

4276 MacArthur Blvd.

Prepared by: Carlin Environmental Consulting, Inc.

Site Address: 4276 MacArthur Blvd.
Oakland, CA 94619

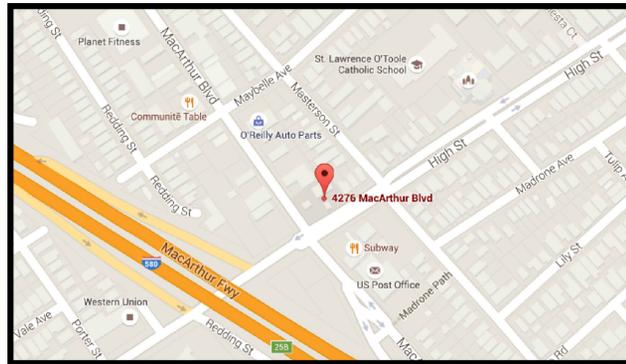
Owner:
Raj Goswamy
4276 MacArthur Blvd.
Oakland, CA 94619

Environmental Consultant:
Carlin Environmental Consulting, Inc.
2522 Chambers Rd. Suite 100
Tustin, CA 92780

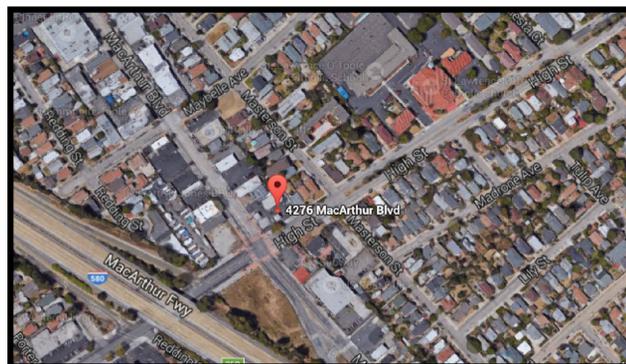
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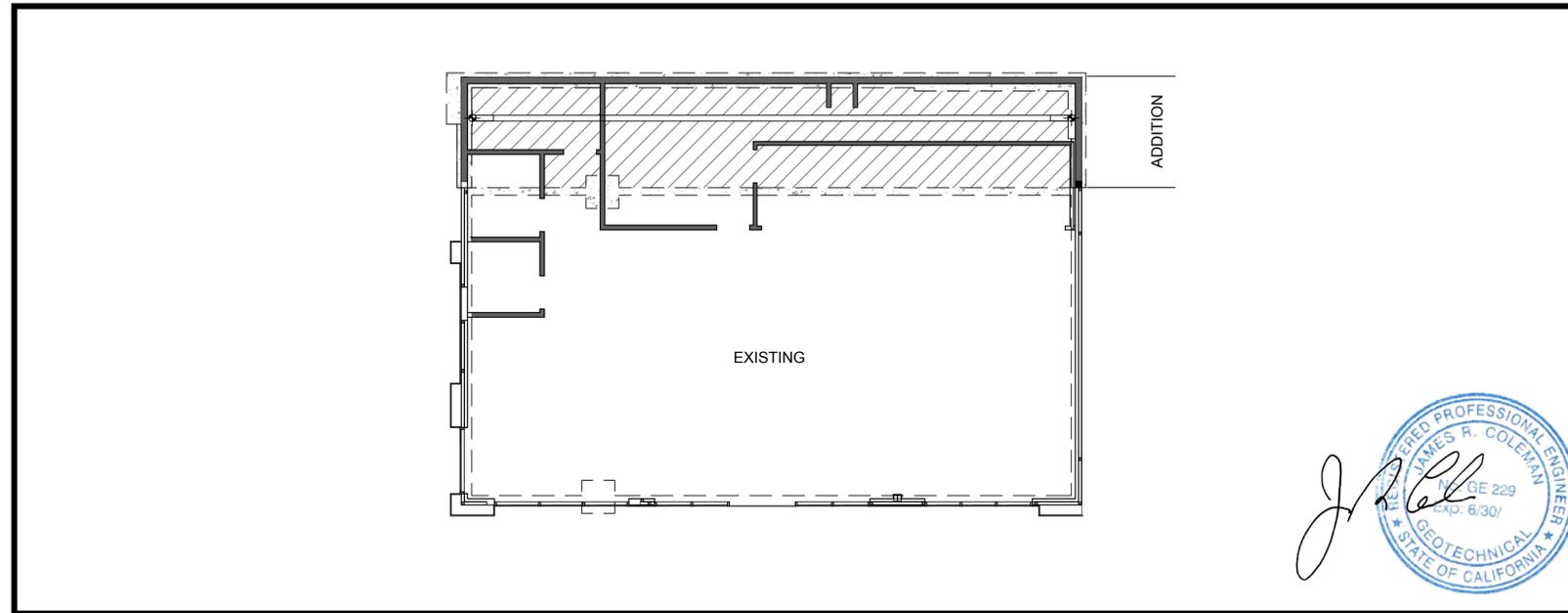
Location Map



Site Map



Site Map



Introduction:

Carlin Environmental Consulting, Inc. (CEC) is pleased to prepare these soil vapor mitigation measure drawings for the convenience store conversion and addition located at the subject site, address 4276 MacArthur Blvd. Oakland, CA 94619. CEC has been informed that a rectangular portion is being added to an existing building at the subject site, which serves as a gasoline service station with convenience store.

These mitigation measures were prepared at the request of the Alameda County Environmental Health (ACEH), who is the lead agency in this case. These mitigation measures were requested by the ACEH, in a letter dated January 7th, 2016 with the subject title:

Feasibility Study Review For Fuel Leak Case No. RO000409 and Geotracker Global ID T0600102279, Unocal #1156, 4267 Mac Arthur, Oakland, CA 94619.

In this letter, ACEH request that mitigation measures be utilized to prevent potential vapor intrusion for the convenience store expansion. The subject site is a 76-branded service station located at the northern corner intersection of MacArthur Blvd and High Street within the city of Oakland, California (see site map left). The station building is situated in the northern

portion of the site and contains an automotive service bay in the northern portion and a mini-mart/cashier area in the southern portion. There are two dispenser islands located on the southern portion of the site. Previous environmental documents indicate that two 10,000-gallon underground storage tanks (USTs) are located in the southwestern portion of the site.

Records of subsurface investigations indicating soil, soil vapor, and groundwater contamination are available from 1997 to date. These investigations report elevated levels of total petroleum hydrocarbons in gasoline and diesel range, benzene, toluene, ethylbenzene, total xylenes (BTEX).

Remediation has occurred at the subject site in the form of soil excavation and groundwater overpurguing events. According to previous environmental reports, approximately 1,350 tons of soil were excavated and removed during the gasoline UST removal activities in 1998. In addition, approximately 4.6 tons of soil was over-excavated and removed during the underground waste-oil storage tank removal (Site Investigation Report: 76 Station No. 1156. 4276 Mac Arthur Boulevard, Oakland, CA. Delta Consultants. 2009. Electronic Copy).

