-down and deep-seated, global modes of failure.
   3. The Retaining Wall Design Engineer shall affirm in writing that he or she has personally supervised the design of the retaining walls for the project, that the design considers all the requirements listed in paragraph 1.06 and that he or she accepts responsibility as the design engineer of record for the retaining walls constructed on the project.
   4. The Retaining Wall Design Engineer shall affirm in writing that he or she has personally designed in excess of 9000 face square meters of modular block earth retaining walls within the previous three (3) years.
   5. In lieu of these specific requirements, the engineer may submit alternate documentation demonstrating competency in Precast Modular Block retaining wall design.

C. The Owner reserves the right to reject the design services of any engineer or engineering firm who, in the sole opinion of the Owner, does not possess the requisite experience or qualifications.

1.08 QUALITY CONTROL

A. The Owner’s Representative shall review all submittals for materials, design, Retaining Wall Design Engineer qualifications and the Retaining Wall Installation Contractor qualifications.

B. The General Contractor shall retain the services of an Inspection Engineer who is experienced with the construction of precast modular block retaining wall structures to perform inspection and testing. The cost of inspection shall be the responsibility of the General Contractor. Inspection shall be continuous throughout the construction of the retaining walls.

C. The Inspection Engineer shall perform the following duties:
   1. Inspect the construction of the precast modular block structure for conformance with construction shop drawings and the requirements of this specification.
   2. Verify that soil or aggregate fill placed and compacted in the reinforced, retained and foundation zones of the retaining wall conforms with paragraphs 2.04 and 2.05 of this section and exhibits the shear strength parameters specified by the Retaining Wall Design Engineer.

3. Verify that the shear strength of the in-situ soil assumed by the Retaining Wall Design Engineer is appropriate.
4. Inspect and document soil compaction in accordance with these specifications:
   a. Required dry unit weight
   b. Actual dry unit weight
   c. Allowable moisture content
   d. Actual moisture content
   e. Pass/fail assessment
   f. Test location – wall station number
   g. Test elevation
   h. Distance of test location behind the wall face
5. Verify that all excavated slopes in the vicinity of the retaining wall are bench-cut as directed by the project Geotechnical Engineer.
6. Notify the Retaining Wall Installation Contractor of any deficiencies in the retaining wall construction and provide the Retaining Wall Installation Contractor a reasonable opportunity to correct the deficiency.
7. Notify the General Contractor, Owner and Retaining Wall Design Engineer of any construction deficiencies that have not been corrected timely.
8. Document all inspection results.
9. Test compacted density and moisture content of the retained backfill with the following frequency:
   a. At least once every 90 square meters (in plan) per 230 mm vertical lift, and
   b. At least once per every 460 mm of vertical wall construction.

D. The General Contractor's engagement of the Inspection Engineer does not relieve the Retaining Wall Installation Contractor of responsibility to construct the proposed retaining wall in accordance with the approved construction shop drawings and these specifications.

E. The Retaining Wall Installation Contractor shall inspect the on-site grades and excavations prior to construction and notify the Retaining Wall Design Engineer and General Contractor if on-site conditions differ from the elevations and grading conditions depicted in the retaining wall construction shop drawings.

1.09 DELIVERY, STORAGE AND HANDLING

A. The Retaining Wall Installation Contractor shall inspect the materials upon delivery to ensure that the proper type, grade and color of materials have been delivered.

B. The Retaining Wall Installation Contractor shall store and handle all materials in accordance with the manufacturer's recommendations as specified herein and in a manner that prevents deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure or other causes. Damaged materials shall not be incorporated into the work.

C. Geosynthetics
   1. All geosynthetic materials shall be handled in accordance with ASTM D4873. The materials should be stored off the ground and protected from precipitation, sunlight, dirt and physical damage.

D. Precast Modular Blocks

   1. Precast modular blocks shall be stored in an area with positive drainage away from the blocks. Be careful to protect the block from mud and excessive chipping and breakage. Precast modular blocks shall not be stacked more than three (3) units high in the storage area.

E. Drainage Aggregate and Backfill Stockpiles
   1. Drainage aggregate or backfill material shall not be piled over unstable slopes or areas of the project site with buried utilities.
   2. Drainage aggregate and/or reinforced fill material shall not be staged where it may become mixed with or contaminated by poor draining fine-grained soils such as clay or silt.

PART 2 – MATERIALS

2.01 PRECAST MODULAR BLOCK RETAINING WALL UNITS

A. All units shall be wet-cast precast modular retaining wall units conforming to ASTM C1776.

B. All units for the project shall be obtained from the same manufacturer. The manufacturer shall be licensed and authorized to produce the retaining wall units by the precast modular block system patent holder/licensor and shall document compliance with the published quality control standards of the proprietary precast modular block system licensor for the previous three (3) years or the total time the manufacturer has been licensed, whichever is less.

C. Concrete used in the production of the precast modular block units shall be first-purpose, fresh concrete. It shall not consist of returned, reconstituted, surplus or waste concrete. It shall be an original production mix meeting the requirements of ASTM C94 and exhibit the properties as shown in the following table:

Concrete Mix Properties

Freeze Thaw Exposure Class[1]	Minimum 28-Day Compressive Strength[2]	Maximum Water Cement Ratio	Nominal Maximum Aggregate Size	Aggregate Class Designation[3]	Air Content[4]
Moderate	27.6 MPa	0.45	25 mm	3M	4.5% +/- 1.5%
Severe	27.6 MPa	0.45	25 mm	3S	6.0% +/- 1.5%
Very Severe	30.0 MPa	0.40	25 mm	4S	6.0% +/- 1.5%
Maximum Water-Soluble Chloride Ion (Cl^-) Content in Concrete, Percent by Weight of Cement[5,6]					0.15
Maximum Chloride as Cl^- Concentration in Mixing Water, Parts Per Million					1000
Maximum Percentage of Total Cementitious Materials By Weight [7,9] (Very Severe Exposure Class Only):					
Fly Ash or Other Pozzolans Conforming to ASTM C618					25
Slag Conforming to ASTM C989					50
Silica Fume Conforming to ASTM C1240					10
Total of Fly Ash or Other Pozzolans, Slag, and Silica Fume[8]					50
Total of Fly Ash or Other Pozzolans and Silica Fume[8]					35
Alkali-Aggregate Reactivity Mitigation per ACI 201					
Slump (Conventional Concrete) per ASTM C143[10]			125 mm +/- 40 mm		
Slump Flow (Self-Consolidating Concrete) per ASTM C1611			450 mm – 800 mm		

[1]Exposure class is as described in ACI 318. “Moderate” describes concrete that is exposed to freezing and thawing cycles and occasional exposure to moisture. “Severe” describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture. “Very Severe” describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture and exposed to deicing chemicals. Exposure class should be specified by owner/purchaser prior to order placement.

[2]Test method ASTM C39.

[3]Defined in ASTM C33 Table 3 *Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregates for Concrete*.

[4]Test method ASTM C231.

[5]Test method ASTM C1218 at age between 28 and 42 days.

[6]Where used in high sulfate environments or where alkali-silica reactivity is an issue, water soluble chloride shall be limited to no more than trace amounts (from impurities in concrete-making components, not intended constituents.)

[7]The total cementitious material also includes ASTM C150, C595, C845, C1157 cement. The maximum percentages shall include:

(a) Fly ash or other pozzolans in type IP, blended cement, ASTM C595, or ASTM C1157.

(b) Slag used in the manufacture of an IS blended cement, ASTM C595, or ASTM C1157.

(c) Silica fume, ASTM C1240, present in a blended cement.

[8]Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.

[9]Prescriptive limits shown may be waived for concrete mixes that demonstrate excellent freeze/thaw durability in a detailed and current testing program.

[10]Slump may be increased by a high-range water-reducing admixture.

D. Each concrete block shall be cast in a single continuous pour without cold joints. With the exception of half-block units, corner units and other special application units, the precast modular block units shall conform to the nominal dimensions listed in the table below and be produced to the dimensional tolerances shown.

Block Type	Dimension	Nominal Value	Tolerance
710 mm Block	Height	457 mm	+/- 5 mm
	Length	1172 mm	+/- 13 mm
	Width*	710 mm	+/- 13 mm
1030 mm Block	Height	457 mm	+/- 5 mm
	Length	1172 mm	+/- 13 mm
	Width*	1030 mm	+/- 13 mm
1520 mm Block	Height	457 mm	+/- 5 mm
	Length	1172 mm	+/- 13 mm
	Width*	1520 mm	+/- 13 mm

* Block tolerance measurements shall exclude variable face texture

E. Individual block units shall have a nominal height of 457 mm.

F. With the exception of half-block units, corner units and other special application units, the precast modular block units shall have two (2), circular dome shear knobs that are 254 mm, 190 mm, or 171 mm in diameter and 102 mm or 51 mm in height. The shear knobs shall fully index into a continuous semi-cylindrical shear channel in the bottom of the block course above. The peak interlock shear between any two (2) vertically stacked precast modular block units, with 254 mm diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 95 kN/m at a minimum normal load of 7 kN/m. as well as an ultimate peak interface shear capacity in excess of 160 kN/m. The peak interlock shear between any two (2) vertically stacked precast modular block units, with 190 mm or 171 mm diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 27 kN/m at a minimum normal load of 7 kN/m as well as an ultimate peak interface shear capacity in excess of 146 kN/m.Test specimen blocks tested under ASTM D6916 shall be actual, full-scale production blocks of known compressive strength. The interface shear capacity reported shall be corrected for a 27.6 MPa concrete compressive strength. Regardless of precast modular block configuration, interface shear testing shall be completed without the inclusion of unit core infill aggregate.

G. When used as a mechanically-stabilized earth system, the 710 mm and 1030 mm precast modular block units shall be cast with a 330 mm wide, continuous vertical core slot that will permit the insertion of a 305 mm wide strip of geogrid reinforcement to pass completely through the block. When installed in this manner, the geogrid reinforcement shall form a non-normal load dependent, positive connection between the block unit and the reinforcement strip. The use of steel for the purposes of creating the geogrid to block connection is not acceptable.

H. Without field cutting or special modification, the precast modular block units shall be capable of achieving a minimum radius of 4.42 m.

I. The precast modular block units shall be manufactured with an integrally cast shear knobs that establishes a standard horizontal set-back for subsequent block courses. The precast modular block system shall be available in the four (4) standard horizontal set-back facing batter options listed below:

Horizontal Set-Back/Blk. Course	Max. Facing Batter
10 mm	1.2˚
41 mm	5.2˚
238 mm	27.5˚
422 mm	42.7˚

The precast modular block units shall be furnished with the required shear knobs that provide the facing batter required in the construction shop drawings.

J. The precast modular block unit face texture shall be selected by the owner from the available range of textures available from the precast modular block manufacturer. Each textured block facing unit shall be a minimum of 0.54 square meters with a unique texture pattern that repeats with a maximum frequency of once in any 1.4 square meters of wall face.

K. The block color shall be selected by the owner from the available range of colors available from the precast modular block manufacturer.

L. All precast modular block units shall be sound and free of cracks or other defects that would interfere with the proper installation of the unit, impair the strength or performance of the constructed wall. PMB units to be used in exposed wall construction shall not exhibit chips or cracks in the exposed face or faces of the unit that are not otherwise permitted. Chips smaller than 38 mm in its largest dimension and cracks not wider than 0.3 mm and not longer than 25% of the nominal height of the PMB unit shall be permitted. PMB units with bug holes in the exposed architectural face smaller than 19 mm in its largest dimension shall be permitted. Bug holes, water marks, and color variation on non-architectural faces are acceptable. PMB units that exhibit cracks that are continuous through any solid element of the PMB unit shall not be incorporated in the work regardless of the width or length of the crack.

M. Preapproved Manufacturers.
Manufacturers of Redi-Rock Retaining Wall Systems as licensed by Redi-Rock International, LLC, 05481 US 31 South, Charlevoix, MI 49720 USA; telephone (866) 222-8400; website www.redi-rock.com.

N. Substitutions. Technical information demonstrating conformance with the requirements of this specification for an alternative precast modular block retaining wall system must be submitted for preapproval at least 14 calendar days prior to the bid date. Acceptable alternative PMB retaining wall systems, otherwise found to be in conformance with this specification, shall be approved in writing by the owner 7 days prior to the bid date. The Owner's Representative reserves the right to provide no response to submissions made out of the time requirements of this section or to submissions of block retaining wall systems that are determined to be unacceptable to the owner.

O. Value Engineering Alternatives. The owner may evaluate and accept systems that meet the requirements of this specification after the bid date that provide a minimum cost savings of 20% to the Owner. Construction expediency will not be considered as a contributing portion of the cost savings total.

2.02 GEOGRID REINFORCEMENT

A. Geogrid reinforcement shall be a woven or knitted PVC coated geogrid manufactured from high-tenacity PET polyester fiber with an average molecular weight greater than 25,000 (M_n > 25,0000) and a carboxyl end group less than 30 (CEG < 30). The geogrid shall be furnished in prefabricated roll widths of certified tensile strength by the manufacturer. The prefabricated roll width of the geogrid shall be 300 mm +/- 13 mm. No cutting of geogrid reinforcement down to the 300 mm roll width from a larger commercial roll width will be allowed under any circumstances.

B. The ultimate tensile strength (T_{ult}) of the geogrid reinforcement shall be measured in accordance with ASTM D6637.

C. Geogrid – Soil Friction Properties
1. Friction factor, F*, shall be equal to 2/3 Tan ϕ, where ϕ is the effective angle of internal friction of the reinforced fill soil.
2. Linear Scale Correction Factor, α, shall equal 0.8.

D. Long-Term Tensile Strength (T_{al}) of the geogrid reinforcement shall be calculated in accordance with Section 3.5.2 of FHWA-NHI-10-024 and as provided in this specification.
1. The creep reduction factor (RF_{CR}) shall be determined in accordance with Appendix D of FHWA-NHI-10-025 for a minimum 75 year design life.
2. Minimum installation damage reduction factor (RF_{ID}) shall be 1.25. The value of RF_{ID} shall be based upon documented full-scale tests in a soil that is comparable to the material proposed for use as reinforced backfill in accordance with ASTM D5818.
3. Minimum durability reduction factor (RF_D) shall be 1.3 for a soil pH range of 3 to 9.

E. Connection between the PMB retaining wall unit and the geogrid reinforcement shall be determined from short-term testing per the requirements of FHWA NHI-10-025, Appendix B.4 for a minimum 75-year design life.

F. The minimum value of T_{al} for geogrid used in design of a reinforced precast modular block retaining wall shall be 29 kN/m or greater.

G. The minimum length of geogrid reinforcement shall be the greater of the following:
1. 0.7 times the wall design height, H.
2. 1.83 m.
3. The length required by design to meet internal stability requirements, soil bearing pressure requirements and constructability requirements.

H. Constructability Requirements. Geogrid design embedment length shall be measured from the back of the precast modular block facing unit and shall be consistent for the entire height of a given retaining wall section.

I. Geogrid shall be positively connected to every precast modular block unit. Design coverage ratio, Rc, as calculated in accordance with AASHTO *LRFD Bridge Design Specifications* Figure 11.10.6.4.1-2 shall not exceed 0.50.

J. Preapproved Geogrid Reinforcement Products.

1. Miragrid XT Geogrids as manufactured by TenCate Geosynthetics of Pendergrass, Georgia USA and distributed by Manufacturers of the Redi-Rock Retaining Wall System.

K. Substitutions. No substitutions of geogrid reinforcement products shall be allowed.

2.03 GEOTEXTILE

A. Nonwoven geotextile fabric shall be placed as indicated on the retaining wall construction shop drawings. Additionally, the nonwoven geotextile fabric shall be placed in the v-shaped joint between adjacent block units on the same course. The nonwoven geotextile fabric shall meet the requirements Class 3 construction survivability in accordance with AASHTO M 288.

B. Preapproved Nonwoven Geotextile Products
1. Mirafi 140N
2. Propex Geotex 451
3. Skaps GT-142
4. Thrace-Linq 140EX
5. Carthage Mills FX-40HS
6. Stratatex ST 142

2.04 DRAINAGE AGGREGATE AND WALL INFILL

A. Drainage aggregate (and wall infill for retaining walls designed as modular gravity structures) shall be a durable crushed stone conforming to No. 57 size per ASTM C33 with the following particle-size distribution requirements per ASTM D422:

U.S. Standard Sieve Size	% Passing
38 mm	100
25 mm	95-100
13 mm	25-60
4.76 mm	0-10
2.38 mm	0-5

2.05 REINFORCED FILL

A. Material used as reinforced backfill material in the reinforced zone (if applicable) shall be a granular fill material meeting the requirements of USCS soil type GW, GP, SW or SP per ASTM D2487 or alternatively by AASHTO Group Classification A-1-a or A-3 per AASHTO M 145. The backfill shall exhibit a minimum effective internal angle of friction, ϕ = 34 degrees at a maximum 2% shear strain and meet the following particle-size distribution requirements per ASTM D422.

U.S. Standard Sieve Size	% Passing
19 mm	100
4.76 mm	0-100
0.42 mm	0-60
0.15 mm	0-10
0.075 mm	0-15

B. The reinforced backfill material shall be free of sod, peat, roots or other organic or deleterious matter including, but not limited to, ice, snow or frozen soils. Materials passing the 0.42 mm sieve shall have a liquid limit less than 25 and plasticity index less than 6 per ASTM D4318. Organic content in the backfill material shall be less than 1% per AASHTO T-267 and the pH of the backfill material shall be between 5 and 8.

C. Soundness. The reinforced backfill material shall exhibit a magnesium sulfate soundness loss of less than 30% after four (4) cycles, or sodium sulfate soundness loss of less than 15% after five (5) cycles as measured in accordance with AASHTO T-104.

D. Reinforced backfill shall not be comprised of crushed or recycled concrete, recycled asphalt, bottom ash, shale or any other material that may degrade, creep or experience a loss in shear strength or a change in pH over time.

2.06 LEVELING PAD

A. The precast modular block units shall be placed on a leveling pad constructed from crushed stone or unreinforced concrete. The leveling pad shall be constructed to the dimensions and limits shown on the retaining wall design drawings prepared by the Retaining Wall Design Engineer.

B. Crushed stone used for construction of a granular leveling pad shall meet the requirements of the drainage aggregate and wall infill in section 2.04 or a preapproved alternate material.

C. Concrete used for construction of an unreinforced concrete leveling pad shall satisfy the criteria for AASHTO Class B. The concrete should be cured a minimum of 12 hours prior to placement of the precast modular block wall retaining units and exhibit a minimum 28-day compressive strength of 17.2 MPa.

2.07 DRAINAGE

A. Drainage Pipe
1. Drainage collection pipe shall be a 100 mm diameter, 3-hole perforated, HDPE pipe with a minimum pipe stiffness of 152 kPa per ASTM D2412.
2. The drainage pipe shall be manufactured in accordance with ASTM D1248 for HDPE pipe and fittings.

B. Preapproved Drainage Pipe Products
1. ADS 3000 Triple Wall pipe as manufactured by Advanced Drainage Systems.

PART 3 – EXECUTION

3.01 GENERAL

A. All work shall be performed in accordance with OSHA safety standards, state and local building codes and manufacturer’s requirements.

B. The General Contractor is responsible for the location and protection of all existing underground utilities. Any new utilities proposed for installation in the vicinity of the retaining wall, shall be installed concurrent with retaining wall construction. The General Contractor shall coordinate the work of subcontractors affected by this requirement.

C. New utilities installed below the retaining wall shall be backfilled and compacted to a minimum of 98% maximum dry density per ASTM D698 standard proctor.

D. The General Contractor is responsible to ensure that safe excavations and embankments are maintained throughout the course of the project.

E. All work shall be inspected by the Inspection Engineer as directed by the Owner.

3.02 EXAMINATION

A. Prior to construction, the General Contractor, Grading Contractor, Retaining Wall Installation Contractor and Inspection Engineer shall examine the areas in which the retaining wall will be constructed to evaluate compliance with the requirements for installation tolerances, worker safety and any site conditions affecting performance of the completed structure. Installation shall proceed only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

A. Fill Soil.
   1. The Inspection Engineer shall verify that reinforced backfill placed in the reinforced soil zone satisfies the criteria of this section.
   2. The Inspection Engineer shall verify that any fill soil installed in the foundation and retained soil zones of the retaining wall satisfies the specification of the Retaining Wall Design Engineer as shown on the construction drawings.

B. Excavation.
   1. The Grading Contractor shall excavate to the lines and grades required for construction of the precast modular block retaining wall as shown on the construction drawings. The Grading Contractor shall minimize over-excavation. Excavation support, if required, shall be the responsibility of the Grading Contractor.
   2. Over-excavated soil shall be replaced with compacted fill in conformance with the specifications of the Retaining Wall Design Engineer and “Division 31, Section 31 20 00 – Earthmoving” of these project specifications.
   3. Embankment excavations shall be bench cut as directed by the project Geotechnical Engineer and inspected by the Inspection Engineer for compliance.

C. Foundation Preparation.
   1. Prior to construction of the precast modular block retaining wall, the leveling pad area and undercut zone (if applicable) shall be cleared and grubbed. All topsoil, brush, frozen soil and organic material shall be removed. Additional foundation soils found to be unsatisfactory beyond the specified undercut limits shall be undercut and replaced with approved fill as directed by the project Geotechnical Engineer. The Inspection Engineer shall ensure that the undercut limits are consistent with the requirements of the project Geotechnical Engineer and

that all soil fill material is properly compacted according project specifications. The Inspection Engineer shall document the volume of undercut and replacement.
   2. Following excavation for the leveling pad and undercut zone (if applicable), the Inspection Engineer shall evaluate the in-situ soil in the foundation and retained soil zones.
      a. The Inspection Engineer shall verify that the shear strength of the in-situ soil assumed by the Retaining Wall Design Engineer is appropriate. The Inspection Engineer shall immediately stop work and notify the Owner if the in-situ shear strength is found to be inconsistent with the retaining wall design assumptions.
      b. The Inspection Engineer shall verify that the foundation soil exhibits sufficient ultimate bearing capacity to satisfy the requirements indicated on the retaining wall construction shop drawings per paragraph 1.06 I of this section.

D. Leveling Pad.
   1. The leveling pad shall be constructed to provide a level, hard surface on which to place the first course of precast modular block units. The leveling pad shall be placed in the dimensions shown on the retaining wall construction drawings and extend to the limits indicated.
   2. Crushed Stone Leveling Pad. Crushed stone shall be placed in uniform maximum lifts of 6” (150 mm). The crushed stone shall be compacted by a minimum of 3 passes of a vibratory compactor capable of exerting 8.9 kN of centrifugal force and to the satisfaction of the Inspection Engineer.
   3. Unreinforced Concrete Leveling Pad. The concrete shall be placed in the same dimensions as those required for the crushed stone leveling pad. The Retaining Wall Installation Contractor shall erect proper forms as required to ensure the accurate placement of the concrete leveling pad according to the retaining wall construction drawings.

3.04 PRECAST MODULAR BLOCK WALL SYSTEM INSTALLATION

A. The precast modular block structure shall be constructed in accordance with the construction drawings, these specifications and the recommendations of the retaining wall system component manufacturers. Where conflicts exist between the manufacturer’s recommendations and these specifications, these specifications shall prevail.

B. Drainage components. Pipe, geotextile and drainage aggregate shall be installed as shown on the construction shop drawings.

C. Precast Modular Block Installation
   1. The first course of block units shall be placed with the front face edges tightly abutted together on the prepared leveling pad at the locations and elevations shown on the construction drawings. The Retaining Wall Installation Contractor shall take special care to ensure that the bottom course of block units are in full contact with the leveling pad, are set level and true and are properly aligned according to the locations shown on the construction drawings.
   2. Backfill shall be placed in front of the bottom course of blocks prior to placement of subsequent block courses. Nonwoven geotextile fabric shall be placed in the V-shaped joints between adjacent blocks. Drainage aggregate shall be placed in the V-shaped joints between adjacent blocks to a minimum distance of 300 mm behind the block unit.
   3. Drainage aggregate shall be placed in 230-mm maximum lifts and compacted by a minimum of three (3) passes of a vibratory plate compactor capable exerting a minimum of 8.9 kN of centrifugal force.

4. Unit core fill shall be placed in the precast modular block unit vertical core slot. The core fill shall completely fill the slot to the level of the top of the block unit. The top of the block unit shall be broom-cleaned prior to placement of subsequent block courses. No additional courses of precast modular blocks may be stacked before the unit core fill is installed in the blocks on the course below.
5. Base course blocks for gravity wall designs (without geosynthetic soil reinforcement) may be furnished without vertical core slots. If so, disregard item 4 above, for the base course blocks in this application.
6. Nonwoven geotextile fabric shall be placed between the drainage aggregate and the retained soil (gravity wall design) or between the drainage aggregate and the reinforced fill (reinforced wall design) as required on the retaining wall construction drawings.
7. Subsequent courses of block units shall be installed with a running bond (half block horizontal course-to-course offset). With the exception of 90-degree corner units, the shear channel of the upper block shall be fully engaged with the shear knobs of the block course below. The upper block course shall be pushed forward to fully engage the interface shear key between the blocks and to ensure consistent face batter and wall alignment. Geogrid, drainage aggregate, unit core fill, geotextile and properly compacted backfill shall be complete and in-place for each course of block units before the next course of blocks is stacked.
8. The elevation of retained soil fill shall not be less than 1 block course (457 mm) below the elevation of the reinforced backfill throughout the construction of the retaining wall.
9. If included as part of the precast modular block wall design, cap units shall be secured with an adhesive in accordance with the precast modular block manufacturer's recommendation.

D. Geogrid Reinforcement Installation (if required)
1. Geogrid reinforcement shall be installed at the locations and elevations shown on the construction drawings on level fill compacted to the requirements of this specification.
2. Continuous 300 mm wide strips of geogrid reinforcement shall be passed completely through the vertical core slot of the precast modular block unit and extended to the embedment length shown on the construction plans. The strips shall be staked or anchored as necessary to maintain a taut condition.
3. Reinforcement length (L) of the geogrid reinforcement is measured from the back of the precast modular block unit. The cut length (L_c) is two times the reinforcement length plus additional length through the block facing unit. The cut length is calculated as follows:

L_c = 2*L + 0.9 m (710 mm block unit)
L_c = 2*L + 1.5 m (1030 mm block unit)

4. The geogrid strip shall be continuous throughout its entire length and may not be spliced. The geogrid shall be furnished in nominal, prefabricated roll widths of 300 mm+/- 13 mm. No field modification of the geogrid roll width shall be permitted.
5. Neither rubber tire nor track vehicles may operate directly on the geogrid. Construction vehicle traffic in the reinforced zone shall be limited to speeds of less than 8 km/hr once a minimum of 230 mm of compacted fill has been placed over the geogrid reinforcement. Sudden braking and turning of construction vehicles in the reinforced zone shall be avoided.

E. Construction Tolerance. Allowable construction tolerance of the retaining wall shall be as follows:
1. Deviation from the design batter and horizontal alignment, when measured along a 3 m straight wall section, shall not exceed 19 mm.
2. Deviation from the overall design batter shall not exceed 13 mm per 3 m of wall height.

3. The maximum allowable offset (horizontal bulge) of the face in any precast modular block joint shall be 13 mm.
4. The base of the precast modular block wall excavation shall be within 50 mm of the staked elevations, unless otherwise approved by the Inspection Engineer.
5. Differential vertical settlement of the face shall not exceed 300 mm along any 61 m of wall length.
6. The maximum allowable vertical displacement of the face in any precast modular block joint shall be 13 mm.
7. The wall face shall be placed within 50 mm of the horizontal location staked.

3.05 WALL INFILL AND REINFORCED BACKFILL PLACEMENT

A. Backfill material placed immediately behind the drainage aggregate shall be compacted as follows:
1. 98% of maximum dry density at ± 2% optimum moisture content per ASTM D698 standard proctor or 85% relative density per ASTM D4254.

B. Compactive effort within 0.9 m of the back of the precast modular blocks should be accomplished with walk-behind compactors. Compaction in this zone shall be within 95% of maximum dry density as measured in accordance with ASTM D698 standard proctor or 80% relative density per ASTM D 4254. Heavy equipment should not be operated within 0.9 m of the back of the precast modular blocks.

C. Backfill material shall be installed in lifts that do not exceed a compacted thickness of 230 mm.

D. At the end of each work day, the Retaining Wall Installation Contractor shall grade the surface of the last lift of the granular wall infill to a 3% ± 1% slope away from the precast modular block wall face and compact it.

E. The General Contractor shall direct the Grading Contractor to protect the precast modular block wall structure against surface water runoff at all times through the use of berms, diversion ditches, silt fence, temporary drains and/or any other necessary measures to prevent soil staining of the wall face, scour of the retaining wall foundation or erosion of the reinforced backfill or wall infill.

3.06 OBSTRUCTIONS IN THE INFILL AND REINFORCED FILL ZONE

A. The Retaining Wall Installation Contractor shall make all required allowances for obstructions behind and through the wall face in accordance with the approved construction shop drawings.

B. Should unplanned obstructions become apparent for which the approved construction shop drawings do not account, the affected portion of the wall shall not be constructed until the Retaining Wall Design Engineer can appropriately address the required procedures for construction of the wall section in question.

3.07 COMPLETION

A. For walls supporting unpaved areas, a minimum of 300 mm of compacted, low-permeability fill shall be placed over the granular wall infill zone of the precast modular block retaining wall structure. The adjacent retained soil shall be graded to prevent ponding of water behind the completed retaining wall.

B. For retaining walls with crest slopes of 5H:1V or steeper, silt fence shall be installed along the wall crest immediately following construction. The silt fence shall be located 0.9 m to 1.2 m behind the uppermost precast modular block unit. The crest slope above the wall shall be immediately seeded to establish vegetation. The General Contractor shall ensure that the seeded slope receives adequate irrigation and erosion protection to support germination and growth.

C. The General Contractor shall confirm that the as-built precast modular block wall geometries conform to the requirements of this section. The General Contractor shall notify the Owner of any deviations.

END OF SECTION 32 32 16

INSTALLATION GUIDE

1. PURPOSE

This manual is intended to serve as a guide for the proper installation and construction of a Redi-Rock retaining wall. The recommendations and guidelines presented here are intended to supplement detailed construction documents, plans, and specifications for the project.

