



9 August 2019

7509-3

Allco Waterproofing Solutions Limited
P.O. Box 101 903
North Shore Mail Centre
AUCKLAND 0745

Dear Sirs,

**CONTAINMENT PRESSURE REQUIREMENTS
VOLCLAY WATERPROOFING MEMBRANE**

Further to our recent discussions, we confirm that you have asked us to examine the provision of containment pressure to maintain the effectiveness of your Volclay waterproofing membrane. This is in the context of an application to a vertical retaining wall under both static and seismic conditions.

The required containment pressure is taken from the Swelltite Product Manual (Page 3 – Backfill / Technical Material Requirements), which indicates that a minimum pressure of 20 lbs/ft² (0.95 kN/m²) is required. A copy of the manual, including the relevant page, showing the requirement for this pressure is attached.

Containment under static conditions

The containment pressure on the rear face of a retaining wall is provided by the horizontal soil pressure. This is determined by the active soil pressure, which is the lowest theoretical pressure that can apply to the wall.

For a backfill material with an angle of internal friction of a nominal 30 degrees, the coefficient of active earth pressure (K_a) is 0.33. Based on the attached calculations, the required lateral earth pressure of 0.95 kN/m² is reached at a depth of 0.18m below ground surface.

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The shallow depth requirement to achieve the containment pressure suggests that compaction of the backfill is theoretically unnecessary. However, to allow for normal construction tolerances and variations, we recommend that the backfill adjacent to the wall is lightly compacted into place using a small plate compactor or similar to a nominal depth of approximately 0.5m below ground surface. This will ensure that there are no loose zones that could compromise the containment.

Containment under seismic conditions

Under seismic conditions, any loose sand or sandy silt below the watertable may be subject to liquefaction. It must be noted that any soils above the watertable will not be subject to liquefaction. When the soil liquefies, all of the loading is taken by the porewater (ground water). The lateral loading on the wall then becomes truly hydrostatic. Based on a hydrostatic load from the groundwater, the depth of water required to maintain the containment pressure is only 0.1m. In addition, the weight of the non liquefied soils above the watertable will act as a surcharge on the water column. This will ensure that the required lateral pressure of 0.95 kN/m^2 is maintained throughout the seismic event by the action of the water pressure.

Lateral loading on the membrane by the non liquefied soils above the watertable is maintained as for the static condition.

Summary

The containment pressure required to support the Volclay waterproofing membrane against the face of a retaining structure is 0.95 kN/m^2 .

Under static loading, the required pressure is obtained from normal soil loading from a depth of 0.18m below ground surface. Irrespective, light compaction of the backfill material against the structure face over a nominal depth of 0.5m is recommended to compensate for normal construction irregularities.

Under seismic loading, if the backfill soils liquefy, the lateral loading becomes hydrostatic. A water depth of 0.1m is required to ensure the requisite lateral containment pressure. Surcharge from the non liquefied soils above the watertable will ensure that a lateral pressure exceeding 0.95 kN/m^2 is maintained at all times.

The above confirms that the containment pressure required to support the Volclay waterproofing membrane is available from a depth of only 0.18m below ground surface.

We trust that our explanation addresses your query. Should you require any further input. Please do not hesitate to contact us.

Yours faithfully,

p.p. KGA Geotechnical Group Limited



R. J. Hutchison

BE, MSc, DIC, MICE, CEng(UK), FEngNZ, CPEng
Principal Geotechnical Engineer

Attachments:-

Swelltite Product Manual

Pressure calculations (sheets 1 and 2)

SWELLTITE[®] PRODUCT MANUAL

COMPOSITE BENTONITE WATERPROOFING SYSTEM



SWELLTITE®

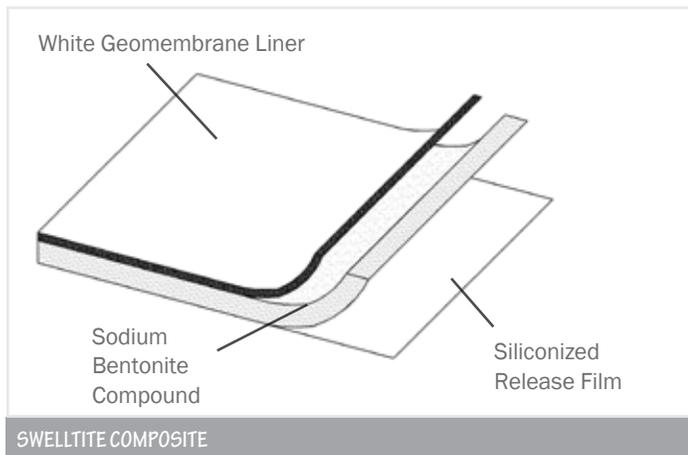
COMPOSITE BENTONITE WATERPROOFING SYSTEM

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- SECTION 8: CONCRETE WALL INSTALLATION**
- SECTION 9: MASONRY BLOCK WALL INSTALLATION**
- SECTION 10: GRADE TERMINATION**

SECTION 1 PRODUCT DESCRIPTION

Swelltite is a waterproofing membrane composite consisting of a thick layer of sodium bentonite compound integrally bonded between a tough geomembrane liner and a clear poly siliconized release liner. Swelltite is manufactured at a factory controlled 90-mil (2.3 mm) thickness. Roll size is 40" x 37' 9" (1.02 m x 11.5 m); 125 square feet (11.5 sq m).



