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Design Manual: Gravity Wall

Section 1





General Information

Company Information

Verti-Block™ is the latest innovative forming system from Verti-Crete, LLC. Recognized worldwide for outstanding aesthetics and performance, Verti-Crete's proprietary and patented forming systems produce the most durable, cost effective and attractive precast elements anywhere. Verti-Crete continues to help precasters around the world provide contractors, developers, and property owners with smart precast solutions.

Verti-Crete's heritage in the precast, concrete, and aggregate industries reaches back decades. From Window Wells to Battery Molds, each innovation has been fueled by our passion for bringing out the beauty of precast concrete. Concrete has been known for centuries for its durability. Through innovative research and design and the application of custom molding technology, Verti-Crete is making concrete known for its low cost and beauty.

Verti-Block Unique Features

- Versatility
- Project Compatibility
- Less Concrete Required
- Engineered Hollow Core
- Lower Transportation Costs
- Faster Return on Investment

Verti-Block was created with landscaping in mind -- we've made it easy to transport and install, even in tight access spots. Blocks can be moved and put into place with smaller equipment; there's no need for heavy machines like a telehandler or crane. The male and female connection eliminates placement error, ensuring strength and an exact installation every time. Also, the engineered hollow cavities allow for more flexibility with drainage and less concrete required for each block which will save time and money.

Verti-Block is ideal for a variety of landscaping projects including residential communities, commercial campuses, schools, parks, back yards, and more. Able to accommodate winding landscapes and even tight curves, Verti-Block is designed to add interest to any landscape while securely retaining earth. For projects also requiring a privacy wall, Verti-Block allows fencing or guard rails to be constructed directly on top of the Verti-Block structure. Fencing can be placed right on the edge of the wall for an attractive, continuous space.



Disclosure

It is important to note that the design parameters for a Verti-Block™ installation come with a suggested maximum height under assumed conditions. Verti-Block wall specifications are calculated using assumed loading conditions and material properties and may fluctuate from location depending on varying soil properties and terrain. In addition to the information included in this manual, please consult with your engineer to determine the specific design requirements for your site as soil and terrain vary by location.

Verti-Crete, LLC provides forming systems to independent Licensed Producers and does not build the actual precast concrete elements themselves. Therefore, Verti-Crete, LLC does not assume any responsibility regarding structural stability of any particular blocks or wall system. Verti-Crete, LLC also assumes no responsibility in connection with any property damage, injury or death claim whatsoever whether asserted against a Lessee, Lessor, Purchasor or others arising out of or attributable to the operation of or products produced with Verti-Crete, LLC equipment.



Design Manual: Gravity Wall with Mass Extenders

Specifications for Verti-Block Gravity Wall

PART 1 GENERAL

1.1 General Information

- A. Work includes supplying and installing precast concrete retaining wall blocks to the lines and grades assigned within the specified construction drawings herein.
- B. The contractor is solely responsible for the means and methods of construction as well as safety of workers and of the public.

1.2 Reference Standards

- A. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- B. ASTM C94: Standard Test Method for Ready-Mixed Concrete.
- C. ASTM C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.
- D. ASTM C1372: Standard Test Method for Segmental Retaining Wall Units.
- E. ASTM D698: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard effort.
- F. ASTM D1557: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified effort.
- G. ASTM D6916: Standard Test Method for Determining the Shear Strength between Segmental Concrete units.

1.3 Delivery, Storage and Handling

- A. Contractor shall check the materials upon delivery to assure proper material has been received.
- B. Contractor shall prevent excessive mud, wet concrete and like substances from adhering to the Verti-Block units.
- C. Contractor shall protect the materials from damage. Damaged material shall not be incorporated in the wall or surrounding reinforced soil embankments.
- D. Exposed faces of precast concrete retaining wall blocks shall be reasonably free of large chips, cracks, or stains when viewed from a distance of 10 feet.