For groundwater remediation, approximately 476,015 gallons of water was removed during 2001 to 2014 from three wells. The purpose of these designed mitigation measures is to prevent the intrusion of soil vapors from contaminated material beneath the subject site into the proposed building extension. The following is the general scope of mitigation measure components that will be incorporated from top to bottom:

- Concrete floor: thickness TBD
- 2" of Sand for membrane protection
- Geo-Seal Membrane System: and impermeable system that consist of three layers: Geo-Seal Base, 60-Mil Geo-Seal Core and Geo-Seal Bond Layer. This membrane will encompass the entire footing of the proposed building extension.
- 2" of gravel to assist in the soil vapor migration to collection piping
- Perforated vent piping for soil vapor collection will run the length of the proposed building extension to ensure adequate coverage
- Vent risers that run from below slab through the building and exit above the road to the atmosphere. Vent risers, similar to any other penetration (plumbing, electrical, etc.) will be properly sealed with the membrane system.

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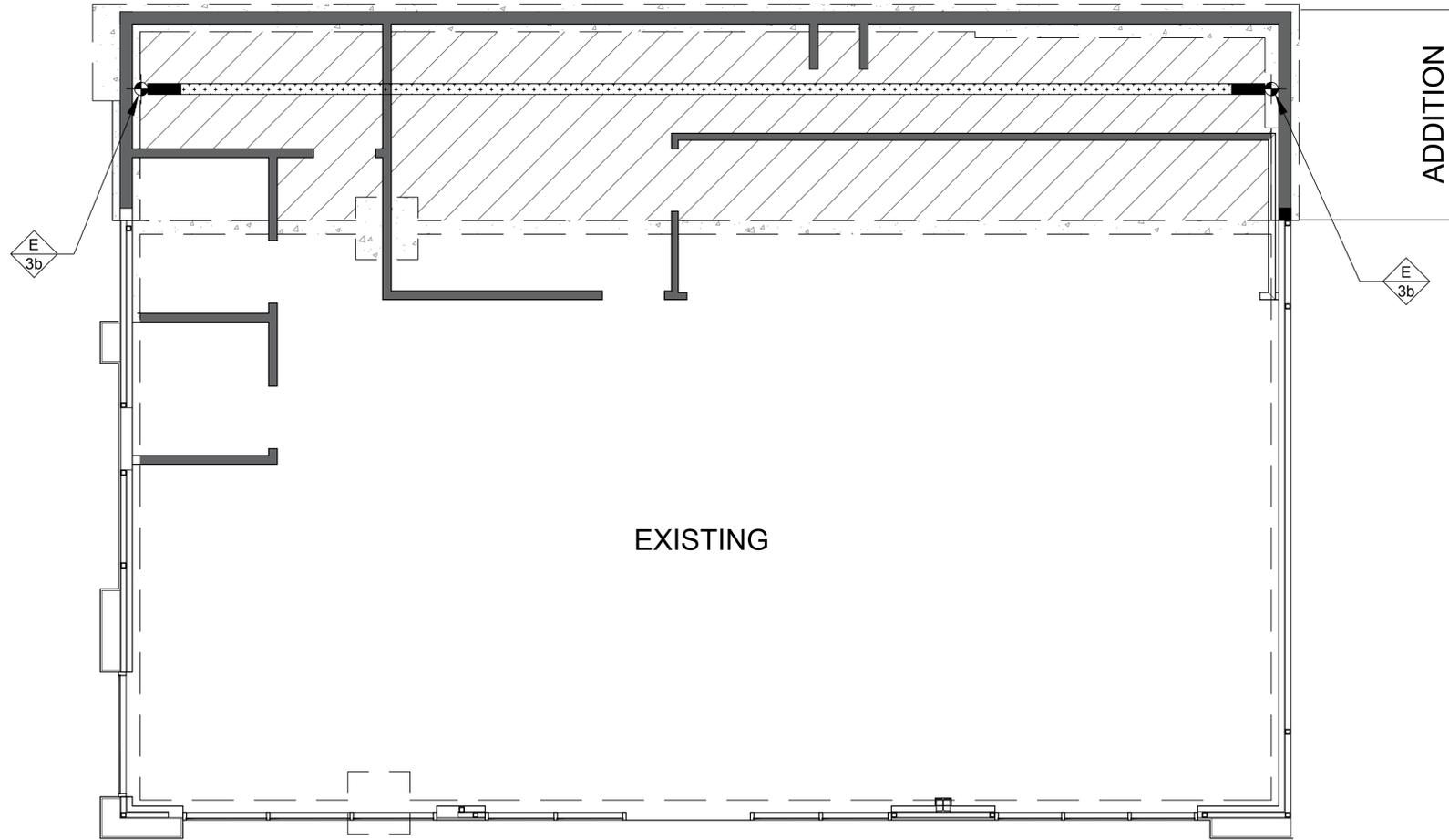
4276 MacArthur Blvd. MITIGATION MEASURES



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4276 MacArthur Blvd.

Building Layout



Legend:

-  - Membrane Application
-  - 4" Perforated Pipe (except in highlighted area)
-  - Solid PVC Pipe
-  - Vent Riser Locations Total of 2 Locations
see detail E/ 3b

Notes:



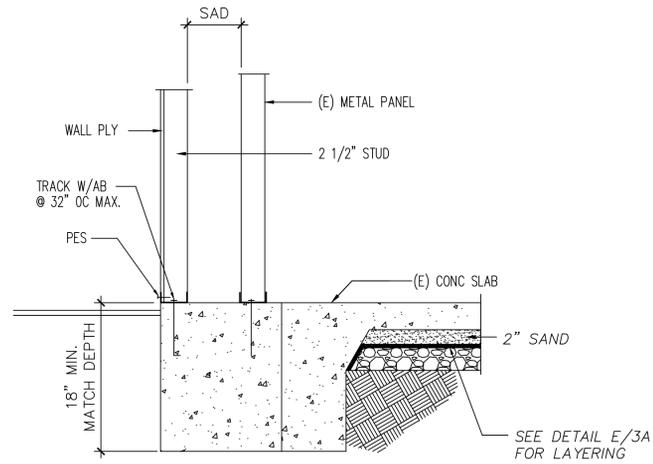
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4276 MacArthur Blvd. MITIGATION MEASURES

