



THE HIDDEN DETAILS OF BLINDSIDE WATERPROOFING

By Douglas Stieve, RRC, AIA

Blindside waterproofing produces numerous challenges to both design and construction teams. Many of these are relatively straightforward. What is the best system to use? How is the membrane applied to the support of excavation (SOE)? How does one protect the membrane as the steel reinforcement is placed? Due to the constraints of the project site, which is the usual precursor to blindside waterproofing, the greatest challenges to the installation of a successful blindside waterproofing system do not become apparent until the SOE is designed and the resulting structure is interfaced with the waterproofing membrane.

SOE DESIGN

When many urban and/or otherwise congested project sites are excavated, there is a need to support adjacent structures,

utilities, tunnels, and earthwork. The design of such support systems is typically performed by a separate geotechnical engineer retained as part of the construction team. The resulting design is typically well coordinated with the foundation contractor's work and will usually result in an efficient method to prevent disturbance to adjacent properties. If the SOE allows enough room to access the exterior walls after they are constructed, then by all means, utilize a post-installed waterproofing system on the walls and avoid the headaches of a blindside installed system. However, over-excavating an additional three to four feet to allow access to the exterior side of the subgrade wall is rarely cost-effective and is also prohibitive when the building needs to be constructed adjacent to another structure or right on the property line. The design of the SOE now has a major impact on the waterproofing, whose design was likely produced

by a separate consultant long before the SOE was designed and/or contemplated.

Listed below are some of the more common SOEs utilized in urban environments, along with some of their nuances and hidden challenges. Many projects will include different SOEs, depending on the project site, as well as other constraints.

PILES AND TIMBER LAGGING

Probably the most popular SOEs are steel piles and timber lagging. Vertical piles consisting of structural steel wide-flange shapes are driven down into the ground slightly below the final elevation of the excavation. Once the piles have been driven, the site is then excavated (*Figure 1*). As the excavation proceeds downward, timber lagging is placed between the piles to support the earth behind the lagging. Additional timber lagging is placed as the excavation proceeds downward.



Figure 1 – Installation of tie-backs to support vertical piles occurs as the excavation proceeds downward.

Figure 2 – Plywood utilized to provide smooth substrate for the blindside waterproofing.



The interface between the piles and lagging—and sometimes gaps between lagging boards—produce offsets that may need to be corrected prior to installing a blindside membrane. When concrete is placed against the blindside membrane, it produces forces that can open joints or possibly rupture the membrane. Eliminating these gaps is critical (Figure 2).

SHEET PILES

Sheet pile walls are constructed by driving prefabricated sections of corrugated metal into the ground. Soil conditions may allow for the sections to be vibrated into the ground instead of being hammer-driven.

The full wall is formed by connecting the joints of adjacent sheet pile sections in sequential installation.¹ As the excavation progresses downwards, the sheet piles can be braced with tie-backs or internal struts. The final excavation shape will follow the profile of the undulating sheet piles. The blindside waterproofing will have to either follow the complicated profile of the sheet piles, which is permitted by some waterproofing manufacturers, or the voids between the sheet piles need

to be filled with a solid material such as wood blocking and sheathing (or sometimes insulation with high compressive strength) that will resist the force of the concrete as it is placed.

SECANT PILE WALLS

Secant pile walls are formed by drilling and casting intersecting circular concrete piles into the ground. Primary piles are installed first, with secondary piles constructed in between primary piles once the latter gain sufficient strength. The secant piles are reinforced with either steel-reinforcing bars or with steel wide-flange shapes.² The piles overlap to form an interconnected wall of overlapping circular piles. Secant piles typically impose less vibration onto adjacent properties than other forms of excavation. The piles are typically drilled down to the level of bedrock or other competent material. This will help cut off the flow of water from outside the excavation into the project site, reducing dewatering and mitigating potential settlement of adjacent structures.