PART 2 MATERIALS

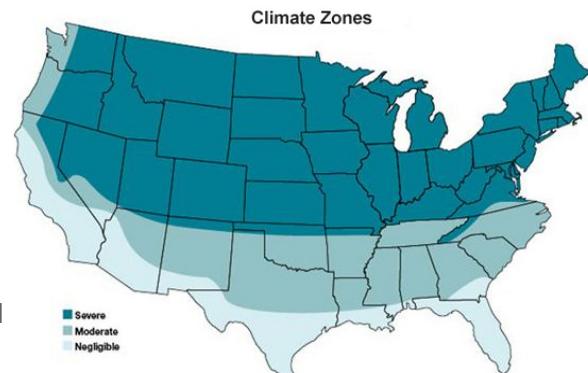
2.1 Wall Units

- A. Precast concrete retaining wall blocks shall be Verti-Block units as produced by a licensed Verti-Block manufacturer.
- B. Exterior precast concrete block dimensions shall be uniform and consistent. Maximum dimensional tolerances shall be within 1 percent excluding the architectural surface. Maximum width (face to back) dimensional deviation including the architectural surface shall be 1 inch.
- C. Exposed face shall be finished as specified. Other surfaces to be smooth form type. Small bug holes on the block face may be patched to blend into the remainder of the block face.

- D. Concrete for precast blocks shall have a minimum of 28-day compressive strength of 4,000 psi (pounds per square inch).
- E. Wall units shall be made with Ready-Mixed concrete in accordance with ASTM C94, latest revision, and per the following chart:

Climate	Air Content	28 Day Compressive Strength, psi	Slump*
Severe	4 1/2 % - 7 1/2 %	4000	5" ± 1 1/2"
Moderate	3% - 6%	4000	5" ± 1 1/2"
Negligible	1 1/2% - 4 1/2%	4000	5" ± 1 1/2"

*Higher slumps are allowed if achieved by use of appropriate admixtures. Nevertheless, all material used in the wall units must meet applicable ASTM and local requirements for exterior concrete.



- F. Typical applications do not require reinforcing steel. However, if an application outside the scope of this design manual calls for it, reinforcing steel (if used) shall be Grade 60. Minimum clear cover to reinforcement shall be 1.5 inches.
- G. The face pattern shall be selected from the manufacturer's standard molds. The color of each block unit shall be natural gray (precast concrete). A concrete stain may be field applied to color the block units if specified by the Owner.

2.2 Leveling Pad and Drainage Pipe

- A. Leveling Pad shall consist of (1 inch minus) crushed stone base.
- B. Drainage infill material shall be stone and be poured into the hollow core of each Verti-Block as each row of blocks is installed. Ensure that all voids are filled and no air pockets are detected.
- C. Backfill material shall be approved by the geotechnical engineer. Native site excavated soils may be compacted in place if approved unless otherwise specified in the drawings. Unsuitable soils with a PL greater than 6, organic soils, and frost susceptible soils shall not be used within a 1 to 1 influence area.
- D. Non-woven geotextile cloth shall be placed between the native retained soil and the block wall.
- E. Where additional fill is needed, Contractor shall submit sample and specification to Engineer for approval.

2.3 Drainage

- A. Internal and external drainage shall be a perforated 4 inch drain pipe but must be evaluated by a professional engineer who is responsible for the final wall design for exact requirements.



Design Manual: Gravity Wall with Mass Extenders

Specifications for Verti-Block Gravity Wall

2.4 GEOTEXTILE FABRIC

- A. Provide a geotextile filter for separation from backfill at the tails of the blocks. The geotextile shall be a needle punched non-woven fabric with a minimum grab tensile strength of 120 pounds (Reference ASTM D4632). The geotextile may cover the entire back face of the blocks or may be cut into strips to cover the gaps between tail units with a minimum of 6 inches of overlap over the concrete tail on both sides.

PART 3 CONSTRUCTION

3.1 EXCAVATION

- A. Excavate as required to the lines and grades shown on construction drawings for installation of the retaining wall. Excavate to the base level for a sufficient distance behind the face to permit installation of the base.
- B. Slope or shore excavation as necessary for safety and for conformance with applicable OSHA requirements.

3.2 FOUNDATION AND SOIL PREPARATION

- A. On-site foundation soil shall be examined by the Geotechnical Engineer to ensure that the bearing foundation soil strength meets or exceeds assumed design conditions and strength. Soil not meeting the required strength shall be removed and replaced with acceptable, compacted material.
- B. Level the gravel base to lines and grades demonstrated on the construction plans. Native foundation soil shall be compacted to 95 percent of the maximum dry density (ASTM D698, Standard Proctor) or 90 percent of modified proctor to ensure a hard and level surface on which the first set of blocks may be suitable replacement fill.
- C. Prepare and smooth the granular material to ensure complete contact of the first course with the base. The surface of granular base may be dressed with finer aggregate to aid leveling, provided that the thickness of dressing layer should not exceed 3 times the maximum particle size used. Native soil compacted in place as each course is set.
- D. Contractor may substitute concrete for granular base material. Concrete may be placed full thickness or as a topping to level the base. If used as a topping, the concrete shall have a minimum thickness of 3 inches.

