Using Vapor Barriers to Prevent Vapor Intrusion

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Abstract

Numerous construction projects in the United States have been built on sites that have a potential or real concern of vapor intrusion into buildings due to prior use or other concerns. Vapor barriers have become an important tool that is used to prevent the vapors from migrating into the structures. These barriers are often used in conjunction with traditional passive or active remediation systems as an added precaution for sites with vapor concerns. Two vapor barrier systems, high-density polyethylene (HDPE) sheet liners and fluid–applied Liquid Boot®, are outlined. Vapor barriers prevent hazardous gas migration and thereby reduce the liability of building on brownfield site.

Key Words

Vapor barrier, environmental liners, geomembranes, vapor intrusion, brownfields, landfills

Text

Brownfields are properties that are abandoned, idled, or under-used due to "real or perceived environmental contamination." Over the last decade, as the number of properties across the country characterized as brownfields rose to over a million, and as policy has shifted towards smart growth and limiting urban sprawl, there has been an increased implementation of current technologies to safely build on and redevelop these sites. A commonly used technology is the vapor barrier.

General Background – Vapor Barriers

Vapor barriers, typically used in conjunction with a soil vapor extraction [SVE] system, will prevent hazardous vapors from entering a building constructed on a site with contaminated soil or groundwater. This article will refer to these systems as gas vapor barriers, but these types of liners can be termed a brownfield liner, an environmental liner, a gas vapor barrier or membrane, or a geomembrane. While used primarily on new construction, these products can often be applied to existing structures as well.

Traditionally, sites that played host to known contamination were cleaned up to current standards and then built upon. As site conditions have become more extensively investigated and the affects of contaminants on human health have become more well known, the use of vapor barriers underneath buildings constructed on contaminated sites is both a scientific decision and a protection from future liability. As the industry and regulatory climate has shifted towards a more conservative approach to redeveloping brownfields, the use of gas vapor barriers in conjunction with venting systems is a key piece of creating a successful project.

While the use of vapor barriers may increase the upfront cost of site redevelopment, it is usually less expensive to install a liner prior to pouring the concrete slab, versus after the building is inhabited. By placing a vapor barrier below the slab, one can eliminate vapor intrusion, maintain compliance with standards, and limit future liability. It is important to note that vapor barriers do not substitute for traditional site investigations and remediation, but are often used in conjunction with these traditional systems to provide added protection from vapors. Vapor barriers, essentially, are a cheap form of insurance.

National Perspective on Vapor Intrusion

The New Jersey Department of Environmental Protection [NJDEP] and the NY State Department of Environmental Conservation [NYSDEC] are both implementing stringent guidelines for assessing the extent of vapor intrusion and its risk. Similar actions have taken place across the country. Brownfield re-use is encouraged and commonplace in many states, and regulations are reflecting that.

As brownfields and landfills are being revitalized across the nation, gas vapor membranes are specified as an integral part of the remediation systems. The precedent has been set by numerous projects built across the country. A recent evaluation performed at the Seaview Mall in Ocean Township, New Jersey which was built on a former landfill, showed that methane levels were lowered to non-detectable levels by placing a vapor barrier below the foundation in conjunction with a sub slab depressurization system or soil vapor extraction system. This site is one of many "Big Box Developments" that have used a similar system to mitigate vapors.

Public school agencies have recommended the use of vapor barriers in districts from Los Angeles to New York City as an added precaution against vapor intrusion.[1] Private developers are also using vapor barriers, both when regulatory bodies require it, and even voluntarily using them to limit their future liability in absence of regulatory action.

Much of Los Angeles is covered by what is deemed "the methane zone" by local regulators. The methane is naturally occurring in many locations due to old oil fields that generate methane gas. This situation has spurred the use of vapor barriers to ensure that the buildings constructed at these sites are safe for occupancy. In Southern California, liners are used on many of the single-family homes built on methane zones for large, well-known home builders such as Toll Brothers, Centex, and KB Homes.

1. Wilson, Janet and Kristina Sauerwein. "Methane is Out Before School Is In." *Los Angeles Times* 11 November 2003, Orange County Edition.

A confidential site in the Midwest was a former warehouse space that was rehabilitated into condominiums, and a vapor barrier was applied onto the existing slab in order to prevent trichloroethylene [TCE] vapors from migrating into the building.

The types of structures built on contaminated sites range from single-family homes to commercial warehouse space, retail and office buildings, in addition to numerous schools and universities. The key component of all of these redevelopments is that a gas vapor membrane was used to prevent harmful vapors from intruding into the structures.

Types of Contamination

There are numerous types of contamination that one might find at a brownfield or landfill sites, and their sources also vary. In some instances the vapor concern exists because of contaminated ground water or, as in the case of Los Angeles, old oil fields which produce naturally occurring methane gas. Methane gas is generated by the decomposition of trash at municipal and unofficial landfill sites. Other common vapors include chlorinated solvents originating from activities on the sites of former gas stations, tank farms, dry-cleaning facilities, and former manufacturing plants.

There are two choices for gas vapor barriers that are considered to be of the highest standard. High-density polyethylene [HDPE] sheets and the fluid-applied LIQUID BOOT® membrane are two systems well established in the environmental community to help prevent vapor intrusion. Both products are suitable for the prevention of methane gas, chlorinated solvents and petroleum bi-products to 20,000 parts per million (PPM), and radon gas. Most manufacturers will be happy to review a soil report for levels of contamination and compatibility, prior to an environmental professional's preparation of the specifications.

Gas Vapor Barriers as Remedial Solutions

The two vapor barriers, which have been in use for over 15 years, are High-density polyethylene [HDPE] sheet liners or the LIQUID BOOT® fluid-applied liner system.

