2025 Outstanding Infrastructure Project

Humber College Station Shotcrete Construction

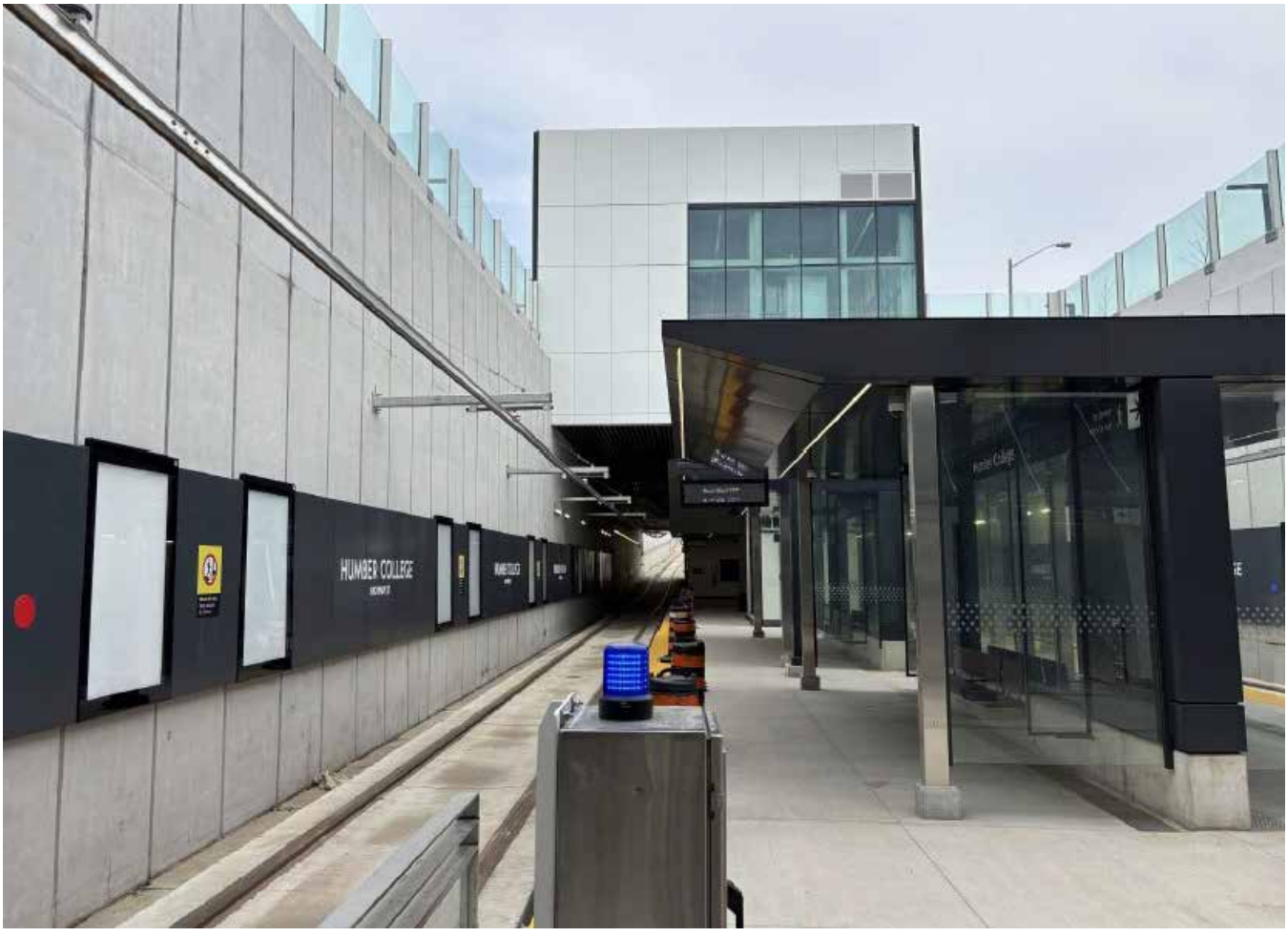
DESIGN, SUSTAINABILITY, AND EXECUTION

By Ross King

Humber College Station is located at the west end of the 6.4 mi (10.3 km) Finch West LRT, which includes 16 stops and two below-grade terminal stations. The Humber College Station is constructed below grade, however open to daylight, which presented unique logistical, structural, and architectural challenges. Two roadway bridges were installed prior to station construction, requiring all work to be completed beneath active bridges carrying live traffic overhead. These conditions, combined with demanding architectural requirements and an aggressive winter construction schedule, made shotcrete the optimal construction solution.