3.3 UNIT INSTALLATION

- A. Place the first course of standard wall block units directly on the compacted (1 inch minus) fractured gravel base. Ensure full contact between adjacent blocks so they fit tightly together. Check all blocks for uniform alignment and level placement.
- B. Fill and compact the unity core and all voids between and within the blocks with clean (1 inch minus) gravel to lock firmly into place. Continue to check for level and alignment between all blocks.

3.4 UNIT INSTALLATION - CONTINUED

- A. Place clean native soil behind the units in maximum loose lifts of 8 inches and compact. Compact all backfill to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). For cohesive soils, the moisture content at the time of compaction should be adjusted to within -2 and +3 percent of optimum. Place backfill in successive lifts until level with the top of the facing unit.
- B. Remove and sweep off all excess aggregate and other materials from the top of the blocks before continuing on the next block course.
- C. Install next course of precast concrete retaining wall blocks to bond on top of the base row. Position blocks to be offset from seams of blocks on lower course. Blocks shall be placed at a 2 3/16 inch setback and recessed over the alignment hoop. Check each block for proper alignment and level. Continue to unit fill and backfill behind each course of units. Hand-operated place and compaction equipment shall be used around the block and within 3 feet of the wall to achieve consolidation.
- D. Continue to install subsequent courses of blocks in a like manner to elevations shown on the construction plans. Construct wall in level stages, placing the units at each course for the entire length of the wall, if possible. Unit fill and backfill shall be placed to the level of the top of the facing block unit before placing the next course.
- E. Final grade above and below the retaining wall shall provide for positive drainage and prevent ponding. Protect completed wall from other construction. Do not operate large equipment or store materials above the wall that exceed the design surcharge loads. All walls shall be installed in accordance with local building codes and requirements.