If the project is below the water table, water infiltration often occurs at vertical overlapping joints, as well as at tie-backs. These leaks should be mitigated by chemical grouting, and the overlapping circular shapes must be parged with a cementitious concrete patching material or other similar

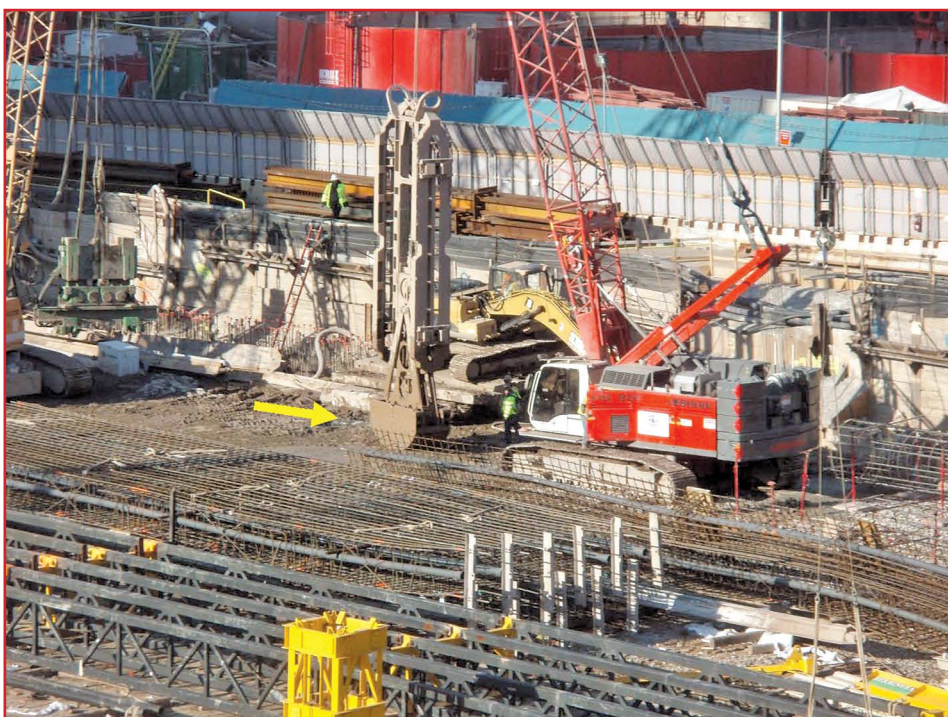


Figure 3 – Clamshell cutter (arrow).

product to provide a smooth and strong surface for the installation of the blindside waterproofing.

SLURRY WALLS

Slurry walls are also used in tight urban environments, as they also mitigate vibration into the ground. A clamshell cutter is used to excavate the ground in small sections (Figure 3). As the cutter removes the soil, a bentonite-based slurry is pumped into the excavation to prevent collapse. Once the excavation reaches bedrock or its final elevation, a reinforcing cage is lowered into the hole, which is still filled with the slurry. Then a tremie tube³ is inserted into the hole, and concrete is placed from the bottom of the excavation upwards. As the concrete flows into the excavation, it displaces the slurry, which is collected for reuse in the next segment of the wall. The wall proceeds, and then the project site is excavated.

Most slurry walls become the foundation wall for the project. Water infiltration often occurs along the vertical joints between panels of the slurry wall, as well as at tie-backs. These leaks are then mitigated by chemical grouting. The slurry wall may