SWELLTITE COMPOSITE

SECTION 2 TYPICAL APPLICATIONS

Swelltite is designed for waterproofing below-grade vertical and horizontal structural surfaces, as well as, above grade split-slab construction used with plaza areas, parking garages and sports stadiums. Swelltite is excellent for below-grade masonry block walls and cut-and-cover tunnels.

- ▶ Split-slab Plaza Deck Construction
- ▶ Cut & Cover Tunnels
- ▶ Masonry Block Foundation Walls
- ▶ Concrete Foundation Walls
- ▶ Earth-covered Structures

SECTION 3 PERFORMANCE CHARACTERISTICS

Swelltite is a dual waterproofing composite that combines the strength and puncture resistance of a geomembrane liner with the proven active waterproofing of sodium bentonite. Swelltite has been successfully tested by independent laboratories to resist over 200 feet (61 m) of hydrostatic pressure.

The flexible, tough geomembrane liner functions as both the first layer of waterproofing and a protection course. The geomembrane liner protects the bentonite compound from inclement weather and possible construction related damage. At the liner seams, the sodium bentonite compound reacts with the water and swells. This swelling effectively seals off the water and prevents it from penetrating the structure or moving laterally behind the liner.

Swelltite is a true advancement in waterproofing membrane technology. It works by forming a monolithic membrane upon hydration with water. When wetted, unconfined bentonite can swell up to 15 times its dry volume. When confined under pressure the swell is controlled, forming a dense, impervious waterproofing membrane. The swelling action of the bentonite compound can seal small concrete cracks caused by ground settlement, concrete shrinkage, or seismic action; problems over which there is normally no control.

SECTION 4 ACCESSORY PRODUCTS

M-2000 Liquid Flashing®: M-2000 Liquid Flashing is a trowel-grade waterproofing mastic used as a detailing product around penetrations, drains and at corner transitions for horizontal deck and vertical wall installations. M-2000 Liquid Flashing is a single-component moisture curing elastomer that meets the requirements of ASTM C836-84.

Bentoseal®: Bentoseal is a trowel grade sodium bentonite compound used as a detailing mastic around penetrations and at corner transitions for vertical wall installations.

A-3000WB Adhesive®: Water-based latex adhesive applied to substrates to promote adhesion of Swelltite Membrane. Typical application rate 250-275 sq ft/gallon (25 sq m).

CETCO Seamtape: CETCO Seamtape is a tape used to seal Swelltite overlap seams. Seamtape seals the membrane edges from inclement weather and construction debris.

Waterstop-RX®: Waterstop-RX is a flexible, expanding strip waterstop designed for nonmoving concrete construction joints. Waterstop-Rx is not a self-adhering product. Use CETSEAL to secure it into place.

Aquadrain®: Subsurface drainage composites consisting of high impact, 3-dimensional polystyrene core and a filter fabric. Aquadrain provides a consistent positive drainage flow rate in both vertical and horizontal applications. Its thin profile and high compressive strength make it ideal for split-slab construction.

GF-40SA: UV resistant flashing membrane for grade terminations and thru-wall flashing.

CETSEAL: Single-component polyether general sealant and adhesive.

SECTION 5 GENERAL GUIDELINES

SURFACE PREPARATION

Structural concrete surfaces should be smooth and free of dirt, rock, debris, oil, grease, laitance, or other foreign materials. Remove form fins and other protrusions to match monolithic surface. Completely fill any honeycombing, voids, and cracks with non-shrink cementitious grout, M-2000 or Bentoseal. Thru-wall form-tie holes should be completely filled with non-shrink cementitious grout with a plug of Waterstop-RX placed in the center. Concrete surfaces to receive M-2000 should be water cured a minimum of 7 days prior to application. Where possible, design horizontal concrete surfaces with proper slope to drain.

WEATHER CONDITIONS

Install Swelltite only in dry weather. Installation should not proceed when work areas are flooded or excessively wet, nor when rain can be reasonably anticipated before Swelltite can be properly covered.

FLOOD TESTING

Flood testing of Swelltite is not required, nor recommended. When a flood test is specified, consult manufacturer for any special installation instructions that may be applicable.

BACKFILL / TOPPING MATERIAL REQUIREMENTS

Swelltite requires proper containment from compacted backfill or topping ballast material. On decks, Swelltite requires a minimum 3" (75 mm) thick structural concrete slab or a minimum paver assembly (includes sand or grout leveling course) weight of 20-lbs (9 kg) per square foot. Compact backfill to minimum 85% Modified Proctor density.

STORAGE & HANDLING

Store product in dry location protected from construction operations and weather. Protect waterproofing materials from moisture, excessive temperatures and prolonged exposure to direct sunlight during storage. Provide cover, top and all sides (allow for adequate ventilation), for materials stored on-site. Do not double stack pallets.

