The Floating Stairs

Private Residence

2020—
NATURAL STONE INSTITUTE AWARDS
RESIDENTIAL INTERIOR

PROJECT DESCRIPTION

The Floating Stairs–Toronto, ON

When stone is specified for a project, no greater compliment of a material is possible, than when it is selected for a historic property renovation, within a home, rich in tradition, and with a celebrated past. This new feature stair addition to this private residence in Toronto, Canada, has an equally compelling story to tell.

Originally envisioned as a wall supported cantilevered stone stair, the owner boldly accepted a unique solution for their show piece element. The 19-tread stair would be designed with 550lb solid stone treads, and fully liberated from traditional supports, and the adjacent rubble wall. To say "it would float", is not an exaggeration. The stair would be designed as a monolithic beam spanning 16.5 ft, 10 ft height. and 41" wide. The required material was G684 Basalt. Aesthetically bold, with a reduced tone from pure black, the strong material was the perfect contrast for the white modern interior of the home.

Making over 10,000 lbs of stone "levitate" indefinitely, would not be easy.

Sourcing the 95 cu. Ft of material was difficult despite the small quantity. Tight material control and low supply, confirmed that we were at the end of this materials range availability. With a secure source in hand, the material was tested to C97, C880, & C170 ASTM standards.

The test results exceeded minimum required values, and structural modeling and calculations proceeded toward design optimization. A special shear key was designed as a bearing surface and interlocking feature between each tread. Heavy steel plate anchorage at the bottom, to concrete; and at the top, to a steel beam would be necessary for span & load transfer. The 3 – ½" tension cables would play the most important role by resisting the large bending moment generated by the stone load and stair geometry. Critical specifications and procedures were deeply considered and dictated.

Fabrication required precise coordination and care to ensure perfect alignment of the interlocking key, and the corresponding cable holes. The fabrication challenge was achieving the highest level of accuracy in notching, coring, and replicating each tread identically. Tolerances beyond 1/16" would have had design implications forcing re-calculation and dimensional adjustments. The craftsmanship was excellent, setting the stage for installation.

Expert precision and skill were key to nesting each tread in sequence and simultaneously with the strands. Meticulous alignment and exacting tolerance assured the true performance and aesthetics were delivered. Finally, hydraulic post-tensioning pulled each cable to 120kN (27,000lbs), infusing strength and structural integrity.

Removing the temporary support and testing was the last critical step. It was also the first time the stone stair was self supporting. CMU blocks were used as ballast to load the stone to its design limits. Measurements confirmed insignificant deflection through the testing cycles and proved the stair was safe for use.

The "floating" stair project is an ultimate achievement and example of innovation, material strength, fabrication quality, installation precision, and expert coordination. A perfect final chapter to a historical journey and modern ode to stone as structure.

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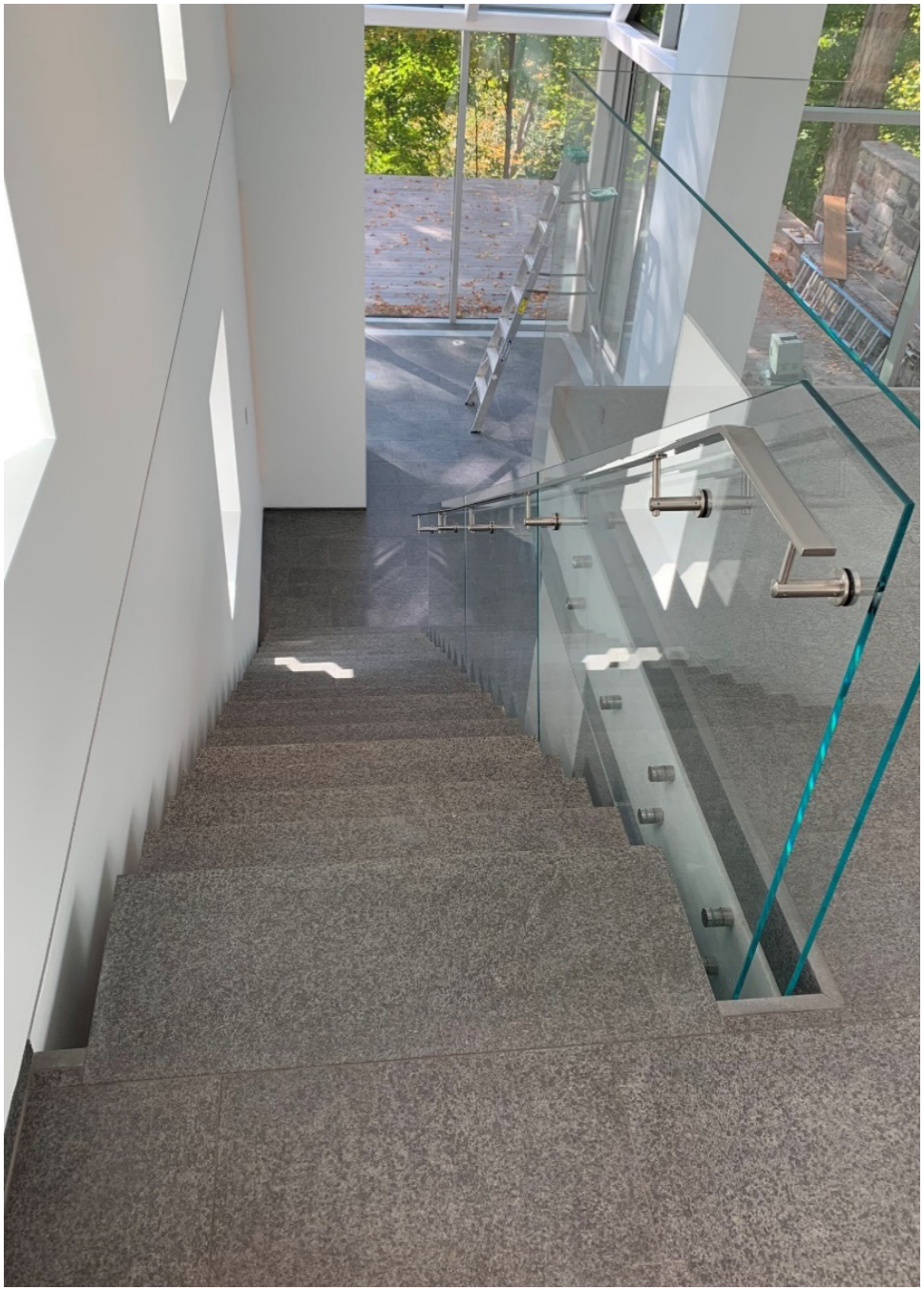