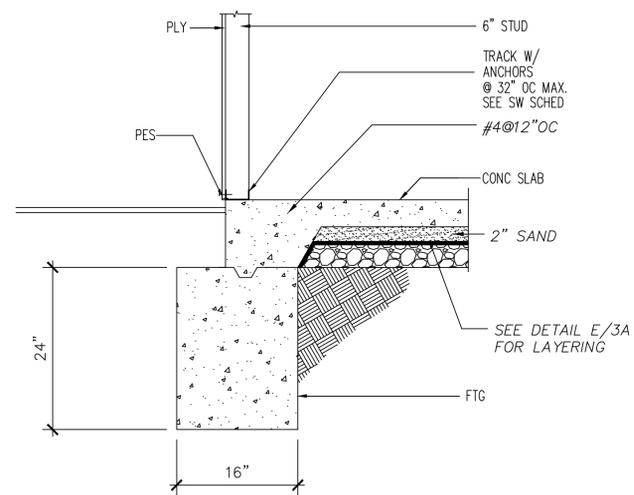
Carl in Environmental Consulting
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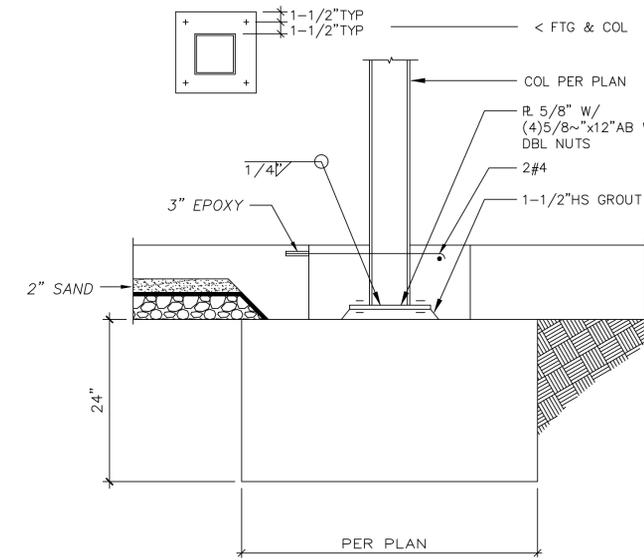
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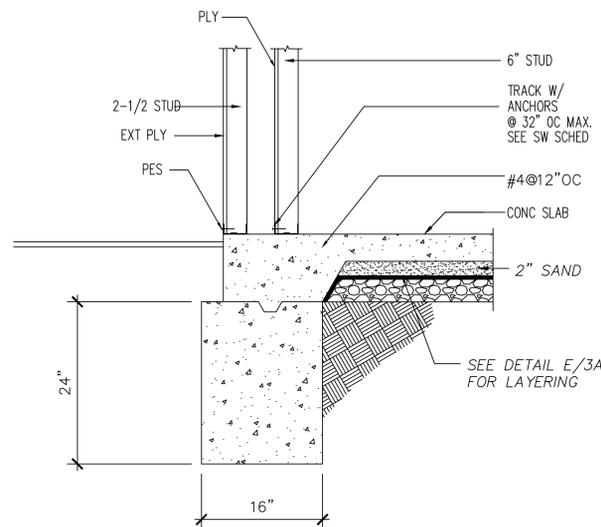
4 SECTION
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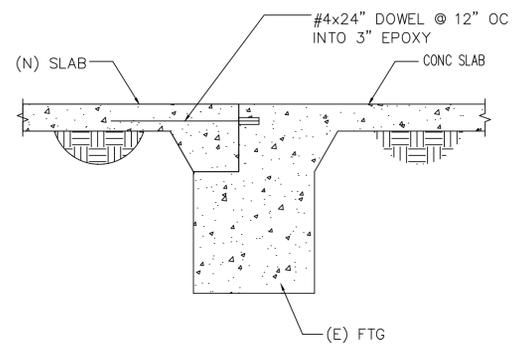
1 DETAIL
S1 3/4"=1'-0"



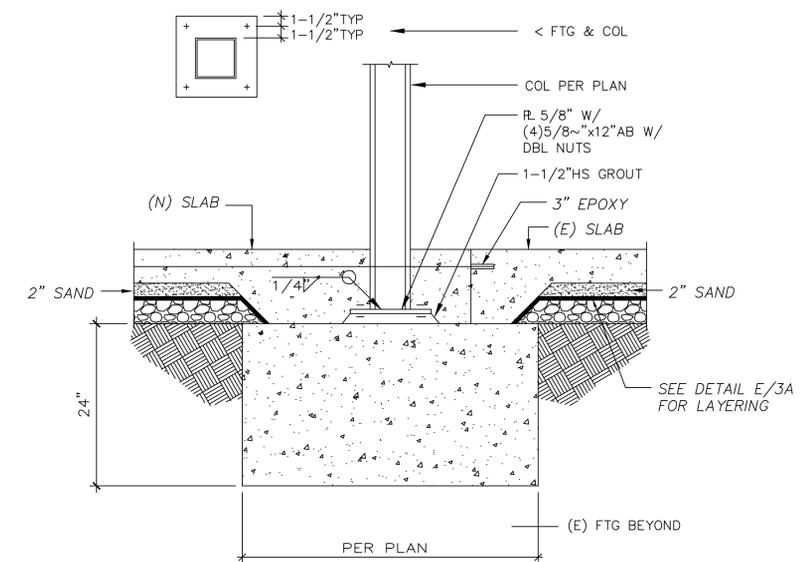
5 DETAIL
S1 3/4"=1'-0"



2 DETAIL
S1 3/4"=1'-0"



3 DETAIL
S1 3/4"=1'-0"



6 DETAIL
S1 3/4"=1'-0"

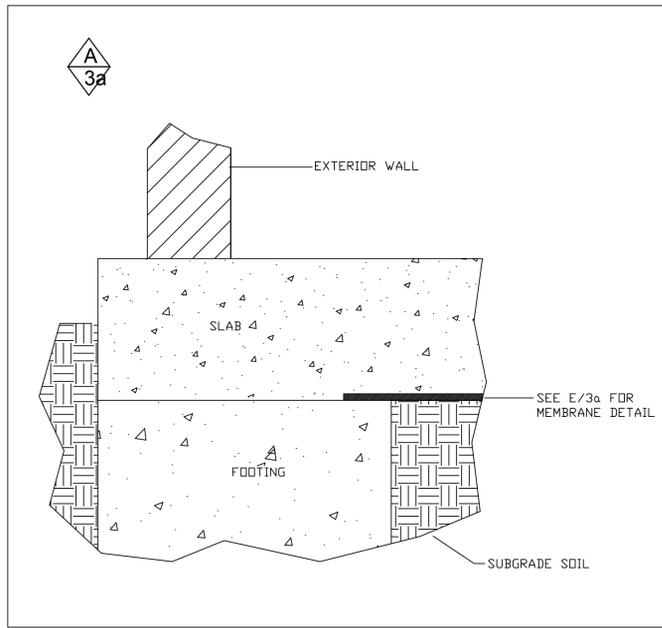
J. Hall
 REGISTERED PROFESSIONAL ENGINEER
 GEOTECHNICAL
 STATE OF CALIFORNIA
 No. GE 229
 Exp. 6/30/

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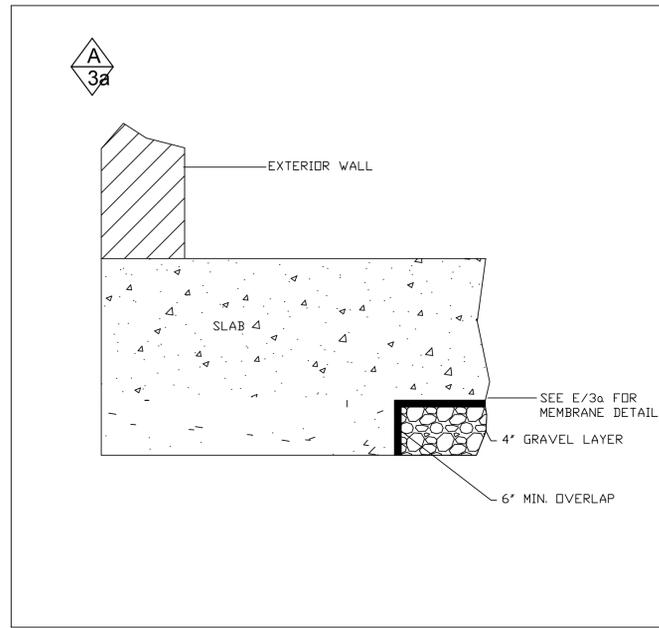
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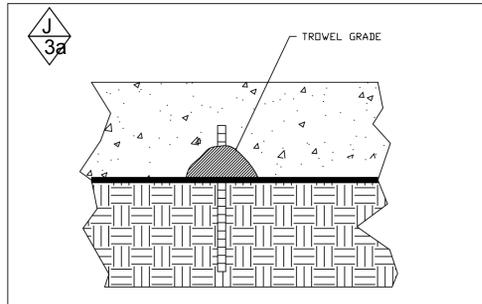