The HDPE systems generally consist of a 40 or 60 mil HDPE sheet liner that is rolled out and secured to the grade beams or footings using a stainless steel batten bar (see Figure 1). The seams are sealed by heat welding. Plastic boots are shaped and heat-welded around pipes or other protrusions in the application surface and welded for adhesion.[2] Sheet products lend themselves very well to large, unobstructed areas such as landfill caps or containment caps on parks or golf courses.

Liquid Boot®, a fluid-applied vapor barrier, is an ideal product to use for complex foundations that have irregular surfaces or numerous penetrations to seal.[3] The product is a rubberized asphalt emulsion that is cold, spray-applied. It is installed through the use of a two-part spray wand. The two parts mix right outside of the spray wand, and then, through a chemical reaction of the two parts, the product sets up as a solid, monolithic membrane (see Figure 2). The fluid spray is pliable and malleable, and

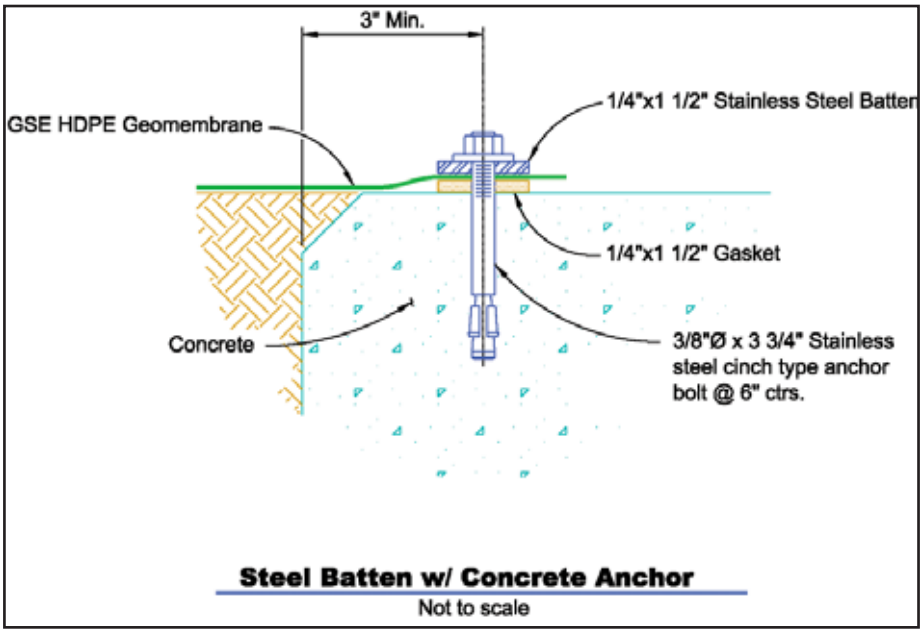

Figure 1

Figure 2. Installation of a fluid-applied vapor barrier at a public school in Queens, NY.

2. GSE World. *29 June 2006* <http://www.gseworld.com/Literature/DetailDrawings /PDF/DDTerminations.pdfwww.gseworld.com>.
3. Liquid Boot. Methane Details. *29 September 2006*. <www.liquidboot.com>.

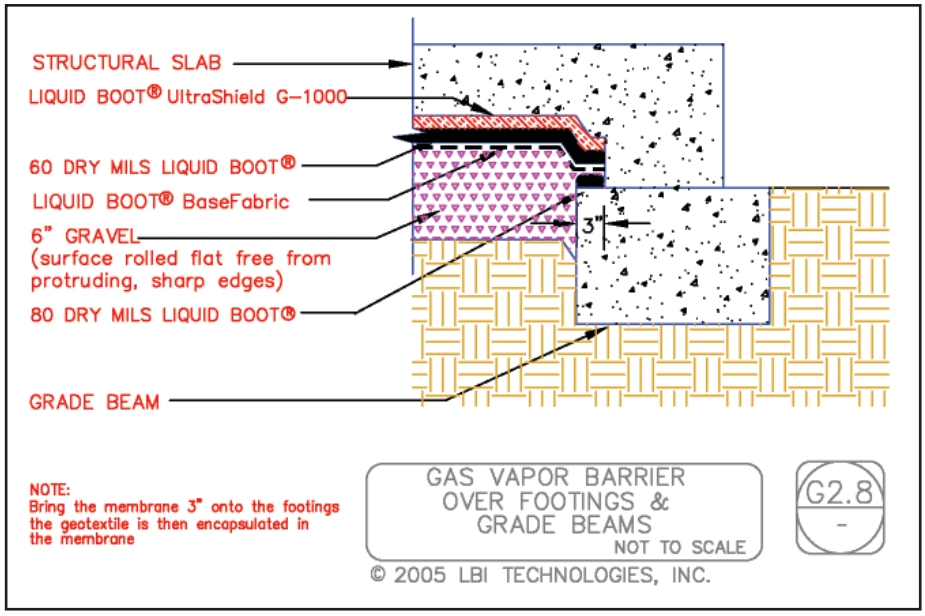

Figure 3

readily conforms to the shapes of any building or structure making it easier, and more cost effective, to install on such sites (see Figure 3).

Conclusion

Vapor barriers are commonly used because of their successful history of use, spanning more than 20 years. Vapor barriers prevent harmful gas from migrating into structures built on sites with a potential concern for vapor intrusion, and they limit the liability of owners and designers. Gas vapor barriers are becoming an integral part of specifications for projects where there is a known or suspected risk of vapor intrusion. The installation of these barriers is a long-term solution that helps to ensure the safety of buildings and human health.

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