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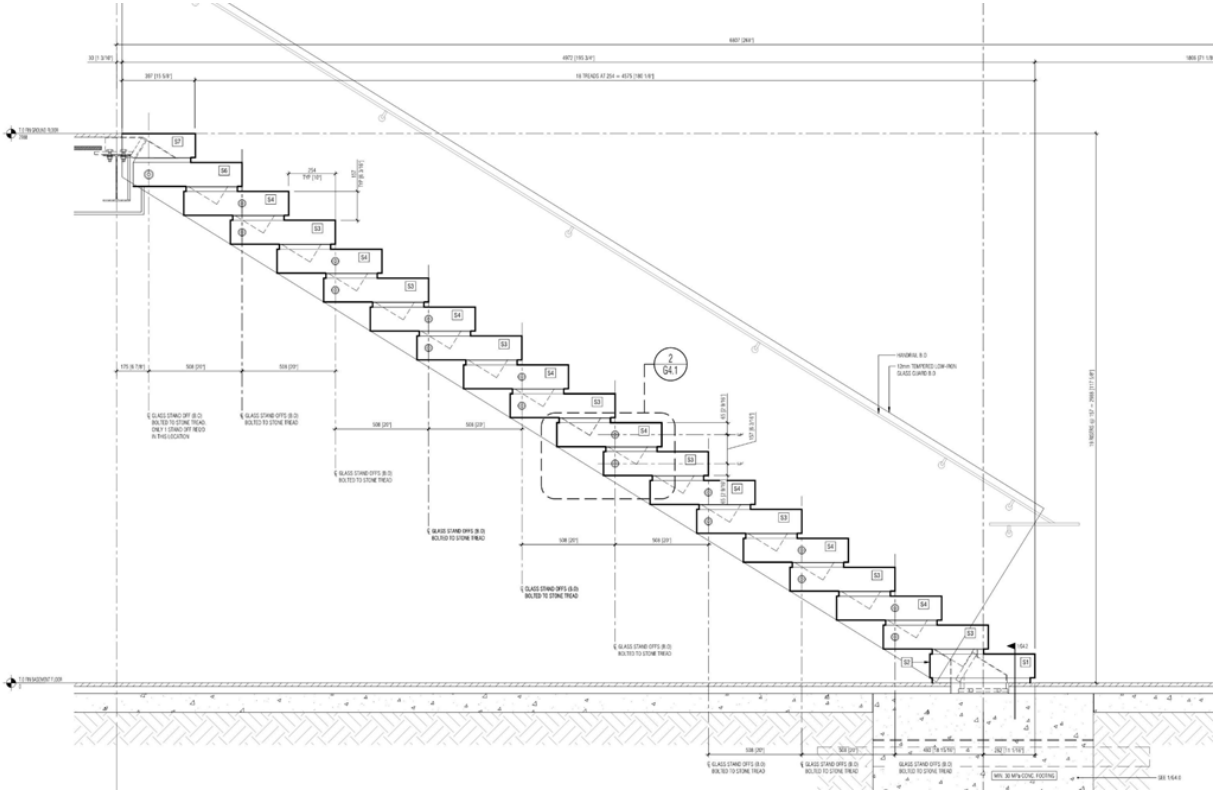