The station measures approximately 50 ft (15 m) wide, 30 ft (9 m) deep, and 550 ft (170 m) long. The vertical shotcrete walls reach a thickness of up to 5 ft (1.5 m) and were designed to meet both demanding structural requirements and strict architectural expectations. The architectural design called for a smooth, high-quality finish with continuous 4 in. (100 mm) triangular vertical reveals spaced at 4 ft (1.2 m) on center and a 1:50 batter, creating a precise and visually prominent surface.

To accommodate the soil retention anchors, the walls were constructed in three lifts. This sequencing allowed for the anchors to be de-tensioned once the



Finished shotcrete wall at Humber College Station

Interior 5 ft. thick wall with keyway and water stop

Top of wall angle iron gauge and revels

Finished walls; three-lift-tall walls with controlled construction joints to replicate a formed concrete seam.

lower lift achieved design strength. The lift lines between placements were required to closely replicate a formed concrete joint, similar to the seam between two sheets of plywood in a form-and-pour wall — an uncommon and highly demanding requirement for shotcrete construction, particularly in an open-to-daylight station where joints are visible in direct sunlight.

The designer specified a low-heat concrete mixture to enhance the durability and minimize the risk of thermal cracking, a critical consideration given the wall thicknesses and constrained geometry. The project schedule was extremely demanding and required continuous shotcrete operation throughout the winter, with temperatures reaching 0°F (-18°C), placing an additional emphasis on thermal control plans, curing practices, and quality control.

Sustainability played a key role in the material selection, and construction methodology. A high-slag, low-cement concrete mixture was used to help meet the project's sustainability targets by reducing cement content and thus lowering the embodied carbon of the structure. In addition, the shotcrete placement and finishing methods produced a denser troweled surface than conventional form-and-pour concrete, increasing durability and extending the overall life cycle of the structure.

The elimination of formwork further reduced the environmental impact by lowering the material consumption, minimizing the trucking to and from the site, and reducing the time spent for erecting wall forms. These sustainability benefits were matched by significant schedule savings, as shotcrete placement eliminated the requirement to leave formwork in place for a seven-day curing period. Under a conventional form-and-pour system, formwork must remain in place during curing, preventing stripping, cycling, handling, and storage. These activities typically require large crews and extensive crane time, which can become critical bottlenecks on constrained transit projects. By using shotcrete placement, these constraints were substantially reduced, allowing the project to maintain momentum despite challenging site and weather conditions.

The elimination of wall formwork also removed the need for a dedicated tower crane on the project. Instead, a small mobile crane was deployed to lower reinforcing bar and scaffold components into the excavation. This substitution eliminated the installation and dismantling of a tower crane and reduced overall crane time to short-duration lifts, resulting in a significant reduction in crane hours, fuel consumption, and associated emissions. The mobile crane approach also reduced site congestion and avoided the continuous crane dependency typically associated with form-and-pour construction. Overall, this strategy improved operational flexibility, reduced costs, and minimized logistical constraints.

The use of shotcrete enabled works on the central platform slab to be performed simultaneously with the station wall construction. The elimination of A-frame and conventional wall formwork kept the slab unobstructed, allowing reinforcing bar installation, formwork, and concrete placement to proceed in parallel with wall operations. Under a traditional form-and-pour approach, A-frame forms would have occupied critical workspace, forcing platform slab construction to occur sequentially and extending the overall schedule. By removing these physical constraints, the shotcrete methodology allowed critical path activities to be performed simultaneously, providing significant schedule benefit to the project.