SLAB PERIMETER DETAIL

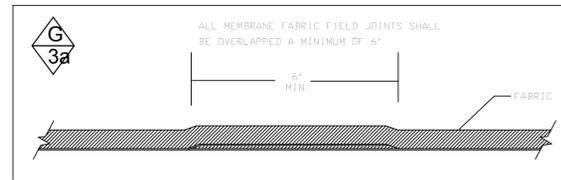
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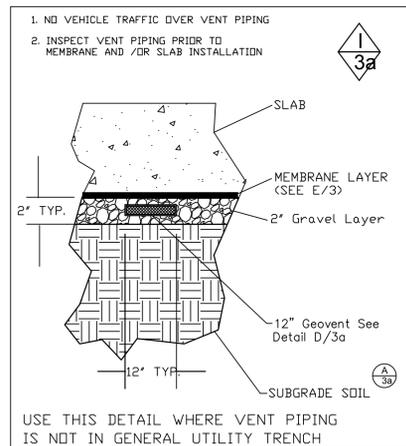
SLAB PERIMETER DETAIL



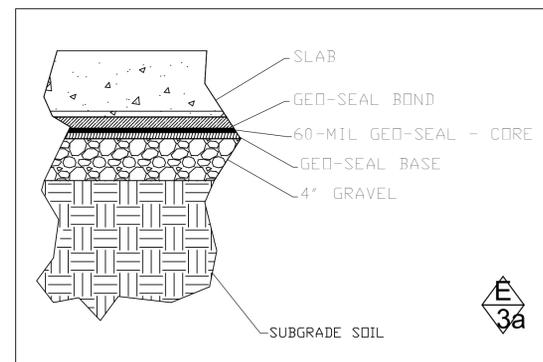
RE-BAR PENETRATION REPAIR DETAIL



MEMBRANE OVERLAP



USE THIS DETAIL WHERE VENT PIPING IS NOT IN GENERAL UTILITY TRENCH
TYPICAL METHANE PIPE TRENCH DETAIL



MEMBRANE LAYERING FOR Geo-Seal

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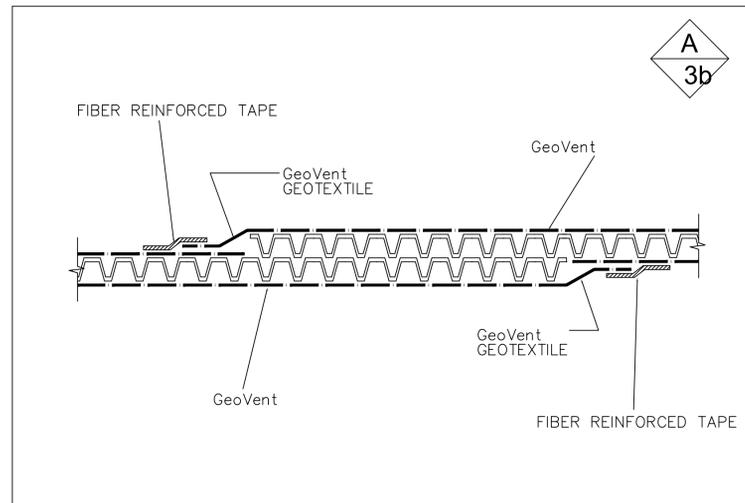
4276 MacArthur Blvd.
MITIGATION MEASURES

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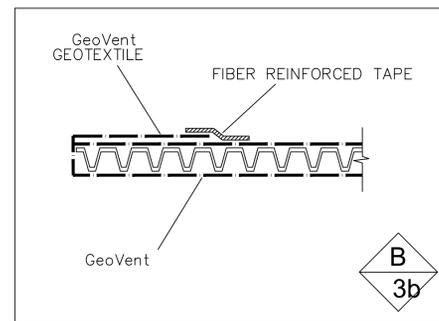
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Sheet 3a