PART 4 QUALITY ASSURANCE

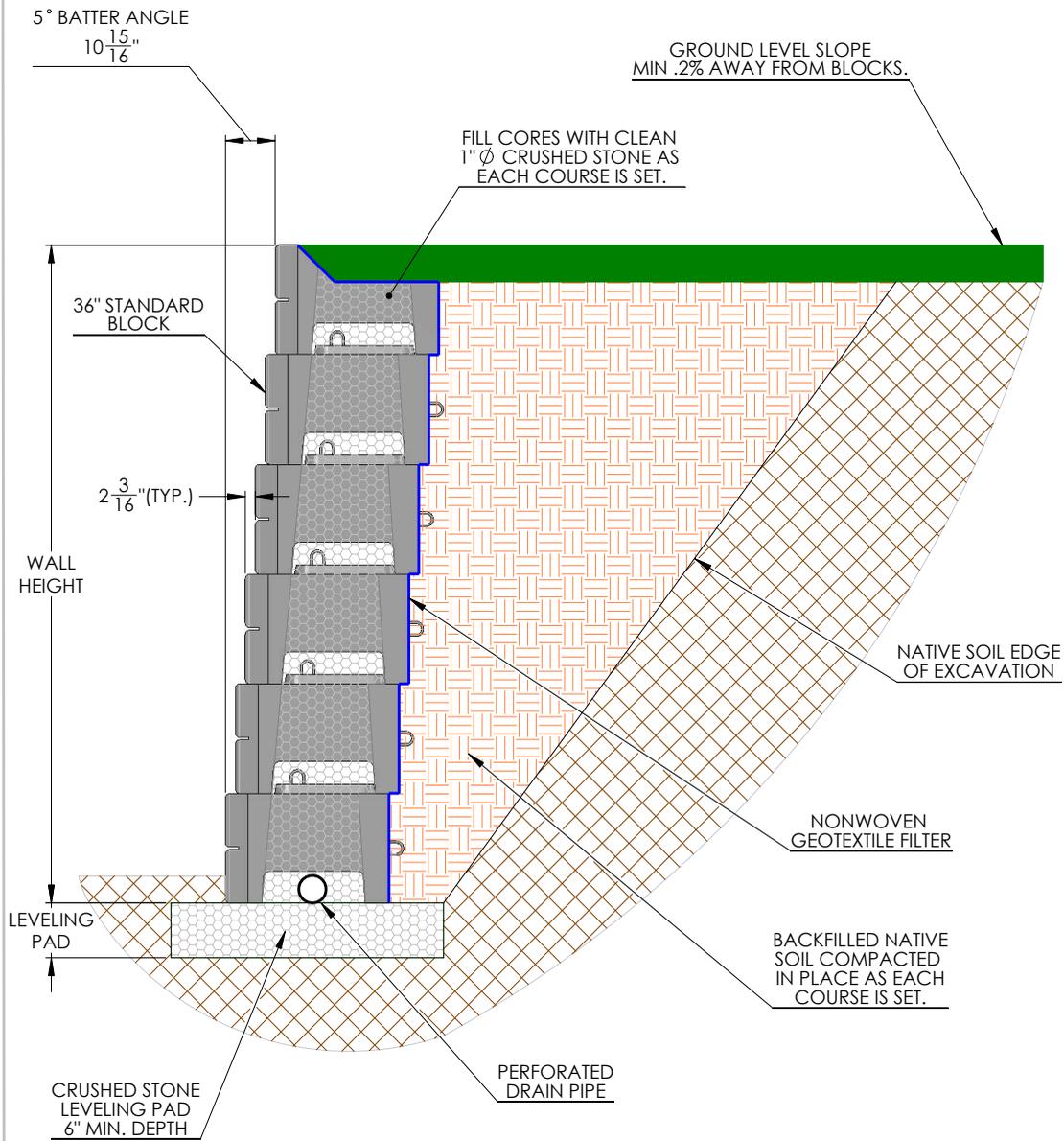
4.1 CONSTRUCTION QUALITY CONTROL

- A. The contractor is responsible to ensure that all installation and materials meet the quality specified in the construction drawings.
- B. The contractor shall verify that installation is in accordance with the specifications and construction drawings.

4.2 QUALITY ASSURANCE

- A. The Owner is responsible to engage testing and inspection service to provide quality construction assurance.
- B. Compaction testing shall be done a minimum of every 1 foot of vertical fill and every 100 lineal feet along the wall.
- C. Testing shall be done at a variety of locations to cover the entire backfill zone.
- D. The inspection professional should perform sufficient testing and observation to verify that wall installation substantially conforms to the design drawings and specifications and complies to all ASTM standards.

TYPICAL GRAVITY WALL WITH 36" VERTI-BLOCK



DRAWN BY
DAN BALLING

DATE
12/30/2013

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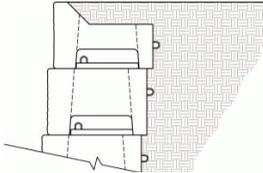
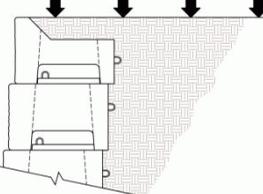
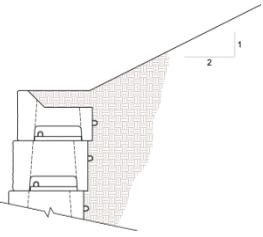
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12' RETAINING SECTION