2. RESPONSIBILITIES

Redi-Rock supports a Total Quality Management approach to Quality Assurance and Quality Control (QA/QC) in the planning, design, manufacture, installation, and final acceptance of a Redi-Rock wall. This approach requires the responsible party at each stage of the project ensure that proper procedures are followed for their portion of the work. The responsible parties during the construction phase of a Redi-Rock wall include the Contractor, Engineer or Owner's Representative, and Redi-Rock licensed manufacturer. Their specific responsibilities for compliance are as follows:

CONTRACTOR

The Contractor is responsible for providing construction according to the contract documents, plans, and specifications for the project. The Contractor shall ensure that employees engaged in construction of the Redi-Rock wall understand and follow the project plans and specifications, are familiar with construction methods required, and have adequate safety training.

ENGINEER OR OWNER'S REPRESENTATIVE

The Engineer or Owner's Representative is responsible for construction review to assure that the project is being constructed according to the contract documents (plans and specifications). The representative shall fully understand the project plans and specifications and shall perform adequate field verification checks to ensure construction is in conformance with the project requirements. The presence of the Engineer or Owner's representative does not relieve the Contractor of their responsibilities for compliance with the project plans and specifications.

REDI-ROCK LICENSED MANUFACTURER

Redi-Rock blocks are produced by independently-owned licensed manufacturers. The manufacturer is responsible for the production and delivery of Redi-Rock units to the job site in accordance with published material quality, size tolerances, construction documents, plans, and specifications. The licensed manufacturer is responsible for adherence to any project specific QA/QC requirements for the production of precast concrete retaining wall units. Often, additional services—such as installation training classes—are available through the Redi-Rock manufacturer.

3. PRE-CONSTRUCTION CHECKLIST

Before you start construction of a Redi-Rock wall, take the time to complete necessary planning and preparation. This process will help ensure a safe, efficient, and quality installation. It will also help avoid costly mistakes.

☐ SAFETY

Safety is of primary concern to Redi-Rock International. Redi-Rock walls must be installed in a safe manner. All local, state, and federal safety regulations must be followed. In addition, Redi-Rock International greatly encourages installers to set up company programs to help their people stay safe at work. These programs should address items such as: personal protective equipment, maintaining safe slopes and excavations, fall protection, rigging and lifting, and other safety precautions. Safety-training materials specific to your company can be found at **www.osha.gov**, by calling 1-800-321-OSHA (6742), or from your local government safety office.

☐ ENGINEERING AND PERMITS

Obtain necessary engineering and permits for your project. Your local building department is an excellent resource to help determine the requirements for your project.

This installation guide is intended to supplement a detailed, site-specific wall design prepared for your project by a Professional Engineer. The construction documents for your project supersede any recommendations presented here.

☐ REVIEW THE PROJECT PLANS

Take the time to review and understand the project plans and specifications. Make sure that the plans take into account current site, soil, and water conditions. Pay close attention to silty or clayey soils and ground water or surface water on the site as these can significantly increase the forces on the wall. A pre-construction meeting with the wall design engineer, construction inspector, wall contractor, and owner or representative is recommended.

☐ CONSTRUCTION PLANNING

Develop a plan to coordinate construction activities on your site. Make sure your plan specifically addresses how to control surface water during construction.

☐ UTILITY LOCATION

Make sure to have underground utilities located and marked on the ground before starting any construction. Call 8-1-1, go online to **www.call811.com**, or contact your local utility company to schedule utility marking for your project site.

☐ MATERIAL STAGING

Store Redi-Rock blocks in a location close to the proposed wall. Blocks should be kept clean and mud free. Blocks should also be stored in a location which will minimize the amount of handling on the project site.

Store geogrid in a clean, dry location close to the proposed wall. Keep the geogrid covered and avoid exposure to direct sunlight.

Be careful where you stockpile excavation and backfill material. Do not stockpile material over buried utility pipes, cables, or near basement walls which could be damaged by the extra weight.

☐ MATERIAL VERIFICATION

Material planned for use as drainage aggregate between and behind Redi-Rock blocks and structural backfill material proposed for use in the reinforced soil zone of mechanically stabilized earth walls must be inspected and verified to comply with requirements of the construction documents, plans, and specifications.

☐ EQUIPMENT

Make sure you have the proper equipment to handle Redi-Rock blocks and install the wall. Redi-Rock blocks are quite large and heavy. Make sure excavators and other construction equipment are properly sized to handle the blocks safely. **(Figure 1)**

Hand-operated equipment should include, at a minimum: shovels, 0.6-meter level, 1.2-meter level, broom, hammer, tape measure, string, spray paint, laser level, pry or Burke bar, walk-behind vibratory plate compactor (capable of delivering a minimum of 8.9 kN centrifugal force), and a 406-millimeter concrete cut-off saw. **(Figure 2)**

Personal protective equipment should include, at a minimum: appropriate clothing, steel toe boots with metatarsal protection, eye protection, hard hat, gloves, hearing protection, fall protection rigging, and other items as necessary to ensure a safe working environment.

Figure 1

Figure 2

4. SUBGRADE SOILS

Proper base preparation is a critical element in the construction of your retaining wall. Not only is it important to provide a stable foundation for the wall, but a properly prepared base will greatly increase the speed and efficiency of your wall installation. Proper base preparation starts with the subgrade soils.

Existing soils must be removed to the bottom of the leveling pad elevation for the retaining wall.

The base and back of excavation should expose fresh, undisturbed soil or rock. Remove all organic, unsuitable, and disturbed soils that “fall-in” along the base of the wall or the back of the excavation. Always provide safe excavations in accordance with OSHA requirements.

The subgrade soil (below the leveling pad) should be evaluated by the Engineer or Owner’s Representative to verify that it meets the design requirements and to determine its adequacy to support the retaining wall. Any unsuitable material shall be excavated and replaced as directed by the on-site representative and per the requirements of the contract drawings, plans, and specifications.

Subgrade soils must be compacted to a density as specified in the contract documents, plans, and specifications but not less than 90% maximum density at ± 2% optimum moisture content as determined by a modified proctor test (ASTM D698). **(Figures 3 and 4)**

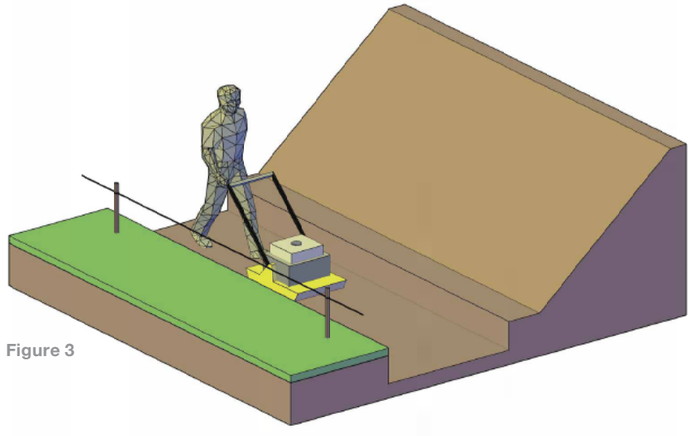


Figure 3

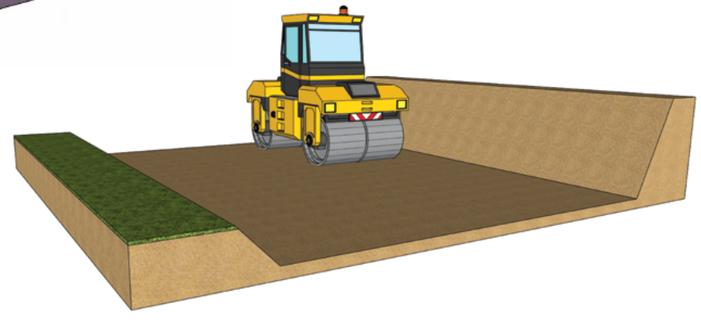


Figure 4

5. LEVELING PAD

Base preparation continues with proper leveling pad construction. Redi-Rock retaining walls can be designed with an open-graded crushed stone, dense-graded crushed stone (GAB), or concrete leveling pad which supports the bottom row of blocks. The choice of which type of leveling pad to use is made by the wall design engineer and depends on several factors including the bearing capacity of the native soil, location of the drain outlet, and conditions at the base of the wall.

Open-graded crushed stone is typically used in cases where the wall drain can outlet to daylight (by gravity) somewhere below the elevation of the bottom of the leveling pad. **(Figure 6A)** The material should be 25-millimeter diameter and smaller stone. A crushed stone meeting the gradation requirements of ASTM No. 57 with no material passing the 0.075-millimeter sieve is preferred. The leveling pad thickness shall be as designed by the wall design engineer. A minimum thickness of 150 millimeters or 300 millimeters is common. The leveling pad should extend at least 150 millimeters in front and 300 millimeters behind the bottom block. Make sure to check your construction documents for details.

Dense-graded crushed stone or graded aggregate base (GAB) material is typically used in cases where the wall drain can only outlet to daylight somewhere above the bottom of the leveling pad. **(Figure 6B)** The material should be dense-graded crushed stone with between 8 and 20% “fines” which will pass through a 0.075 millimeter sieve. The leveling pad thickness shall be as designed by the wall design engineer. Minimum dimensions are the same as those for an open-graded crushed stone leveling pad.

The leveling pad material should be placed and compacted to provide a uniform, level pad on which to construct the retaining wall. **(Figure 5)** Proper elevation can be established with a laser level or transit. You can also set two 6 meter long grade (screed) pipes to the desired grade and screed the crushed stone material between the pipes.

Place the stone leveling pad in uniform loose lifts a maximum of 150 millimeters thick. Consolidate

Figure 5

the stone with a minimum of three passes with a 610-millimeter wide walk-behind vibrating plate compactor capable of delivering at least 8.9 kN of centrifugal force. This should achieve 90% relative density of the stone determined in accordance with ASTM D-4253 and D-4254. In place density of the stone fill should be confirmed using ASTM D-6938. If you don’t achieve a minimum of 90% relative density, place the stone in smaller lifts or apply more compaction effort until you do achieve desired density of the stone.

Unless specifically included in the design calculations, do NOT place a thin layer of sand between the leveling pad and bottom block. This layer will reduce the sliding resistance between the leveling pad and bottom block.

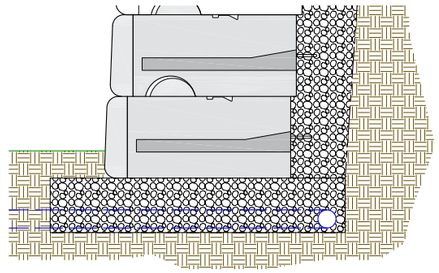
In some cases, the wall design requires the construction of a concrete leveling pad. **(Figures 6C and 6D)** Construct the leveling pad according to the detailed plans for your project.

Some designs require a shear key in the bottom of the footing and/or a lip in front of the Redi-Rock blocks. These items would be shown in the project plans.

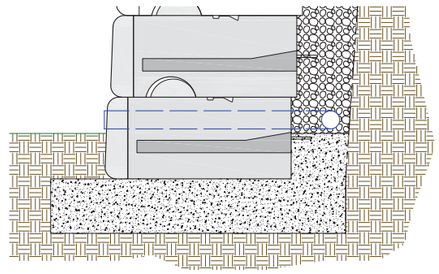
If steel rebar is to be placed in the footing, secure the bars together with wire ties in the pattern shown in the construction documents. Use rebar supports to hold the rebar structure in the proper position in the footing.

Place wood formwork at the front and back of the concrete leveling pad or footing. The top of the formwork should be placed at the elevation of the top of the concrete footing so you can screed the top smooth in preparation for block placement. It is important that the top surface be smooth and level for full contact of the retaining wall blocks. Place concrete as specified in the wall design. Once the concrete has been allowed to cure to the minimum specified strength, place the bottom blocks and continue construction of the retaining wall.

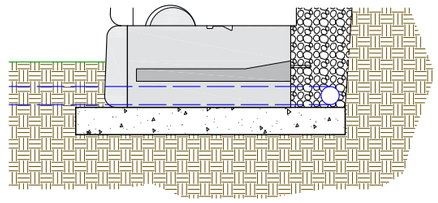
Figure 6



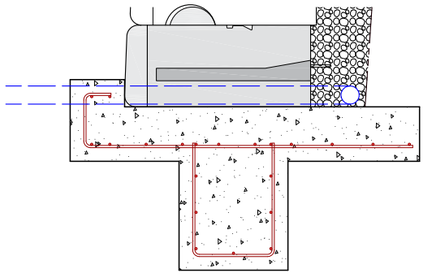
A. Open Graded Stone Leveling Pad



B. Dense Graded Stone Leveling Pad



C. Lean Concrete Leveling Pad



D. Reinforced Concrete Leveling Pad

6. SETTING THE BOTTOM ROW OF WALL BLOCKS

Redi-Rock blocks are typically delivered to the construction site using a flatbed trailer or boom truck. **(Figure 7)** Rubber tired backhoes, loaders, skid steers, or excavators are used to set the retaining wall blocks. **(Figure 8)** Make sure to use the proper sized equipment to handle the large blocks. All lifting chains, rigging, or slings must be OSHA compliant and safety rated for proper working loads.

Properly mark the location of the retaining wall. A string line or offset stakes are typically used to establish horizontal and vertical alignment. If offset stakes are used, the stakes should be placed at least 1.5 meters but no more than 3 meters in front of the face of the retaining wall. A stake should be provided at every elevation change and at a maximum of 15 meters apart.

> **Wall construction should start at a fixed point such as a building wall, 90° corner, or at the lowest elevation of the wall.**

Place the blocks on the prepared leveling pad. Blocks shall be placed in full contact with the leveling pad and other immediately adjacent block units. **(Figure 9)** Block alignment should be established by lining up the “form line” where the face texture meets the steel form finished area at the top of the block, approximately 130 millimeters back from the front face. **(Figure 10)**

Check all blocks for level and alignment as they are placed. Small adjustments to the block location can be made with a large pry or Burke bar. Proper installation of the bottom block course is critical to maintaining the proper installation of all subsequent block courses within acceptable construction tolerance. It also makes installation of the upper rows of blocks much easier and more efficient.

Place and compact backfill in front of the bottom block course prior to placement of subsequent block courses or backfill. This will keep the blocks in place as drainage aggregate and backfill are placed and compacted.

Place a 457 millimeter x 305 millimeter piece of non-woven geotextile fabric in the vertical joint between the blocks to prevent the drainage aggregate and backfill material from migrating through the vertical joints between blocks. **(Figure 11)**

Figure 7

Figure 8

Place washed drainstone or open-graded crushed stone backfill between blocks and at least 300 millimeters behind the wall. A stone meeting the gradation requirements of ASTM No. 57 with no material passing the 0.075-millimeter sieve is preferred. Place the stone in uniform loose lifts a maximum of 150 millimeters thick. Consolidate the stone with a minimum of three passes with a 610 millimeters wide, walk-behind, vibrating plate compactor capable of delivering at least 8.9 kN of centrifugal force. **(Figure 12)** This should achieve 90% relative density of the stone determined in accordance with ASTM D-4253 and D-4254. In place density of the stone fill should be confirmed using ASTM D-6938. If you don’t achieve a minimum of 90% relative density, place the stone in smaller lifts or apply more compaction effort until you do achieve desired density of the stone.

Place non-woven geotextile fabric between the drainstone and the remaining backfill material if specified.

Backfill behind the drainage aggregate with material as specified in the project construction documents. Place the lifts as specified, but not to exceed 230 millimeters maximum. Granular backfill shall be compacted to a minimum of 95% maximum density as determined by a standard proctor test (ASTM D698). Use proper equipment to insure complete compaction of the backfill material. It may be necessary to wet or dry the backfill material, place the material in smaller lifts, and/or apply more compaction effort to reach 95% maximum density. Do not use any organic, topsoil, frozen, soft, wet, or loose soils when backfilling the wall.

Re-check all units for level and alignment and sweep the top of each course of blocks clean before starting construction of the next course.

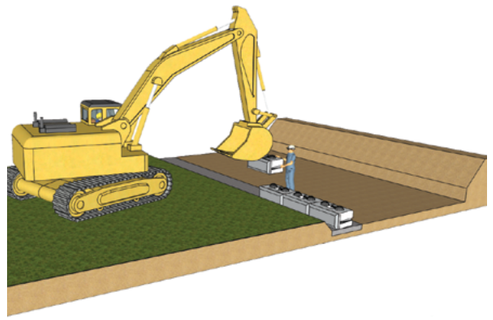


Figure 9

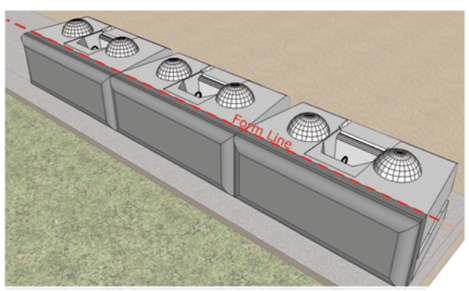


Figure 10

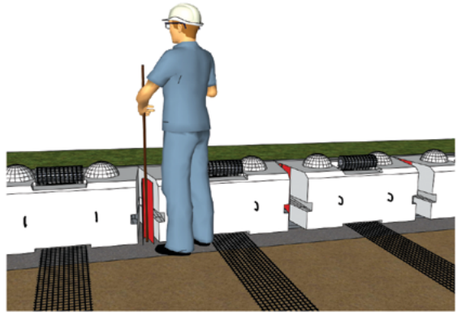


Figure 11

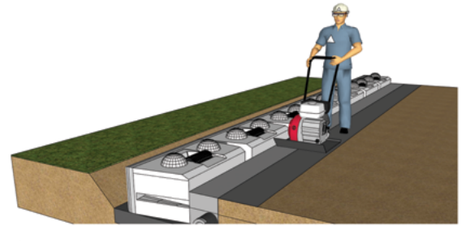


Figure 12

7. INSTALLING THE WALL DRAIN

A drain is placed behind the Redi-Rock wall blocks at the lowest elevation where the pipe can safely outlet to daylight. Drainage aggregate should be placed to the bottom of the drain as shown in the construction documents. A 100 millimeter perforated sock drain is commonly used for the drain pipe. Often the drain is encapsulated with drainage aggregate and wrapped with a non-woven geotextile fabric. The drain should run the entire length of the wall and needs to have proper outlets on the ends and at regularly spaced points along the wall. Solid pipe should be used for weep hole outlets through the face or under the retaining wall. **(Figure 13)**

Care needs to be taken during installation to avoid crushing or damaging the drain pipe or outlets.

8. SETTING UPPER ROWS OF WALL BLOCKS

Once the backfill is fully placed and compacted for the block course below, place the next row of blocks in a running bond configuration with the vertical joint of the lower block units centered under the mid-point of the block units above. If needed, a half block can be used at the end of every other row to maintain a running bond. **(Figure 14)**

Push the Redi-Rock blocks forward until the groove on the bottom of the block comes in full contact with the knobs on the blocks below. Adjacent blocks shall be placed with their front edges tightly abutted together.

Place non-woven geotextile fabric in the vertical joint between the blocks, and place and compact the drainage aggregate and backfill material the same way you did for the bottom row.

Never install more than one course of blocks without placing and compacting drainage aggregate and backfill to the full height of the block units. Placing multiple courses of blocks without backfill will prevent the proper placement and consolidation of the drainage aggregate between the blocks.

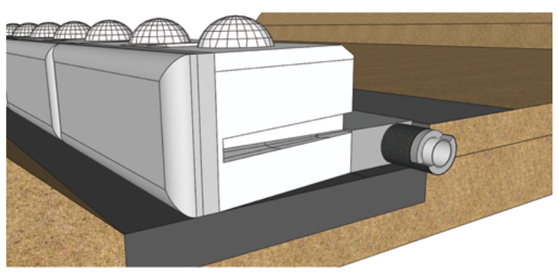


Figure 13

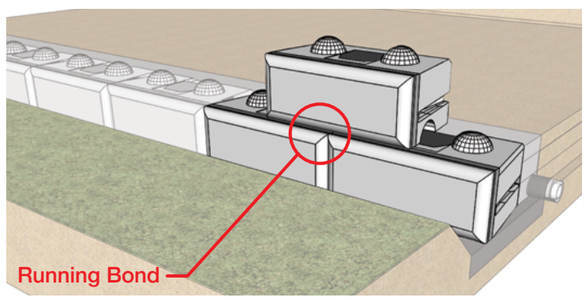


Figure 14

9. INSTALLING GEOGRID FOR MECHANICALLY STABILIZED EARTH WALLS

Redi-Rock blocks are designed to allow you to build relatively tall non-reinforced (or gravity) walls which use the weight of the blocks to provide stability. However, for some projects you may need to build even taller walls. In these cases, mechanically stabilized earth (MSE) retaining walls can be built with the Redi-Rock Positive Connection (PC) System.

The geogrid used in Redi-Rock PC System walls are 300-millimeter wide strips of PVC coated polyester geogrid that wrap through a vertical core slot cast into the block and extend full length into the reinforced soil zone on both the top and bottom of the block.

> **It is critical that you only use factory cut strips of Mirafi geogrid that are certified by TenCate Mirafi for width and strength. Field cutting strips of geogrid from larger rolls can significantly degrade the capacity of the wall system and is not allowed. Geogrid strips are only available through a Redi-Rock Manufacturer. (Figure 15)**

Verify that you have the correct geogrid material and then cut the individual strips to the required length. The distance a geogrid strip must extend into the reinforced soil zone (design length) is measured from the back of the block to the end of the geogrid. Since the geogrid wraps through the block, the actual cut length of a given geogrid strip is two (2) times the design length plus enough additional geogrid to wrap though the block. For the Redi-Rock 710-millimeter PC blocks, the cut length is two (2) times the design length plus 0.9 meters.

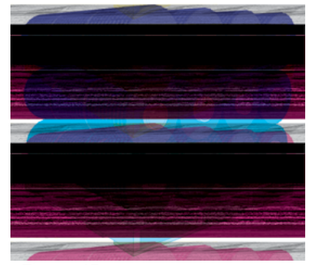


Figure 15

Inspect the Redi-Rock PC blocks for any concrete flashing or sharp edges in the slot and groove through the block. Remove any flashing and grind smooth any sharp edges which could damage the geogrid reinforcement.

Place the geogrid strip in the vertical core slot from the bottom of the block and pull approximately half of the length of the strip up through the core slot. Measure from the back of the block unit to the required design length and pin the bottom leg of the geogrid strip with staples, stakes, or other appropriate methods. Pull the geogrid strip tight to remove any slack, wrinkles, or folds. Secure the geogrid firmly in place by putting a pin through the geogrid and the steel lifting insert which is located in the recessed area on the top of the PC block **(Figure 16)** or placing drainage aggregate in the vertical core slot.

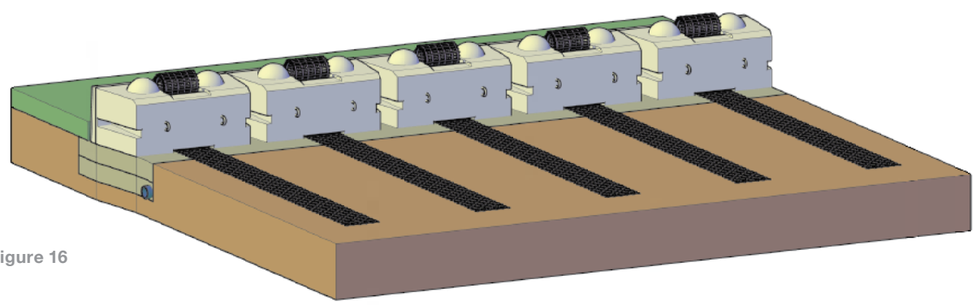


Figure 16

Place drainage aggregate between and behind the blocks. **(Figure 17)** Place the stone in uniform loose lifts as required in the project plans and specifications. Consolidate the stone between the blocks by hand tamping. Make sure to tamp stone into the ends of the groove on the bottom of the Redi-Rock PC blocks. Consolidate the stone behind the blocks with a minimum of three passes with a 610-millimeter wide walk-behind vibrating plate compactor capable of delivering at least 8.9 kN of centrifugal force. Provide further compaction if needed to meet the density specified in the contract documents, but not less than 90% relative density of the stone determined in accordance with ASTM D-4253 and D-4254.

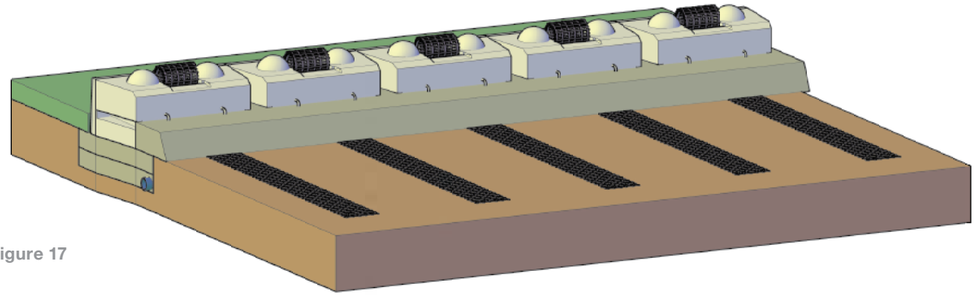


Figure 17

Place a strip of non-woven geotextile fabric between the drainage aggregate and the reinforced soil zone if specified.

Place the reinforced soil zone material in uniform loose lifts as required in the project plans and specifications. Reinforced soil zone material must be compacted to a density as specified in the contract documents, plans, and specifications but not less than 95% maximum density as determined by a modified proctor test (ASTM D1557).

Begin compaction at the back of the wall blocks and proceed to the embedded end of the geogrid strip using care to maintain the reinforcement strip in a level, taut condition oriented perpendicular to the back of the block unit to which it is attached.

Use hand operated compaction equipment within 1 meter of the back of the PC blocks. Heavier equipment can be used beyond 1 meter away from the PC blocks. Tracked construction equipment must not be operated directly on the geogrid strip reinforcement. A minimum fill thickness of 150 millimeters is required for the operation of tracked vehicles over the geogrid strips. Turning of tracked vehicles should be kept to a minimum to prevent displacement of the fill and the geogrid strips. Rubber-tired vehicles may pass over the geogrid strips at a slow speed of less than 8 km/hr. Sudden breaking and sharp turning should be avoided.

After placing and properly compacting backfill to the elevation of the geogrid strip at the top of the block, extend the top leg of the geogrid strip to the design length required. Pull the geogrid strip tight to remove any slack, wrinkles, or folds. **(Figure 18)** Pin the top leg of the geogrid strip with staples, stakes, or other appropriate methods to hold it in place and keep the geogrid strip taut.

Fill the center slot in the PC blocks with drainage aggregate. Be careful to keep the grid flat against the back of the slot in the PC block and prevent any stone from lodging between the geogrid and the concrete block. Fill the vertical core slot completely with drainage aggregate. Consolidate the drainage aggregate by hand tamping. Use a broom to sweep clean the top of the blocks. Do not operate a walk

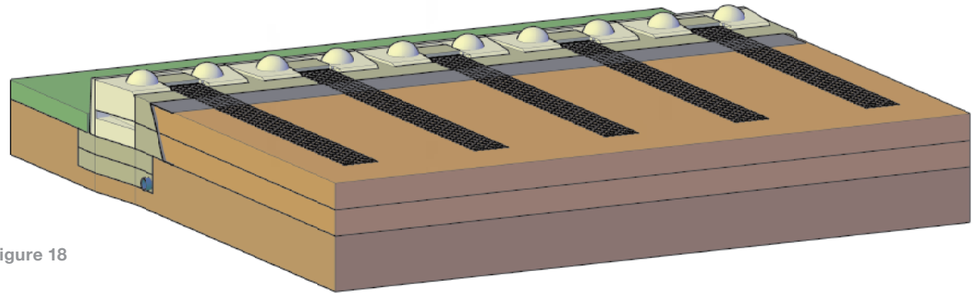


Figure 18

behind vibratory plate compactor on top of the Redi-Rock PC blocks.

Place retained soil immediately between the end of the reinforced soil zone (identified as the embedded end of the geogrid reinforcement strips) and the back of the excavation. Compact retained soil to a density as specified in the contract documents, plans, and specifications but not less than 95% maximum density as determined by a standard proctor test (ASTM D698). Maximum differential elevation between the reinforced fill and the retained soil fill should never exceed 450 millimeters.