The complexity of the Humber College Station walls further reinforced why structural shotcrete was the right construction method choice. The combination of height, thickness, and highly congested, large 5-layered reinforcing steel required a placement approach capable of achieving full consolidation and encapsulation of the rebar. The specifically designed concrete mixture was paired with the supplemental internal vibration when required, which was intermittently vibrated at every bench to ensure proper encapsulation of the reinforcement bars and to maintain consistent density throughout the wall section.

Maintaining the architectural continuity between the three lifts was critical. An angle-iron gauge line was installed to establish a straight, flat, and consistent top-of-wall edge, allowing the subequal lifts to align precisely with the lower lift. This approach effectively concealed the horizontal

Mobile crane replacing tower crane by using shotcrete placement instead of a form-and-pour approach

Multi-level scaffold provided access for the shotcreter to shoot the walls, and for the crew to blowpipe, vibrate, and finish

construction joint and gave the appearance of a continuous, formed concrete wall — an especially important detail, given the station's exposure to natural light.

The architectural reveals presented another significant technical requirement. The specified 4-inch-wide by 2.5-inch (64-millimeter) deep triangular reveals could not be reliably hand-cut into the finished concrete without risking aggregate pullout or irregular edges. To achieve the required precision, the reveals were pre-hung prior to shooting, allowing the shotcrete to be fully consolidated behind them. This method produced crisp, straight reveal lines while maintaining the surface integrity and finish quality.

The flexibility of structural shotcrete placement also allowed for the wall thicknesses to be easily adjusted at the top of the structure to create thinner parapet walls, internal haunches, and bearing seats for the steel structures above, without redesigning or constructing formwork.

Finally, the high-quality troweled finish eliminated the need for secondary rendering or surface treatments, providing additional schedule and cost efficiencies, while meeting the project's architectural durability requirements.

Prior to commencing any shotcrete work at Humber College Station, a full-scale preconstruction mock-up was required. This panel was shot under site-specific conditions to demonstrate that the proposed concrete mixture, equipment, and application methods would achieve full consolidation around the reinforcing steel with no shadowing or voids. The mock-up also served to confirm that shotcrete was a suitable construction method for the project, meeting both the structural and quality requirements. Successful completion and review of the preconstruction mock-up provided assurance that the specified reinforcement coverage, encasement, bond, and overall performance could be reliably achieved in the field.

Humber College Station demonstrates how thoughtful structural shotcrete design, innovative placement methods, and sustainable material choices can successfully meet the needs of the complex architectural, structural, and environmental requirements of a large-scale transit

infrastructure project. This project illustrates that shotcrete was not only a viable solution, but the optimal choice — delivering durability, precision, adaptability, and schedule savings within a highly constrained urban environment.

Preconstruction mock-up wall

2025 OUTSTANDING INFRASTRUCTURE PROJECT

Project:
Humber College Station

Project Location:
Toronto, ON, Canada

Shotcrete Contractor Company:
Consolidated Shotcrete Inc.*

Architect Company:
Arup

Engineer Company:
Arup

Materials Supplier Company:
Dufferin Concrete

Equipment Manufacturer Company:
Western Shotcrete Equipment*

General Contractor:
Mosaic Transit Group Joint Venture (Aecon Infrastructure and Management Inc., Dragados Canada Inc., Dufferin Construction Company)

Additional Team Members:
Avenue Building Corp; Wood; LZhang Consulting & Testing Ltd

Owner:
Metrolinx

**ASA Sustaining Corporate or Corporate Member*

Completed shotcreted mock-up wall to be cut with a diamond saw into sections to inspect for full consolidation and encapsulation of reinforcing steel

Cut-out section of shotcreted wall demonstrating proper consolidation and full encapsulation of reinforcing steel, including keyway and water stop

***Ross King**, President of Consolidated Shotcrete, is widely regarded as a pioneer in establishing the shotcrete industry in Canada. With more than four decades of experience, his leadership has set benchmarks for quality, innovation, and safety across major infrastructure and heavy concrete projects. Under his guidance, Consolidated Shotcrete has grown into a national leader in shotcrete and comprehensive concrete solutions.*