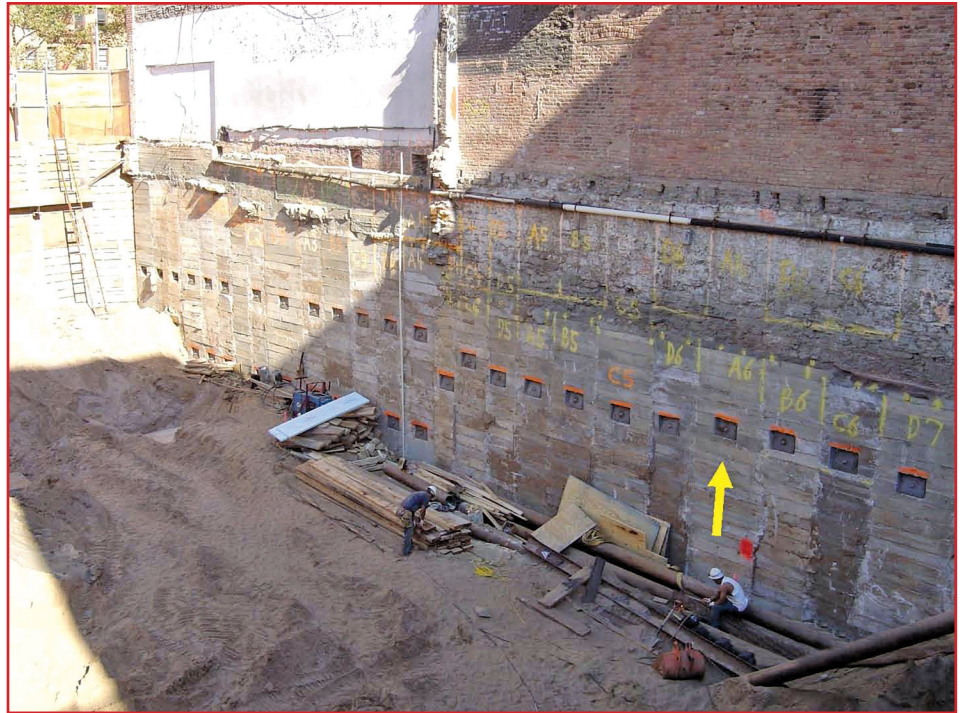


Figure 4 – Underpinned wall. Note the tie-backs used to provide lateral support (arrow indicates a typical tie-back).

remain exposed, or another wall is constructed inboard of the slurry wall, and the space between the two walls is used to col-

lect the infiltrating water and direct it into sump pits, where it is then ejected from the structure.

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Figure 5 – Tie-back waiting to be waterproofed.

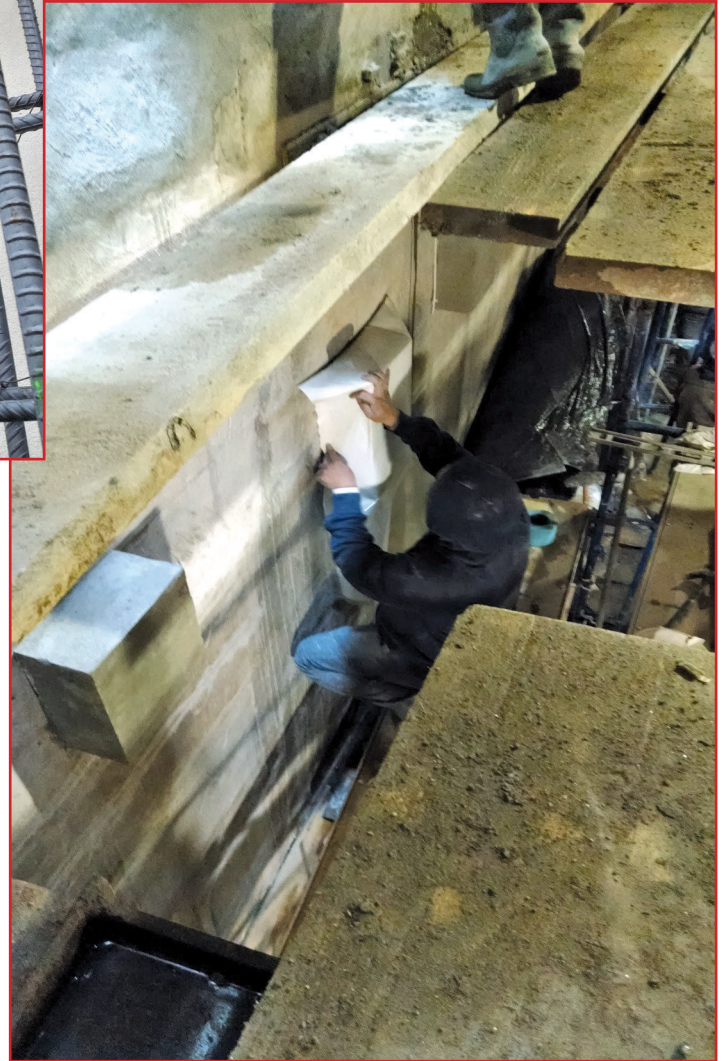


Figure 6 – Tie-back cover being flashed.