LIMITATIONS

Swelltite should only be installed after proper substrate preparation has been completed and is suitable to receive the waterproofing system. Concrete work should use conventional cast-in-place forms that produce a smooth surface. Do not use stay-in-place concrete forming; use removable forming products only.

Do not use product without proper backfill or topping slab confinement. Swelltite is not designed, nor intended as a primary seal for waterproofing expansion joints. Do not use Swelltite with a pedestal paver system on a deck. Do not install in standing water or during precipitation. Illustrations are not shown to scale.

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COMPOSITE BENTONITE WATERPROOFING SYSTEM

SECTION 6 HORIZONTAL MEMBRANE INSTALLATION

Before installing the membrane, prepare substrate, and detail all drains, transition corners and penetrations.

MEMBRANE INSTALLATION

REMOVE CLEAR RELEASE FILM from back of membrane before installation. Install membrane with bentonite compound against the structure (white liner side up) from the low point to the high point across the fall line to create a shinglestyle installation. Overlap all membrane edges a minimum of 2" (50 mm). Stagger membrane roll end seams a minimum 12" (300 mm). Seal all membrane overlap seams with CETCO Seam-tape.

Cut membrane to closely fit around penetrations overlapping previously installed M-2000. Trowel 60-mil (1.5 mm) thick counter flashing of M-2000 over membrane edge around penetrations, drains, and elevation changes. Seal all membrane overlap seams with CETCO Seamtape (see Figure 8).

Optional Adhesive Method: Apply A-3000WB Adhesive by roller or sprayer at a rate of 250-275 sq ft per gallon (25 sq m per 3.8 l) and allow to cure (turn black) before applying membrane. After adhesive has cured, follow membrane installation instructions above. Primed surfaces not covered by membrane during same working day must be re-primed.

Consult manufacturer if deck is precast concrete planks or for other conditions not stated herein.

