Case Study
ONTARIO CAST-IN-PLACE CONCRETE DEVELOPMENT COUNCIL
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Audi Midtown Toronto is a seven-storey flagship store consisting of a reinforced concrete structure utilizing roughly 8,500 m$^3$ of concrete of varying strengths (reaching as high as 113 MPa).

**Terminal Design**
Audi Midtown Toronto is based on the new “Terminal Design” from Audi AG and serves as the Canadian flagship store. Located at one of the most heavily traveled areas of Toronto, the 401/404 interchange, Audi had the opportunity to mesmerize passersby. This seven (7) storey reinforced concrete structure utilized roughly 8,500 m$^3$ of concrete of varying strengths (testing verified one element reaching 113 MPa at 28 days). The Toronto marketplace is rich with concrete structures; the Audi building exudes strength through its monolithic structure beneath a multi-faceted lightweight aluminum cladding.

**Overall Building Composition**
The layout and programmatic requirements of the facility challenged the Design Team to accommodate a vast palette of interior/exterior finishes. Floor plans are comprised of the following elements:

**Ground Floor**
Showroom Entrance with escalators and Detail Bays.

**Second Floor**
Offices and the captivating two-storey high Showroom space with eight-meter-tall concrete columns, poured monolithically.

**Third Floor**
Offices and Handover Area separated by the Showroom high space.

**Fourth Floor**
Mechanic Shop

**Floors Five through Seven**
Parking for 206 cars. The density of parking within the building resulted in a structural point load of 11kN with loads varying throughout the building; for instance, the ramp on Level 2 was designed for 2.4 kPa live load and 3.1 kPa superimposed dead load.

This arrangement resulted in slab transfer beams criss-crossing each floor and required the use of custom, non-uniform shoring systems.

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**PROJECT SUMMARY**

**LOCATION**
Toronto, Ontario

**COMPLETION**
April 2016

**BUDGET**
$32,000,000

**SIZE OF PROJECT**
143,000 s.f.

**OWNER**
Audi Canada

**ARCHITECT OF RECORD**
Teeple Architects Inc.

**ENGINEER OF RECORD**
Read Jones Christoffersen Ltd.

**GENERAL CONTRACTORS**
Eastern Construction Company Limited

**FORMING CONTRACTOR**
Avenue Building Corporation

**MATERIAL SUPPLIERS**
Dufferin Concrete, a Division of CRH Canada Group Inc.

**ADDITIONAL PARTICIPANTS**
- Aluma Systems Inc.
- Carpenters Local 27
- Euclid Canada
- Gilbert Steel
- Ironworkers Local 721
- LIUNA local 506
- Peto MacCallum Ltd.
Multiple types of concrete were utilized in the construction of the building to accommodate the non-contiguous column design, with extensive use of 80 MPa concrete transfer beams integrated with 35 MPa slabs.

The construction program called for a monolithic pour and required the use of a technique called ‘puddling’ whereby the transfer beam was over-poured with 80 MPa high strength concrete forming a perimeter barrier against the pour of 35 MPa concrete scheduled for the slabs.

Once the pour hardened and the forms removed, the slabs in the areas immediately surrounding the transfer beams appeared to have a localized ‘puddle’ of darker, stronger concrete. Utilizing the ‘puddling’ technique ensured 35 MPa concrete did not migrate into the transfer beam pockets.

### Spiral Interchange Ramp

The jewel of the structure is the Spiral Interchange which allows cars to ascend to the 5th level with straight ramps for access above. The spiral ramp serves as the main conduit into the building accessing the Services Bays. The design of the ramp is a chandelier where slabs below are hung from above utilizing a complex arrangement of reinforcing steel and strategically placed control joints.

The Forming Contractor selected by Eastern Construction using a qualitative tendering process, Avenue Building Corporation, recognized Audi Midtown Toronto would be a challenging project and assigned the task of constructing it to one of their most tenured foremen; Guido Tessaro, a seasoned veteran of 35 years experience.

An innovative approach to the spiral ramp employed by Avenue was the use of shotcrete specialists to advance the spiral core shear walls to the proceeding floor level. Shotcrete allowed for greater lifts with Avenue placing a key with blind dowels to connect each level of the spiral ramp reinforcement.

The spiral slabs were cast monolithically, rather than limiting the pours to segments based on the progress of the shear walls. The process, although messy, enabled Avenue and Eastern to accelerate the schedule of the spiral ramp core walls.

The construction of the spiral ramp was challenging, utilizing both an outside upstand beam and the interior core of the ramp for support. The elevation of the floor levels was not consistent, yet the pitch of the ramp and degree of slope had to meet each of these floors with exactitude, placing an emphasis on the accuracy of the concrete forms to accommodate variability. As the spiral ramp was poured, Avenue closely monitored the slump of the concrete; the pitch of the inner radius of the ramp created a situation where high slump concrete could detach and slide down the deck.

An unbonded 125 mm concrete topping was placed on the spiral and straight ramps, which protects the snow melting systems and waterproofing below. These toppings were adorned with a grooved surface treatment forming chevrons to increase traction control and control the flow of water to area drains. It should be noted the glycol inslab heating system at Audi Midtown Toronto is the longest system ever installed in Ontario.

### Smooth Architectural Finishes

Exposed concrete was utilized in customer areas to create a striking visual impact, communicating strength in contrast to the soft curves incorporated in branding elements throughout the facility. Examples include the columns located in the Showroom, Detail Bays, and Offices. Avenue utilized sonotubes with high quality liners to provide the smoothest possible concrete finish. After the pour, the sonotubes were left on the columns in customer areas to create a striking strength in contrast to the soft curves incorporated in branding elements throughout the facility.

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