UNDERPINNING

When a new building's foundations are placed below the foundation wall of an adjacent building, there is a danger that the excavation will undermine the bearing of the adjacent structure. A scheme of excavating the earth under the adjacent structure and installing segments of underpinning walls, typically with reinforced concrete in a sequential manner, is used. When complete, the adjacent building's walls will be successfully lowered as the subject building's excavation occurs (Figure 4). The underpinned walls can provide a smooth and solid surface for the blindside waterproofing membrane. However, the author has been involved with several projects in which the underpinning occurs to a wall that is shared by both property owners. In these cases, the underpinning became the exterior wall for the project, and the blindside waterproofing had to be installed in segments exterior to the underpinning, creating numerous tricky waterproofing details to accommodate the sequence of underpinning.

HIDDEN DETAILS

When a project is developed, the design team may be aware of where blindside and post-applied waterproofing membrane systems will be used. However, they may not be aware of the eventual SOE that will be developed by the construction team for the project. These SOEs and their encroachments into the building structure, along with the means and methods of construction, are the genesis of the hidden details of blindside waterproofing.

Waterproofing shop drawings need to be produced by the construction team to bridge the gap between the design documents and the actual installation of the waterproofing. These details should not be deferred to be worked out later in the field. The shop drawings need to be well thought out by the construction team and coordinated with the SOE as well as the structural and architectural design for the building. The shop drawings must be project-specific and be sent to all parties, including the waterproofing material's manufacturer, for review and eventual approval. Rarely do manufacturer's typical details include all of the conditions that will be encountered.

A common SOE encroachment into the building and the



Figure 7 – This anchor rod will be cut back. Then the membrane and wall will be patched.

blindsiding waterproofing is from tie-backs (also known as soil nails), which are wire rods and/or helical anchors used to reinforce the SOE. The tie-back heads typically extend into the structure. The head of the tie-back should be encased in a solid structure, and then the waterproofing needs to be detailed around the tie-back cover (Figures 5 and 6). Make sure that the resulting tie-back cover does not encroach into the steel reinforcing of the foundation wall. It is good practice to grout the tie-back if it is leaking prior to installing the waterproofing. The tie-back cover also needs to be strong enough so that it is not crushed or displaced as the concrete is placed. One method of accomplishing this is to fill the interior of the tie-back cover with non-shrink grout or with granular bentonite.

Walers, rakers, and corner braces can also be used to support the excavation. In most cases, these support members must remain in place until the structure within the excavation is completed and the building can support the excavation. The ideal situation would be to remove the excavation bracing once the structure within is complete, patch the waterproofing, and then patch the wall (Figure 7). However, in many cases, blindsiding waterproofing is flashed to the excavation brace, the wall is constructed, and the brace is cut off at the face of the wall when it is no longer needed. This leaves a condition where the waterproofing is permanently flashed to the remaining stub of the excavation brace.

For narrow excavations, internal struts are most appropriate. Before struts are installed, a horizontal member called a waler

is placed against the soil support. Intermediate struts are then installed from waler to waler across the excavation.⁴ A raker is a sloped brace that transfers the horizontal loads from the SOE to grade. These can penetrate blindsiding waterproofing on the wall and also the waterproofing under the floor slab (Figure 8). Both penetrations should be removed and patched, if possible.

Corner braces are another strut, which should also be cut away so that the waterproofing can be patched rather than flashed to the corner brace. Remember that every penetration through the waterproofing is another potential source of water infiltration. However, on many complicated SOEs, the membrane must be flashed to the braces (Figure 9).

Yet another brace is a king post, which is used to support structures overhead. King posts are needed for support when one tunnel is constructed under another, when the new structure is constructed under an active street, or if there are utilities overhead that cannot be relocated.