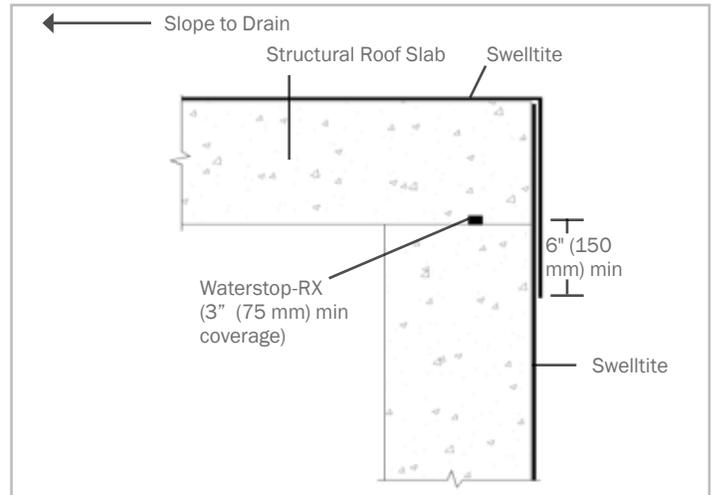


Figure 2 - Horizontal to vertical detail

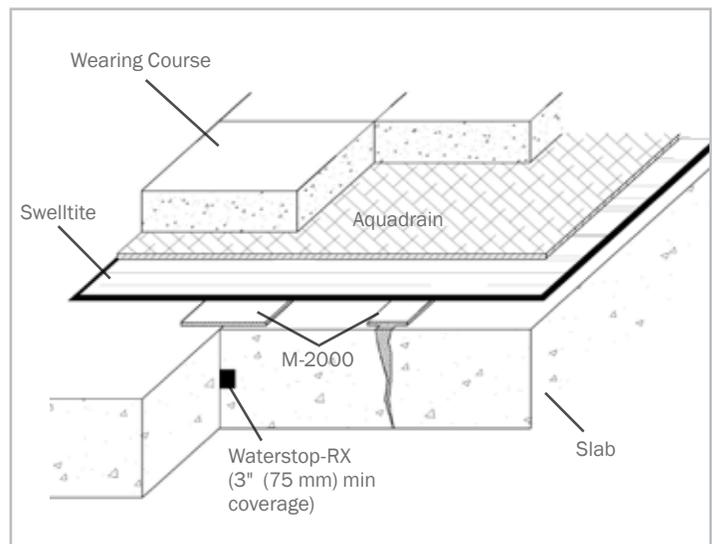


Figure 3 - Horizontal joint and crack detail

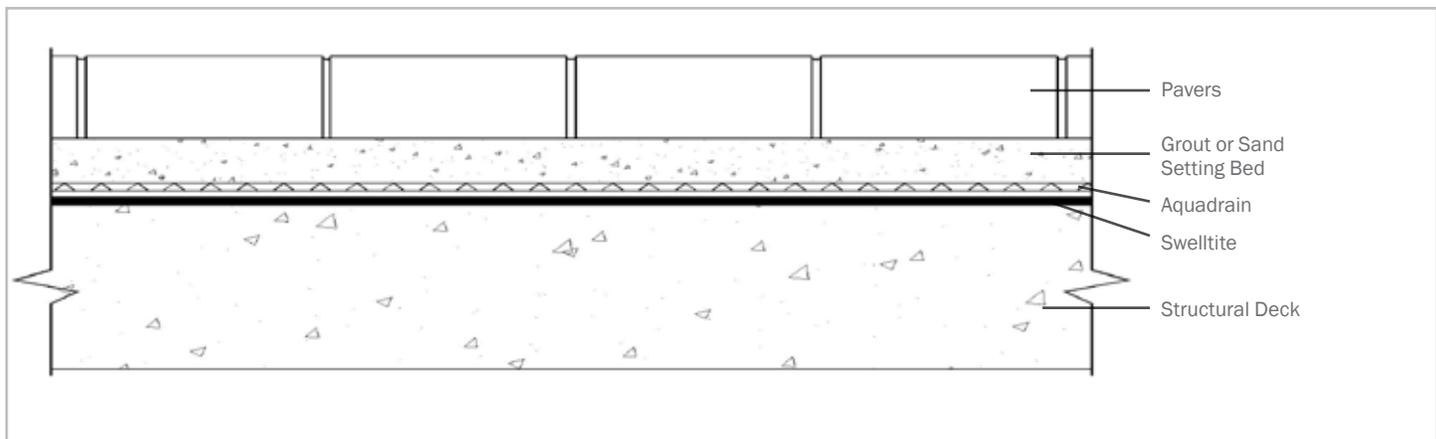


Figure 4 - Typical paver plaza deck detail

SECTION 7 DECK DETAILING

Before installing the membrane, prepare substrate, and detail all drains, transition corners and penetrations.

DRAINS

Trowel a minimum 90-mil (2.3 mm) thick layer of M-2000 on the drain ring and continuing into the drains inward throat slope. Extend M-2000 a minimum of 6" (150 mm) around the drain (see Figure 5). Allow M-2000 to cure a minimum of 12 hours prior to installing membrane. After Swelltite is installed to contour drain, apply a 60-mil (1.5 mm) thick layer of M-2000 to counter flash membrane edge.

PENETRATIONS

Trowel a minimum 3/4" (18 mm) cant of M-2000 around the penetration. Extend M-2000 outward from penetration a minimum of 6" (150 mm) at 90-mils thick (see Figure 6). After membrane has been installed overlapping M-2000 2" (50 mm), apply a 60-mil thick counter flashing of M-2000 at the membrane edge.

TRANSITION CORNERS

Apply a 3/4" (18 mm) thick M-2000 fillet to inside transition corners. Then extend M-2000 at 90-mil minimum thickness for 6" (150 mm) in both directions from the corner (see Figure 7). Allow M-2000 to cure a minimum of 12 hours prior to installing membrane. After membrane has been installed to the corner, apply a 60-mil thick counter flashing of M-2000 or CETSEAL to cover the membrane edge.

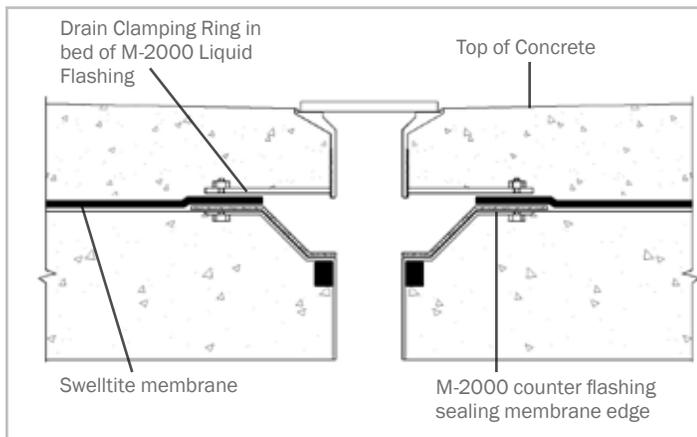


Figure 5 - Deck drain detail. CETCO recommends using a double stage drain for all deck drains.