Continue construction in a similar fashion to the top of the wall. **(Figure 19)**

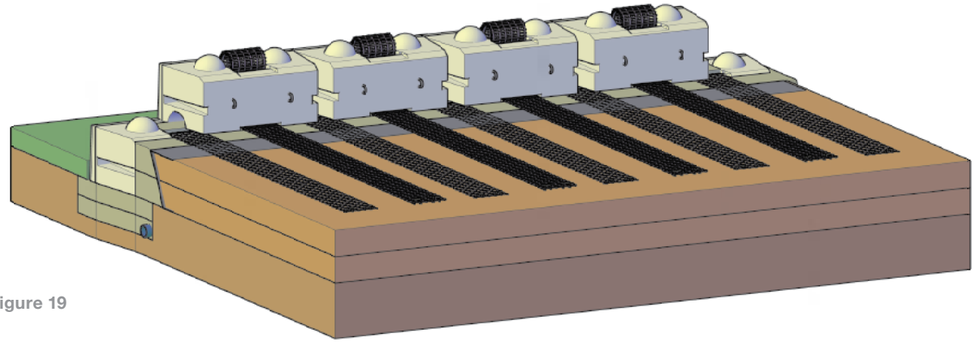


Figure 19

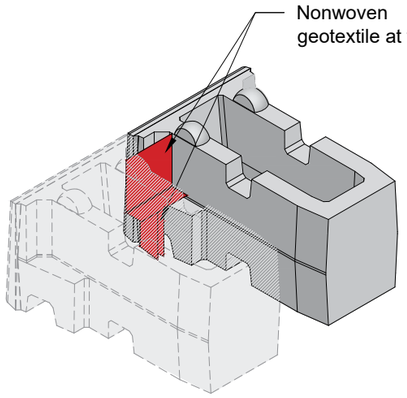
10. XL HOLLOW-CORE RETAINING BLOCKS

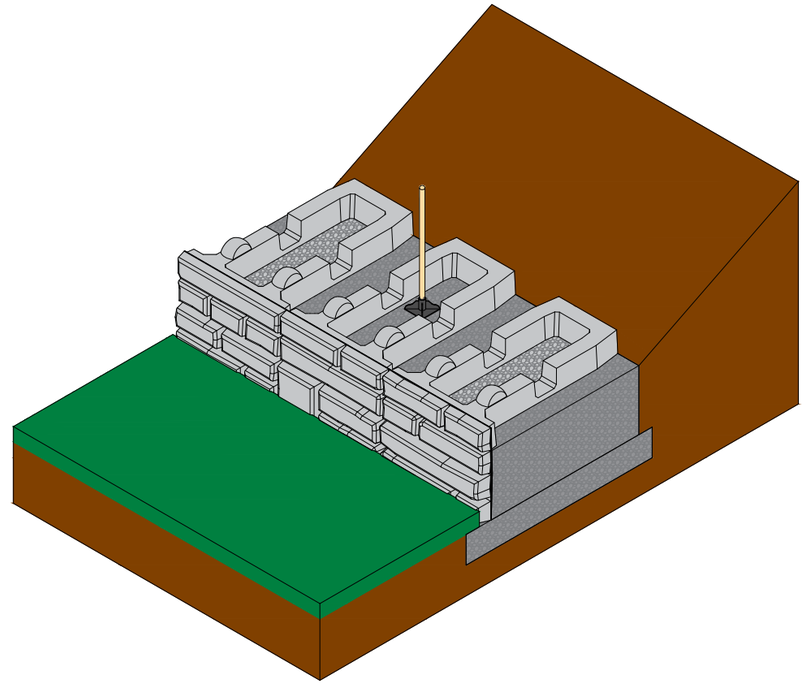
The greater width of XL blocks allows gravity walls to be built to greater height, while the greater individual block heights means that each block creates more area of wall face. XL block retaining wall installation generally follows the procedures of other Redi-Rock products, with a few differences.

Following the general procedures of sections 1 to 9, prepare the subgrade soils and place the leveling pad. The required leveling pad thickness will depend on the design by the wall design engineer, but will generally be a minimum of 305 millimeters thick.

Use appropriately-rated rigging fastened to the three lift hooks (one in the middle and two in the back of the blocks) and suitable heavy equipment to lift blocks into place. Place the first row of blocks to the correct line and grade. Just as with other Redi-Rock products, extra attention to ensure the first row of blocks is level and installed to the correct line and grade will save effort later as the installation proceeds.

Place two 457 millimeter by 457 millimeter pieces of non-woven geotextile fabric in each vertical joint between blocks – one on the upper half of the joint and one in the lower, wedge-shaped portion of the joint - to prevent the drainage aggregate and backfill material from migrating through the vertical joints at the blocks' face. Place washed drainstone or open-graded crushed stone backfill into the hollow cores of the blocks and between blocks in lifts of no more than 230 millimeters deep. Compact each lift by tamping until no further consolidation occurs with a soil tamper or other similar method. Strike off the top and sweep the upper surface of the blocks so the next row will sit cleanly on the lower row.





Due to the high percentage of open-graded stone within and between blocks, a drainage course behind the blocks is not required, but may be desirable to ease compaction of backfill and improve drainage. Place a layer of nonwoven geotextile fabric between the back of blocks (or drainstone layer, if used) and retained backfill.

Place and compact backfill as described above and repeat as necessary to reach the required height. Finish the top of wall with one or more rows of 457 millimeter high retaining blocks or freestanding blocks.

11. SPECIAL FEATURES

Some walls require special features such as curves, corners, top of wall details, details for elevated groundwater applications, and other details. Refer to the construction documents, plans, and specifications for details to construct these features. Additional general reference construction details are available on the Redi-Rock website, **redi-rock.com**.

Figure 21

Figure 22

Figure 23

12. IMPORTANT NOTES

Best practice dictates that wall construction should continue without interruption or delays. This will help expedite construction and minimize the time the excavation is open.

The construction site should be graded and maintained to direct surface water runoff away from the retaining wall throughout the entire construction process.

Do not exceed the allowable construction tolerances specified in the contract documents, plans, and specifications. At no time should tolerances at the wall face exceed 1° vertically and 25 millimeters 3 meter (1:120) horizontally.

Immediately report the following site conditions, if encountered, to the Engineer or Owner's representative to determine the corrective action needed:

- Any observed groundwater seepage.
- Surface water run-off directed toward the retaining wall during construction.
- Erosion or scour of material near the wall.
- Ponded water near the wall.
- Wet, soft, or easily compressible soils in the foundation zone.
- Existing rock that differs in location from that shown on the project plans or rock located above the elevation of the bottom of the leveling pad.
- Existing or proposed toe or crest slopes that differ from typical cross-sections shown in the project plans.
- Any other items not specifically mentioned which raise questions or cause concerns during wall construction.

Immediately implement any corrective action before resuming wall construction.

13. FREESTANDING WALLS

Redi-Rock freestanding wall blocks have facing texture on two or three sides. They are used in applications where two or three sides of the wall are visible. Freestanding blocks can be installed as “stand alone” walls, such as perimeter walls or fences. They can also be designed and installed as the finishing top courses on a Redi-Rock retaining wall.

Freestanding wall installation is similar to that for Redi-Rock retaining walls. The main exception is that there is typically no backfill material behind the freestanding walls. Even though there is no backfill acting on the walls, freestanding walls need to be properly engineered. They require adequate stability at the base of the wall and they need to resist any applied forces such as wind loads or forces from railings or fences.

If you are building a “stand alone” freestanding wall, prepare the subgrade soils and leveling pad as described previously. Place bottom blocks on the leveling pad. A 150 millimeter minimum bury on the bottom block is typical. Extra bury may be required for some projects. Middle and top blocks are placed directly on top of the bottom blocks with no batter.

If you are building a freestanding wall on the top of a Redi-Rock retaining wall, end the last row of retaining wall blocks with a middle block. The size of the knob on top of the last row of retaining wall blocks will establish the setback for the first row of freestanding blocks. Retaining blocks with a 254-millimeter diameter knob will produce a 73 millimeter setback between the retaining block and the first freestanding block. If the retaining blocks have a 190 millimeter diameter knob, the setback between the retaining block and the first freestanding block will be 41 millimeters. Be sure to contact your local Redi-Rock manufacturer to determine availability of blocks with different knob sizes.

Begin and end freestanding walls with full or half Corner blocks.

Freestanding walls are installed plumb with no batter.

Variable radius freestanding blocks with a 100 millimeter x 305 millimeter pocket in one or two ends of the block are used to make curved walls. Field cut the relatively thin face texture on the ends of the variable radius blocks as needed to make the desired radius for your wall. **(Figure 24)**

Figure 24

Colored foam “Backer Rod” can be used to fill any small gaps which may occur between the blocks when installing walls. Backer rods can be purchased from concrete supply centers. Call your local Redi-Rock manufacturer for help locating foam backer rods for your project.

14. FREESTANDING HOLLOW-CORE WALLS

Redi-Rock Freestanding Hollow-Core units are stacked, similar to other Redi-Rock freestanding blocks, but then filled with concrete. Freestanding Hollow-Core Blocks work well for freestanding barriers, and can also be utilized for cantilever retaining walls.

CANTILEVERED WALLS

For many applications, the Freestanding Hollow-Core Blocks will be supported by a reinforced concrete footing. Prior to placing the footing, layout the wall to determine the locations of the open cores in the staggered rows of hollow-core units. This will help determine where rebar should be placed in the footing. When determining vertical rebar placement, consider the equipment that will be used to set the block to help avoid conflicts. Number and size of rebar will depend upon the engineer’s structural design.

Construct the footing on a competent subgrade per the design drawings. Once the footing has cured, use a stringline to mark the alignment of the blocks (usually the inside of the block). Begin setting blocks. A scissors-type clamp works well. **(Figure 25)** Alternatively, straps looped around the interior ribs can be used, as well.

Figure 25

Corners can be constructed in the wall using hollow-core corner blocks. These blocks have texture on three sides. For a tight fit between blocks, the texture on the corner block can be trimmed by 50 to 75 millimeters where it abuts the adjacent block. If the design requires continuous rebar, cut a section out of the side of the corner block aligned with the hollow core of the adjacent block. **(Figure 26)**

Place horizontal rebar in the blocks, supported in the grooves on the interior structural ribs. Place the vertical rebar, lapping and tying, as required.

Stack the next row of block, making sure to carefully align the blocks and staggering the joints to create a running bond. We recommend stacking no more than three courses of block without filling the core.

Prior to infilling the wall, we suggest grouting the joints between blocks with non-shrink standard grout. This helps prevent leakage during infilling, and provides an aesthetic element.

Infill the hollow core of the wall with ready-mix concrete meeting the requirements of the design. Place the concrete carefully to prevent misalignment of the rebar. While filling, use an internal concrete vibrator to ensure consolidation and eliminate voids.

Figure 26

COPING

Freestanding Hollow-Core Blocks can be placed on Redi-Rock PC-series walls to create a freestanding coping. The connection uses a No. 3 rebar hook to tie the coping to the upper PC blocks.

Install a No. 3 rebar hook through the lifting hook in each PC block and let the hook lay on the shear knob.

Install PC geogrid strips, if required. Fill the PC core with stone to the recess area. Place plastic sheeting over the geogrid exposed in the PC core.

Set the Freestanding Hollow-Core Blocks in place on the PC blocks.

Install the horizontal and vertical reinforcing steel, as required by the design. Pull the rebar hooks up into the Freestanding Hollow-Core Blocks core and engage with the horizontal rebar. Fill the hollow cores with concrete. **(Figures 27 & 28)**

Figure 27

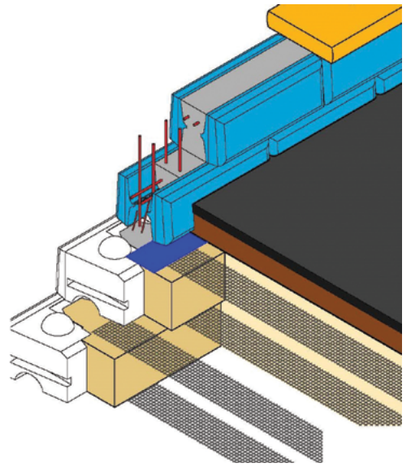


Figure 28

WATER CONTROL APPLICATIONS

A few additional details can be incorporated into Freestanding Hollow-Core walls to improve their water-tightness for flood control and other water-related applications. **(Figure 29)**

Prior to constructing the footing, perform any subgrade preparation, soil improvements, and/or drainage installation as required by the design.

Install an appropriate waterstop at the joint between the footing and the bottom of the wall, following the waterstop manufacturer's recommendations.

When using a ribbed center bulb strip, install it prior to pouring concrete for the footing such that it will be half embedded in the footing. Commonly, it will require attaching to the footing rebar with wire ties.

A bentonite/butyl rubber expandable waterstop can be installed on top of the footing prior to installing the first row of blocks. Be sure to protect the strip from damage and keep it clean.

A keyway can be cast into the footing if required by the design.

Avoid block-to-block joints where structural ribs from adjacent blocks will be in contact, as this will result in a joint with little, if any, cast-in-place concrete available to resist water flow. If necessary, remove one of the offending ribs with a concrete saw.

When placing concrete, extra care should be taken to fully consolidate the concrete to eliminate voids which could become conduits for water. Integral crystalline waterproofing admixtures are available that can reduce permeability and seal small cracks. Additional measures, such as sealing exposed joints with non-shrink grout and/or mastic and casting a slab against the wall can also be used to reduce water penetration. Foundation waterproofing experts should be consulted to select and assist with the installation of any performance improvement measures.

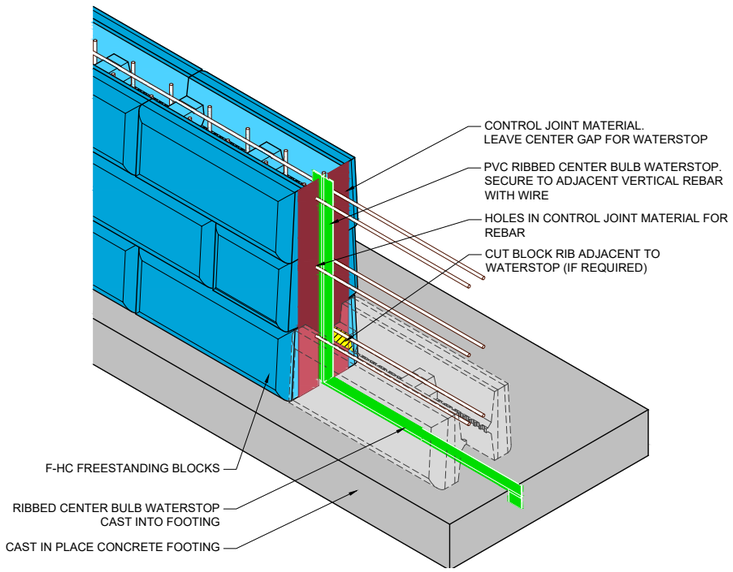


Figure 29

15. CAP INSTALLATION

Cap or step blocks are commonly used on top of freestanding walls to provide a finished look. **(Figure 30)**

Mark the center of the freestanding blocks to monitor the correct running bond spacing.

Secure the cap with construction adhesive, polyurethane sealant, or mortar. If construction adhesive is used, it should meet the requirements of ASTM D3498 and C557 and HUD/FHA Use of Materials Bulletin #60. Two examples are Titebond Heavy Duty Construction Adhesive by Franklin International or PL Premium Construction Adhesive. If polyurethane sealant is used, it should be one-component, highly-flexible, non-priming, gun-grade, high-performance elastomeric polyurethane sealant with movement of ± 25% per ASTM C719, tensile strength greater than 1.4 MPa per ASTM D412, and adhesion to peel on concrete greater than 3.5 N/mm per ASTM C794.

Adhesive or sealants should be applied in 40 millimeter diameter round "Hershey Kiss" shaped dollops located in two rows at the top of the freestanding blocks at 200 millimeters on center.

Caps can be cut as needed for proper alignment. If desired, grout the joints between cap blocks after installation with a non-shrink grout.

Figure 30

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16. FORCE PROTECTION WALLS

Install a threaded termination end on the end of the cable. Electroline M Series terminations manufactured by *Esmet, Inc.* work well.

Thread cable with a termination end through all the blocks. It is important that the cable is placed in each course of blocks prior to placing the next course.

Pull the cable through the block on the far end of the wall until approximately 50 millimeters of threads protrude beyond the end of the blocks. The exposed threads will provide room to place for a 16 millimeter x 150 millimeter x 230 millimeter steel plate over the exposed threads and start the nut.

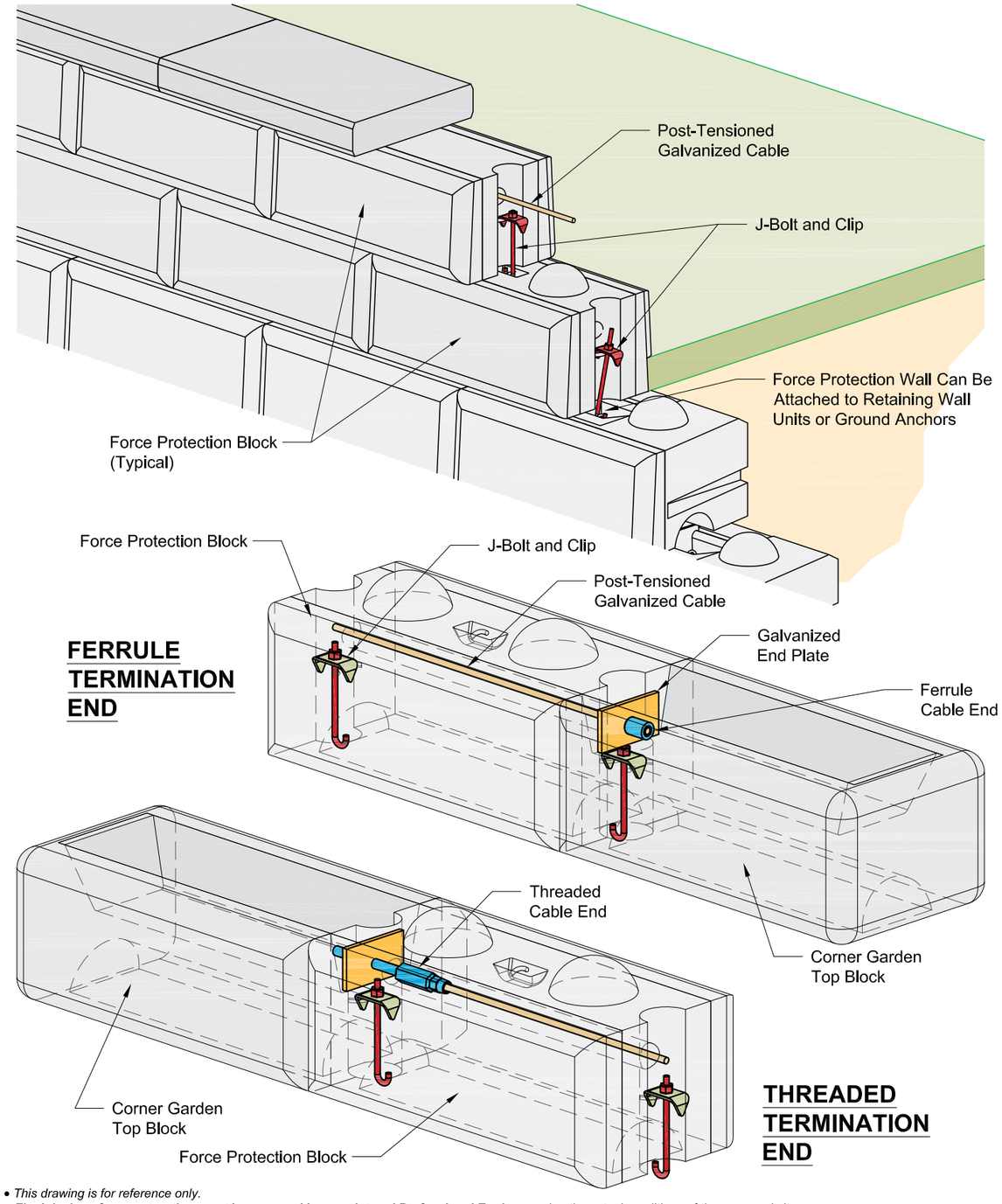
Mark and cut the cable at the starting end of the wall so that 100 millimeters of cable protrudes beyond the block, providing room a 16 millimeter x 150 millimeter x 230 millimeter steel plate and ferrule termination fitting.

After the cable has been cut, slide the entire cable several feet (meters) towards the ferrule end so that you will have room to work. Install a steel plate and ferrule termination end on the cable.

Pull the cable snug so that the ferrule is against the steel plate. There will be 51 millimeters of thread exposed at the far end of the wall which has the termination end on the cable.

Place the steel plate over the threads and start the nut. The nut can be tightened to the desired tension.

Force Protection Coping With J-Bolts and Post-Tensioned Cable



- *This drawing is for reference only.*
- ***Final designs for construction must be prepared by a registered Professional Engineer*** *using the actual conditions of the proposed site.*
- ***Final wall design must address both internal and external drainage and shall be evaluated by the Professional Engineer who is responsible for the wall design.***

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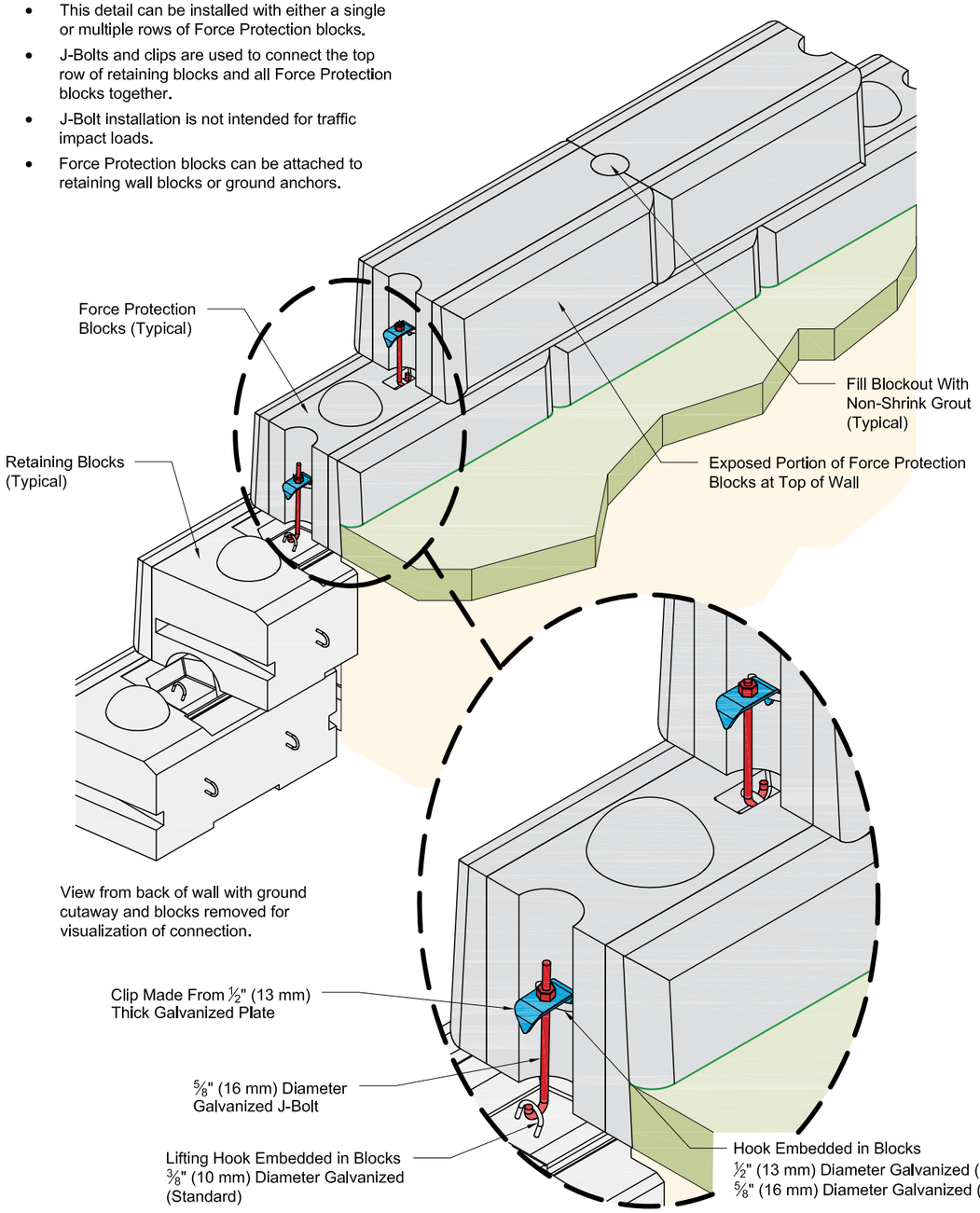
Force Protection Coping With J-Bolts

- This detail can be installed with either a single or multiple rows of Force Protection blocks.
- J-Bolts and clips are used to connect the top row of retaining blocks and all Force Protection blocks together.
- J-Bolt installation is not intended for traffic impact loads.
- Force Protection blocks can be attached to retaining wall blocks or ground anchors.



- *This drawing is for reference only.*
- ***Final designs for construction must be prepared by a registered Professional Engineer** using the actual conditions of the proposed site.*
- ***Final wall design must address both internal and external drainage and shall be evaluated by the Professional Engineer who is responsible for the wall design.***

J-BOLT INSTALLATION

J-Bolts can be used to secure force protection walls to the top row of retaining wall blocks (when used on the top of a Redi-Rock wall) or to concrete anchors set in the ground (for a stand alone wall).

Set force protection blocks with the ends centered on ground anchors or the center of Redi-Rock middle retaining wall blocks immediately below.

Place a clip between blocks in hooks provided in the middle of the block on each end.

Place a J-bolt through center of the clip, thread a nut on the J-bolt, and tighten.

Repeat for all remaining courses of force protection blocks.

17. REDI-ROCK COLUMNS

Redi-Rock column blocks are available to complement Redi-Rock walls. Columns can be installed by themselves or with fences or gates.

Column blocks can be placed on properly prepared aggregate or concrete leveling pads or directly on Redi-Rock retaining wall blocks, depending on the specific design for your project.

Column blocks can be manufactured with pockets for concrete or split wood fence rails.

Concrete adhesive or polyurethane sealant can be used between stacked column blocks.

Install a cap on the top of a column. Adjust the cap position until all sides are equidistant and square to the column. Secure the column cap with construction adhesive or polyurethane sealant.

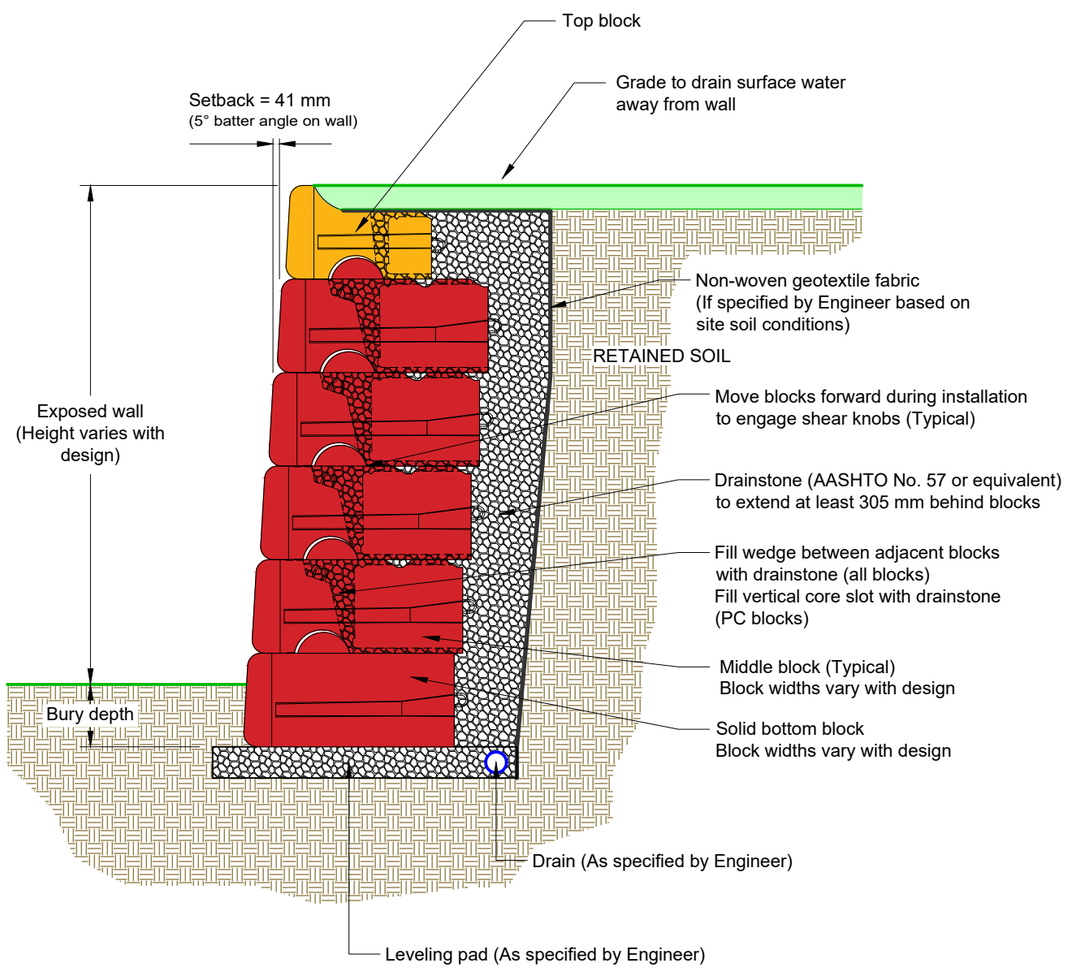
Special inserts are available for mounting gates or similar features to Redi-Rock columns.

Column blocks are available with 100 millimeter or tapered 200 millimeter diameter cores which can be filled with stone or concrete and steel rebar reinforcement.

A conduit can be left through the core if needed for lighting or other features.

