Denver mid-rise employs unusual dewatering method for foundation

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[1]
Aerial view of the Platte 15 site in Denver. Clear view of the completed ejector pump station, groundwater filtration equipment, and ejector wells along the north side of the excavation are visible. *Photos © Josh Peltier of TerraFirma Earth Technologies*

by Sue Rose

One of Denver's first cross-laminated timber (CLT) mid-rises has employed a rarely utilized means of groundwater control, known as ejector well dewatering. Offering a reduced carbon footprint, the Platte 15 project has reached its final depth of 8.5 m (28 ft) below ground surface.

David Giles, president of the dewatering firm chosen for the Platte 15 project, explained, "Though more costly upfront, in the long run, this unusual use of ejector dewatering wells in controlling the groundwater within soils typical to downtown Denver has proven more reliable and cost efficient."

The added benefit of this use of the ejector well dewatering system was the lowering of groundwater to the maximum extent possible, allowing for the excavation and installation of the foundation mat slabs and waterproofing membrane in "near-dry" conditions.

"The concrete slabs and waterproofing membrane create a watertight foundation, commonly referred to as a 'bath tub' foundation. The bath tub-like foundation eliminates the need for the often costly and maintenance-intensive permanent foundation dewatering system typical of Denver's downtown buildings," explained Shiloh Hicks, project engineer.

[2]
Single pipe ejector body installed within a 102-mm (4-in.) 40 polyvinyl chloride (PVC) well assembly. High-pressure supply and low pressure return lines can also be seen.

Dewatering methods

To control groundwater dewatering contractors typically employ the following three means:

- vacuum wellpoints;
- deepwells; and
- ejector wells.

The most commonly known in the Denver area are deep wells (sometimes referred to as sump wells). However, ejector wells are generally one of the best solutions for Denver's soil conditions (water-bearing alluvial soils over shallow bedrock). Though these types of wells are typically utilized in deeper excavations, they are well suited for this project because of the necessity to lower the groundwater to the very top of the confining bedrock.

The Platte 15 project team ruled out vacuum wellpoints because of suction limitation, generally 4.5 m (15 ft) or less. Since ejector wells use a continuous, recirculating supply of water through an ejector body to create a vacuum at the bottom of each well, suction limits was not a concern (water is pushed up) in this project.

Deepwells, though suited for deeper excavations, would have proven ineffective because of the proximity of the relatively shallow bedrock (6 m [20 ft] below ground surface) in relation to the much deeper subgrade (8.5 m [28 ft] below ground surface). Since deepwells would have to be spaced closely to achieve the desired results, they quickly would have become cost inefficient. Additionally, deepwells, which rely on the continuous flow of groundwater to cool the electrically driven submersible pump located near each well bottom, would quickly run dry under the Platte 15 soil conditions, making them a maintenance nightmare. The ejector well, on the other hand, is a self-priming pump. If it runs out of groundwater, it will proceed to pump air without interruption, until the groundwater returns.

Dewatering of the site was further complicated by the fact one entire side was inaccessible. The excavation had a perimeter footprint of approximately 244 m (800 ft). More than 60 ejector wells were installed around the site's three accessible sides—one every 3 m (10 ft).

Also unique to the project was the use of sonic drilling methodology to advance each borehole several feet into the bedrock. By employing sonic drilling technology, the project team was not only able to fully penetrate the water-bearing alluvium overburden, but also penetrate the highly weathered portion of the bedrock, often another source of groundwater. With the sonic drilling methodology, the ejector wells were installed and ready for operation just three weeks after mobilizing.


[3]
A recirculation tank with ejector pump.

Treating contaminated groundwater

From the ejector wells, the groundwater was directed through a storm drain leading to the Platte River. However, as is true of many construction sites in downtown Denver, the preliminary geotechnical and environmental sampling reports revealed the groundwater was contaminated. A remedial activities management plan to reduce the pollutants of concern to below the limits set forth in a permit issued by the Colorado Department of Public Health and Environment (CDPHE) was developed.

The groundwater treatment plan included the introduction of a 10 percent solution of sodium hydroxide (NaOH) into the dewatering influent water to oxidize the metals iron (Fe), and manganese (Mg). This reaction took place in a single, 79,493-L (21,000-gal) flocculation tank. From the flocculation tank, the water was pumped through two, four-unit bag filtration pods to capture the flocculated metals. Further, an ion exchange medium was utilized to reduce the elevated levels of selenium and arsenic. Granular activated carbon was added to the treatment train to remove any volatile compounds encountered, as well as for the removal of any residual chlorine in the treated water. In the end, pure, drinkable water was discharged into the Platte River.

Cross-laminated timber

Introduced in Austria and Germany in the early 1990s, CLT is unlike traditional heavy timber. It is harvested from young trees and laminated together to create a dense and strong material.

Platte 15's use of highly engineered CLT panels will combine the characteristics found in historic brick and timber buildings, while reducing environmental waste and improving energy efficiency through use of a more sustainable renewable material.

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Endnotes:

1. [Image]: https://www.constructionspecifier.com/wp-content/uploads/2018/07/dewater.jpg
2. [Image]: https://www.constructionspecifier.com/wp-content/uploads/2018/07/Pipe.jpg
3. [Image]: https://www.constructionspecifier.com/wp-content/uploads/2018/07/Tank.jpg
4. sue@suerosepr.com: mailto:sue@suerosepr.com

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