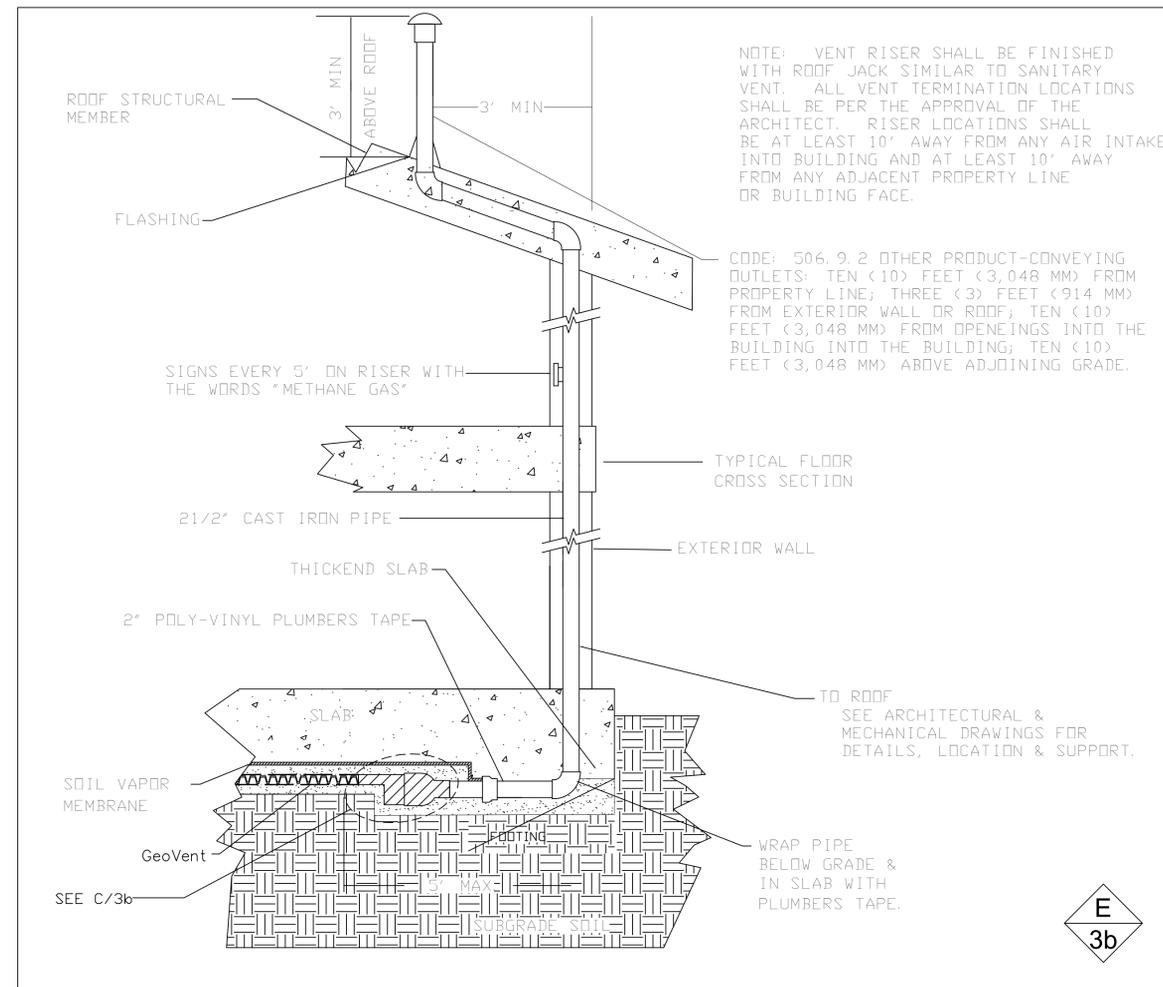




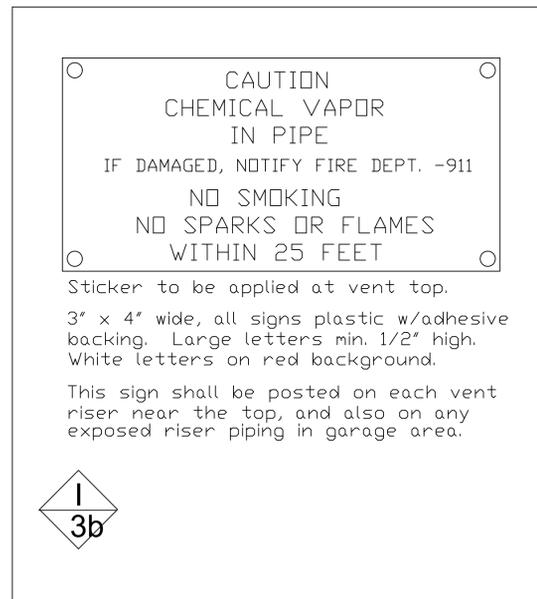
VENTING CONNECTION DETAIL



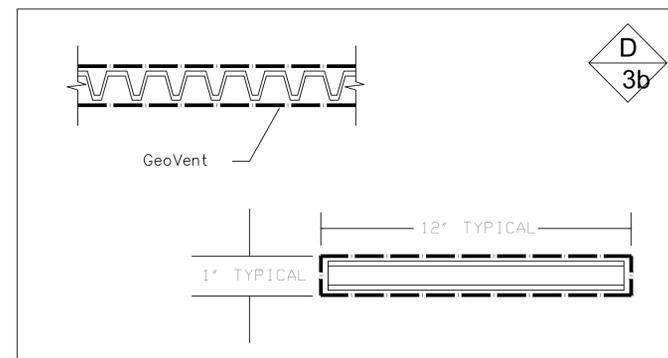
VENT PIPING TERMINATION DETAIL



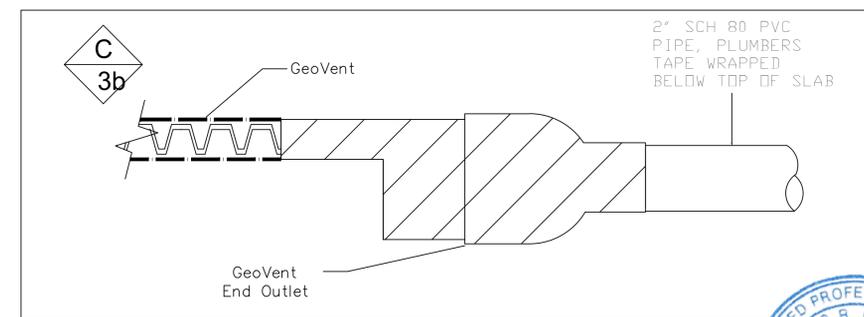
TYPICAL VENT TO ROOF



MISCELLANEOUS SIGNAGE



Geovent PIPING



VENT/SCH 80 PVC TRANSITION FITTINGS AT VENT TO ROOF



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Sheet 3b

SOIL VAPOR MITIGATION MEASURES INSTALLATION SPECIFICATIONS

SUBSURFACE CONDITIONS AT THIS SITE HAVE BEEN FULLY INVESTIGATED AND REMEDIATED WHERE NECESSARY TO PREPARE THE SITE FOR COMMERCIAL REDEVELOPMENT. RISK ASSESSMENT INVESTIGATIONS INDICATE THAT THE RISK TO BUILDING OCCUPANTS AND THE ENVIRONMENT CAN BE MITIGATED BY THE DESIGN AND INSTALLATION OF SOL VAPOR MITIGATION MEASURES. BASED ON THIS RECOMMENDATION, THE PROPOSED BUILDING AT THE SUBJECT SITE WILL INCLUDE THE FOLLOWING VAPOR MITIGATION MEASURES:

- A 60-Mil Chemically Compatible Membrane System. This membrane will be Geo-Seal;
- A Sub-Slab Passive Venting System;
- Sealing of utility penetrations, structural columns or other penetrations through the membrane;
- Sealing of utility conduits where they enter the elevator structure;

THIS PLAN DOES NOT RELIEVE RESPONSIBLE PARTIES FROM COMPLYING WITH APPROPRIATE AIR QUALITY DISCHARGE REQUIREMENTS, INCLUDING LOCAL, STATE AND FEDERAL, IF ANY.

INSTALLATION SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS SPECIFIED BELOW AND AS SHOWN ON THE ATTACHED PLAN SET.

MEMBRANE SYSTEM SPECIFICATIONS:

The project team has selected a membrane system. The Soil Vapor Mitigation Engineering firm of record, Carlin Environmental Consulting, Inc. (CEC), recognizes that other alternatives are available but has accepted this membrane system as suitable for installation on the project. This membrane system is designated below:

- The Geo-Seal system includes a spray applied component at a thickness of 60 mils and two composite sheets to achieve a minimum thickness of 70 mils. This system includes a spray applied membrane (referred to as Geo-Seal Core) and an underlying composite layer of HDPE sheeting (referred to as Geo-Seal Base) which is reported by Land Science Technologies to be 5 mils in thickness and is combined with a 3 oz. non-woven geotextile. This product also includes a 5 mil layer of HDPE above the spray applied membrane (referred to as Geo-Seal Bond). The total thickness of the spray applied Geo-Seal Core membrane system is required to be 60 mils. The total thickness of the Geo-Seal system is required to be 70 mils and includes both layers of 5 mil HDPE Sheeting and the spray applied Geo-Seal Core membrane. Installation of the membrane system shall be in accordance with the manufacturer's instructions specified below. Specific details, including penetration details, are included herein for the Geo-Seal application.

MEMBRANE INSTALLATION AND REPAIR PROCEDURES.

PART 1 - GENERAL

1.01 DESCRIPTION -

General and Supplementary Conditions and General Requirements are included in this section. Provide vapor barrier as indicated, specified and required.

A. Work in this section - principally includes the items designated below:

Vapor barrier providing protection from Volatile Organic Compounds (VOC's) and natural gas.