CONSTRUCTION DETAILS

Typical Gravity Wall Section



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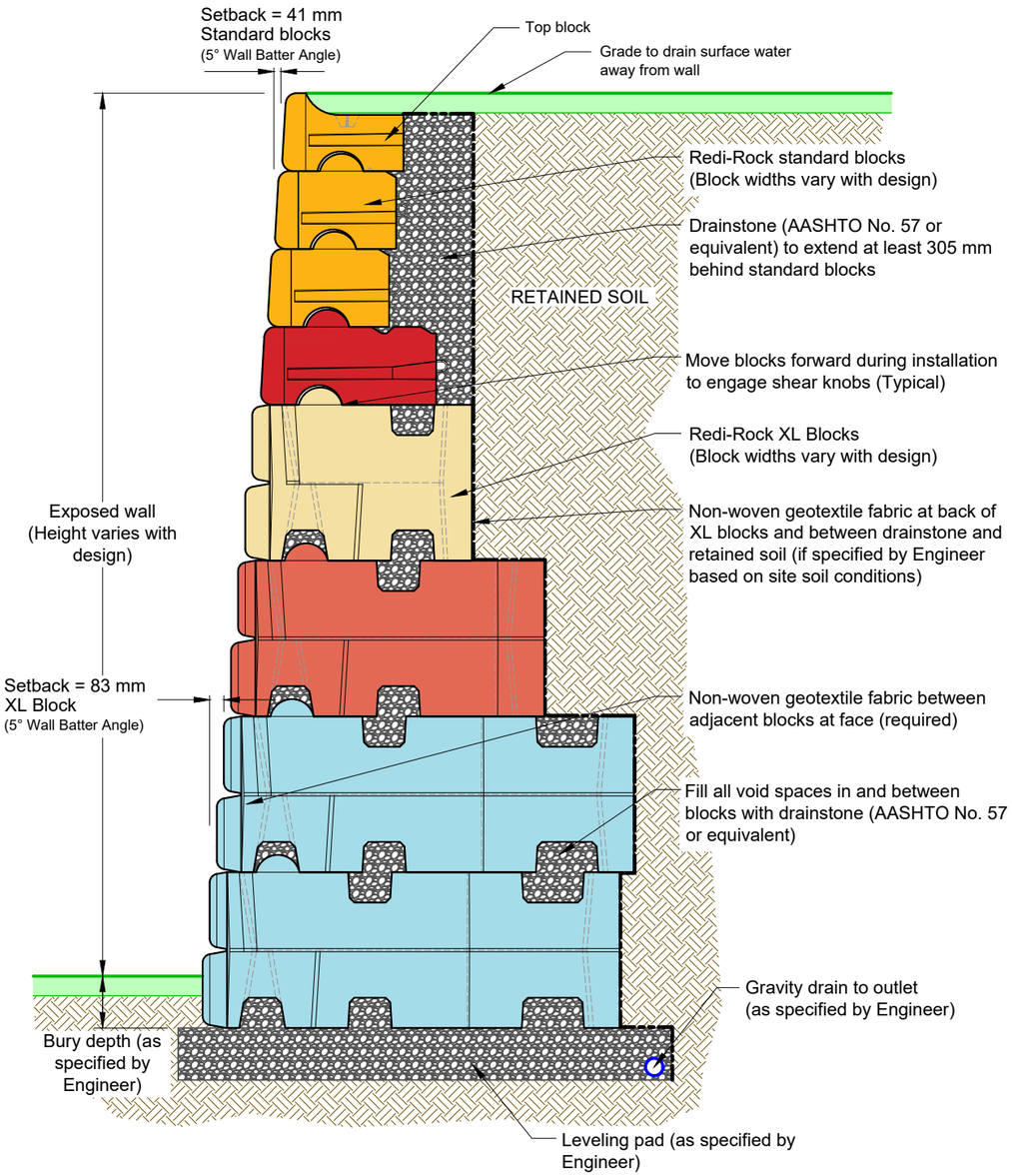
Typical XL Gravity Wall Section



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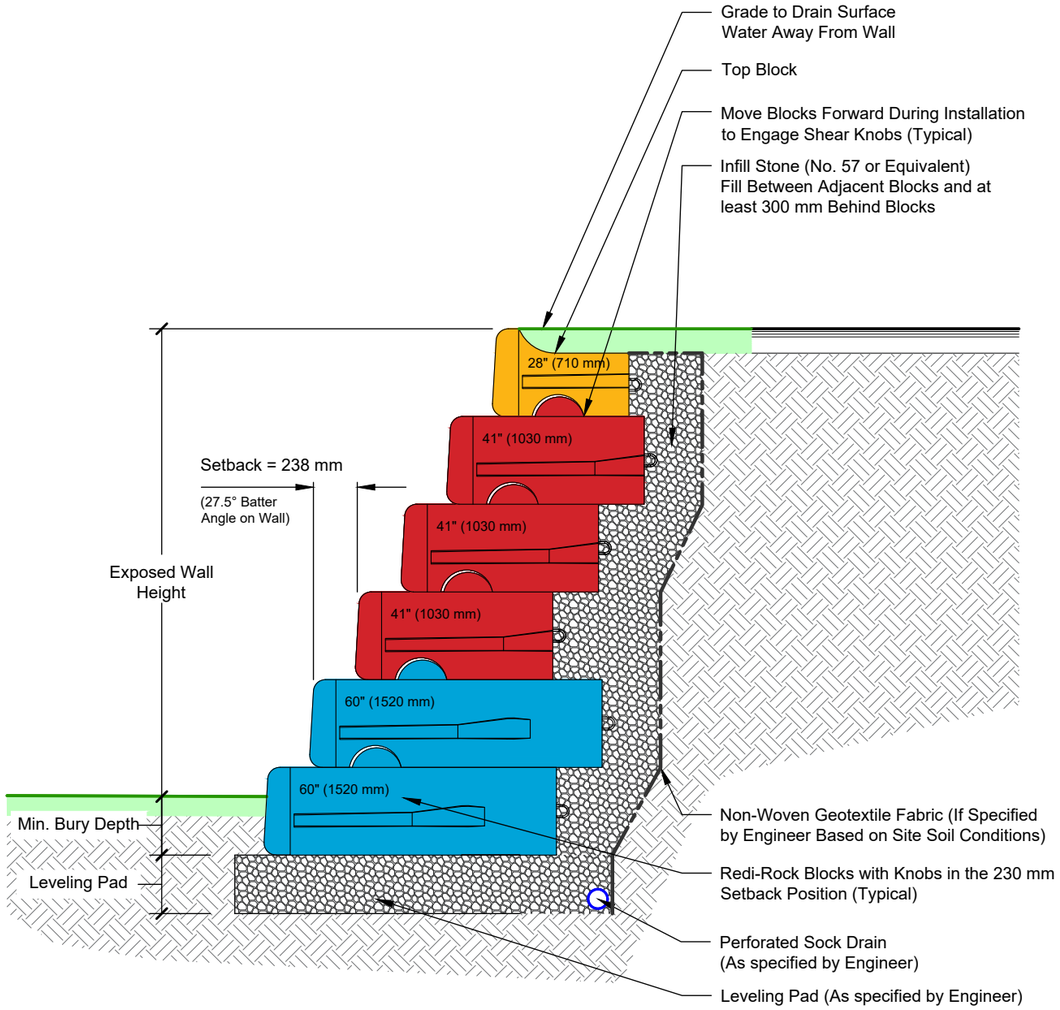
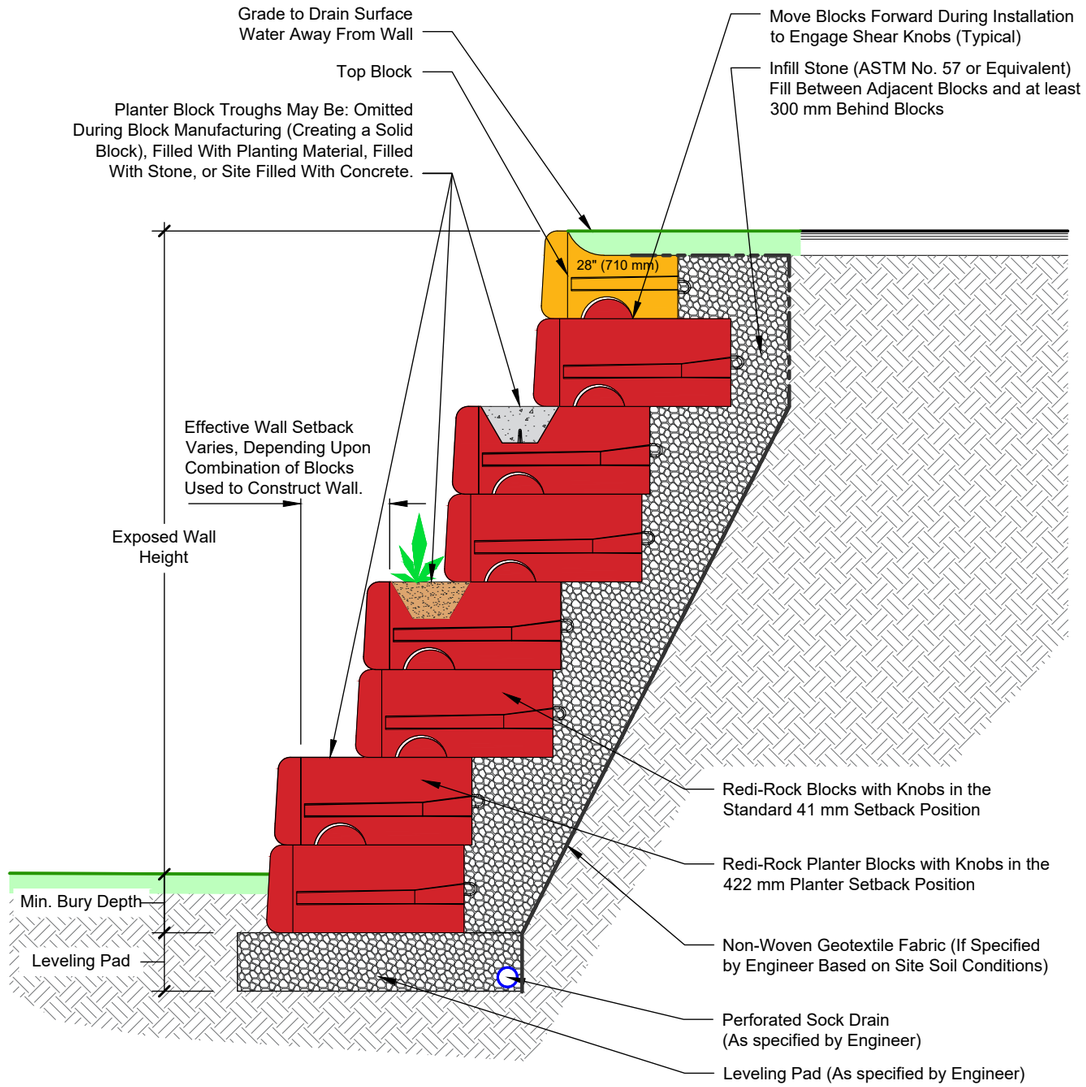
Large Batter Wall Section

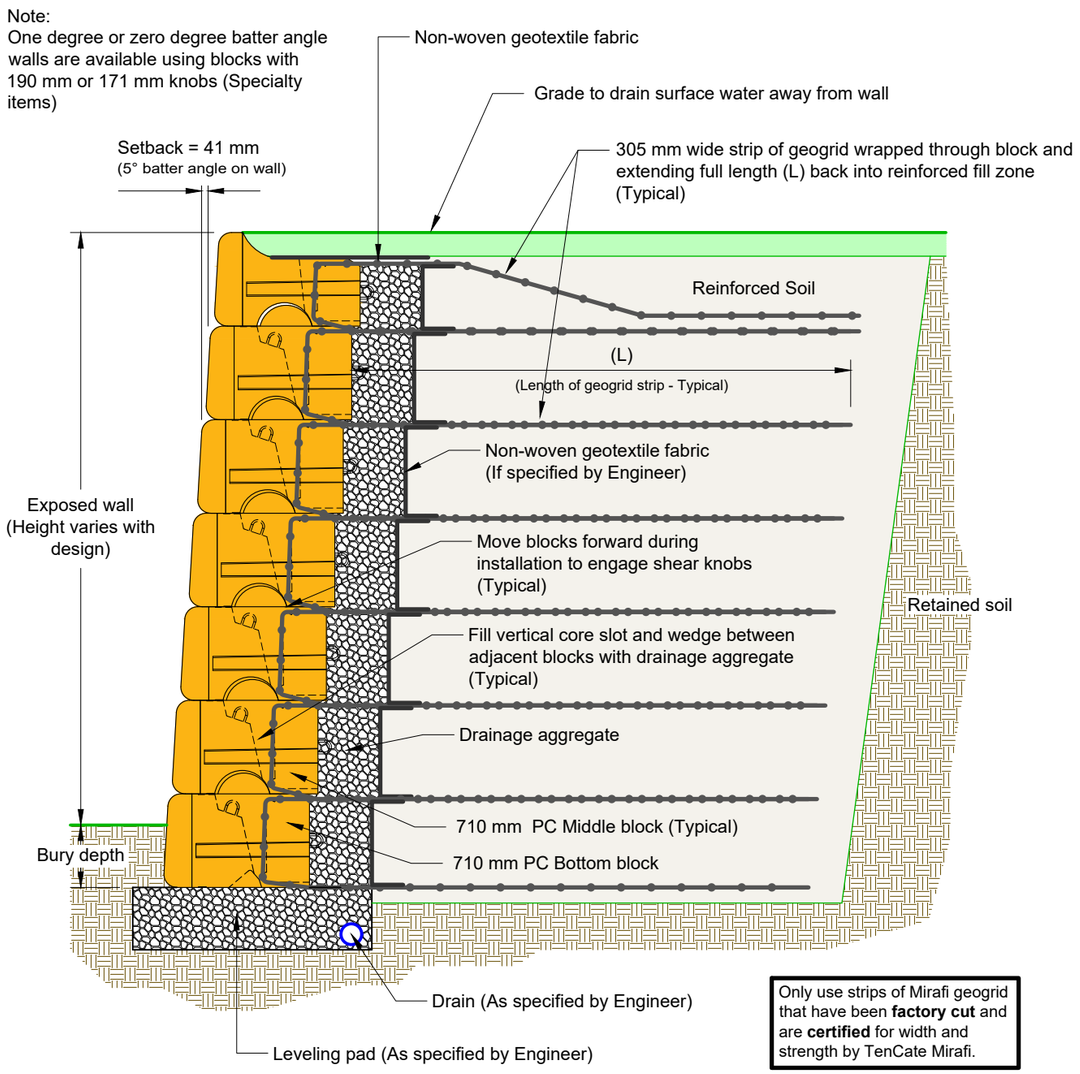


Alternating Planter & Standard Batter Wall Section

The Redi-Rock retaining blocks are available with multiple shear knob size and location options, to permit wall batter design flexibility. This detail depicts alternating 422 mm Planter and 41 mm Standard setback blocks, however designs are possible using more than one Standard setback block between Planter blocks. The regular repetition of combinations of different setback blocks within a wall profile can have structural and aesthetic significance. Abrupt changes in wall batter that carry over multiple blocks are not recommended.

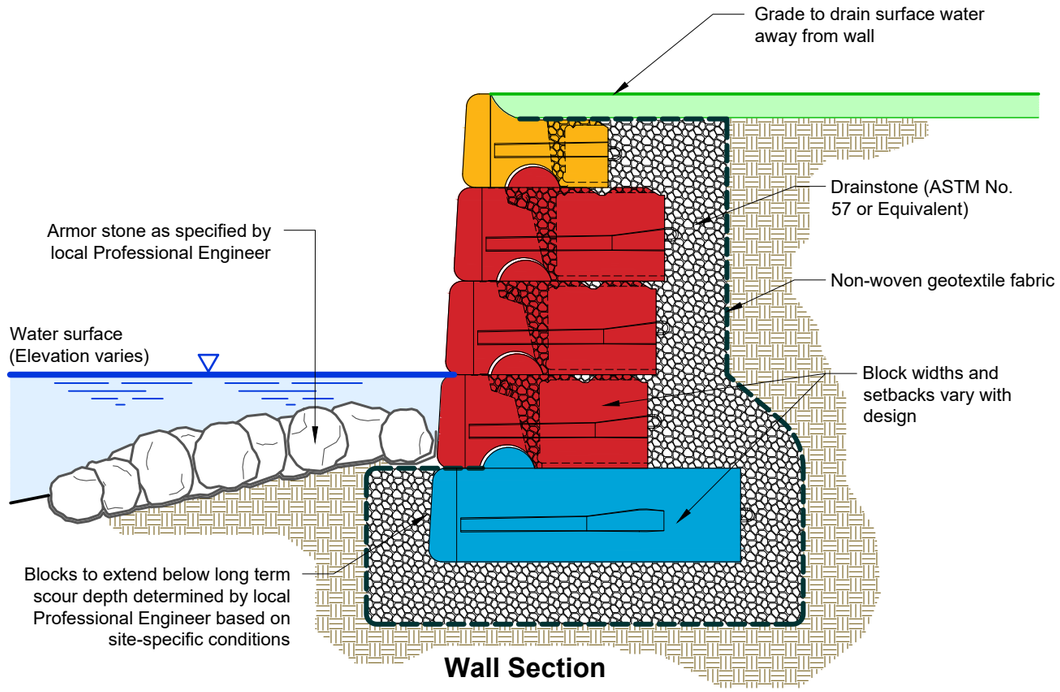


Typical Reinforced Wall Section



Only use strips of Mirafi geogrid that have been **factory cut** and are **certified** for width and strength by TenCate Mirafi.

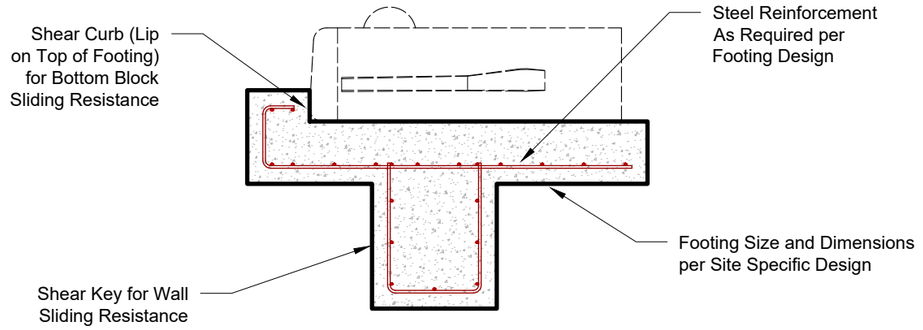
Conceptual Seawall Detail



Wall Section

Notes:

- Use ASTM No. 57 stone (or as specified by local Professional Engineer) to infill between blocks.
- Preliminary wall height charts do not apply and should not be used for walls in water applications due to the variety of site-specific variables.
- Contact your local Professional Engineer for specific details and final design.
- Walls may require geogrid reinforcement.
- Refer to final engineering plans.



Optional Concrete Footing

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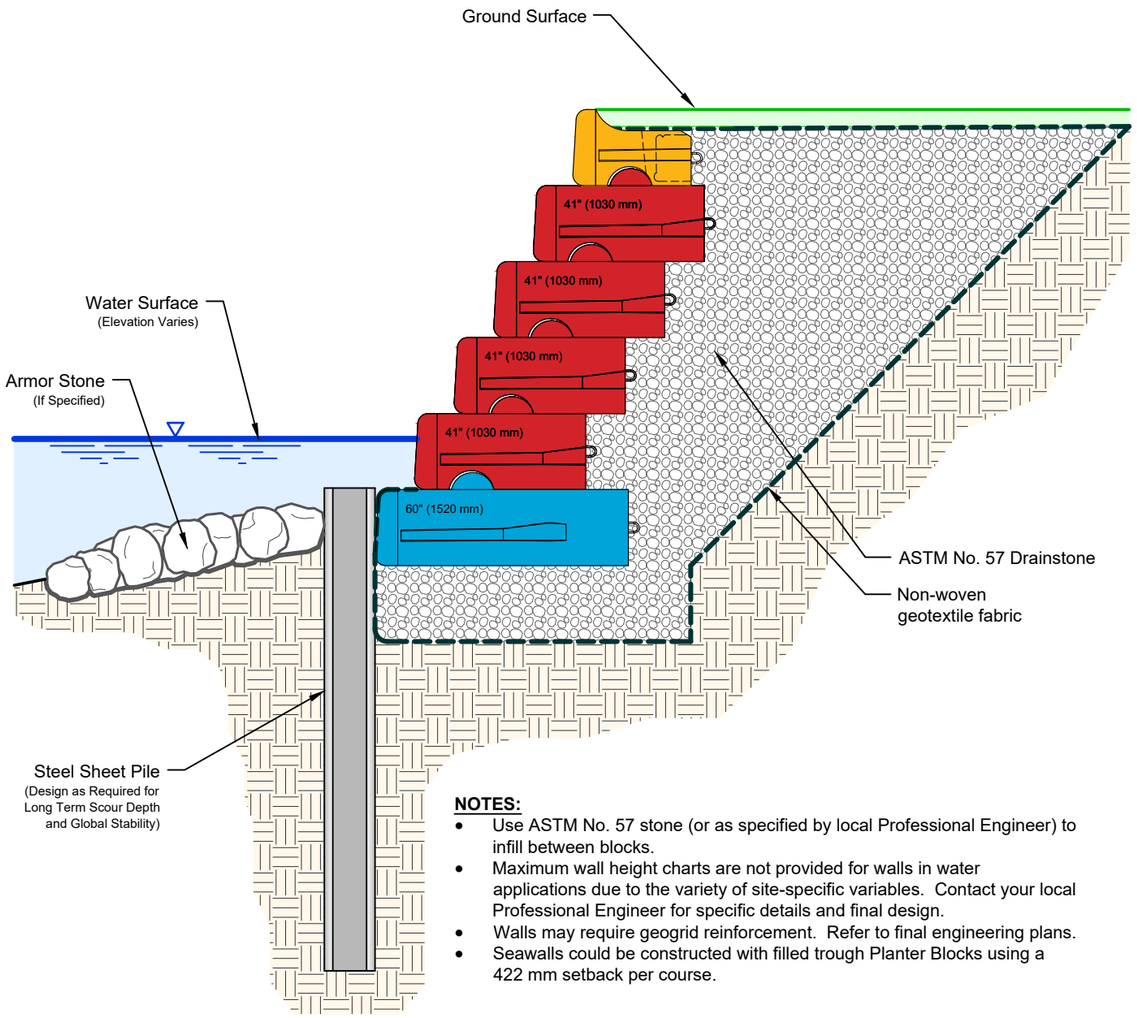
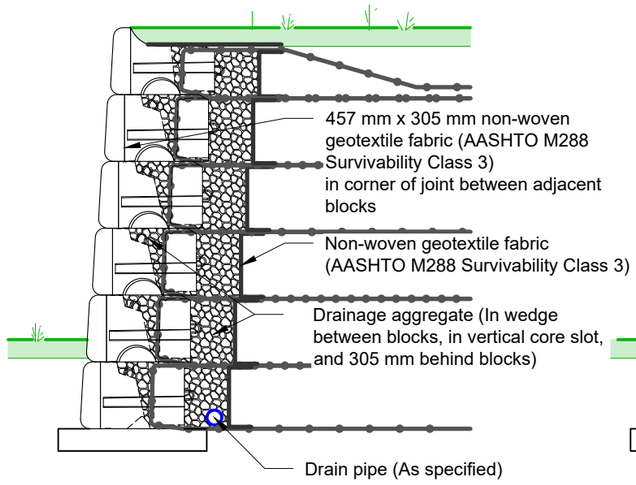
Conceptual Sheetpile Protected Seawall Detail



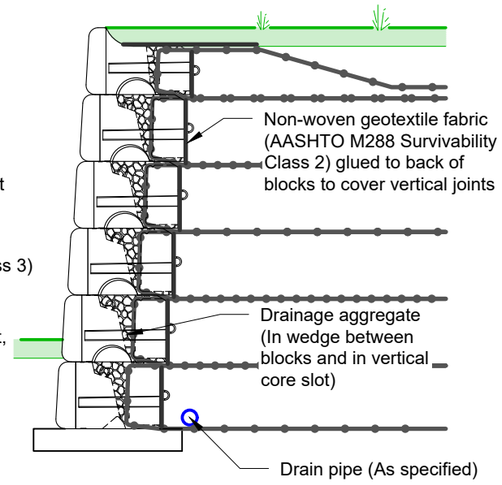
NOTES:

- Use ASTM No. 57 stone (or as specified by local Professional Engineer) to infill between blocks.
- Maximum wall height charts are not provided for walls in water applications due to the variety of site-specific variables. Contact your local Professional Engineer for specific details and final design.
- Walls may require geogrid reinforcement. Refer to final engineering plans.
- Seawalls could be constructed with filled trough Planter Blocks using a 422 mm setback per course.

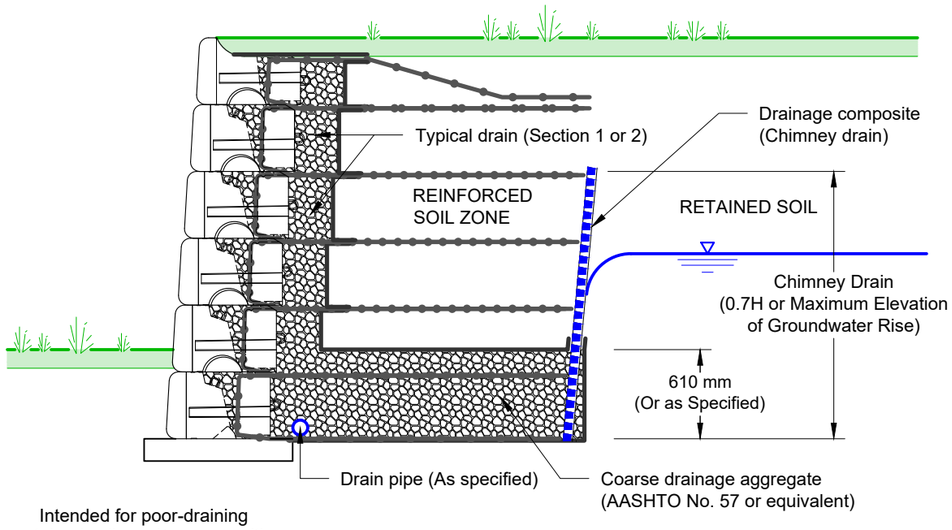
Wall Drainage Options



Typical Section - Option 1



Typical Section - Option 2



Intended for poor-draining retained soils and/or areas with potential groundwater impact

Blanket and Chimney Drain Section

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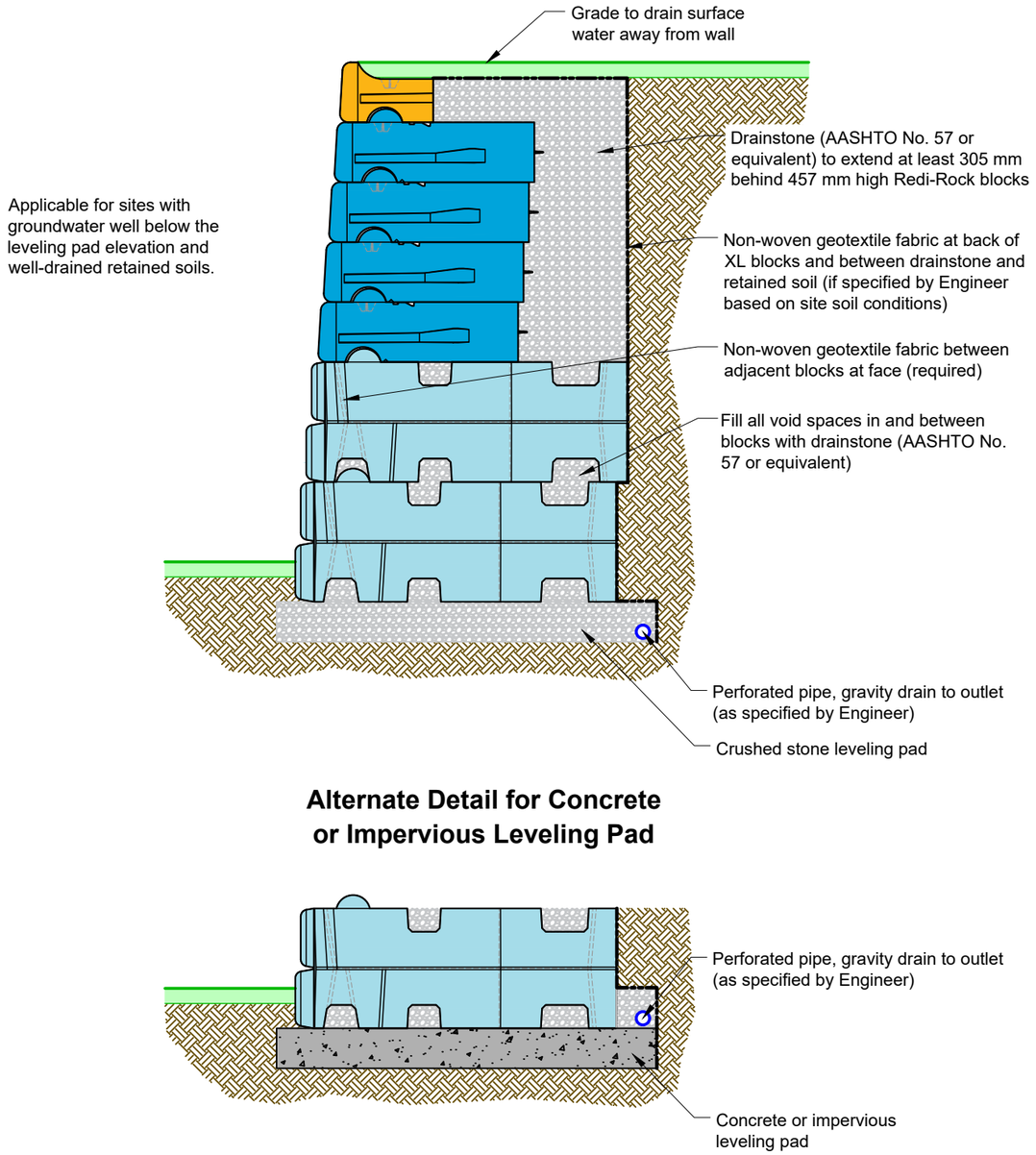
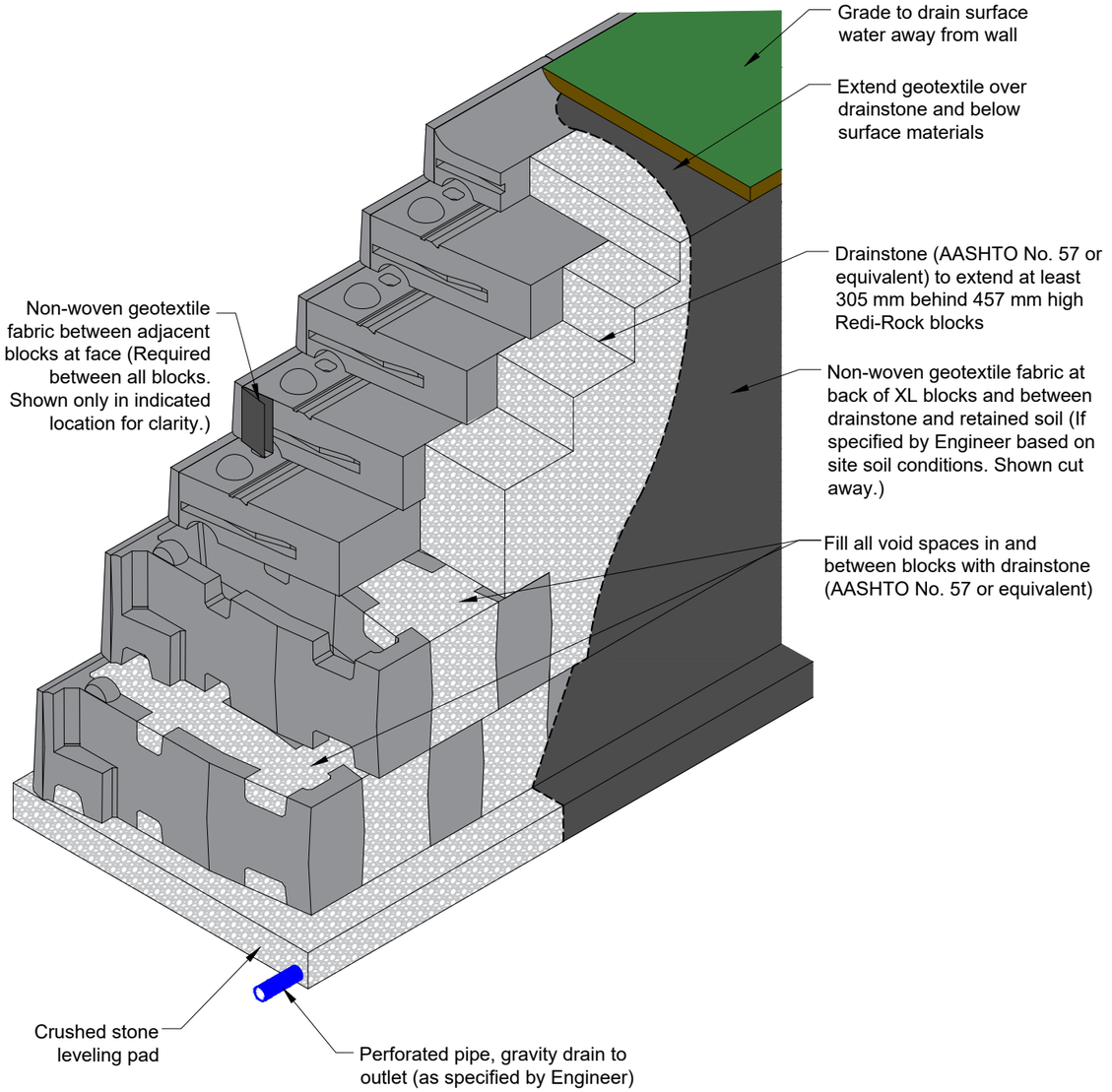
Typical Drainage Detail - Cross Section