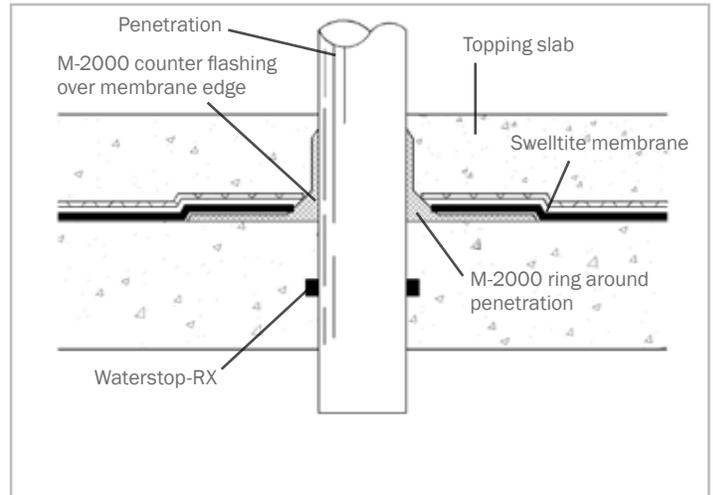


Figure 6 - Deck penetration detail

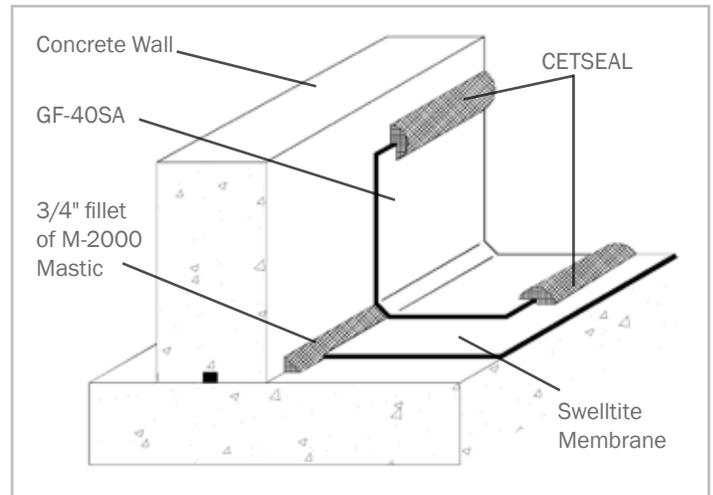


Figure 7 - Deck to wall inside corner detail

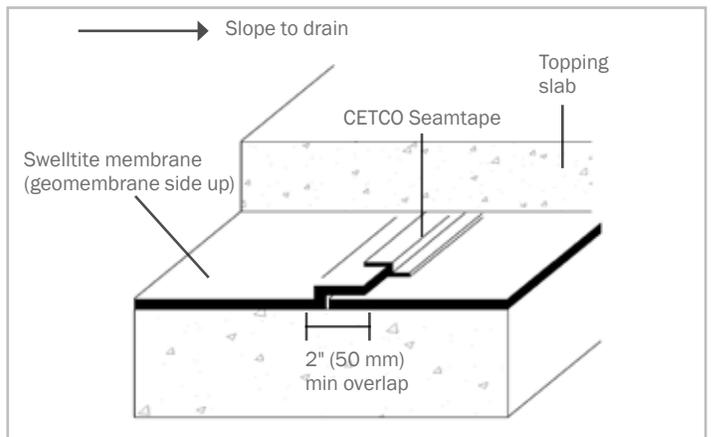


Figure 8 - Horizontal membrane overlap detail

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SECTION 8 CONCRETE WALL INSTALLATION

Before installing the membrane, prepare substrate, and detail all drains, transition corners and penetrations.

VERTICAL INSIDE CORNERS

Install a 3/4" (18 mm) thick, continuous fillet of Bentoseal at all vertical inside corners.

PENETRATIONS

Apply a 3/4" (18 mm) thick fillet of Bentoseal around base of penetrations. Extend Bentoseal a minimum of 6" (150 mm) outward from penetration 90-mils thick. After Swelltite membrane is installed, apply a counter flashing of Bentoseal at membrane edge around penetration.

FOOTING/WALL JOINT

Install at footing/wall joint a continuous 3/4" (18 mm) thick, 45° angle fillet of Bentoseal.

MEMBRANE INSTALLATION

REMOVE CLEAR RELEASE FILM from back of membrane before installation. Starting at the base of the wall, install the membrane over the Bentoseal cant and onto the footing a minimum of 6" (150 mm) with bentonite compound directly against the wall (white liner side toward installer). Secure membrane with washer-head fasteners maximum 24" (600 mm) on center or less as required along the membrane edges. Overlap all membrane edges a minimum 2" (50 mm). Stagger membrane roll end seams a minimum 12" (300 mm). Swelltite membrane may be installed either horizontally or vertically oriented. Seal all overlap seams with CETCO Seamtape.

Cut membrane to closely fit around penetrations. Trowel a minimum 3/4" (18 mm) thick layer of Bentoseal around penetrations. Extend Bentoseal onto penetration and completely fill area between membrane edge and penetration. Membrane should not be left exposed for prolonged periods of time). Continue membrane installation to finished grade detail and terminate membrane at finished grade per section 10 herein. Seal all overlap seams with CETCO Seamtape (see Figure 13).

Optional Adhesive Method: Apply A-3000WB Adhesive by roller or sprayer at a rate of 250-275 sq ft per gallon (25 sq m per 3.8 l) and allow to cure (turn black) before applying membrane. After adhesive has cured, follow membrane installation instructions above without the mechanical fasteners. Primed surfaces not covered by membrane during same working day must be re-primed.

Note: When hydrostatic conditions exist, the vertical waterproofing should continuously overlap the underslab waterproofing a minimum 6" (150 mm) (see Figure 11).