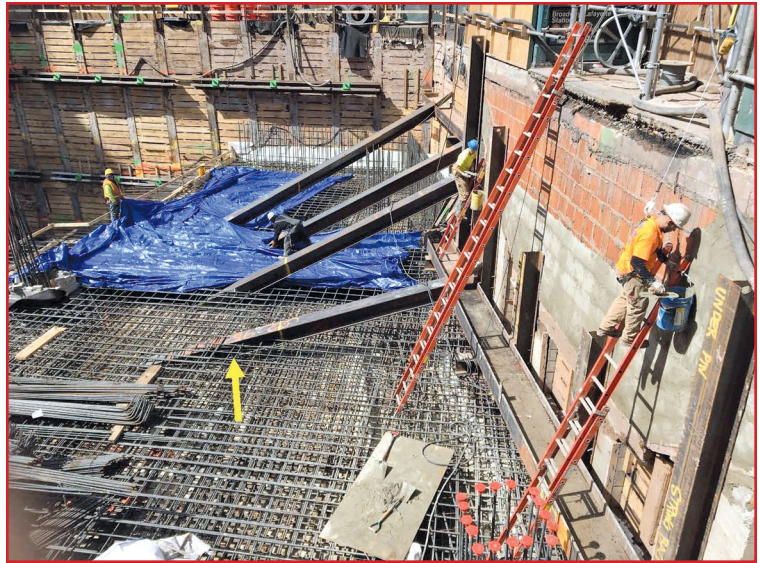


Figure 8 – The rakers on this project will be cast into the floor slab and cut away when the basement structure is complete (arrow indicates a typical raker as it will penetrate the mat slab).

However, the most common penetrations through blindsiding waterproofing membranes are from formwork ties. The ties are used to support formwork for cast-in-place concrete. They are rarely shown on the construction documents but can outnumber



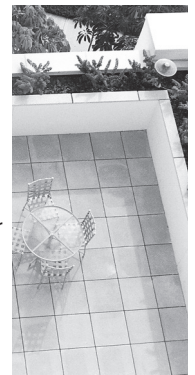
Figure 9 – Waterproofing is being flashed to a waler brace.



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Figure 10 – The use of stay forms resulted in a change to negative-side waterproofing for this project.

all other penetrations through the waterproofing. Most waterproofing manufacturers recommend that formwork ties be reduced or eliminated. Gang forms or other types of load-gathering ties can be used. One-sided framing or “A” frames should be used so that there are no formwork ties through the waterproofing. However, this needs to be established in the project specifications and made a part of the bidding documents that are given to the foundation contractors, as this is a more expensive method of construction.

If concrete is placed directly against an existing structure with questionable stability, stay-in-place forms (a.k.a. stay forms) are sometimes used. These are sheets of expanded metal mesh, which transfer

the loads of the concrete placement back to the reinforcing bars within the pour with hook ties. Unfortunately, there can be numerous hook ties, and the stay forms prevent the concrete from making intimate contact with the membrane, eliminating the effectiveness of blind-side waterproofing systems that rely on the bond of the membrane to the concrete. The use of stay forms may necessitate a change from a blindside waterproofing to a negative-side waterproofing strategy (Figure 10).

CONCLUSION

Blindside applications are one of the most challenging subgrade waterproofing membrane systems to properly construct. Hidden details and conditions often come up and can compromise the watertight integrity of the final installation. Both the design and construction teams need to work together so that the waterproofing is properly coordinated and detailed in concert with the means and methods of construction. 

REFERENCES

1. www.deepexcavation.com
2. *Ibid.*
3. The tremie concrete placement method uses a pipe or tube through which concrete is placed below water level. The lower end of the pipe is kept immersed in fresh concrete so that the rising concrete from the bottom displaces the water without washing out the cement content.
4. Kamran M. Nemati. *Temporary Structures, Excavation and Excavation Support*. University of Washington. 2007.



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NYC REQUIRES SAFETY TRAINING FOR CONSTRUCTION WORKERS

New York City Council recently approved a bill requiring at least 40 hours of safety training for construction workers. The bill, called Intro 1447, has been heavily opposed by real estate and development groups, who allege it unfairly targets minority, immigrant, and small-firm workers without the resources to complete the training, and who claim it will “paralyze” construction and benefit unions. There have been more than 40 deaths at construction sites in the city from 2015 through September 2017.

The bill requires workers to complete the course by December 2018 or 2020 if the Department of Buildings (DOB) determines there are insufficient training facilities available before the first deadline.

By March 2018, workers must complete the equivalent of OSHA 10, the Occupational Safety and Health Administration's 10-hour course. They will then complete an additional 30 hours of training, followed by 10-25 hours, still to be determined by the DOB. At least eight will pertain to the dangers of falling and objects at construction sites. Workers who have undergone such training or completed a 100-hour training course (often seen in apprenticeship programs) in the past five years are exempt.

The bill includes some incentives for developers to pay for the training, but contractors are still expected to shoulder some of the costs. Some \$5 million in tax money is earmarked for training, but opponents claim that is not enough for 120,000 non-union construction workers.

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