Alternate Detail for Concrete or Impervious Leveling Pad

Typical Drainage Detail - Isometric View



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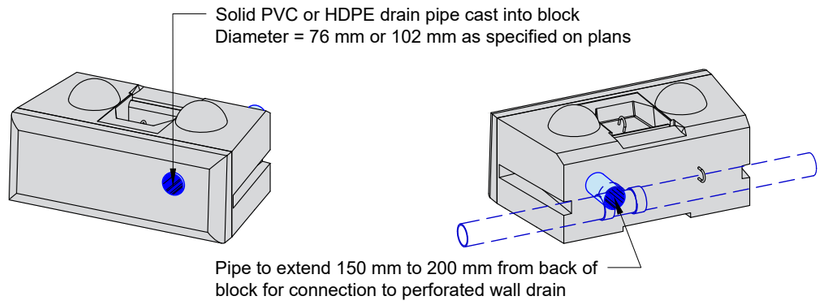
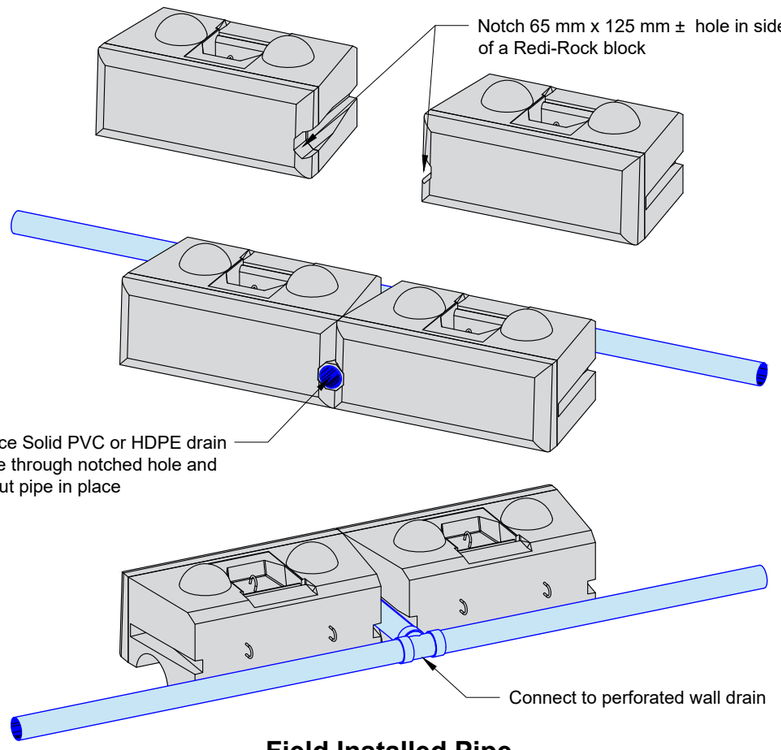
Wall Drain Weep Hole Options



Custom Pipe Cast into Block



Field Installed Pipe

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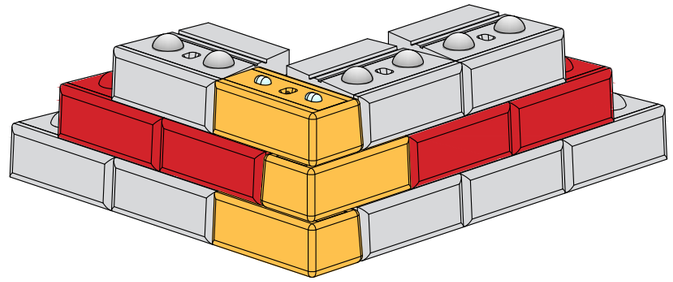
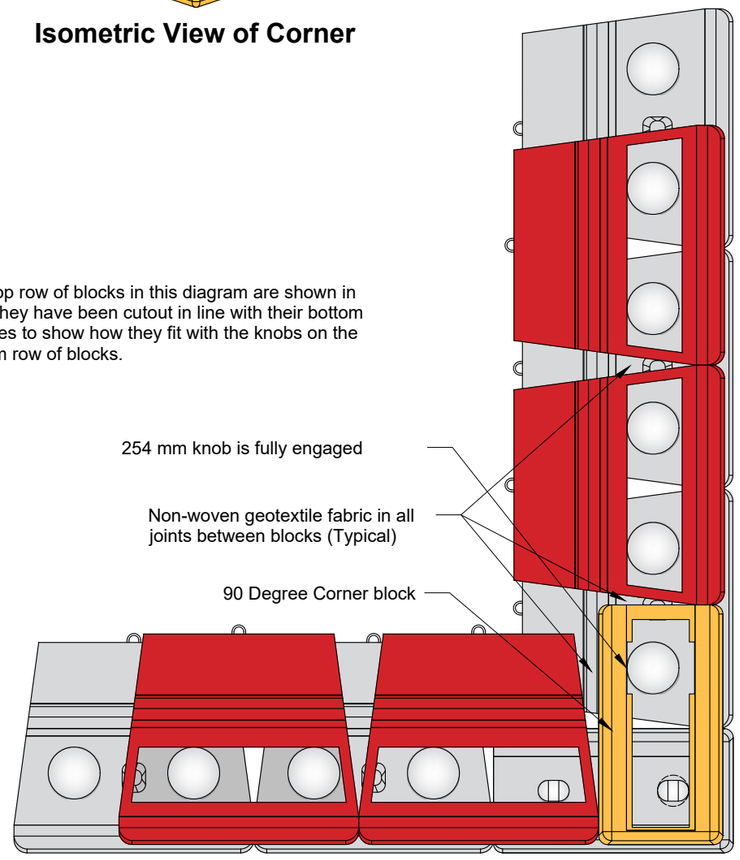
90° Outside Corner



Isometric View of Corner

The top row of blocks in this diagram are shown in red. They have been cutout in line with their bottom grooves to show how they fit with the knobs on the bottom row of blocks.



Top View of Bottom Two Rows

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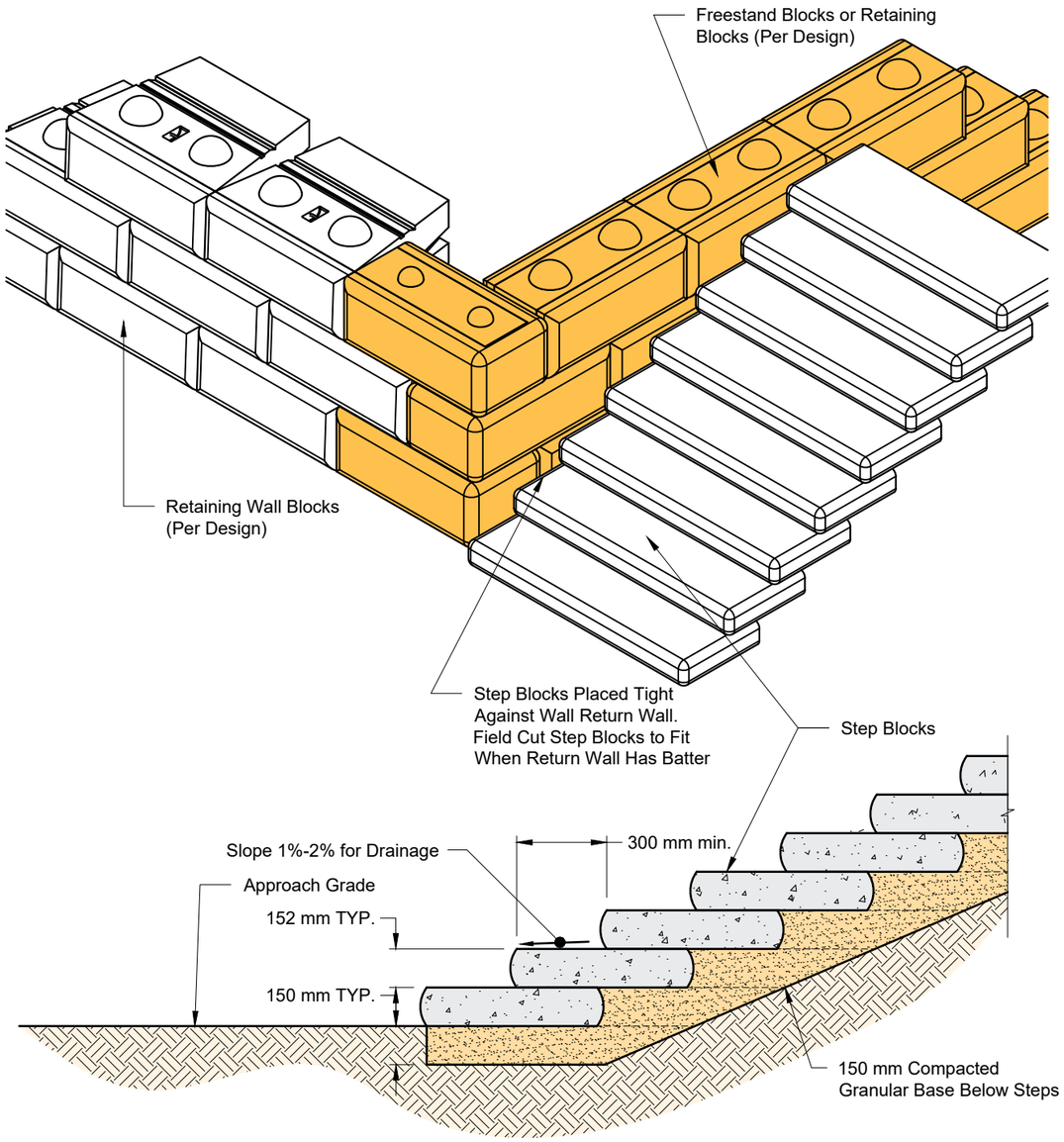
Steps Through Wall



Stair Section

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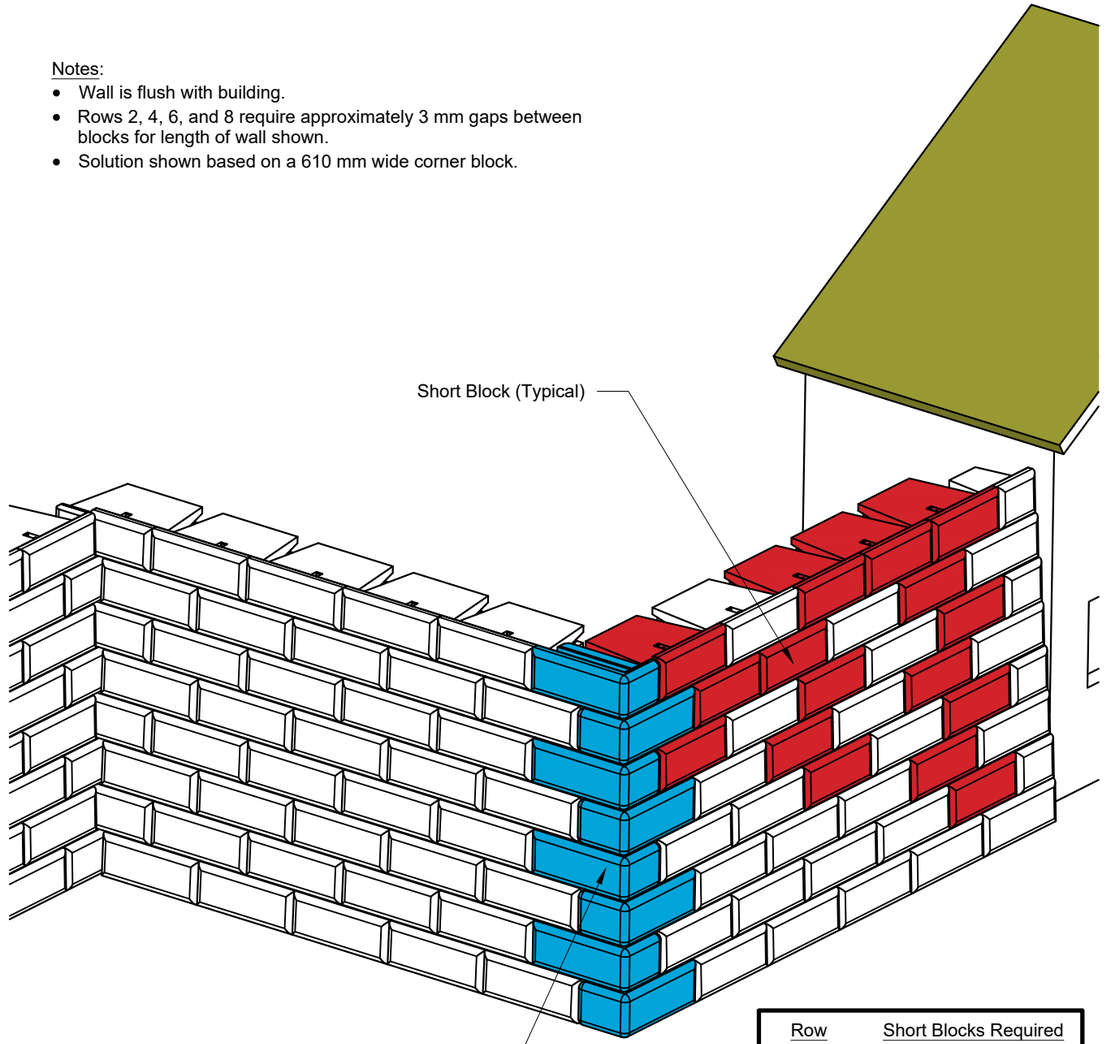
90° Battered Corner - Flush End

Notes:

- Wall is flush with building.
- Rows 2, 4, 6, and 8 require approximately 3 mm gaps between blocks for length of wall shown.
- Solution shown based on a 610 mm wide corner block.



Row	Short Blocks Required
1	0
2 and 3	1 per Row
4 and 5	2 per Row
6 and 7	3 per Row
8	4 per Row

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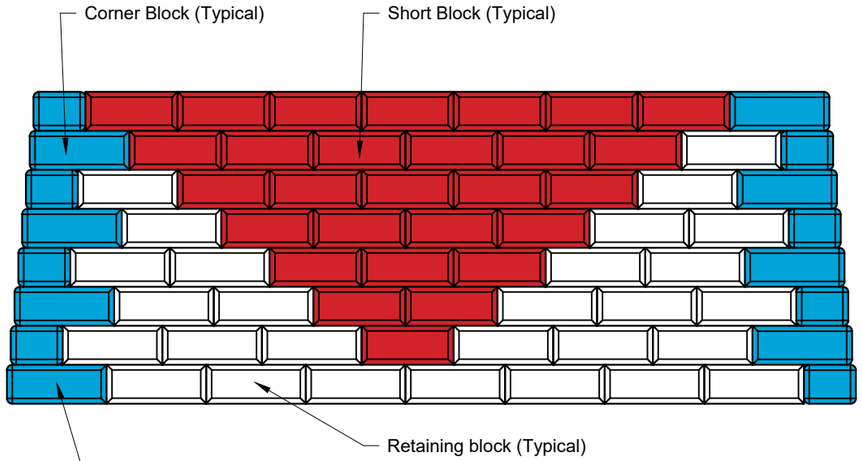
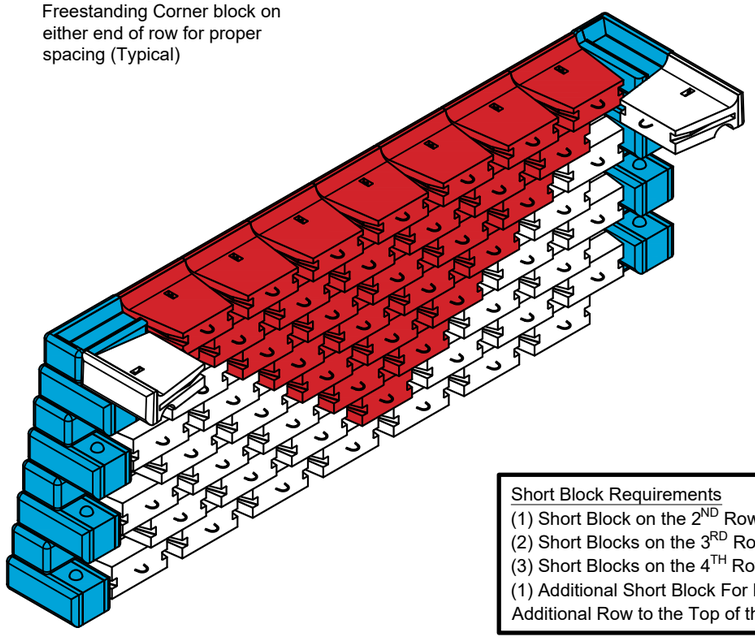
Double 90° Outside Corner - Short Block Solution





Short Block Requirements
(1) Short Block on the 2ND Row
(2) Short Blocks on the 3RD Row
(3) Short Blocks on the 4TH Row
(1) Additional Short Block For Every Additional Row to the Top of the Wall

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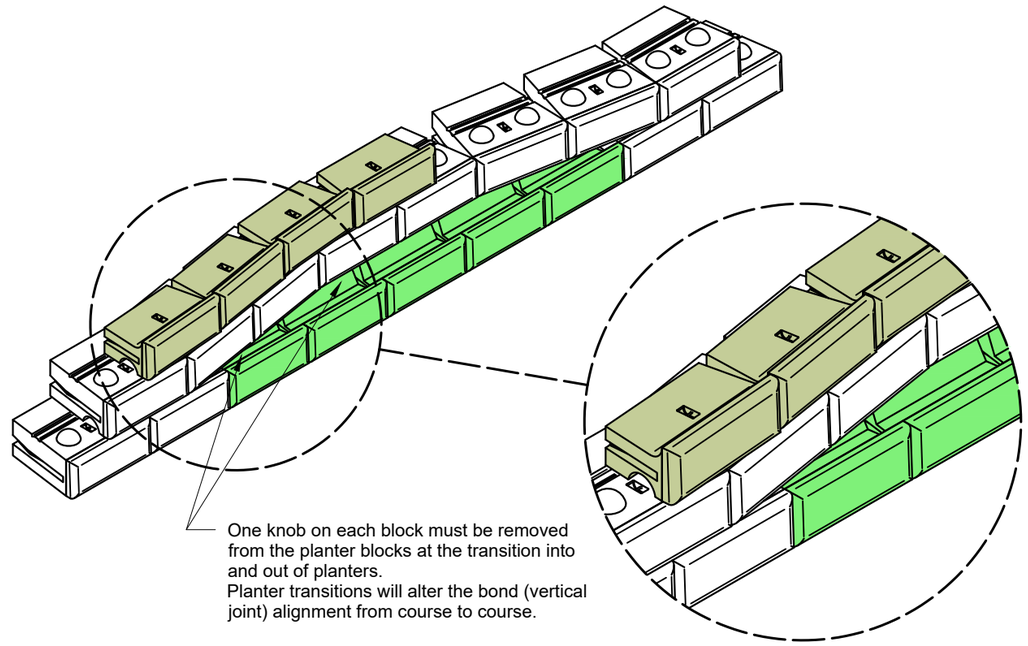
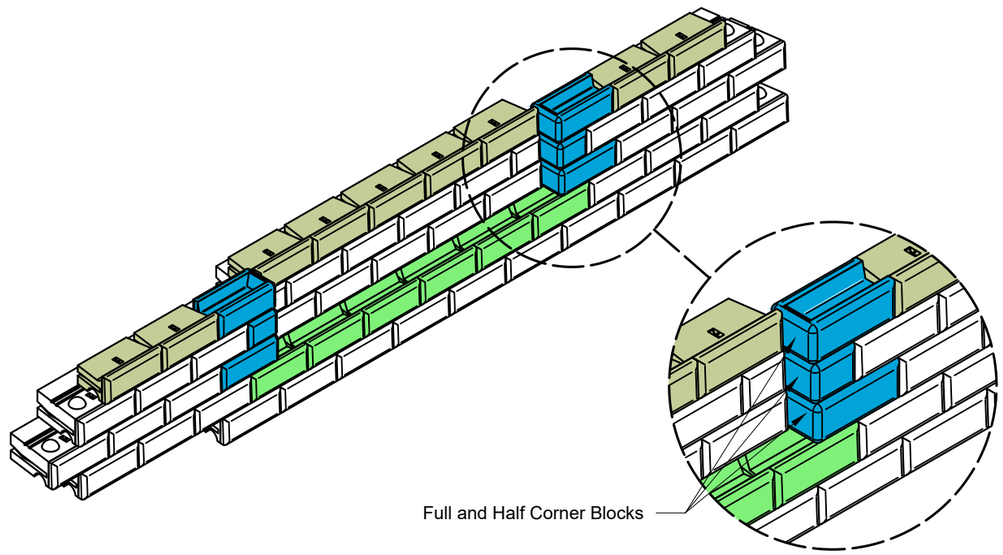
Transitions Into Planters





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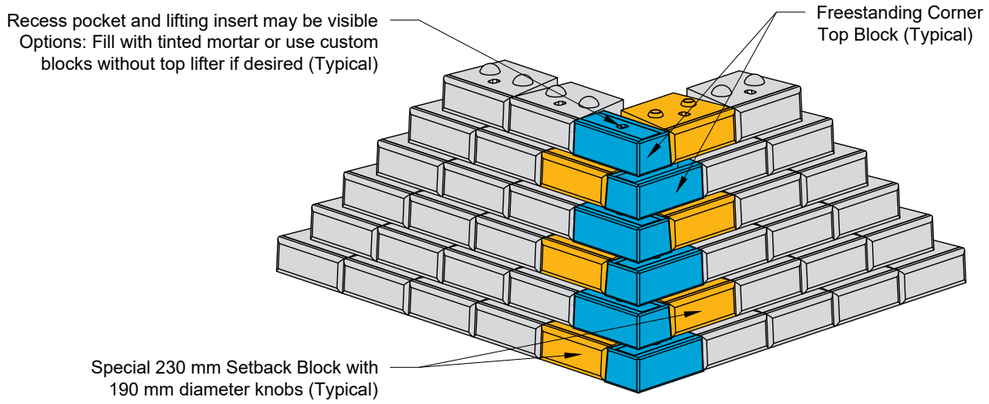
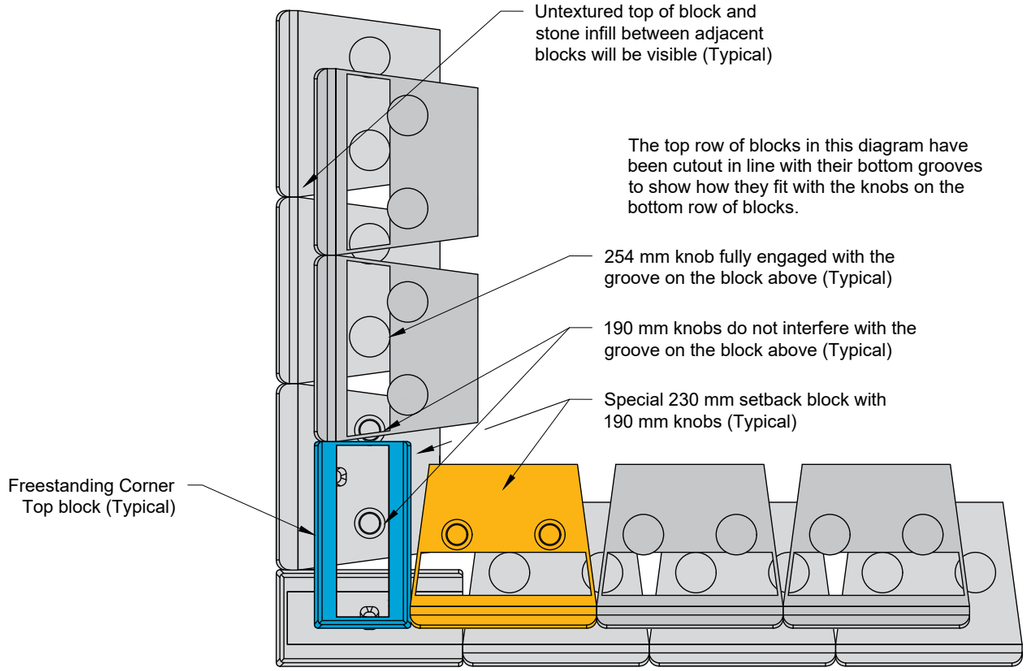
90° Outside Corner for 230 mm Setback Walls



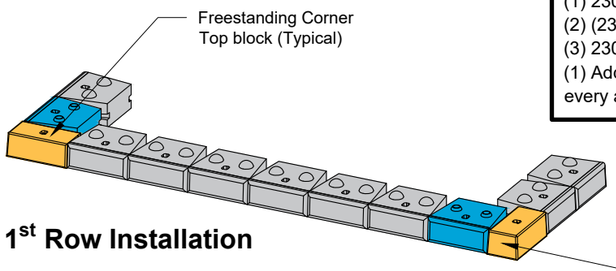
Multiple Row Installation



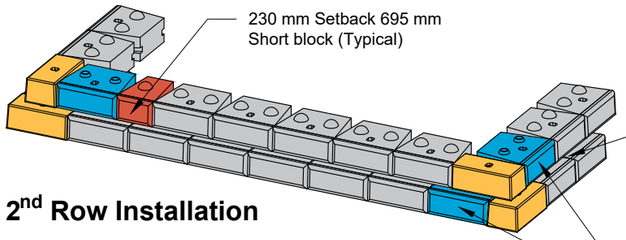
Top View of Bottom Two Rows

Double 90° Outside Corner for 230 mm Setback Walls

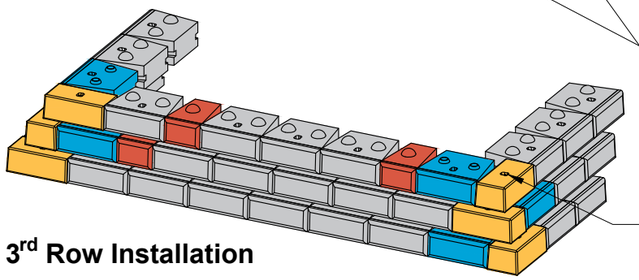
Short Block Requirements
(1) 230 mm Setback Short block on the 2nd row
(2) (230 mm Setback Short block on the 3rd row
(3) 230 mm Setback Short block on the 4nd row
(1) Additional 230 mm Setback Short block for every additional row to the top of the wall



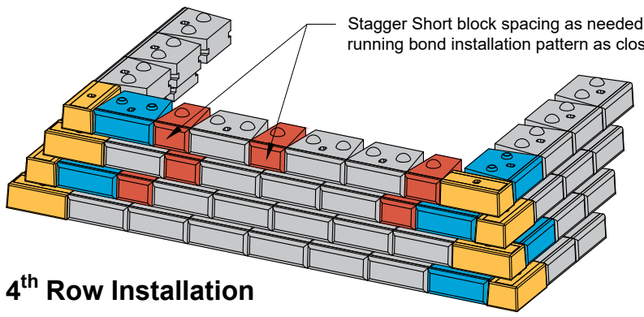
1st Row Installation



2nd Row Installation

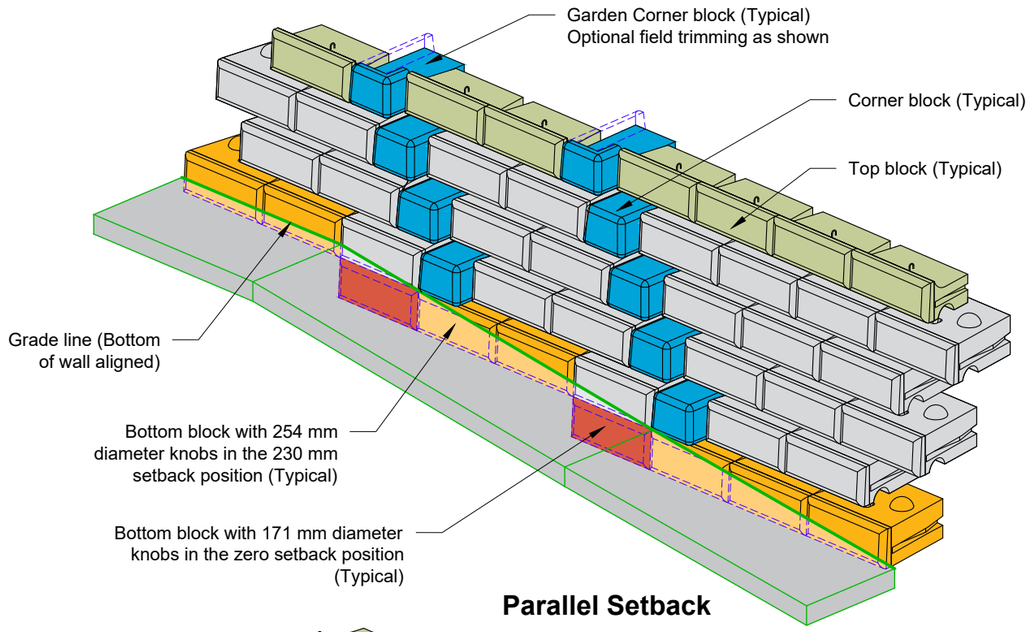


3rd Row Installation

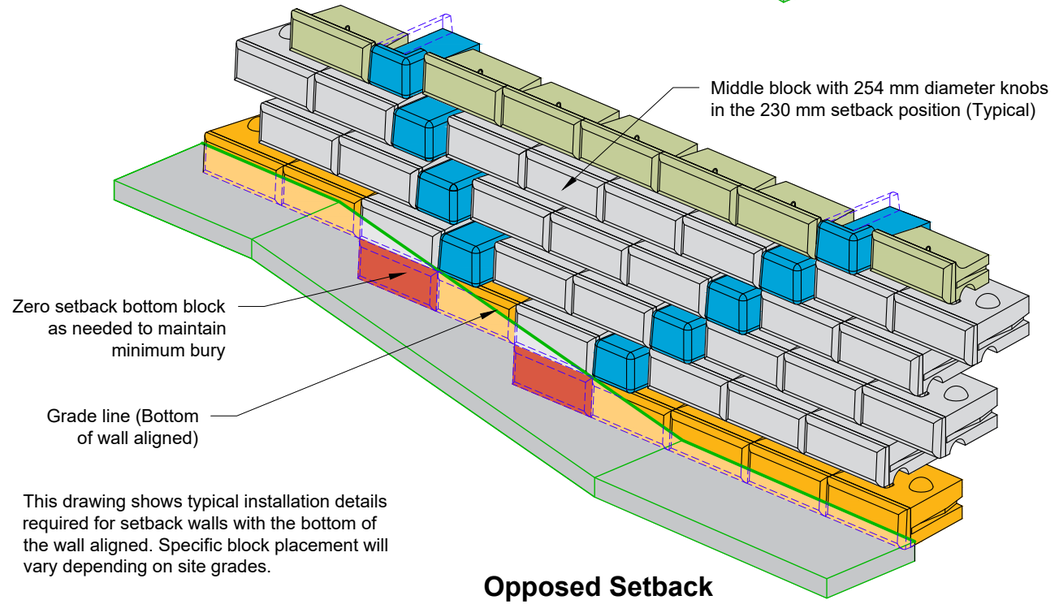


4th Row Installation

Stepped 230 mm Setback Wall with Aligned Base



Parallel Setback



This drawing shows typical installation details required for setback walls with the bottom of the wall aligned. Specific block placement will vary depending on site grades.