A. Related work not in this section:

1. Excavation and backfilling; and
2. Protective toppings over vapor barrier membranes.

1.02 QUALITY ASSURANCE

A. Soil vapor barrier contractor/applicator shall be trained and approved by vapor barrier manufacturer. Since the two membrane alternatives include spray applied layers, each spray applicator must be certified by the membrane manufacturer, and have their certificate on the job site when spraying the membrane. The certificate shall be renewed on an annual basis.

B. A pre-installation conference shall be held prior to application of soil vapor barrier to assure proper substrate and installation conditions, to include contractor, applicator, architect/engineer and special inspector (if any). To reduce costs, tele-conferencing is permitted for certain individuals on a pre-approved basis. Minutes from this meeting must be recorded and distributed to all involved and otherwise interested parties. These minutes must be made available on site by the general contractor upon request.

C. The owner shall provide an independent inspector, approved and where appropriate trained by the membrane manufacturer to perform continuous inspection during membrane installation and periodic inspection at critical points in the installations. For example, it is required that all subterranean vent piping is inspected prior to covering. This inspector must be approved by Soil Vapor mitigation engineering firm of record (CEC).

1.03 SUBMITTALS

A. Product Data - Submit manufacturer's product data and installation

Instructions for specific application: These specific application instructions, if any are to be used as corrections to or supplemental to those included herein.

B. Samples - Submit representative samples of the following for approval:

- Vapor barrier membrane material or membrane system materials.

1.04 DELIVERY, STORAGE AND HANDLING -

Deliver materials to site in original unbroken packages bearing manufacturer's label showing brand, weight, volume, and batch number. Store materials at site in strict compliance with manufacturer's instructions. Do not allow materials to freeze in containers.

1.05 JOB SITE CONDITIONS -

A. Protect all adjacent areas not to receive gas vapor barrier. Where necessary, apply masking to prevent staining of surfaces to remain exposed wherever membrane abuts to other finish surfaces.

B. Perform work only when existing and forecasted weather conditions are within manufacturer's recommendations for the material and product used.

C. Minimum clearance required for application of product:
* 90 degree spray wand - 2 feet.

* Conventional spray wand - 4 feet.

D. Ambient temperature shall be within manufacturer's specifications.

* (Greater than +45 F / +7C).

E. All plumbing, electrical, mechanical and structural items to be under or passing through the gas vapor barrier shall be positively secured in their proper positions and appropriately protected prior to membrane application.

F. Soil vapor barrier shall be installed before placement of reinforcing steel. When not possible, all exposed reinforcing steel shall be masked by General Contractor prior to membrane application.

G. Expansion joints must be filled with a conventional waterproof expansion joint material.

H. Surface preparation shall be per manufacturer's specification.

1.06 PRODUCT WARRANTY -

The Manufacturer of the membrane system selected will warrant its products to be free of defects. This warranty only applies when the product is applied by Manufacture's Approved Applicators. Factors which affect the result obtained from this product -- including weather, equipment utilized, construction, workmanship and other variables -- are to be considered into this warranty by the manufacturer. The manufacturer must upon completion of the installation of the membrane system certify and warrant that the material conforms to its product specifications. Under this warranty the manufacturer warrants that the membrane system will not leak for a minimum of 20 years and will replace or repair at no charge any product not meeting these specifications within 12 months of installation.

B. Perform work only when existing and forecasted weather conditions are within manufacturer's recommendations for the material and product used.

C. Minimum clearance required for application of product:

* 90 degree spray wand - 2 feet.

* Conventional spray wand - 4 feet.

D. Ambient temperature shall be within manufacturer's specifications.
* (Greater than +45 F / +7C).

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PART 2 - PRODUCTS

2.01 MATERIALS -

A. HDPE sheeting of minimum 5 mil thickness.

B. Fluid spray applied soil vapor membrane system - Geo-Seal Core; a single course, high build, polymer modified asphaltic membrane water borne and spray applied at ambient temperatures. A minimum total thickness of 60 dry mils. Non-toxic and odorless.

Land Science Technologies (Geo-Seal), 1011 Calle Sombra, Suite 110, San Clemente, California 92673 (949) 366-8000.

B. System Configuration

-Geo-Seal will consist of Geo-Seal BASE (5 mil HDPE and 3 oz. Geotextile fabric), 60 mils of Geo-Seal CORE and Geo-Seal BOND (5 mil HDPE and 3 oz. Geotextile fabric).

C. Additional Protection

On horizontal surfaces, a 2-inch thick sand layer will be installed.

PART 3 - EXECUTION

3.01 EXAMINATION -

All surfaces to receive gas vapor barrier shall be inspected and approved by the applicator at least one day prior to commencing work.

3.02 SURFACE PREPARATION -

Provide 24 inch minimum clearance out from surfaces to receive the soil vapor membrane system. The application surface shall be prepared and provided to the applicator in accordance with manufacturer's specifications listed below:

A. Concrete/Shotcrete/Masonry (e.g. structural footings):

Concrete surfaces must be a light trowel, light broom or equivalent finish, free of any dirt, debris, loose material, release agents or curing compounds. Remove fins, ridges and other projections and fill honeycomb, aggregate pockets, grout joints and tie holes, and other voids with hydraulic cement or rapid-set grout. Masonry joints, cold joints, and form joints shall be struck smooth. It is the applicator's responsibility to point out unacceptable substrate conditions to the general contractor and ensure the proper repairs are made.

J. H. [Signature]

Professional Engineer
No. GE 229
Exp. 6/30/16
STATE OF CALIFORNIA

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MITIGATION MEASURES**

Carlin Environmental Consulting
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All penetrations shall be prepared in accordance with manufacturer's specifications.

For Geo-Seal: Apply 30 mils of Geo-Seal CORE Detail to all horizontal to vertical terminations and other inside corners of 120° or less, embed reinforcement fabric, and apply a second 30 mil layer of Geo-Seal CORE Detail. Allow to set before commencing additional layers.

All form tie holes must be completely grouted from the inside to outside of wall with non-shrink grout as approved by engineer.

All cracks or cold joints greater than 1/16 inch must be completely grouted with non-shrink grout as approved by engineer.

Install 6" Hardcast reinforcing tape over all cold joints, cracks and form tie holes (after holes and cracks are grouted) or use the 30 mils Geo-Seal CORE Detail, reinforcement fabric and an additional later of 30 mil Geo-Seal CORE Detail to reinforce joint.

Surfaces may need to be wiped down or cleaned prior to application. This includes, but is not limited to, the removal of forming oils, concrete curing agents, dirt accumulation, and other debris. Contact form release agent manufacturer or concrete curing agent manufacturer for VOC content and proper methods for removing the respective agent.

B. Soil & Gravel (e.g. building pad area)

The sub-grade shall be moisture conditioned and compacted to a minimum relative compaction of 90 percent or as specified by civil/geotechnical engineer. The finished surface shall be smooth, uniform, and free of debris and standing water. Remove all stones or soil clods greater than 1/4 inch. (NOTE: Aggregate sub-bases shall be rolled flat). Final sub-grade preparation shall not precede the membrane application by more than 72 hours. All penetrations shall be prepared in accordance with manufacturer's specifications. All form stakes that penetrate the membrane shall be of rebar which shall be bent over and left in the slab.