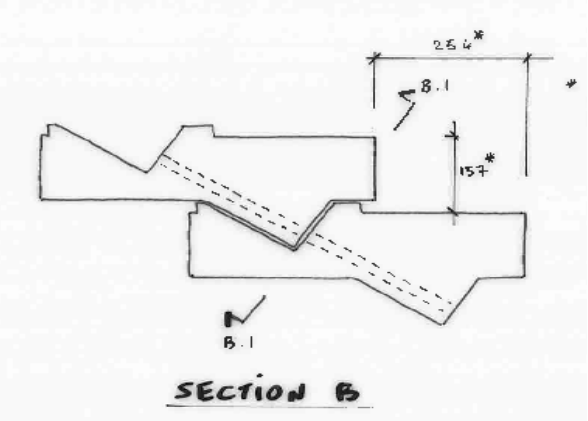
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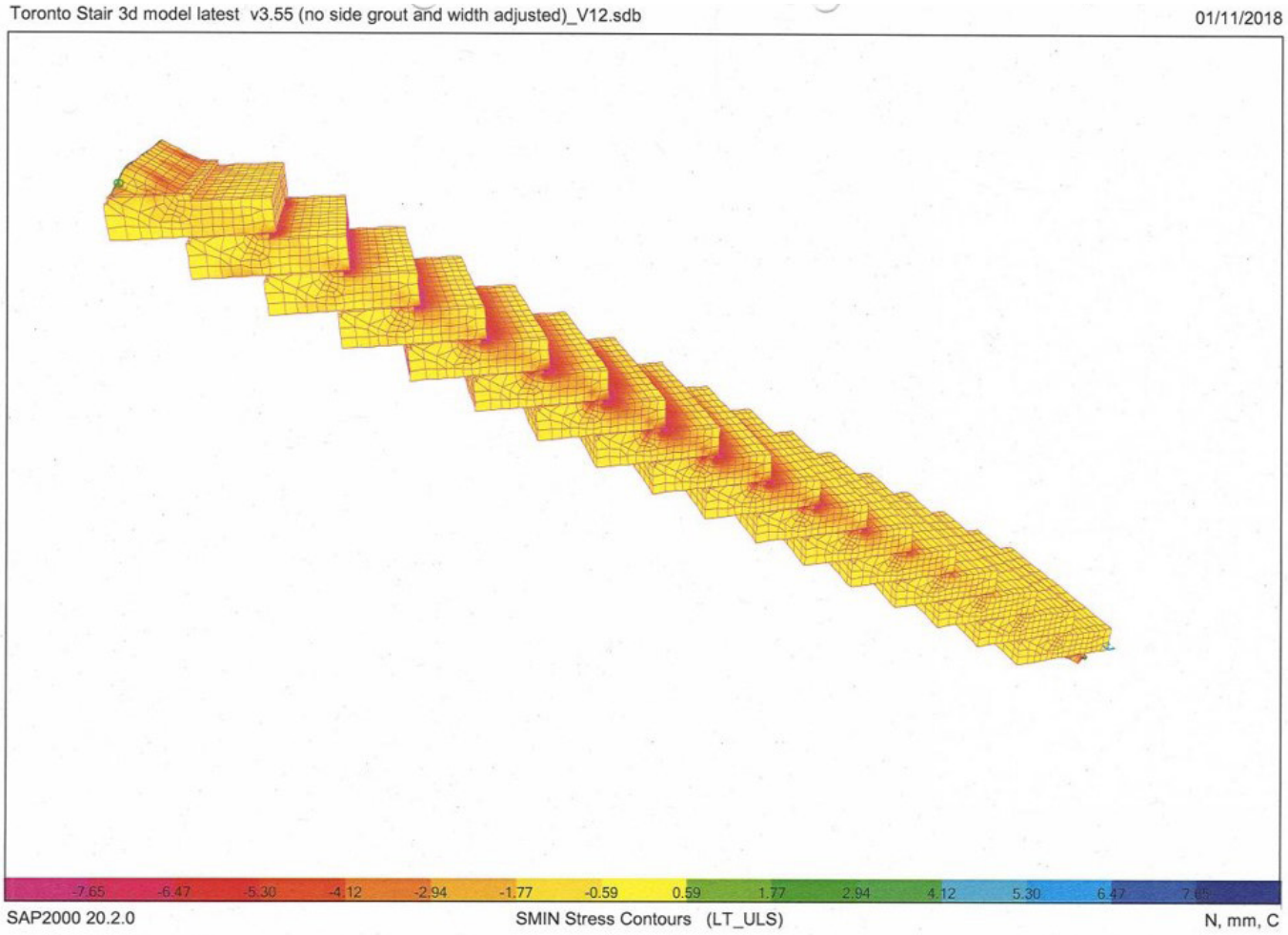

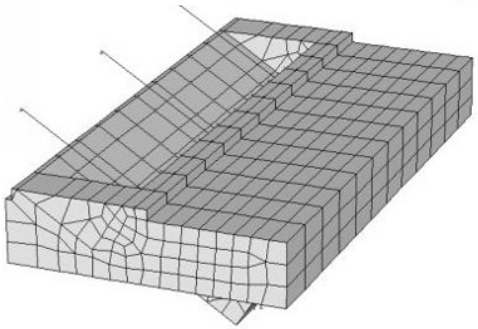

Figure 2 - 3D Typical tread