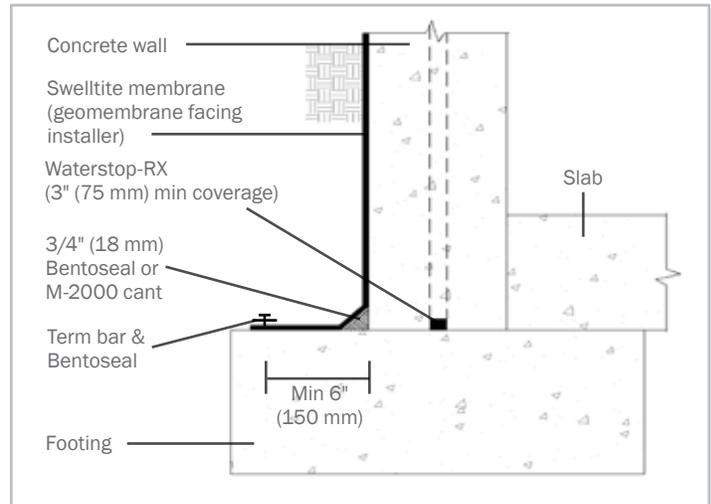


Figure 9 - Concrete wall/footing joint (non-hydrostatic)

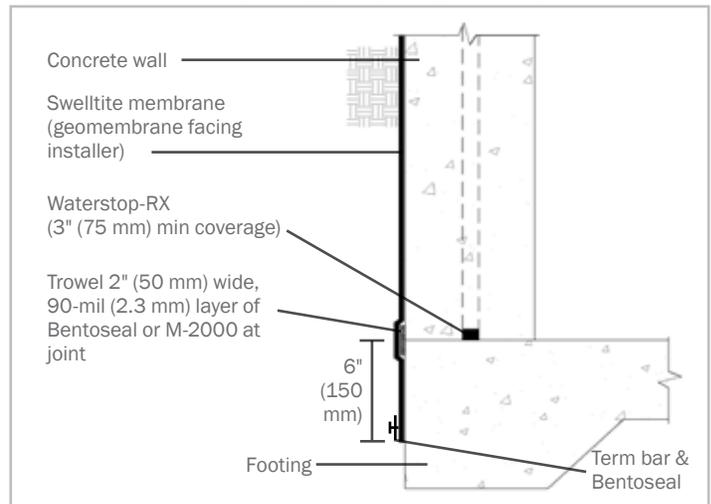


Figure 10 - Concrete wall with flush footing surface

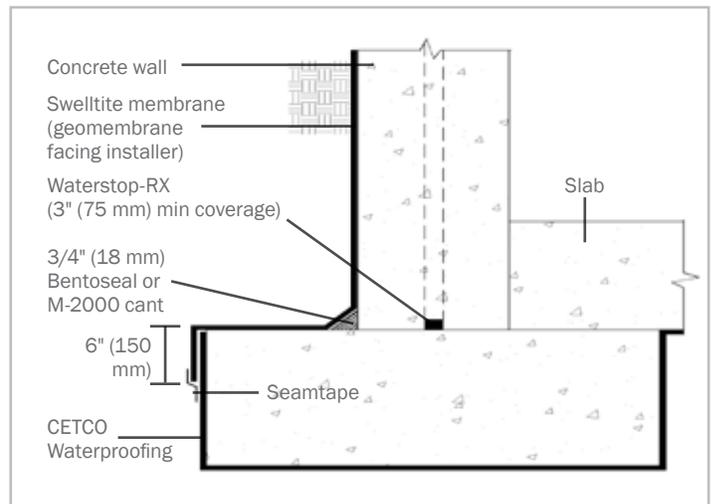


Figure 11 - Concrete wall-footing joint (hydrostatic)