Trenches shall be cut oversized to accommodate vapor membrane and protection course with perpendicular to sloped sides and maximum obtainable compaction. Adjoining grade shall be finish graded and compacted. Excavated walls shall be vertical or sloped back, free of roots and protruding rocks. Specific sub-grade preparation shall be designed by a qualified civil or geotechnical engineer.

If organic materials with potential for growth (ie: seeds or grasses) exist within the sub base, spray apply soil sterilant at the sterilant manufacturer's recommended rate.

C. Lagging (Lagging is not anticipated to be a part of this project)

Lagging shall be held securely in place. All sharp edges and nails shall be removed or protected so as not to penetrate the membrane.

3.03 INSTALLATION -

3.03.10 INSTALLATION ON CONCRETE/SHOTCRETE/MASONRY (e.g. structural footings):

Follow the procedures below carefully.

A. Refer to "Sealing Around Penetrations" details and the section below for procedures to seal around penetrations.

For Geo-Seal: To properly seal around penetrations, cut a piece of the Geo-Seal BASE layer that will extend 6" beyond the outside perimeter of the penetration. Cut a hole in the Geo-Seal BASE layer just big enough to slide over the penetration, ensuring the Geo-Seal BASE layer fits snug against the penetration, this can be done by cutting an "X" no larger than the inside diameter of the penetration. There should not be a gap larger than a 1/8" between the Geo-Seal BASE layer and the penetration. Other methods can also be utilized, provided, there is not a gap larger than 1/8" between the Geo-Seal BASE layer and the penetration.

B. For Geo-Seal: Apply one coat of Geo-Seal CORE Detail or Geo-Seal CORE spray to the Geo-Seal BASE layer and around the penetration at a thickness of 30 mils. Penetrations should be treated in a 6-inch radius around penetration and 3 inches onto penetrating object.

Embed a fabric reinforcing strip after the first application of the Geo-Seal CORE spray or Geo-Seal CORE Detail material and then apply a second 30 mil coat over the embedded joint reinforcing strip ensuring its complete saturation of the embedded strip and tight seal around the penetration.

After the placement of the Geo-Seal BOND layer, a cable tie should then be placed around the finished penetration. The cable tie should be snug, but not overly tight so as to slice into the finished seal.

C. Do not penetrate the membrane. Keep membrane free of soil and debris and traffic until a protective cover is in place. It is the responsibility of the General Contractor to insure that the membrane and the protection system are not penetrated.

D. After membrane has cured and checked for proper thickness and flaws, install protection material pursuant to manufacturer's instructions.

NON-HORIZONTAL SURFACES: Application of spray applied membrane on non-horizontal surfaces should begin at the bottom and work towards the top. This method allows the product to adhere to the surface before hitting catalyst runoff.

3.03.20 INSTALLATION ON SOIL OR GRAVEL SURFACES AND PROTECTIVE SLABS

A. Roll out Geo-Seal Base on sub-grade with the geo-textile side facing up. Overlap seams a minimum of six inches (6"). Lay sheeting tight at all inside corners. Spray Geo-Seal Core within the seam overlap of each layer to a

thickness of 60 mils minimum.

Line trenches with Geo-Seal Base sheeting extending at least six inches (6") onto

adjoining sub-grade if slab and footings are to be sprayed separately. Overlap seams a minimum of six inches (6"). Lay Geo-Seal Base sheeting tight at all inside corners. Spray Geo-Seal Core within the seam overlap or each layer to a thickness of 60 mils minimum.

B. Refer to sealing around penetrations details and the section below for procedures to seal around penetrations.

C. Spray Geo-Seal Core onto Geo-Seal Base to a 60 mil minimum dry thickness. If a second coat is required, remove any standing water from membrane before proceeding with the second application.

D. When connecting to (applying on top of) Geo-Seal Core membrane, spray apply to a minimum 60 mil dry thickness a minimum six inches (6") over the previously applied membrane.

E. Do not penetrate membrane. Keep membrane free of dirt, debris and traffic until a protective cover Geo-Seal Bond is in place. It is the responsibility of the General Contractor to insure that the membrane and the protection system are not penetrated.

F. After membrane has cured and checked for proper thickness and flaws, install protection material Geo-Seal Bond pursuant to manufacturer's instructions.

G. Protection course should be applied after the proper quality control procedures have been conducted.

Geo-Seal: Install Geo-Seal BOND protection course perpendicular to the direction of the Geo-Seal BASE course with overlapped seams over nominally cured membrane no later than recommended by manufacturer and before starting subsequent construction operations.

Remove any water that has collected on the surface of the Geo-Seal CORE layer, prior to the placement of the Geo-Seal BOND layer.

Overlap and seam the Geo-Seal BOND layer in the same manner as the Geo-Seal BASE layer.

To expedite the construction process, the Geo-Seal BOND layer can be placed over the Geo-Seal CORE immediately after the spray application is complete, provided the Geo-Seal CORE mil thickness has been verified.

Membrane Terminations for Geo-Seal: Prepare the substrate surface in accordance with surface preparation section of this document. Concrete surfaces that are not a light trowel, light broom or equivalent finish, will need to be repaired.

Terminations on horizontal and vertical surfaces should extend 6" onto the termination surface. Job specific conditions may prevent a 6" termination. In these conditions, contact manufacturer for recommendations.

Apply 30 mils of Geo-Seal CORE to the terminating surface and then embed the Geo-Seal BASE layer by pressing it firmly into the Geo-Seal CORE layer. Next, apply 60 mils of Geo-Seal CORE to the BASE layer. When complete, apply the Geo-Seal BOND layer. After the placement of the Geo-Seal BOND layer is

complete, apply a final 30 mil seal of the Geo-Seal CORE layer over the edge of the termination. For further clarification, refer to the termination detail provided by manufacturer.

The stated termination process is appropriate for terminating the membrane onto exterior footings, pile caps, interior footings and grade beams. When terminating the membrane to stem walls or vertical surfaces the same process should be used.

NOTE: In addition to the procedures outlined in this specification, the manufacturer's specification should also be consulted.

3.03.40 SEALING AROUND PENETRATIONS

A. Clean all penetrations. All metal penetrations shall be sanded clean with emery cloth.

B. For the sequence of the application of Geo-Seal Base sheeting, refer to manufacturer's instructions. Cut the Geo-Seal Base sheeting around penetrations so that it lays flat on the sub-grade. Lay Geo-Seal Base sheeting tight at all inside corners.

Spray Geo-Seal Core within the seam overlap to a thickness of 60 mils minimum.

Cut the Geo-Seal Base around penetrations so that it lays flat on the sub-grade. Lay Geo-Seal Base tight at all inside corners. Spray Geo-Seal Core within the seam overlap to a thickness of 60 mils minimum.

D. At the base of each penetration install a minimum 3/4 inch thick membrane cant of Geo-Seal Core.

Apply the membrane at a 60 mil thickness three inches (3") around the base of penetration and up the penetration a minimum of three inches (3"). Allow to cure overnight before the application of Geo-Seal Core membrane around the penetration.

C. Roll out Geo-Seal Base sheeting with the geo-textile side facing up, overlapping seams a minimum of 6-inches.

E. After curing overnight, spray apply Geo-Seal Core to a minimum 60 mils dry thickness around the penetration,

completely encapsulating the collar assembly and to a minimum height of one and one half inches (1 1/2") above the previously applied membrane. Spray apply Geo-Seal Core to surrounding areas as specified for the particular application.