Opposed Setback

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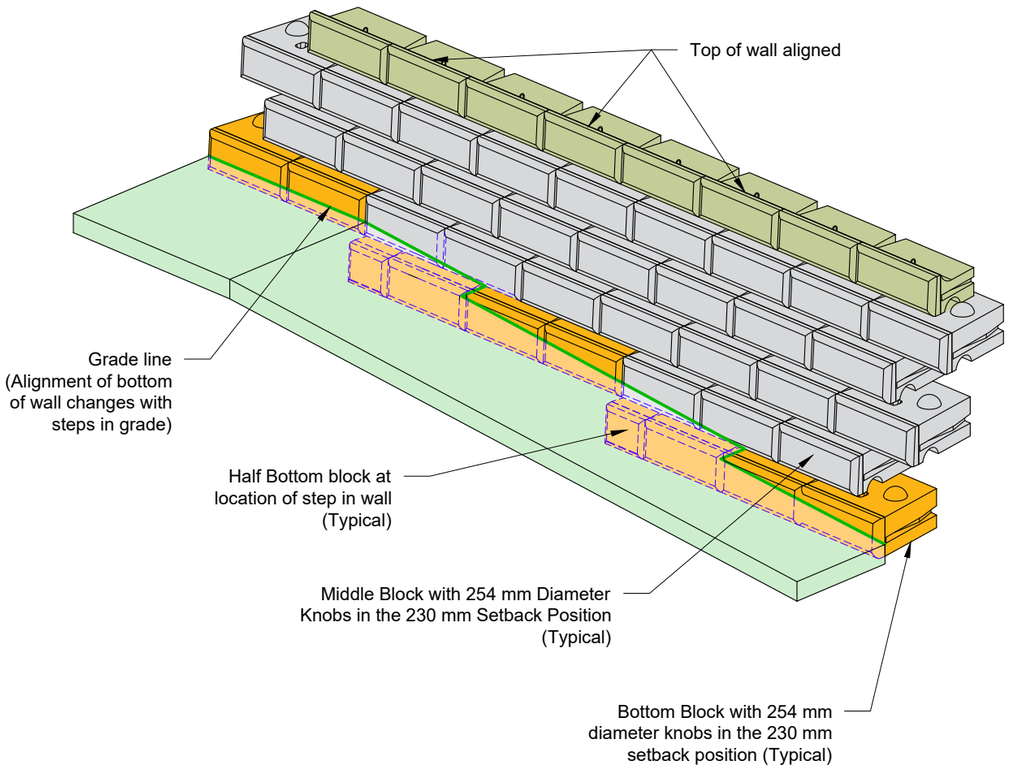
Stepped 230 mm Setback Wall with Aligned Top



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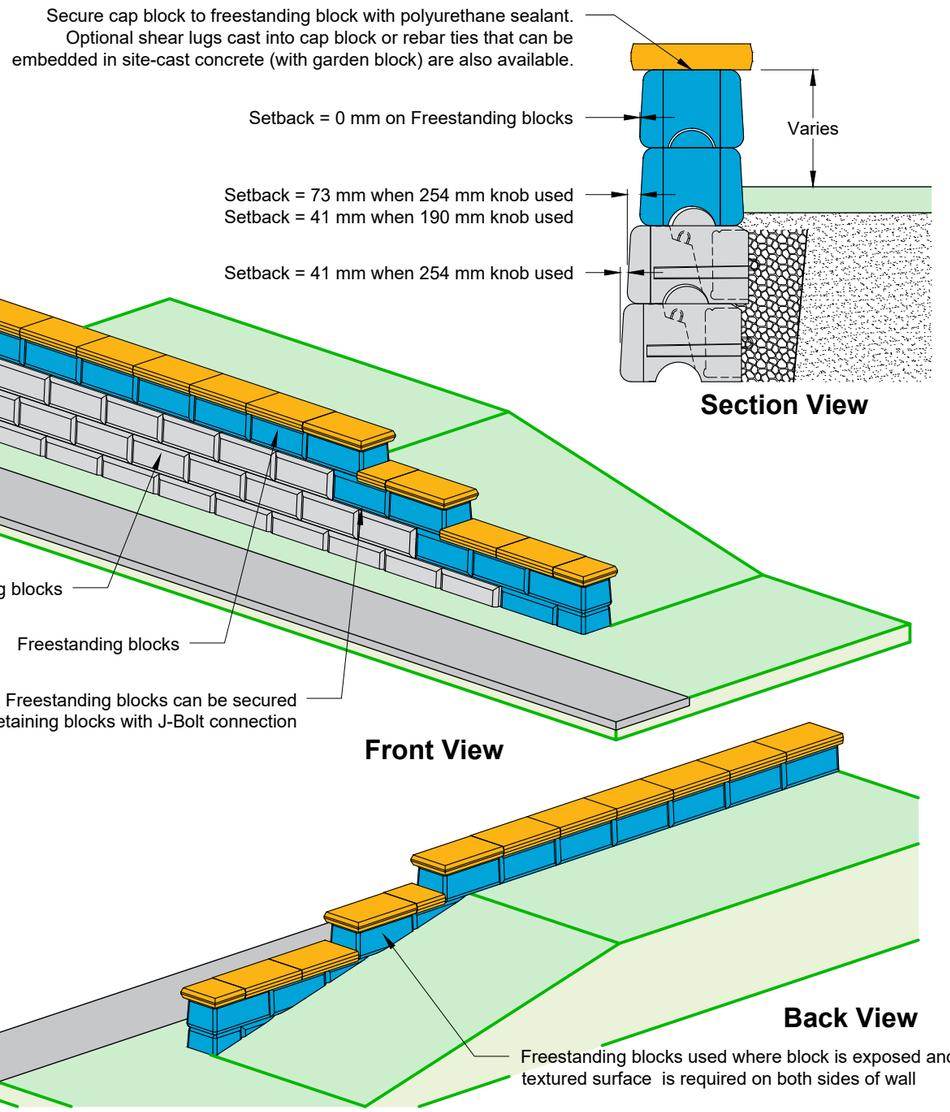
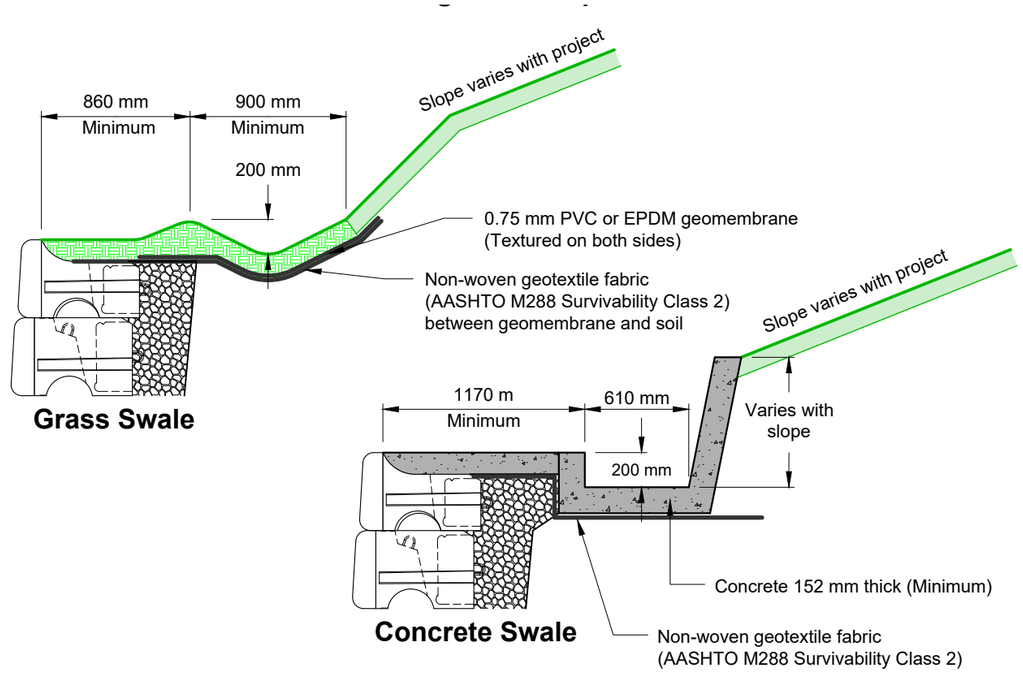
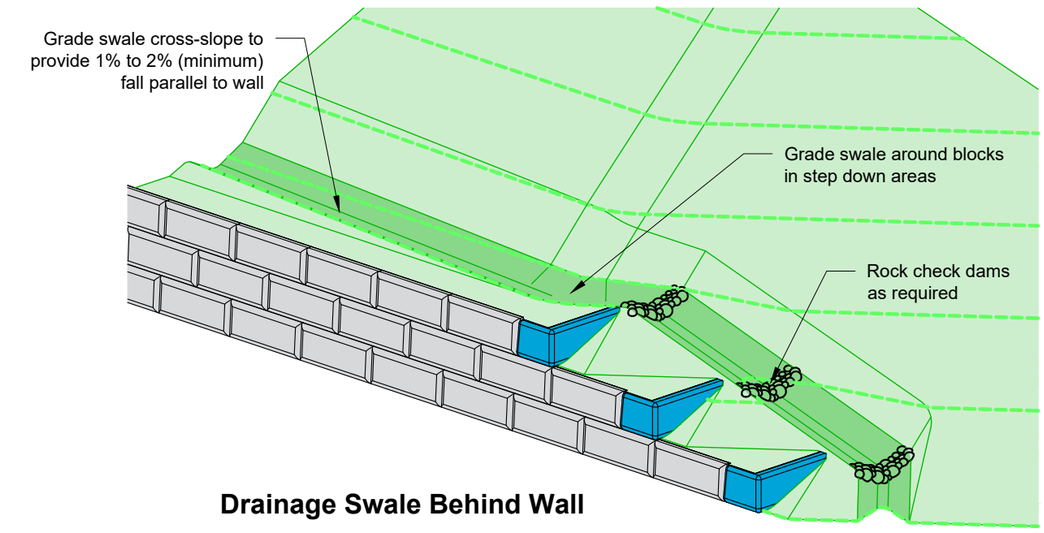
Freestanding Blocks with Cap at Top Wall



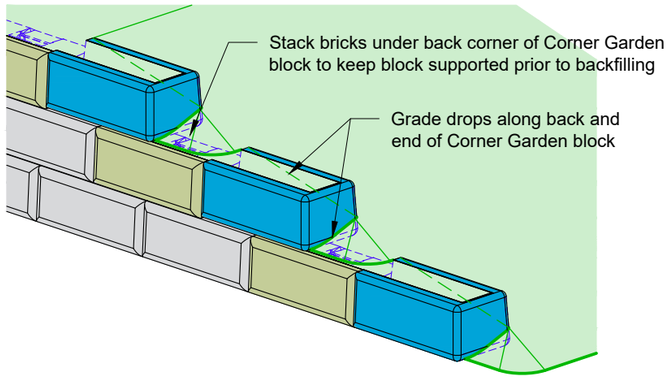
One-component, highly flexible, non-priming, gun grade, high performance elastomeric polyurethane sealant shall have movement of plus or minus 25% per ASTM C719, tensile strength greater than 1.4 MPa per ASTM D412, and adhesion to peel on concrete greater than 3.5 N/mm per ASTM C794. Apply sealant in 38 mm diameter round “hersey kiss”-shaped dollops located in two rows at the top of the Freestanding blocks at 200 mm on center.

Drainage Swale Options

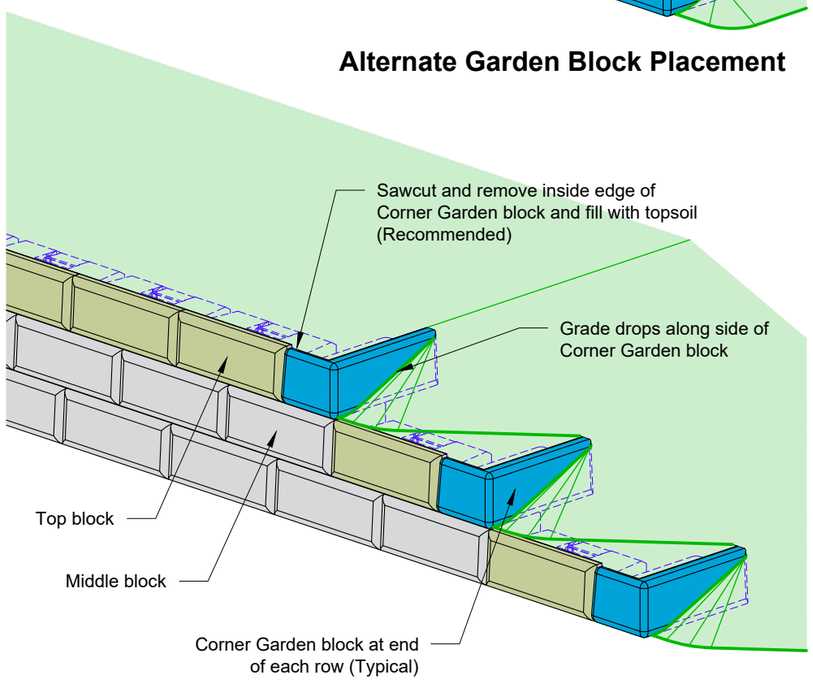




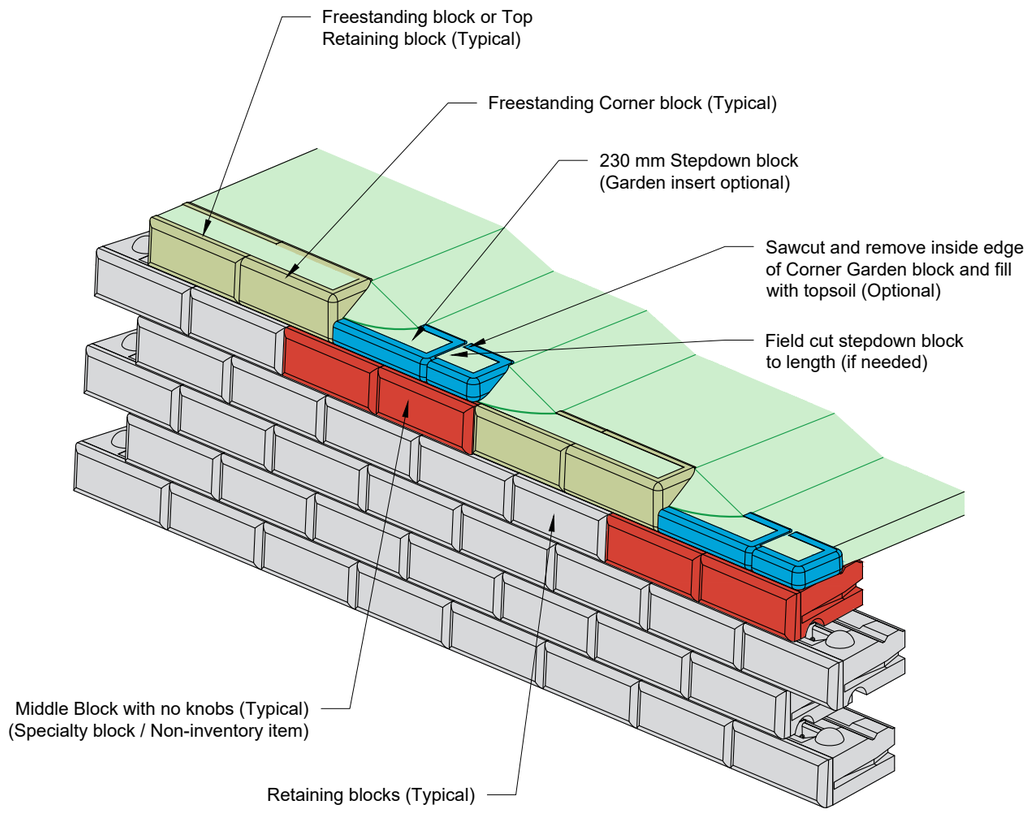
Top of Wall Step Options



Alternate Garden Block Placement



Top of Wall 230 mm Stepdown Blocks



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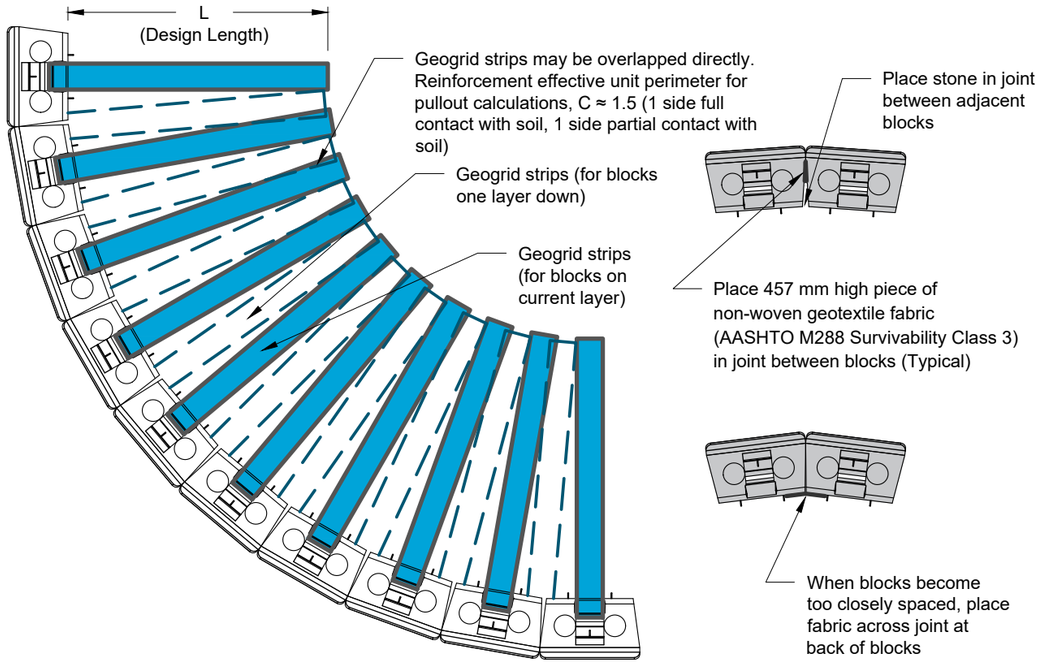
Geogrid Layout for Convex Curves and Radial Corners

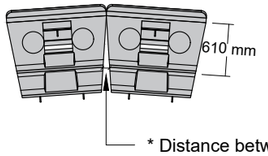


Minimum radius for bottom row

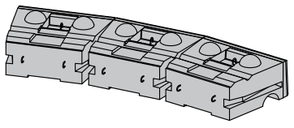
Number of courses	Height of wall	Radius from face of block	Distance between blocks*
1	0.46 m	4.42 m	3 mm
2	0.91 m	4.47 m	5 mm
3	1.37 m	4.52 m	7 mm
4	1.83 m	4.57 m	9 mm
5	2.29 m	4.62 m	11 mm
6	2.74 m	4.67 m	13 mm
7	3.20 m	4.72 m	15 mm
8	3.66 m	4.78 m	16 mm
9	4.11 m	4.83 m	18 mm
10	4.57 m	4.88 m	19 mm
11	5.03 m	4.93 m	21 mm
12	5.49 m	4.98 m	22 mm
13	5.94 m	5.03 m	24 mm
14	6.40 m	5.08 m	26 mm

* Distance between blocks is measured at the back of 710 mm blocks and 610 mm behind the form parting line (back edge of face texture) for 1030 mm blocks. This distance is intended to be a guide only. Minimum radius is controlling.

4.42 m is the minimum radius for Redi-Rock blocks. It occurs when all the blocks are placed tight together. A larger radius is required on the bottom row of a Redi-Rock wall to account for the batter between courses of blocks and still provide enough space to construct the top row of blocks.

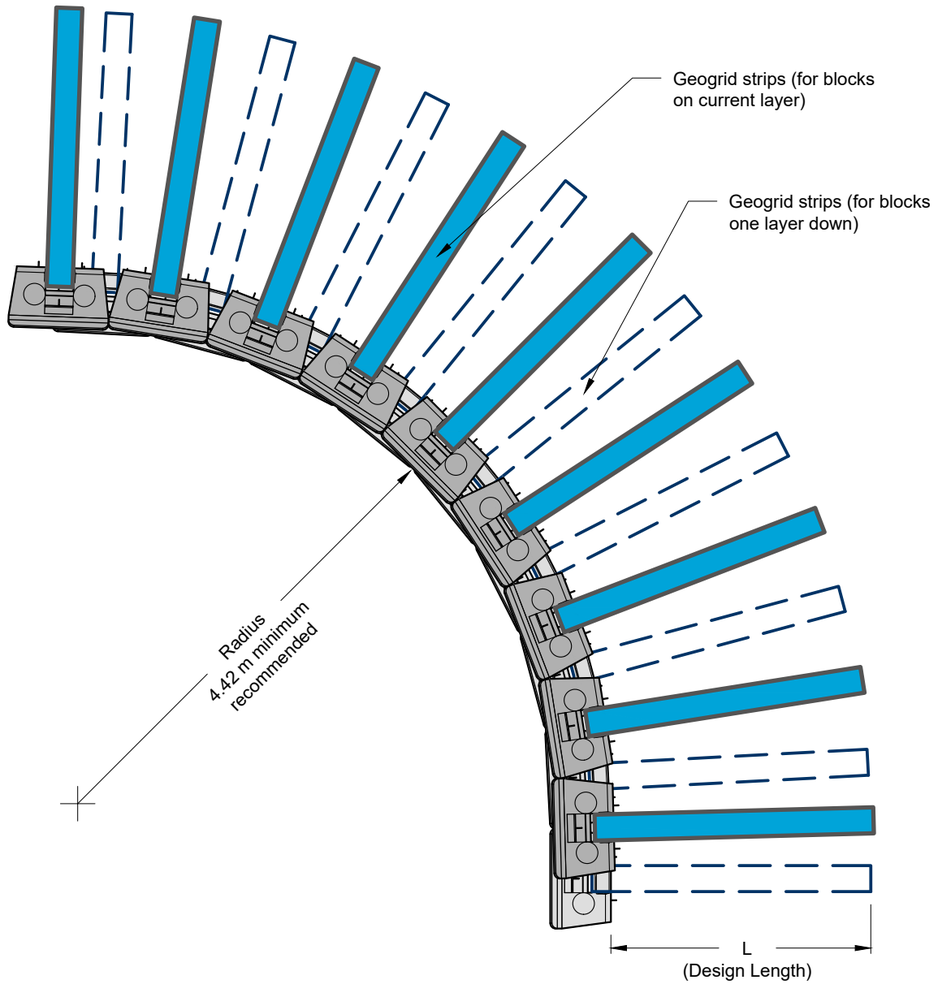


Top View



Back View

Geogrid Layout for Concave Curves and Radial Corners



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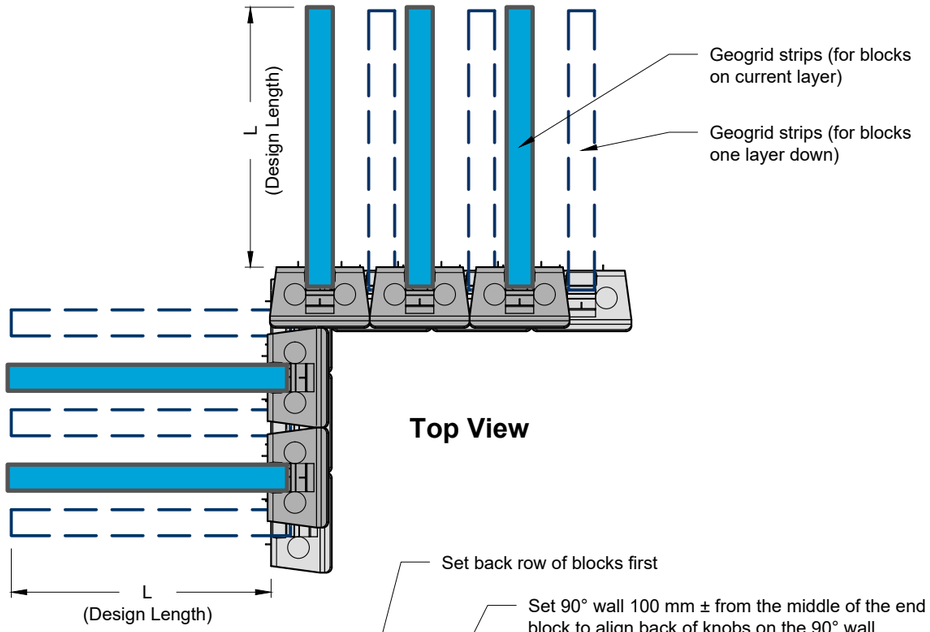
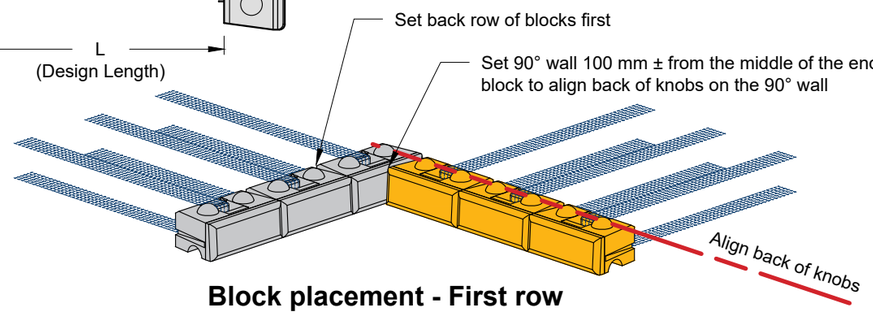
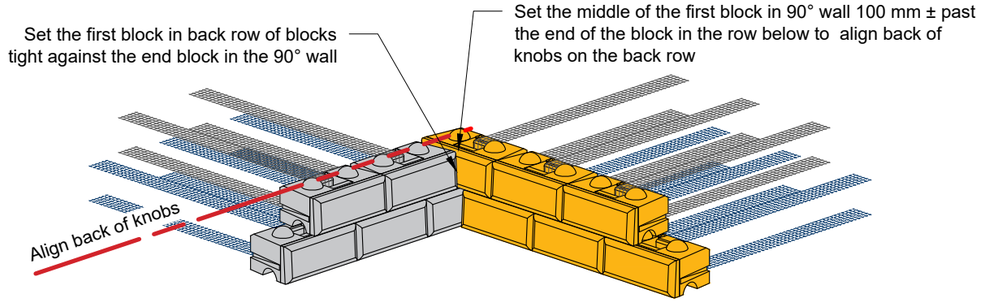
Geogrid Layout for 90° Inside Corner



Top View



Block placement - First row



Block placement - Second row

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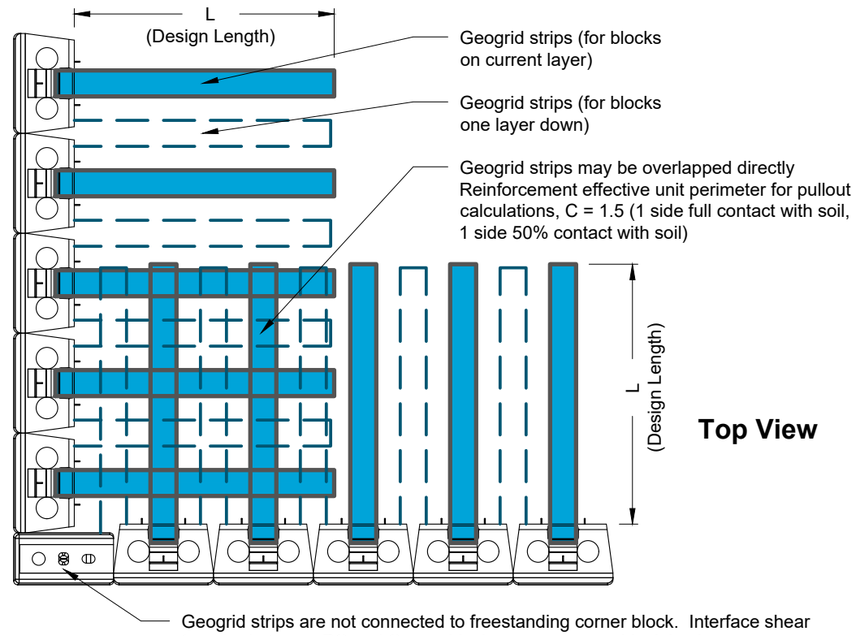
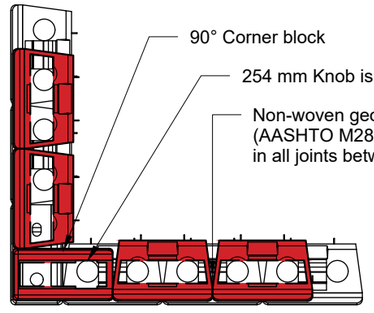
Geogrid Layout for 90° Outside Corner



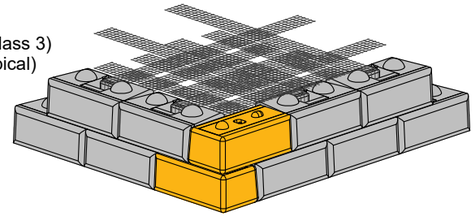
Top View

Block Layout for 90° Outside Corner

The top row of blocks are shown in red. They have been cutout in line with their bottom grooves to show how they fit with the knobs on the bottom row of block. The geogrid strips are not shown for clarity.