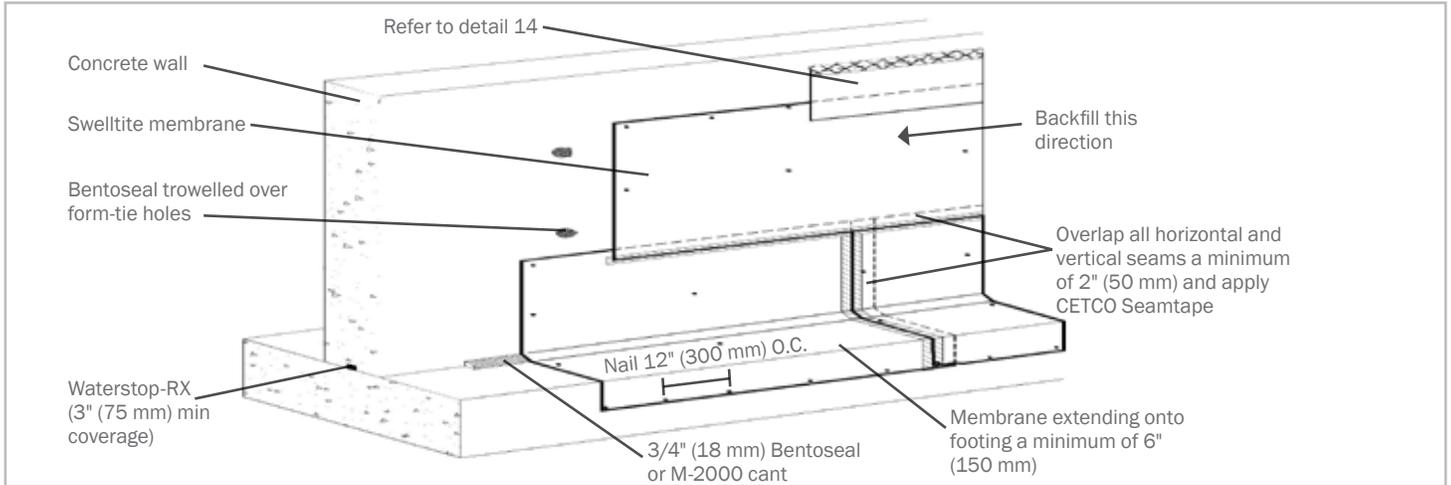


Figure 12 - Foundation wall detail (non-hydrostatic condition)

SECTION 9: MASONRY BLOCK WALL INSTALLATION

CETCO recommends that the masonry block cells be filled with cementitious grout or concrete. All mortar joints should be completely filled and struck flush before membrane is installed to masonry block walls (see Figure 13). Detail all vertical inside corners, penetrations and footing/wall joints per Section 8, Concrete Wall Installation.

Starting at the wall/footing intersection, install bottom course of Swelltite horizontally (see Figure 12) with bentonite compound toward the structure (geomembrane facing installer). Membrane should extend over Bentoseal cant and onto footing a minimum of 6" (150 mm). All succeeding membrane lifts may be installed either horizontally or vertically. Overlap all membrane edges a minimum 2" (50 mm). Stagger membrane roll end seams a minimum 12" (300 mm).

Secure membrane with mechanical fasteners or A-3000WB Adhesive following installation instructions in Section 8, Concrete Wall Installation. Terminate membrane at finished grade per Section 10 herein.

Install CETCO Seamtape centered over all membrane overlap seams (see Figure 13).

SECTION 10 GRADE TERMINATION

Terminate Swelltite membrane 12" (300 mm) below finished grade elevation with washer-head fasteners maximum 12" (300 mm) on center. Install GF-40SA flashing to primed concrete substrate with bottom edge overlapping top edge of Swelltite membrane minimum 4" (100 mm). Overlap all roll ends a minimum 4" (100 mm) to form a continuous flashing. Height of flashing shall be per project details and specifications. Install a rigid termination bar along top edge of GF-40SA;

fastened maximum 12" (300 mm) on center. Complete grade termination detail with tooled bead of CETSEAL along the top edge, at all penetrations through the flashing and all exposed overlap seams.

Backfill material should be placed and compacted to 85% Modified Proctor density immediately following the application of the membrane. If backfill cannot be applied immediately, protect membrane edges from precipitation with CETCO Seamtape. If backfill contains sharp or irregular material, cover membrane with CETCO approved protection material course to avoid damage during backfilling and compaction.

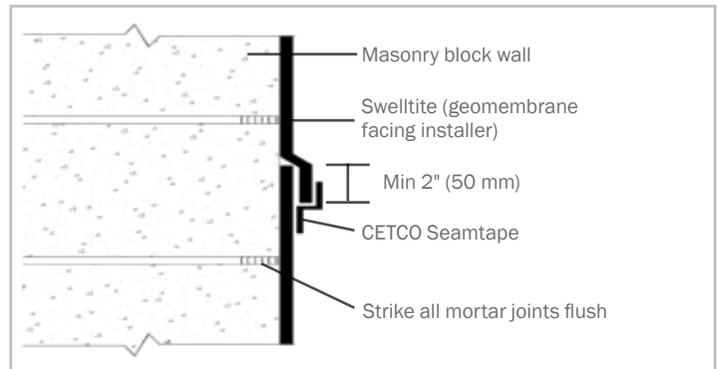


Figure 13 - Masonry wall joint detail

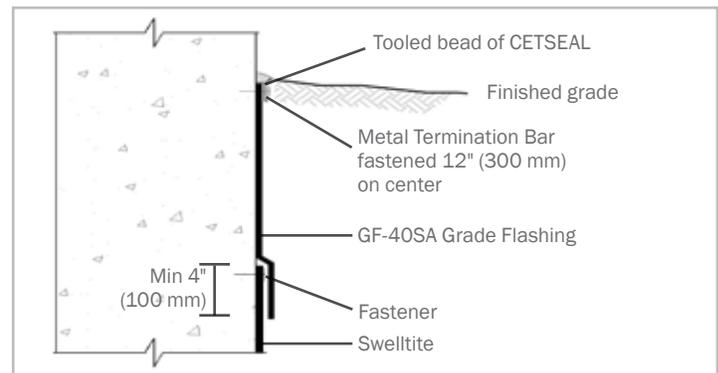
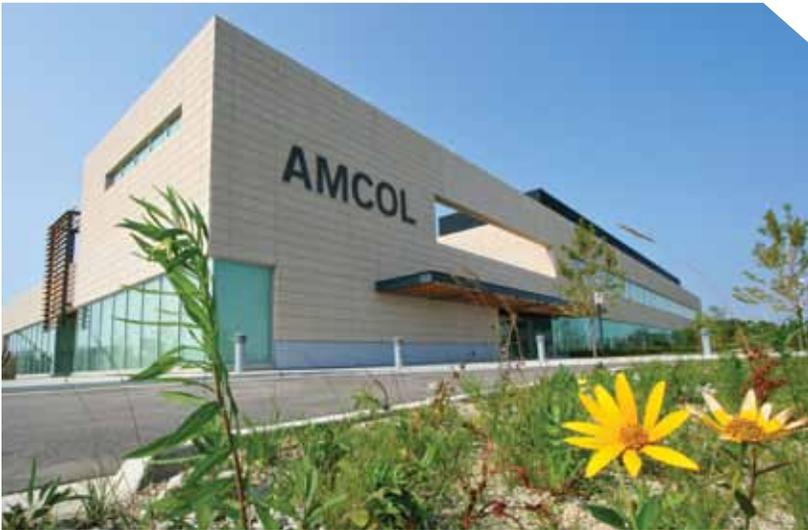