DWG NO.
WD-14

SCALE: 1:30

SHEET 1 OF 1

Gravity Wall Matrix with 36 inch Deep Blocks

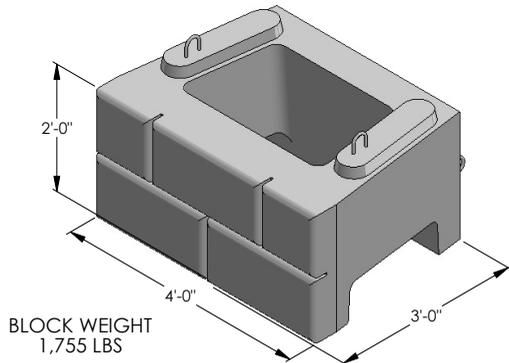
Soil Type	Silty Soil <i>Internal Angle of Friction $\geq 30^\circ$</i>			Sandy Soil <i>Internal Angle of Friction $\geq 35^\circ$</i>			Gravelly Soil <i>Internal Angle of Friction $\geq 40^\circ$</i>		
	Wall Height	Min. Bury Depth	Leveling Pad	Wall Height	Min. Bury Depth	Leveling Pad	Wall Height	Min. Bury Depth	Leveling Pad
Level Backfill <i>No Surcharge</i> 	3'-6"	6"	6"	3'-6"	6"	6"	3'-6"	6"	6"
	5'-6"	6"	6"	5'-6"	6"	6"	5'-6"	6"	6"
	7'-6"	6"	6"	7'-6"	6"	6"	7'-6"	6"	6"
				9'-6"	6"	6"	9'-6"	6"	6"
							11'-6"	6"	6"
							13'-6"	6"	6"
Level Backfill <i>250 psf Surcharge</i> 	3'-6"	6"	6"	3'-6"	6"	6"	3'-6"	6"	6"
	5'-6"	6"	6"	5'-6"	6"	6"	5'-6"	6"	6"
				7'-6"	6"	6"	7'-6"	6"	6"
							9'-6"	6"	6"
2:1 Sloping Backfill <i>No Surcharge</i> 	3'-6"	6"	6"	3'-6"	6"	6"	3'-6"	6"	6"
	5'-6"	6"	6"	5'-6"	6"	6"	5'-6"	6"	6"
				7'-6"	6"	6"	7'-6"	6"	6"
							9'-6"	6"	6"
							11'-6"	6"	6"

The above chart was prepared by Verti-Crete, LLC for estimating and conceptual design purposes only. All information is believed to be true and accurate; however Verti-Crete, LLC assumes no responsibility for the use of these design charts for actual construction. Determination of the suitability of each chart is the sole responsibility of the user. Final designs for construction purposes must be performed by a registered Professional Engineer, using the actual conditions of the proposed site.

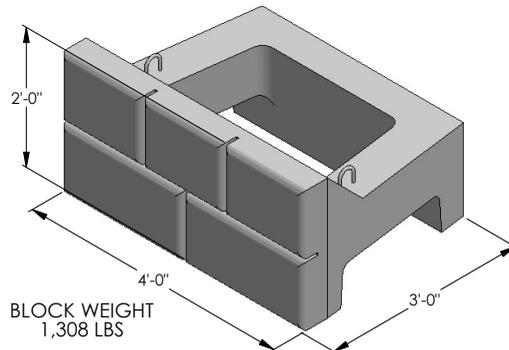
Notes: Unit weight of soil is 120 psf. Minimum factors of safety are sliding: 1.5, overturning: 1.5, and bearing: 2.0. Wall design shall address both internal and external drainage and shall be evaluated by the professional engineer responsible for final design. Backfill material to be compacted to 95% modified proctor density.