Top View of Corner



3D View of Corner

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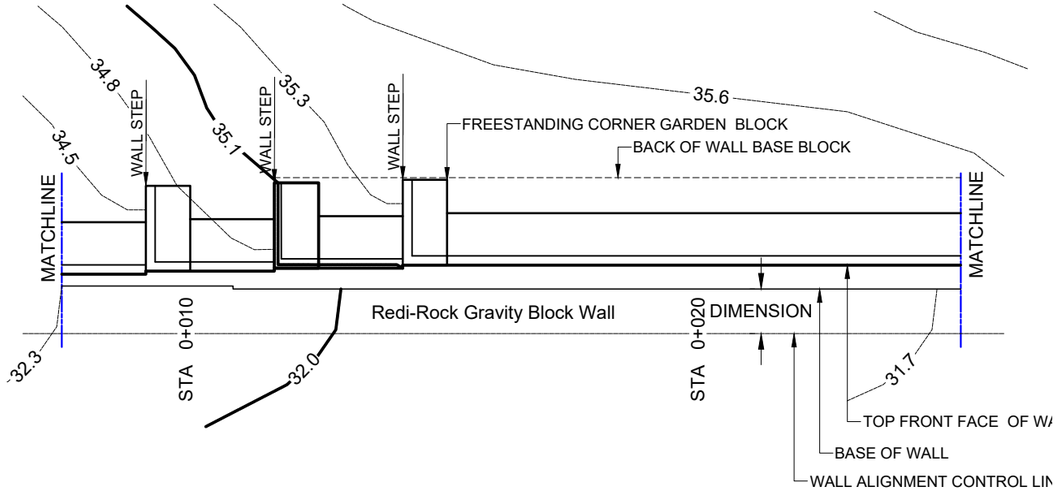
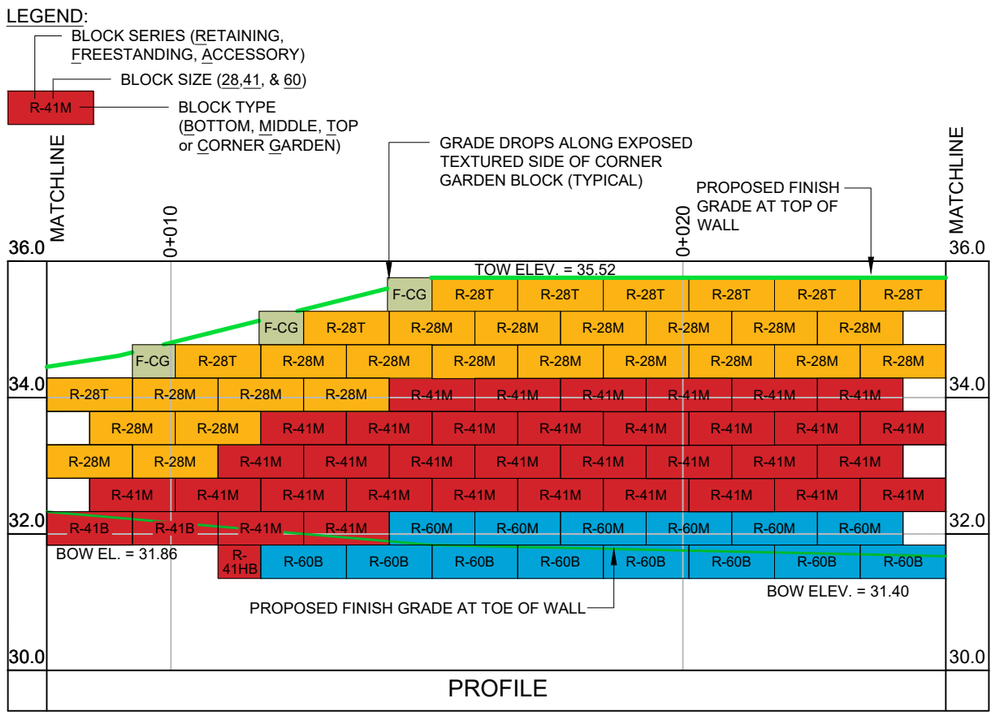
Sample Plan and Profile Gravity Wall





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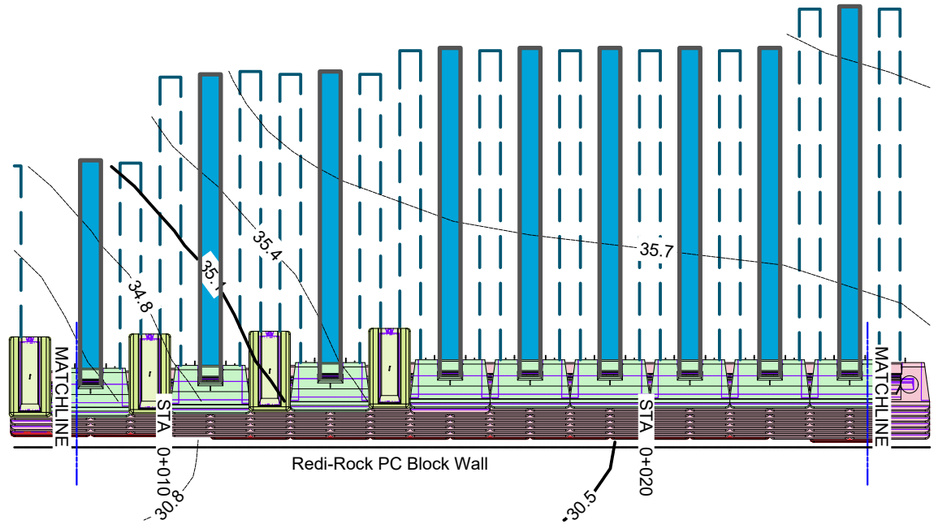
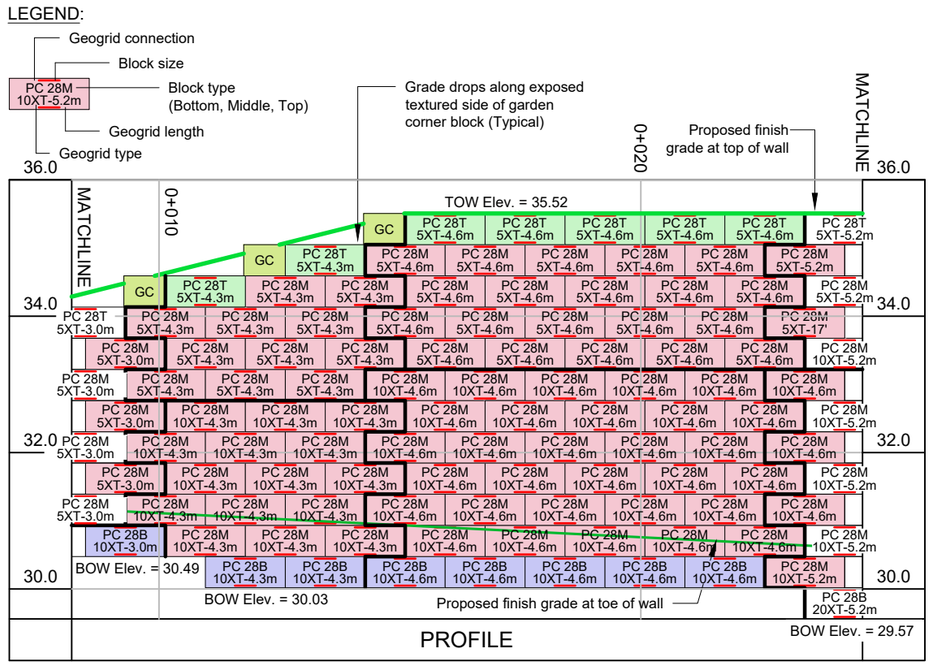
Sample Plan and Profile





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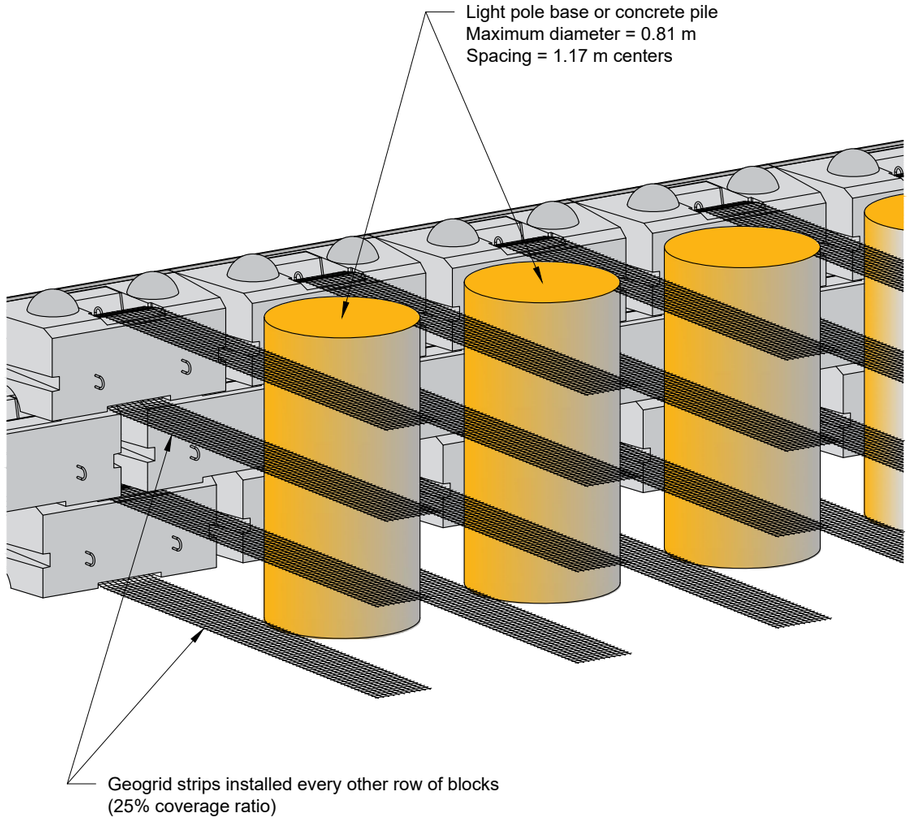
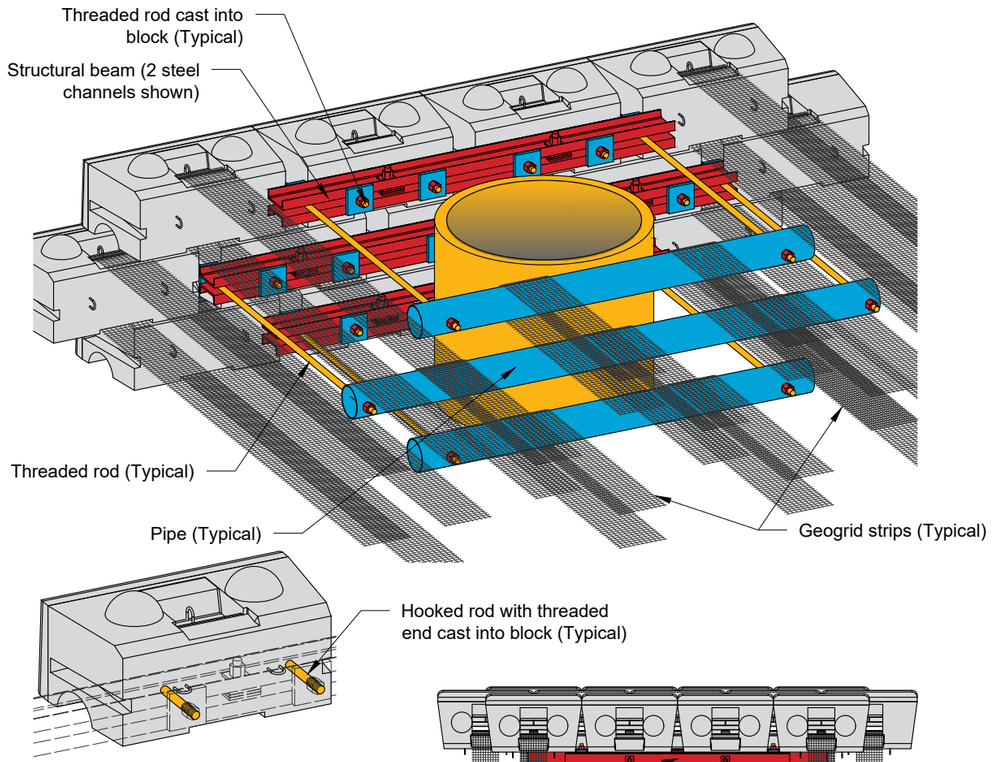
Light Pole Base or Concrete Pile in Reinforced Soil Zone



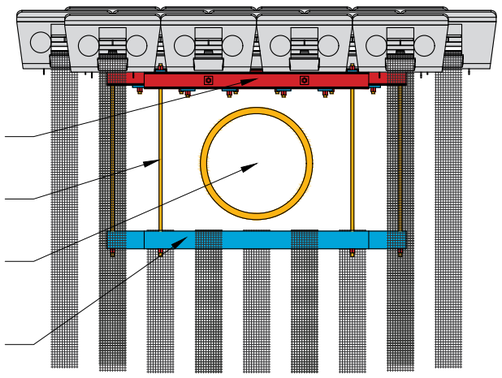
3D View from Back

Manhole or Large Obstruction in Reinforced Soil Zone



Block Detail

Steel structural elements to be sized and galvanized per engineer for project specific requirements.



Top View

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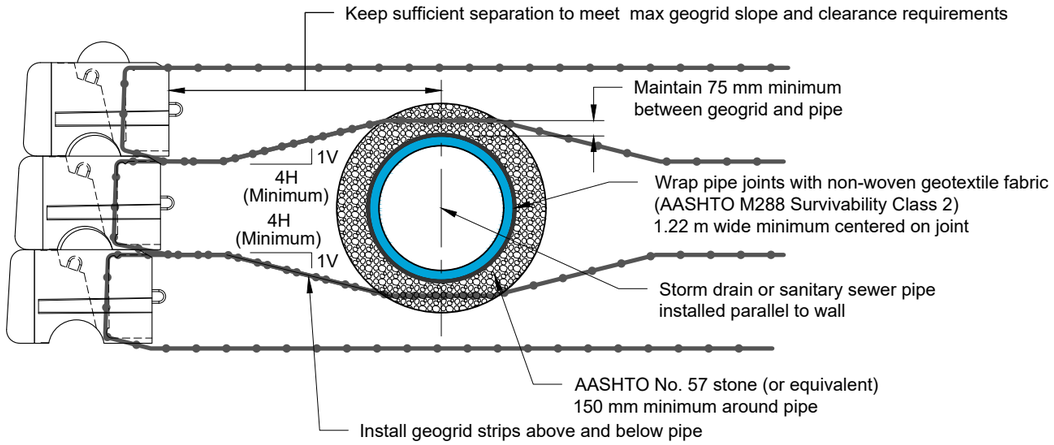
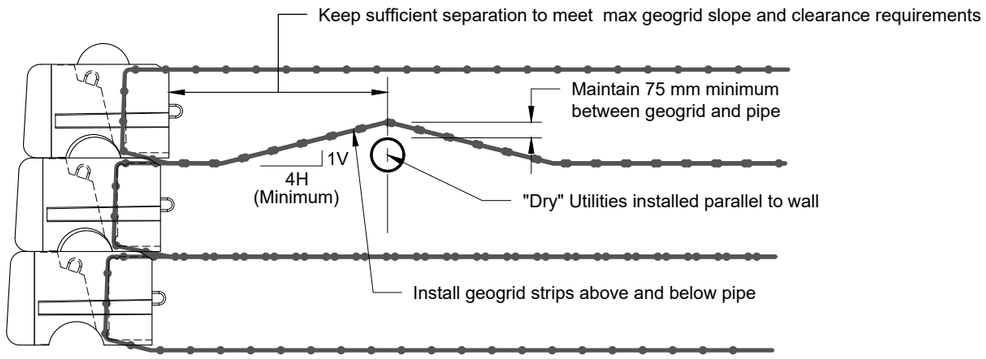
Utilities in the Reinforced Soil Zone



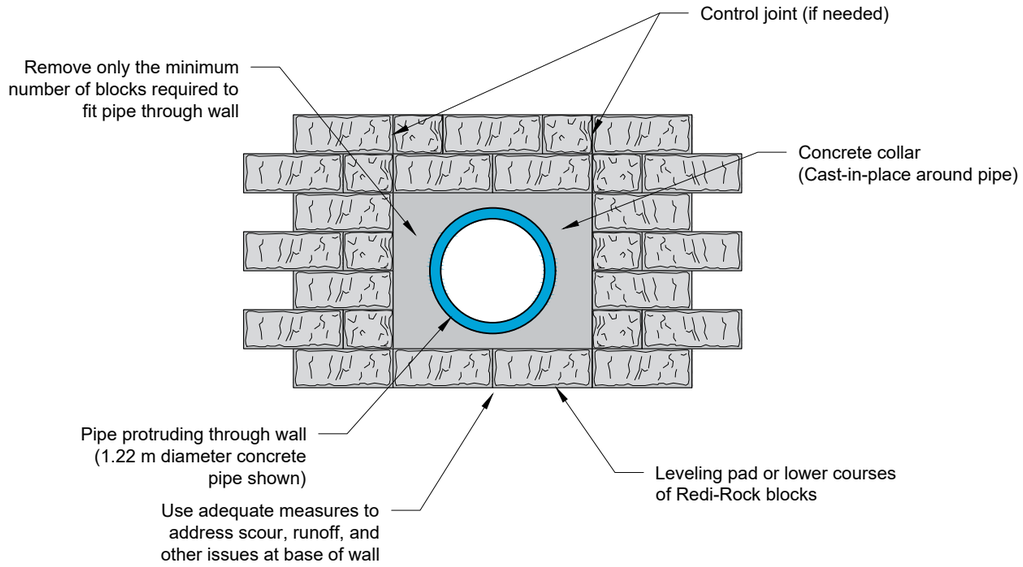
Storm or Sanitary Sewer Pipe



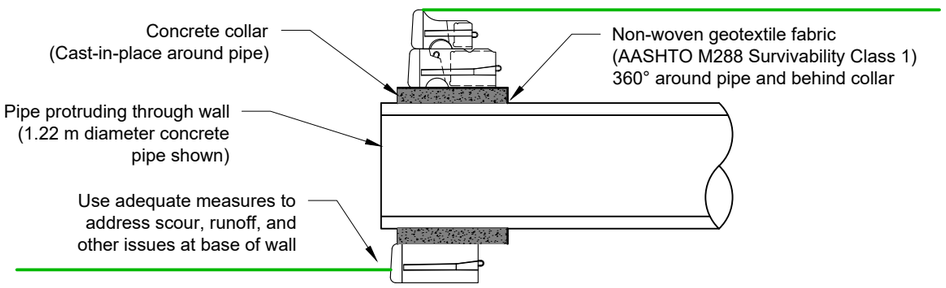
"Dry" Utilities (Electric, Gas, Telecommunications)

Redi-Rock International follows the recommendations of FHWA GEC 011 and discourages placing pipes or other horizontal obstructions behind the wall in the reinforced soil zone. Placing pipes in this zone could lead to maintenance problems and potential wall failure.

Pipes Installed Perpendicular Through Wall



Plan View



Section View

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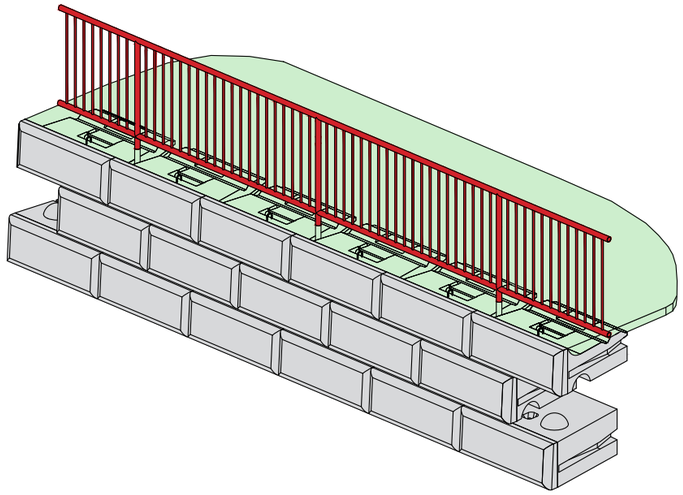
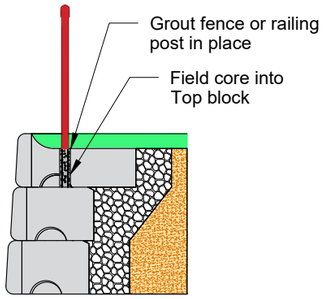
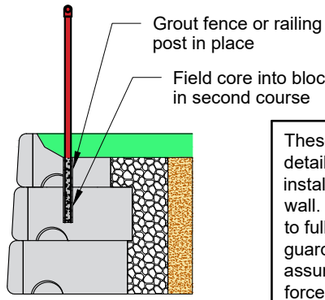
Fence or Pedestrian Guard Connection Options



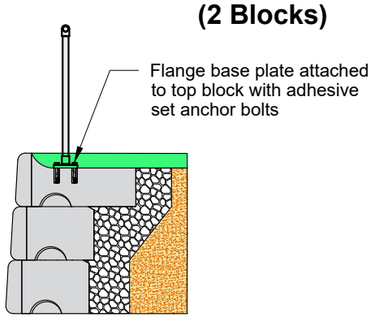


Grouted Connection (1 Block)

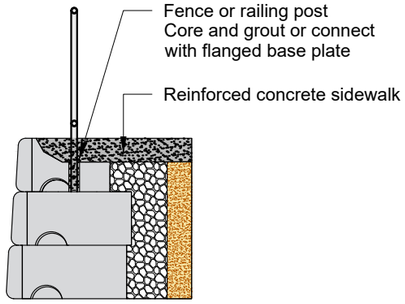


Grouted Connection (2 Blocks)

These generic pedestrian guard and fence details show a few potential options for their installation on the top of a Redi-Rock retaining wall. It is the design engineer's responsibility to fully design and detail the connection of the guard posts to the retaining wall blocks and assure acceptable resistance to the applied forces. Redi-Rock blocks are plain concrete, without steel reinforcement.

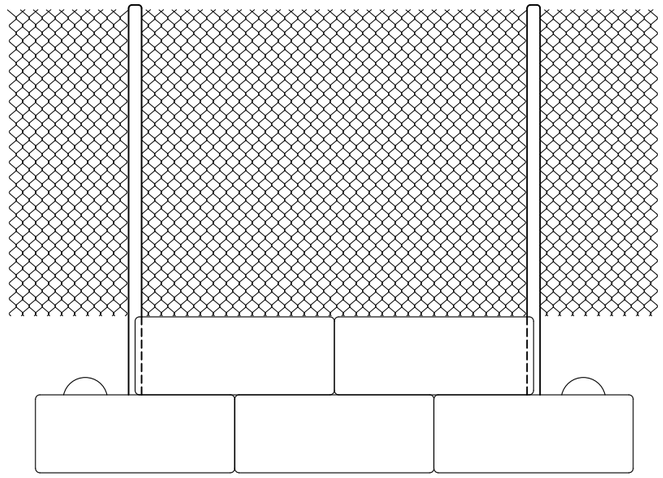


Flange Bolted Connection

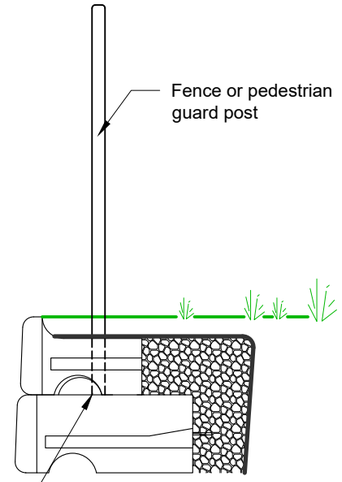


Moment Slab Connection

Fence or Pedestrian Guard Connection Locations

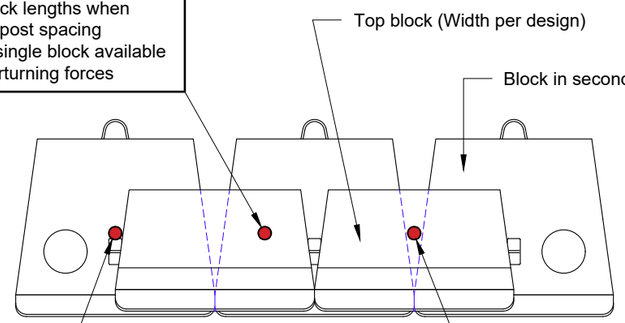


Front View



Side View

Connection Option #1
Anchor into the top block
- Consider block lengths when determining post spacing
- Weight of a single block available to resist overturning forces

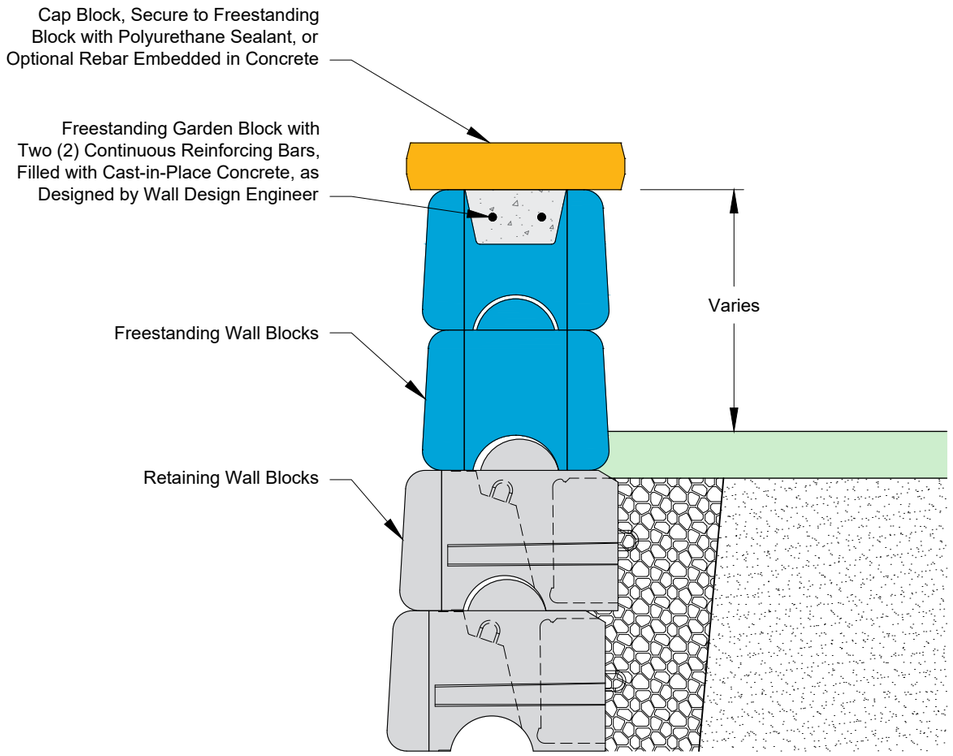


Top View

Connection Option #2
Grout posts in v-shaped opening between top blocks
- Spacing in multiples of 1172 mm
- Weight of a 2 adjacent blocks available to resist overturning forces

Connection Option #3
Core through top block and grout posts in V-shaped opening between lower blocks
- Spacing in multiples of 1172 mm
- Weight of a 2 adjacent blocks on second level down and 3 top row blocks available to resist overturning forces