Figure 14 - Vertical wall grade termination

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LIMITED WARRANTY

The information and data contained herein are believed to be accurate and reliable. Specifications and other information contained herein supersede all previously printed material and are subject to change without notice.

Manufacturers warranty of installed system is available. Contact seller for terms and sample document including all limitations.

All goods sold by seller are warranted to be free from defects in material and workmanship. The foregoing warranty is in lieu of and excludes all other warranties not expressly set forth herein, whether express or implied by operation of law or otherwise including but not limited to any implied warranties of merchantability or fitness.

Seller shall not be liable for incidental or consequential losses, damages or expenses, directly or indirectly arising from the sale, handling or use of the goods, or from any other cause relating thereto, and seller's liability hereunder in any case is expressly

limited to the replacement (in the form originally shipped) of goods not complying with this agreement or at seller's election, to the repayment of, or crediting buyer with, an amount equal to the purchase price of such goods, whether such claims are for breach of warranty or negligence.

Any claim by buyer with reference to the goods sold hereunder for any cause shall be deemed waived by buyer unless submitted to seller in writing within thirty (30) days from the date buyer discovered or should of discovered, any claimed breach.

Materials should be inspected and tested by purchaser prior to their use if product quality is subject to verification after shipment. Performance guarantees are normally supplied by the applicator.

Note: Waterstop-RX is not an expansion joint material. Expansion joints shall be the responsibility of OTHERS.

NOVEMBER 2010

IMPORTANT: The information contained herein supersedes all previous printed versions, and is believed to be accurate and reliable. For the most up-to-date information, please visit www.CETCO.com. CETCO accepts no responsibility for the results obtained through application of this product. CETCO reserves the right to update information without notice.

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CALCULATION SHEET

Job

Alko - Oddoys

No 7509

Subject Containment

Sheet 1 of 2

Calc by ZH

Checked by

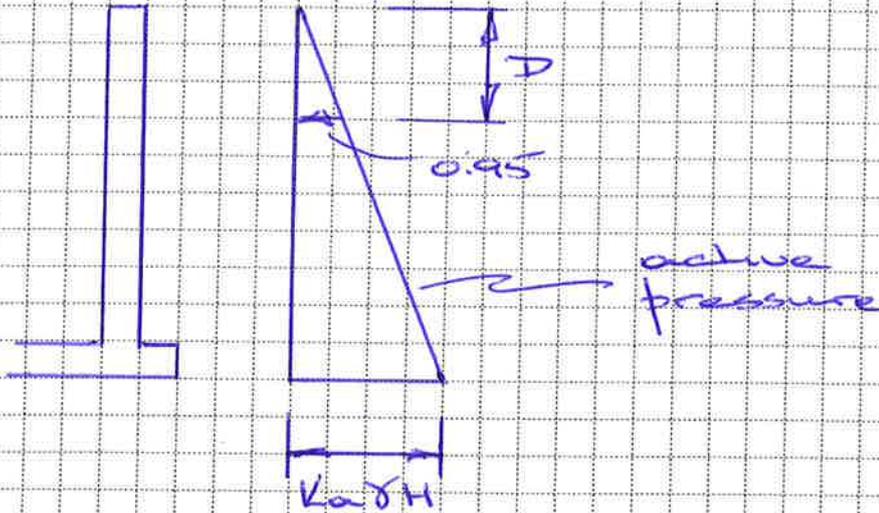
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① Containment Pressure

- Given in Swallite Product Manual as

$$P = 20 \text{ lb/ft}^2 \\ = 0.95 \text{ kN/m}^2$$

② Active Pressure



$$0.95 = K_a \times D$$

$$0.95 = 0.33 \times 18 \times D$$

$$\underline{D = 0.18 \text{ m}}$$

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CALCULATION SHEET

Job

Alco Volclay

No

7509

Subject

Contaminant

Sheet 2 of 2

Calc by ZH

Checked by

Date 14.10.13

③ Seismic Conditions - Liquefaction

Soils below water table liquefy.

Non liquefied soils above the water table apply a surcharge loading on the water column.