E. Allow Geo-Seal Core to cure completely before proceeding to step "F".

F. Wrap each penetration with a polypropylene cable tie at a point two inches (2") above the base of the penetration. Tighten the cable tie firmly so as to squeeze the cured membrane collar.

3.04 FIELD QUALITY CONTROL -

The owner shall provide an independent inspector, trained by the

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membrane manufacture, to perform continuous inspection during membrane installation. This inspector shall be approved by CEC.

3.04.10 TESTING FOR PROPER THICKNESS

A. On concrete, shotcrete, masonry, and other hard surfaces, membrane may be checked for proper thickness with a blunt-nose depth gauge, taking one reading every 500 square feet. Record the readings, and if necessary, mark the test area for repair. Test areas are to be patched over with Geo-Seal Core to a 60 mil minimum dry thickness, extending a minimum of six inches (6") beyond the perimeter of the test area.

B. On soil and other soft substrates, samples may be cut from each of the Geo-Seal membrane system of layers to a maximum area of 2 square inches, per 500 square feet. Measure the thickness with a mil-reading caliper.

Mark the test area for repair. Areas cut out during sampling are to be patched with Geo-Seal Base sheeting overlapping the cut out area by a minimum of 2 inches (2") on each side. Apply 60 mils minimum Geo-Seal Core above the Geo-Seal Base sheeting. Then spray Geo-Seal Core to a 60 mil minimum dry thickness over the patch, extending at least six inches (6") beyond patch.

3.04.20 TESTING FOR HOLES

Upon completion of thickness testing, all Geo-Seal installations shall be subjected to a Smoke Test. Testing shall be designed by CEC and shall meet, at a minimum, the following criteria:

A. The vapor membrane shall be visually inspected. Any apparent deficiencies and/or installation problems shall be corrected prior to Smoke Testing.

B. The date, time, address, tract #, lot #, temperature, humidity barometric pressure, wind speed/direction, and cloud cover shall be recorded on the Smoke Testing Record by the Soil Vapor Mitigation Engineering firm (CEC). The ambient air temperature at the time of testing should be in excess

of 45° F and the wind speed at ground level should be 15 mph or less. Note: Visual identification of leaks becomes more difficult with increasing wind speed.

Additional Note: Holes discovered during the smoke testing indicate holes in the Geo-Seal Base Sheeting as well as the spray applied layer and therefore cannot be repaired by simply over-spraying the hole with spray applied Geo-Seal Core membrane materials. When smoke is found to be emanating through the membrane, it will be necessary to repair the entire membrane system, including the underlying Geo-Seal Base layer, by cutting out the hole and patching the cut-out area as described above.

C. Assemble / connect smoke testing system to sub-slab vent riser (Alternative A) OR configure smoke testing system to inject smoke beneath membrane through a temporary gas tight boot or sleeve attached to the membrane (Alternative B). Only inert, non-toxic smoke is to be utilized for the membrane Smoke Test.

D. Activate smoke generator / blower system @ nominal 150 cfm to 950 cfm flow rate and 2.0" H2O duct pressure with vent riser outlet(s) **uncapped**. Note: Minimum 2" H2O duct pressure should be measured at or near blower outlet. Continue to purge system for 60 seconds after smoke begins to emerge from vent outlet(s).

E. Cap vent outlet(s). Adjust smoke generator / blower control valve to maintain 1" to 2" H2O over-pressure in vent piping system (Alternative A only). Blower / Smoke Generator system should be capable of sufficient pressure and flow to induce slight (i.e. »¼") lifting of membrane. Monitor membrane for lifting. Reduce pressure / flow rate if excessive lifting occurs.

F. Select one membrane coupon sampling location for every 500 sq ft of membrane area. Select sampling locations so as to (1) facilitate purging of fresh air pockets from beneath membrane; and (2) provide a representative test location for confirmation of membrane thickness.

G. Label membrane coupons. Mark coupon location/designation on floor plan. Marked-up floor plan to be included with Smoke Testing Inspection Form.

H. Confirm adequate flow of smoke from coupon sampling locations. Low rate of smoke flow may be indicative of poor communication between vent piping gravel backfill and base of membrane for Alternative A (i.e. first placed above trench gravel). If low rate of smoke flow from coupon sampling location(s) occurs, use Alternative B described under Item #C above for smoke injection. Connect smoke generator to injection boot and continue with smoke injection. (Note: At least localized continuity of the sand or gravel between the vent lines and the base of the membrane should be confirmed prior to membrane

installation.

I. Install temporary seal at the membrane sampling locations after purging using HDPE with GSE double-sided butyl-asphaltic tape or other procedure approved by the Vapor Mitigation System Engineer. Mark coupon-sampling

location with fluorescent green paint. Repair sampling locations as described above with spray-applied or trowel grade Geo-Seal Core and a layer of associated Geo-Seal Base sheeting that is a minimum of 12-inches square following completion of test.

J. Select one 0.05" perforation test location for every 1,000 sqft of membrane area up to a maximum area of 2,000 sqft and one additional perforation test location for every 5,000 sqft thereafter. Select representative test locations dispersed somewhat uniformly across the surface of membrane. Perforate membrane at test locations using 0.05" pin. Confirm / photograph smoke emergence at each test location. Mark test locations with fluorescent paint. Temporarily repair test locations after verification using HDPE tape or other material approved by the Vapor Mitigation System Engineer. Repair test perforations as described above

with spray applied or trowel grade Geo-Seal Core and underlying associated Geo-Seal Base sheeting that is a minimum of 12-inches square following completion of test.

K. Maintain operation of smoke generator / blower system for at least 15 minutes minimum following purging of membrane. Thoroughly inspect entire membrane surface. Use fluorescent paint to mark / label any leak locations. Mark / label leak locations on floor plan which is to be included with the Smoke Testing Inspection Form.

L. Repair leak locations marked in Step K as described above using spray applied or trowel

grade Geo-Seal Core and the underlying associated HDPE sheeting that is a minimum of 12-inches square.

M. Repeat steps K and L, as necessary, to confirm integrity of membrane.

N. Prepare smoke testing Inspection Form. Notes to include date, tract #, lot #, Name of soil vapor mitigation Engineer, name of person who performed

the test, number of leaks identified, distribution of leaks identified (i.e. tears, pin-holes or thin sections, seam leaks, boot leaks, etc.), and building floor plan with leak locations, coupon locations, and test perforation locations. The Inspection Form is to be signed and

stamped by a CEC representative/inspector.

Operation and Maintenance:

The mitigation measures depicted on these drawings are designed to operate in a passive condition. No mechanical equipment is included, thus no operation and minimal maintenance is required. CEC recommends that future inhabitants be instructed to reframe from any alteration of the concrete floor of buildings without permission from the Building Department. Additionally, any alteration of the concrete floor should be conducted in a manner that will return mitigation measures to a condition that precludes vapor intrusion. If the mitigation measures beneath the buildings are damaged, inhabitants will not be adequately protected. Replacement and or repair of mitigation measures that are affected by concrete floor alterations should be conducted under the oversight of the Building Department and if required under the oversight of an appropriately experienced professional such as a geologist or engineer. Vent pipes should be periodically inspected by the homeowner or agent to assure that pipes are not damaged or clogged by windblown debris or birds nest type materials.

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