36" BLOCK SERIES

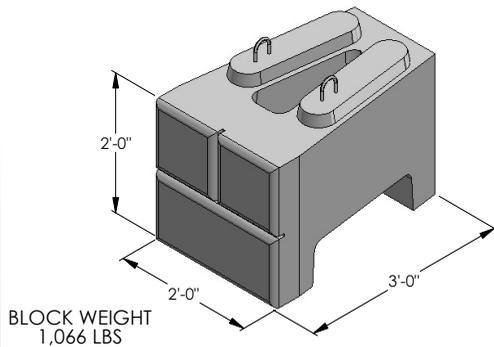
STANDARD BLOCK



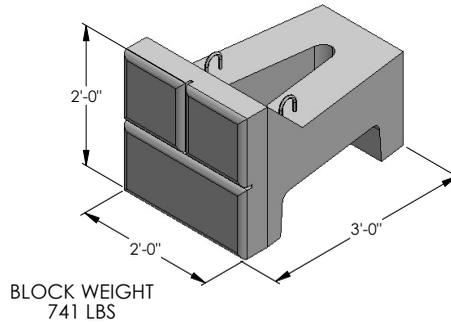
STANDARD TOP BLOCK



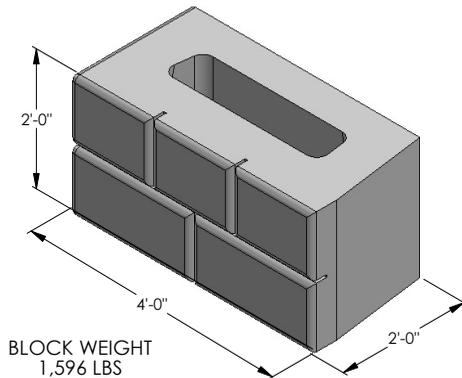
HALF BLOCK



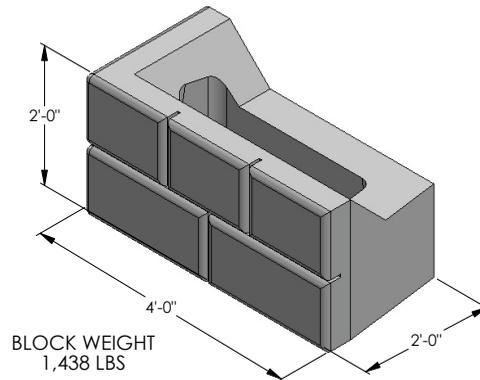
HALF TOP BLOCK



CORNER BLOCK



CORNER TOP BLOCK



DRAWN BY	DATE
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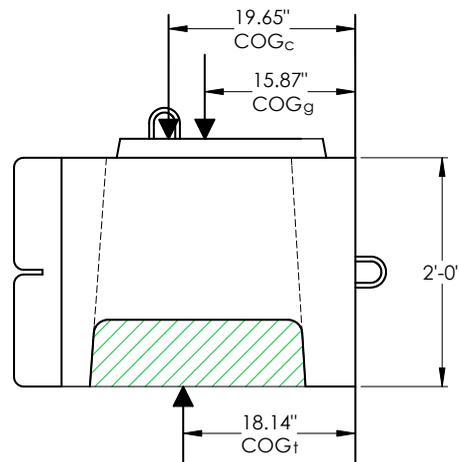
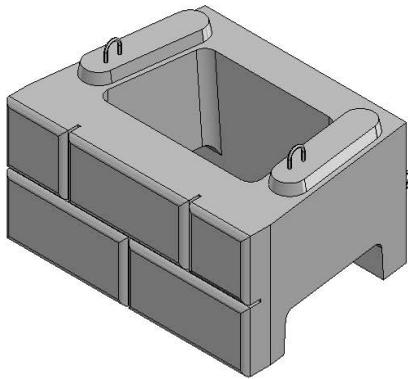
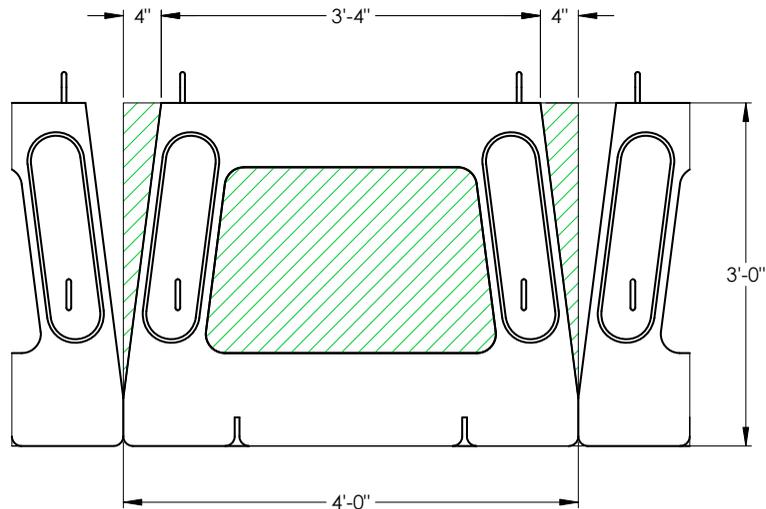
TITLE:
36" BLOCK SERIES

DWG. NO.
BD-01

SCALE: 1:20

SHEET 1 OF 1

36" STANDARD BLOCK & GRAVEL INFILL



CONCRETE BLOCK DATA

DESIGN UNIT WEIGHT (γ_c) = 142 pcf
 VOLUME (V_c) = 12.36 cft
 BLOCK WEIGHT (W_c) = 1,755 lbs
 CENTER OF GRAVITY (COG_c) = 19.65" (SEE NOTES)

GRAVEL INFILL DATA

DESIGN UNIT WEIGHT (γ_g) = 110 pcf
 VOLUME (V_g) = 11.64 cft
 GRAVEL INFILL WEIGHT (W_g) = 1,280 lbs
 CENTER OF GRAVITY (COG_g) = 15.87" (SEE NOTES)

NOTES:

- VOLUME, WEIGHT AND COG CALCULATIONS WERE DONE USING CAD SOFTWARE.
- COG MEASUREMENTS ARE FROM BACK OF BLOCK

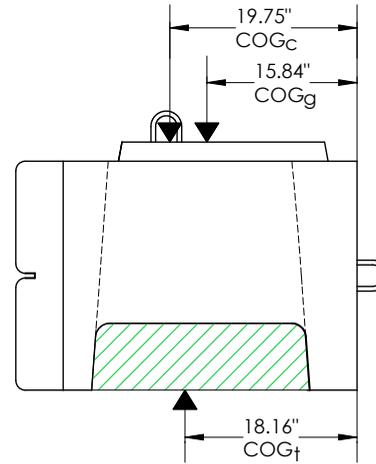
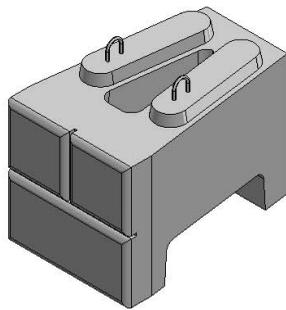
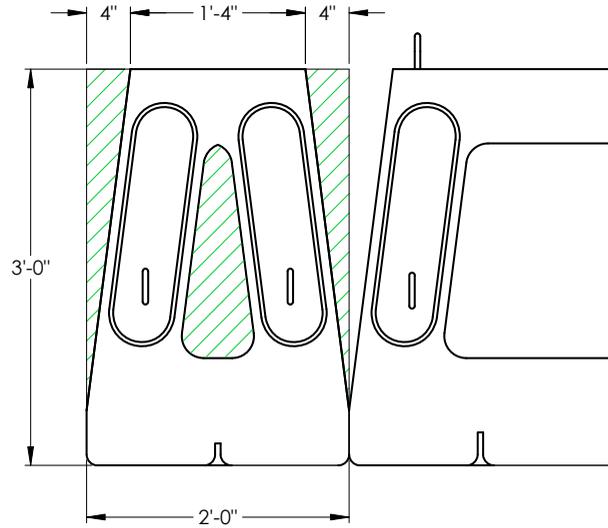
COMBINED UNIT DATA

DESIGN UNIT WEIGHT (γ_t) = $(1,755 \text{ lbs} + 1,280 \text{ lbs}) / 24 \text{ cft} = 126 \text{ pcf}$
 VOLUME (V_t) = $12.36 \text{ cft} + 11.64 \text{ cft} = 24.00 \text{ cft}$
 TOTAL UNIT WEIGHT (W_t) = 3,035 lbs
 CENTER OF GRAVITY (COG_t) = 18.14" (SEE NOTES)



DRAWN BY	DATE	TITLE:
DAN BALLING	11/25/2013	STANDARD BLOCK
16500 SOUTH 500 WEST BLUFFDALE, UTAH 84065 PHONE: (801) 571-2028		DWG NO.
		BD-02
SCALE: 1: 15		SHEET 1 OF 1

36" HALF BLOCK & GRAVEL INFILL



CONCRETE BLOCK DATA

DESIGN UNIT WEIGHT (γ_c) = 142 pcf
 VOLUME (V_c) = 7.52 cft
 BLOCK WEIGHT (W_c) = 1,068 lbs
 CENTER OF GRAVITY (COG_c) = 19.75" (SEE NOTES)

GRAVEL INFILL DATA

DESIGN UNIT WEIGHT (γ_g) = 110 pcf
 VOLUME (V_g) = 4.48 cft
 GRAVEL INFILL WEIGHT (W_g) = 493 lbs
 CENTER OF GRAVITY (COG_g) = 15.84" (SEE NOTES)

NOTES:

- VOLUME, WEIGHT AND COG CALCULATIONS WERE DONE USING CAD SOFTWARE.
- COG MEASUREMENTS ARE FROM BACK OF BLOCK

COMBINED UNIT DATA

DESIGN UNIT WEIGHT (γ_t) = (1,068 lbs + 493 lbs) / 12 cft = 130 pcf
 VOLUME (V_t) = 7.52 cft + 4.48 cft = 12.00 cft
 TOTAL UNIT WEIGHT (W_t) = 1,561 lbs
 CENTER OF GRAVITY (COG_t) = 18.16" (SEE NOTES)



