PROJECT CASE STUDY

ABINGDON HEIGHTS CONDOMINIUM TOWER
Arlington, VA

Support of excavations in urban areas can be extremely challenging. The placement of external support components, such as anchors or soil nails in right-a-ways and subway utility setbacks, must be precise to avoid the disruption of existing, adjacent structures.

In 2006, construction began on Abingdon Heights (now known as Vista on Courthouse,) an 11-story condominium complex located in the heart of Arlington, Virginia. The new, state-of-the-art complex would replace a low-rise Quality Inn hotel, which had been demolished in preparation for the site's redevelopment.

PROJECT BACKGROUND

The construction of the Abingdon Heights complex required a permanent retaining wall to support a 48.5-ft (15 m) cut and an existing 16-story building at the top of an adjoining slope.

In addition to the common challenges of excavations in the close quarters of urban areas, the Abingdon Heights project had an additional challenge in that the owner of a neighboring condominium property would not allow any of the retaining wall's tie-back anchors to encroach on the adjacent land.

Owner:
Arlington Condominium, Inc.

General Contractor:
Donohoe Construction Company

Technique(s):
Barrettes, Tieback Anchors

Subsurface Conditions:
Granular fill, Potomac formation very stiff clays and medium dense sands, Weathered Gneiss and Gneiss

Approximate Key Quantities:

Barrettes	44
Tieback Anchors	44
Wall Length	400 feet

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To accommodate this restriction, the original design included a temporary, raked soldier pile and lagging wall and a permanent cantilever wall with large pile footing. This solution was extremely complicated, potentially cost ineffective and based on conservative geologic assumptions on the stability of the subsurface soil's makeup.

THE WORK

Nicholson was contracted to create an alternate design-build solution that would not only meet the unique requirements of this project, but also be both cost and time effective.

The initial vision for the alternate solution included a diaphragm wall with vertically anchored T-sections. However, upon further review of the site's logistics, it became apparent that access restrictions would make it extremely difficult to configure a crane to excavate perpendicular sections using typical hydraulic grab equipment.

Steep slopes, the close proximity of utilities (approximately 25 feet from the existing building,) two tiered retaining walls down the slope and a large swimming pool at the base made the site extremely challenging. To further complicate things, the project's General Contractor (GC) needed to provide a stable bench (20 feet wide) to support the crane in an extremely confined space, which was even more confined with the use of T-sections.

Based on these access constraints, the design evolved to single-bite panels using diaphragm wall technology. A system of 9.2-ft by 3.3-ft load-bearing elements (LBEs) were used as the support of excavation. These LBEs were spaced at 9 feet c-c and were oriented perpendicular to the cut face. Each LBE included a 32-strand vertical anchor located two feet (0.6 m) from the upslope edge that was post tensioned to 1125 kips (5,500 kN.) The system required that the bottoms of the LBEs be embedded five feet in sound bedrock in order to resist the large overturning toe pressures from the retained soil and anchor load. Wood lagging was placed between the LBEs during excavation.

Hydraulic clam shell used for barrette installation

After considering several alternatives for permanent facings, including shotcrete, pre-cast panels and cast-in-place (CIP) concrete, a CIP system was constructed. To facilitate construction, threaded inserts were embedded into the LBEs to accommodate both the hooked bars for connection of the CIP wall and to connect and support the forms. This approach provided significant advantage in lieu of drilling and doweling.

Finite element analyses using PLAXIS were completed to support the design submittal. This effort was necessary to better understand mobilized active and passive wall loads and stresses below the LBEs due to anchor loads and the large moments around the toe. The benefit of the finite element method is that it provided a better understanding of the relative magnitude of stress in the various materials, which was important because of the significant contrast in material stiffness across the profile. A conventional stability analysis would have provided little insight into just how much passive resistance could be relied upon because differences in strain need to mobilize stress changes between materials on the active and passive sides. Critical to this design was the recognition and acceptance that the over-consolidated hard clays be treated as cohesive-frictional materials in the drained state as this leads to a lower lateral stress. The anticipated top-of-wall movement based on the finite element analyses was slightly less than two inches.

THE RESULT

The unique, alternate design put together by Nicholson, combined with the joint efforts of Donohoe Construction, Weidlinger Associates, Superior Foundations, Metro Earthworks and SMC Concrete Construction made this project a success in terms of cost, logistics, performance and aesthetics.

The LBE wall constructed at Abingdon Heights, which is thought to be the tallest, top-down cantilever wall in the world, was constructed without any permanent elements encroaching on the adjacent property.

The Abingdon Heights condominium complex is a 213-unit, 12-story urban village that stretches across three acres in the heart of Arlington and features a state-of-the-art, green design.

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