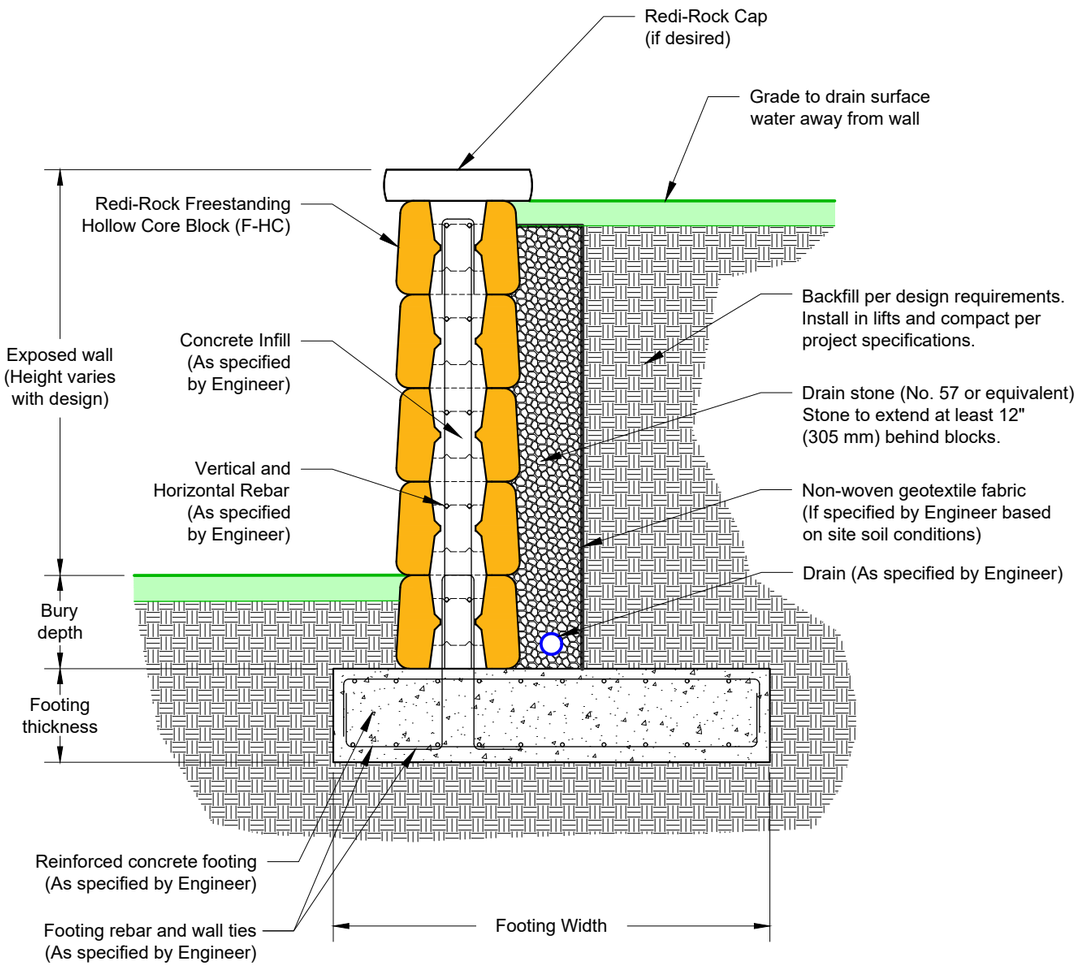
Freestanding Bond Beam at Top of Wall



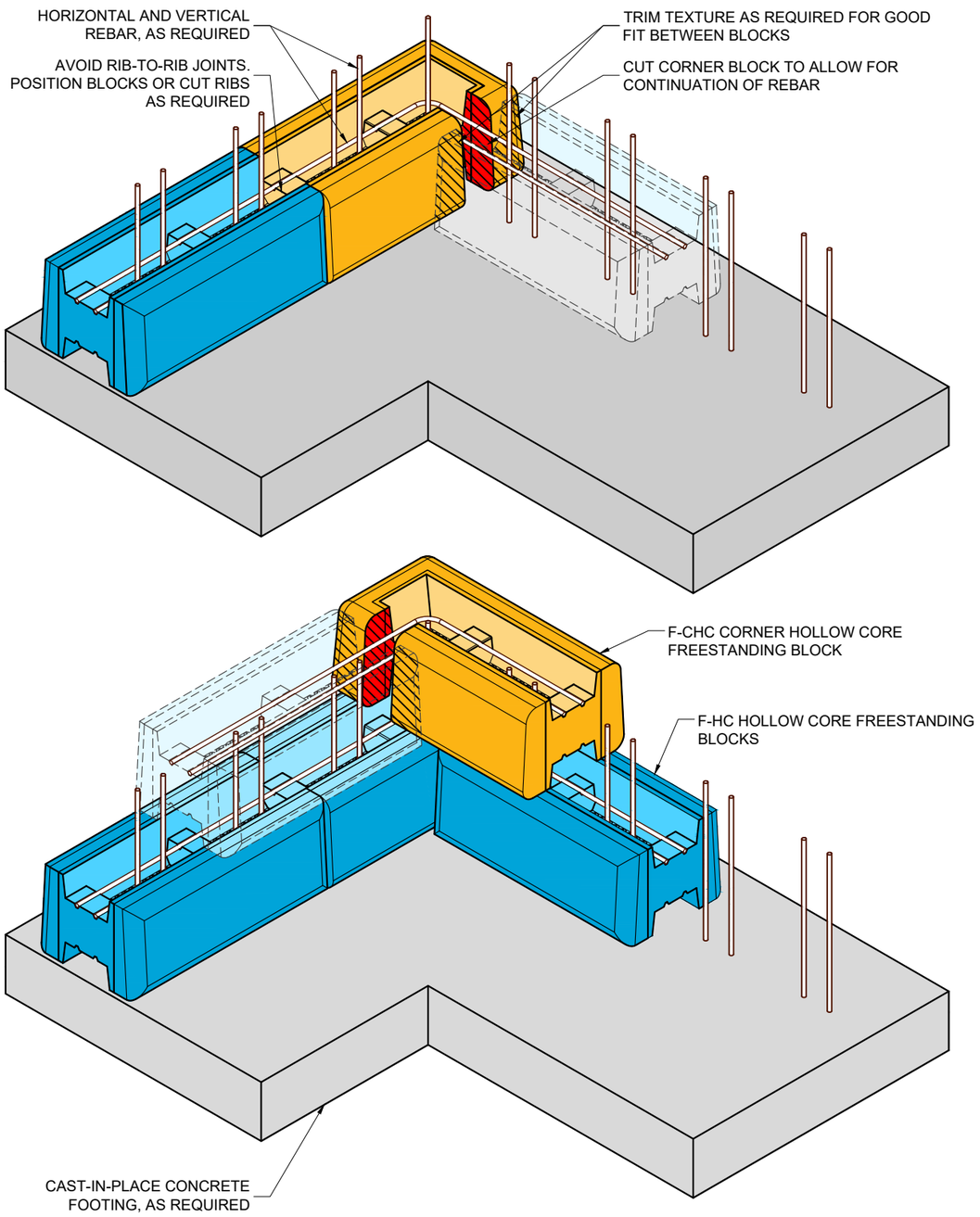
Section View

Sealant Adhesive: One-component, highly flexible, non-priming, gun grade, high performance elastomeric polyurethane sealant shall have movement of plus or minus 25% per ASTM C719, tensile strength greater than 1.4 MPa per ASTM D412, and adhesion to peel on concrete greater than 3.5 N/mm per ASTM C794. Apply sealant in 38 mm diameter round “hersey kiss”-shaped dollops located in two rows at the top of the Freestanding blocks at 200 mm on center.

Typical Cantilever Wall Section



F-HC Freestanding Block Continuous Corner Detail



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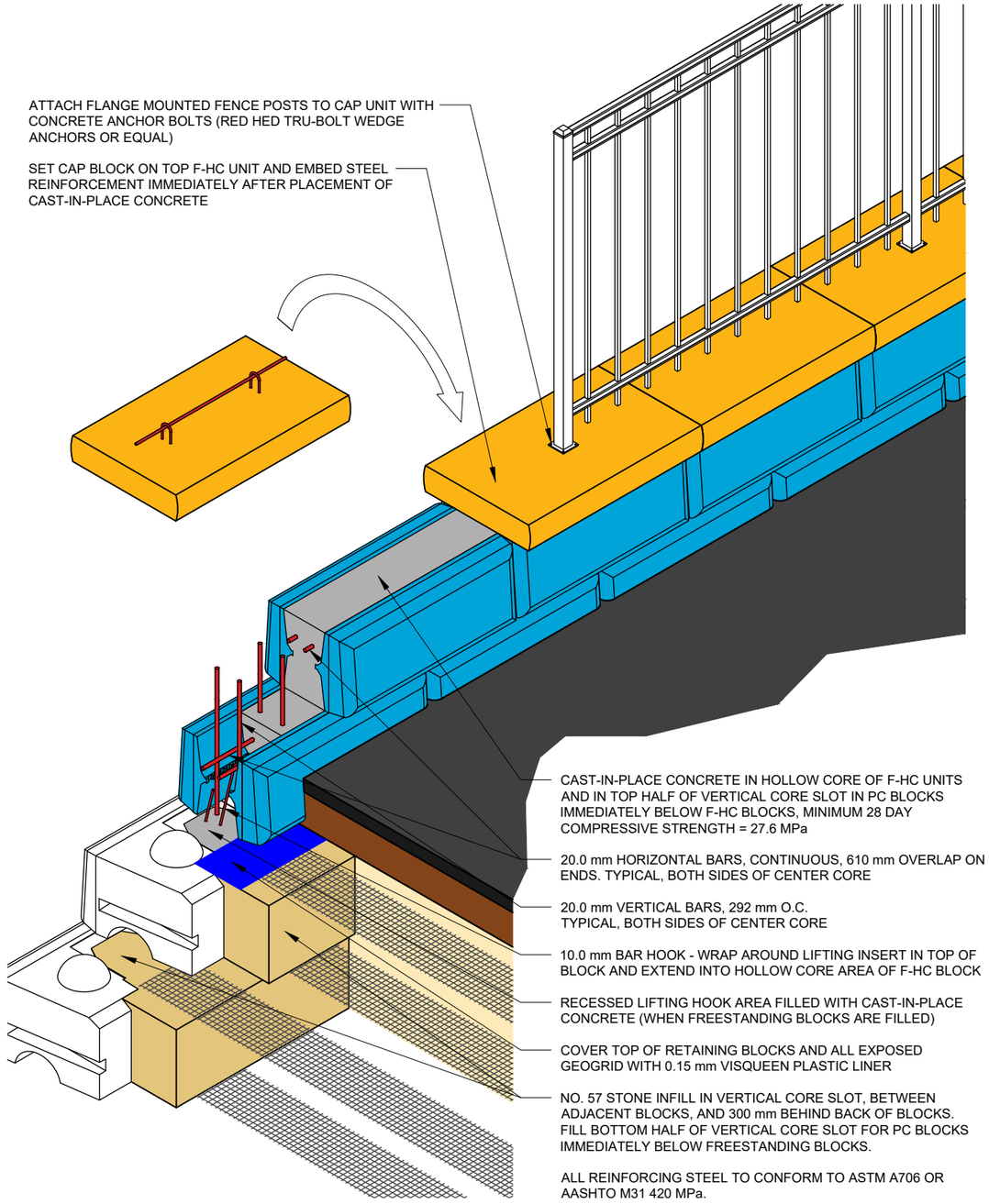
F-HC Freestanding Block Coping with Fence Attachment



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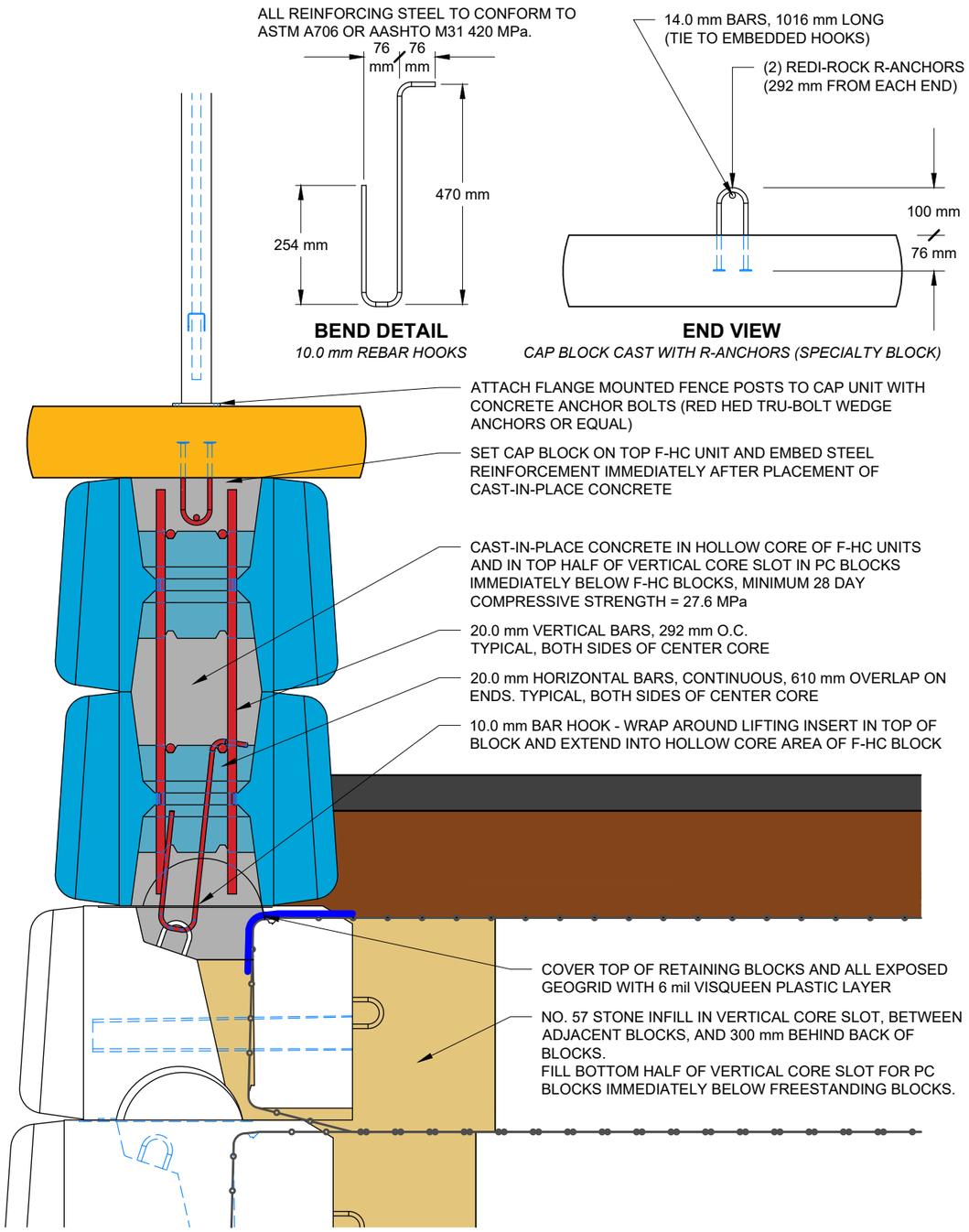
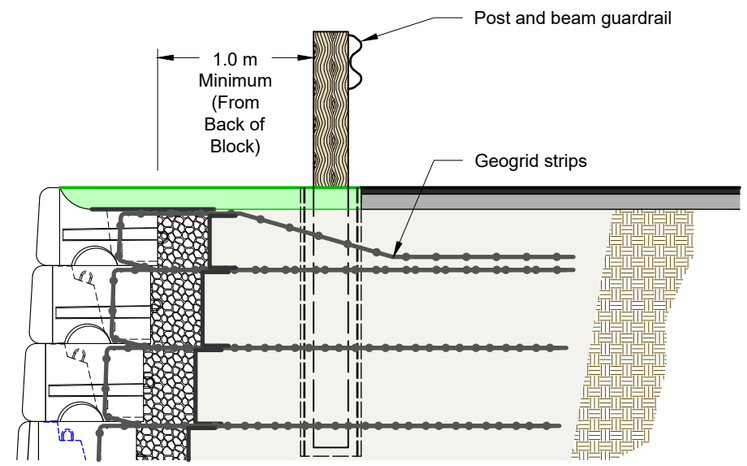
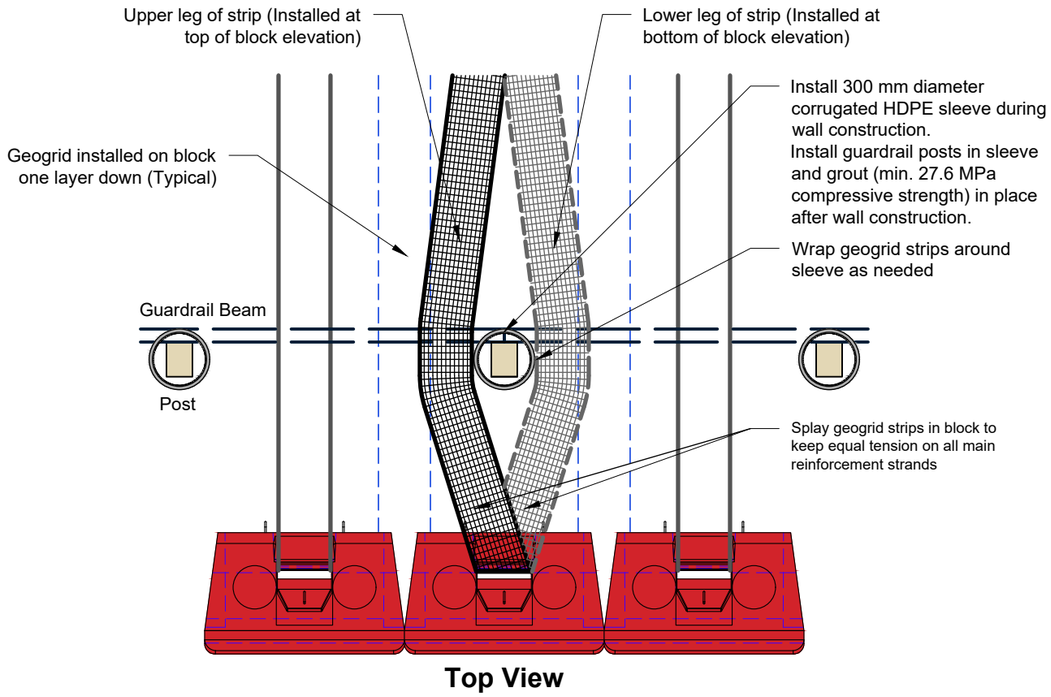
F-HC Freestanding Block Coping with Fence Attachment



Post and Beam Guardrail



Section View



Top View

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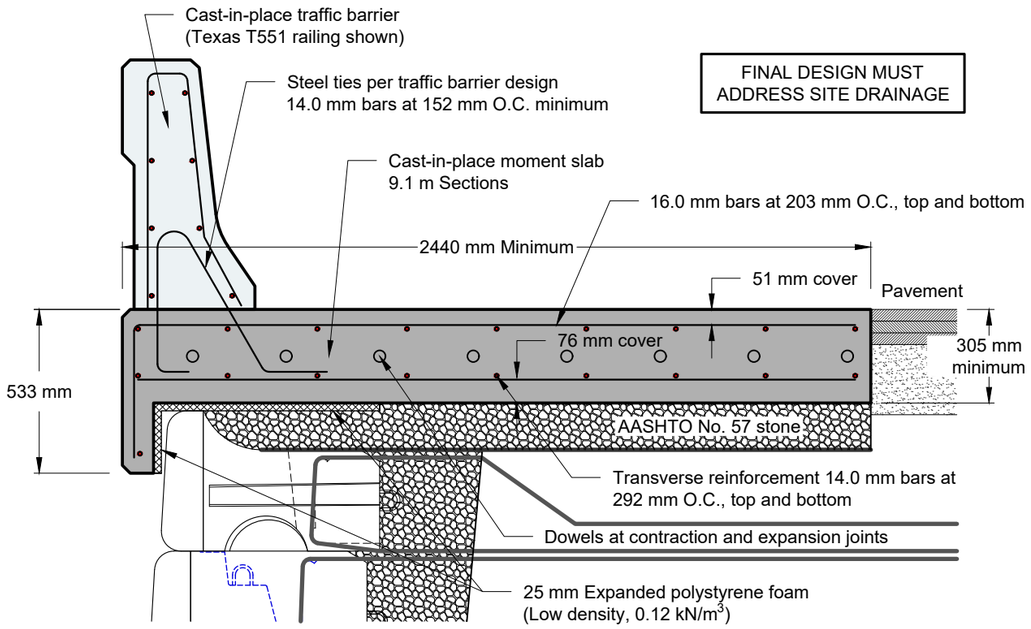
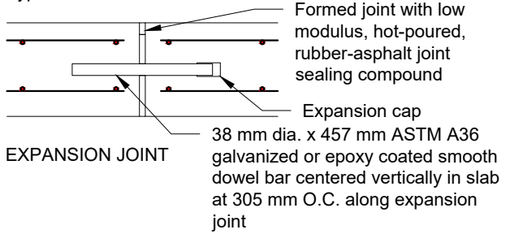
Cast-in-Place Moment Slab Traffic Barrier - Flat Grade Installation

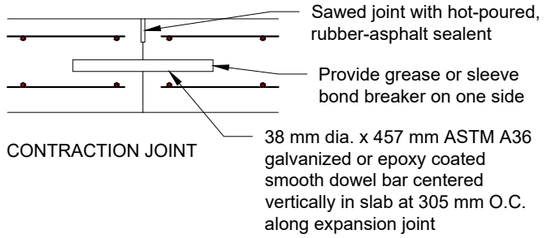


Expansion joints shall be provided in moment slab every 27.4 m. Expansion joint shall be dot standard detail. Typical features shown for reference.



EXPANSION JOINT

Contraction joints shall be provided in moment slab every 9.1 m between expansion joints. Contraction joint shall be transportation agency standard detail. Typical features shown for reference.



CONTRACTION JOINT

Materials

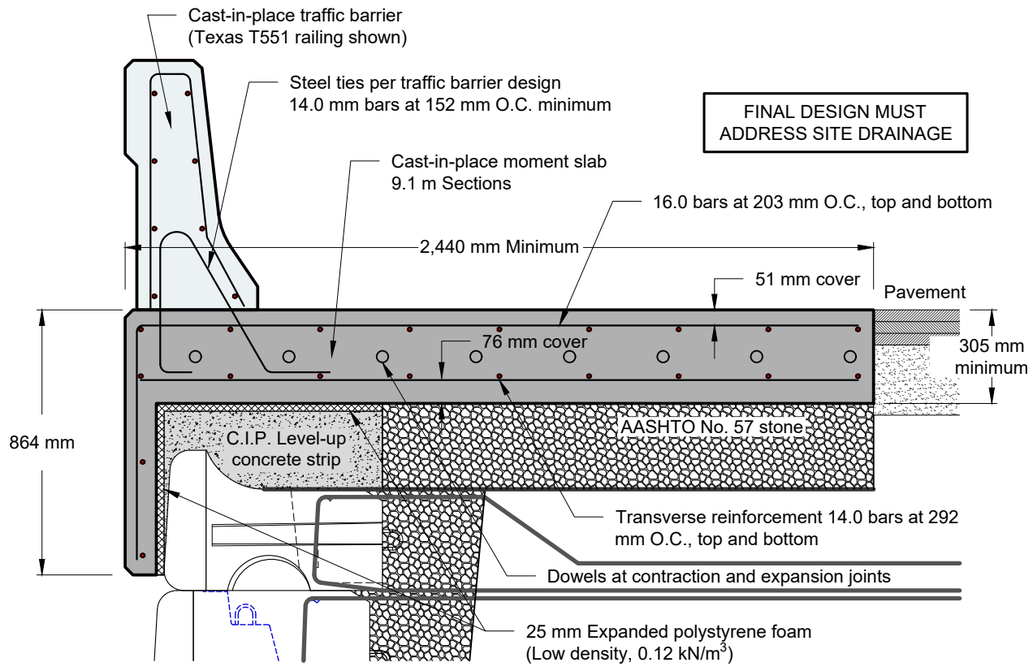
Concrete for cast-in-place barrier and moment slab shall be dot standard structure mix. Minimum 28-day compressive strength shall be 27.6 MPa or higher as specified. Reinforcing steel shall conform to ASTM A706 or AASHTO M31 Grade 60 (420 MPa).

Design

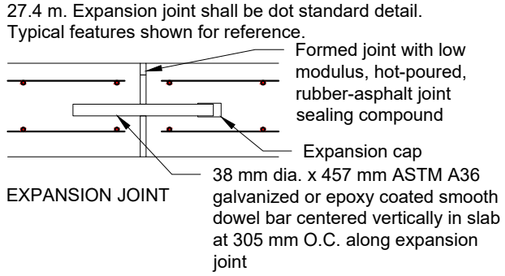
Moment slab shown is dimensioned based on an equivalent static load of 44.5 kN per NCHRP Report 663. Moment slab reinforcement shown is based on *AASHTO LRFD Bridge Design Specifications, 5th edition, 2010*, **TL-4** loading detailed in Table A13.2.1.

The selection and use of this detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the registered professional engineer in charge of the project.

Cast-in-Place Moment Slab Traffic Barrier - Sloping Installation

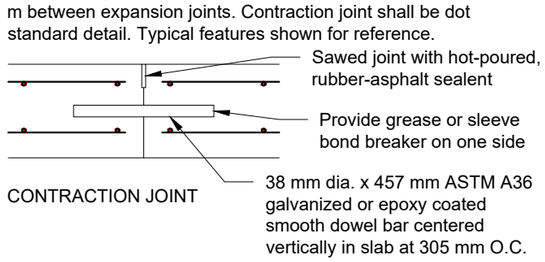


Expansion joints shall be provided in moment slab every 27.4 m. Expansion joint shall be dot standard detail. Typical features shown for reference.



EXPANSION JOINT

Contraction joints shall be provided in moment slab every 9.1 m between expansion joints. Contraction joint shall be dot standard detail. Typical features shown for reference.



CONTRACTION JOINT

Materials

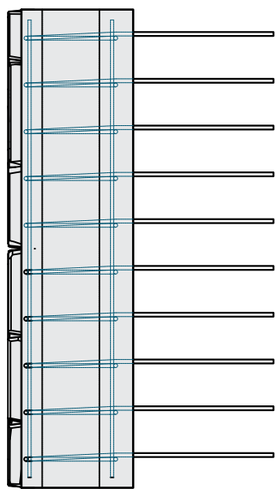
Concrete for cast-in-place barrier and moment slab shall be dot standard structure mix. Minimum 28-day compressive strength shall be 27.6 MPa or higher as specified. Cast-In-Place level-up concrete shall be manufactured in accordance with ASTM C94. Minimum 28-day compressive strength shall be 24.1 MPa or higher as specified. Reinforcing steel shall conform to ASTM A706 or AASHTO M31 Grade 60 (420 MPa).

Design

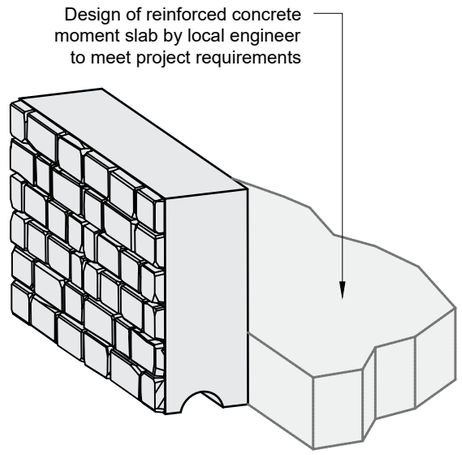
Moment slab shown is dimensioned based on an equivalent static load of 44.5 kN per NCHRP Report 663. Moment slab reinforcement shown is based on *AASHTO LRFD Bridge Design Specifications, 5th edition, 2010*, **TL-4** loading detailed in Table A13.2.1.

The selection and use of this detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the registered professional engineer in charge of the project.

Precast Barrier Block

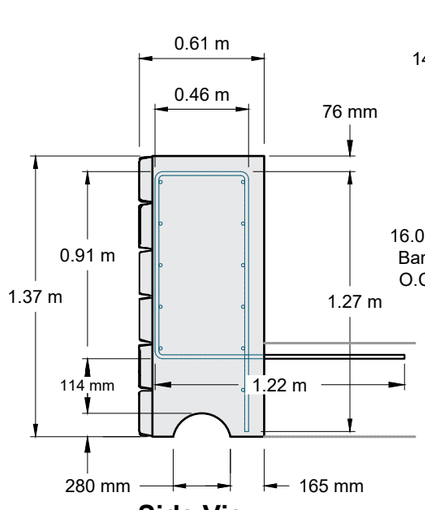


Top View

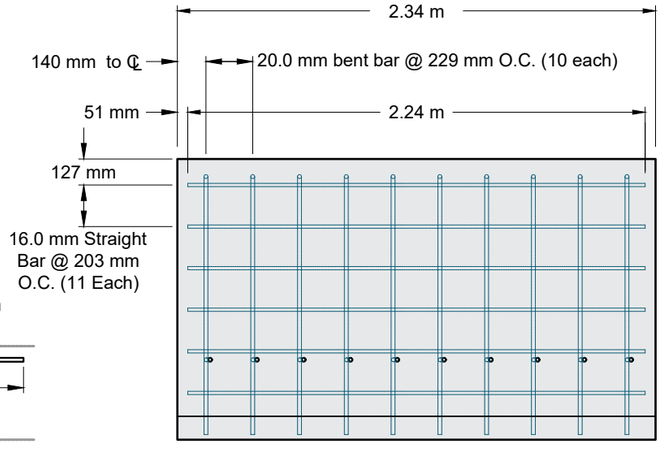


Isometric View

Rebar shown in barrier block meets AASHTO TL-3 loading requirements.
Rebar design in barrier block is intended to be modified as necessary to meet other loading conditions.
All reinforcing steel shall be 420 MPa deformed rebar. All concrete shall have a minimum 28-day compressive strength of 27.6 MPa.



Side View



Back View

This drawing is for reference only. Determination of the suitability and/or manner of use of any details contained in this document is the sole responsibility of the design engineer of record. Final project designs, including all construction details, shall be prepared by a licensed professional engineer using the actual conditions of the proposed site.

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