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 DATE: 11/25/2013

TITLE: HALF BLOCK

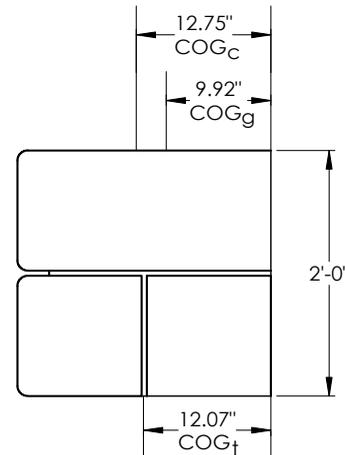
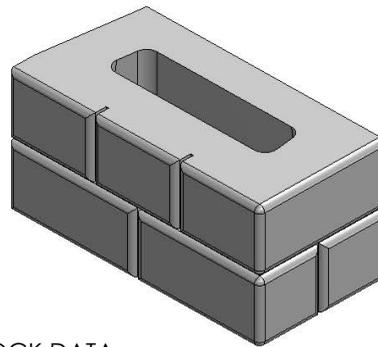
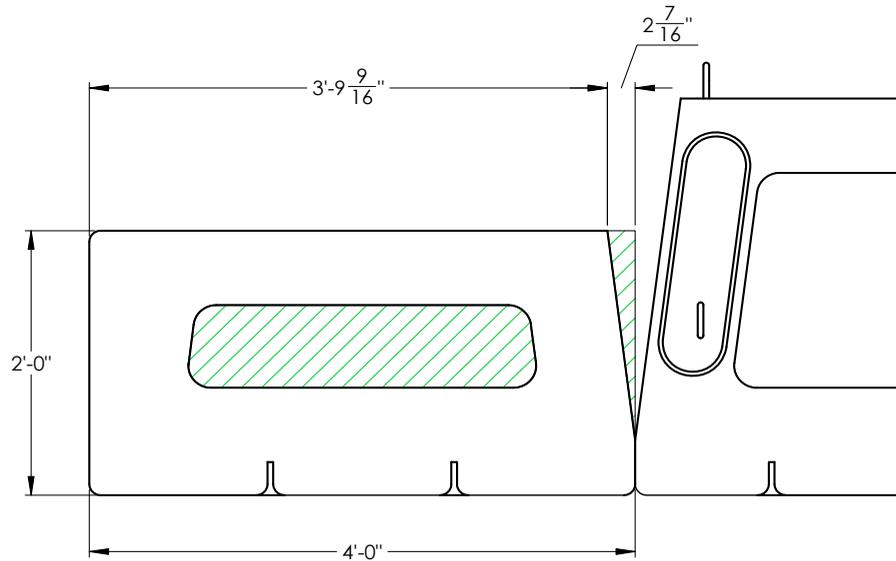
16500 SOUTH 500 WEST
 BLUFFDALE, UTAH 84065
 PHONE: (801) 571-2028

DWG NO. BD-03

SCALE: 1: 15

SHEET 1 OF 1

24" CORNER BLOCK & GRAVEL INFILL



CONCRETE BLOCK DATA

DESIGN UNIT WEIGHT (γ_c) = 142 pcf
 VOLUME (V_c) = 11.23 cft
 BLOCK WEIGHT (W_c) = 1,595 lbs
 CENTER OF GRAVITY (COG_c) = 12.75" (SEE NOTES)

GRAVEL INFILL DATA

DESIGN UNIT WEIGHT (γ_g) = 110 pcf
 VOLUME (V_g) = 4.77 cft
 GRAVEL INFILL WEIGHT (W_g) = 508 lbs
 CENTER OF GRAVITY (COG_g) = 9.92" (SEE NOTES)

NOTES:

- VOLUME, WEIGHT AND COG CALCULATIONS WERE DONE USING CAD SOFTWARE.
- COG MEASUREMENTS ARE FROM BACK OF BLOCK

COMBINED UNIT DATA

DESIGN UNIT WEIGHT (γ_t) = (1,595 lbs + 508 lbs) / 16 cft = 131 pcf
 VOLUME (V_t) = 11.23 cft + 4.77 cft = 16.00 cft
 TOTAL UNIT WEIGHT (W_t) = 2,103 lbs
 CENTER OF GRAVITY (COG_t) = 12.07" (SEE NOTES)



DRAWN BY	DATE	TITLE:
DAN BALLING	11/25/2013	CORNER BLOCK
16500 SOUTH 500 WEST BLUFFDALE, UTAH 84065 PHONE: (801) 571-2028		DWG NO.
		BD-04
SCALE: 1: 15		SHEET 1 OF 1