case study
VOLUME 4, ISSUE 2
Ontario Cast-In-Place Concrete Development Council
OCCDC

Four Seasons Centre For The Performing Arts

Located in Toronto's entertainment district, The Four Seasons Centre for the Performing Arts is the new home to the Canadian Opera Company and a new performance venue for the National Ballet of Canada. The 15,000 m^2 world-class opera house accommodates retail, lounge, rehearsal and superb performance space in an inspiring five-storey concrete and glass-walled centre.

Design

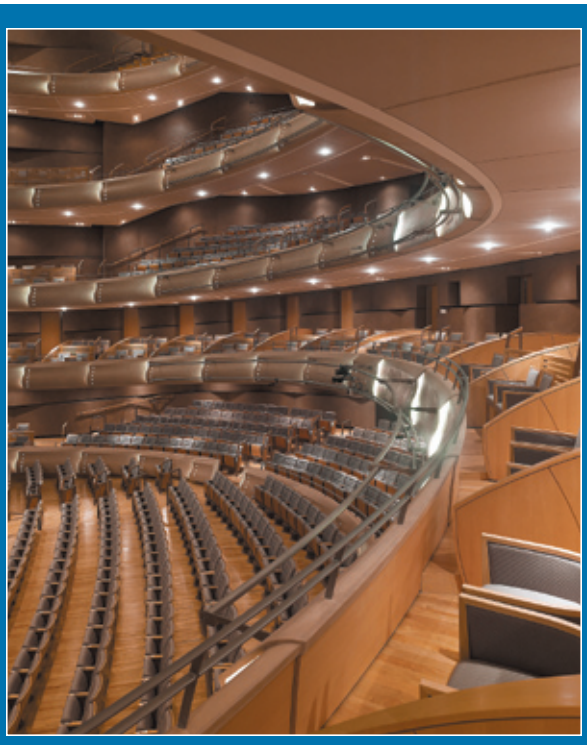
Inspired by the great European venues, the Centre's 2,000-seat auditorium provides an intimate and functional viewing space. Known as R. Fraser Elliot Hall, the auditorium is comprised of five levels, including box seating, a mezzanine and two balconies. Its tiered horseshoe configuration is a fundamental component of the design, maximizing seating proximity to the stage, and providing unhindered sightlines and superior acoustics for all patrons. The auditorium geometry itself is complex, with balconies and perimeter walls curved in plan and elevation, to maximize volume and space while contributing to improved acoustics.

Building features:

The use of concrete as the structural material was obvious. A formed concrete surface would allow for the thin slab profile and numerous sweeping curves and steps that defined the venue. Concrete would also provide flexibility in accommodating the required mechanical, electrical, theatre and life safety equipment in a clean and aesthetic manner. The various concrete systems used in the project speak to the versatility of concrete as a design material.

Construction employed a variety of reinforced concrete slab and plate systems in conjunction with concrete perimeter walls rising to the roofline. The basement floor is a flat slab supported on a series of isolation pads. This slab forms the floor of a mechanical plenum space immediately below the orchestra. The orchestra level floor is a two-way flat slab system, reinforced with a mesh of bars and allowing for several hundred sleeves to deliver fresh air below the seats. Slab depressions and pits were incorporated to create the "trap rooms" required for theater staff. All of the communication wiring and power sources were also formed into the slabs to provide a clean roof surface. The stage floor is also a flat slab, but uses tapered cantilever beams that create the stage's thin-edge profile required for improved acoustics.

The 2nd floor box level consists of a tapered flat plate supported by a series of L-shaped concrete walls hung from the mezzanine above. This design allowed for a very shallow, column free structure. The slab cantilevers towards the stage, reducing in thickness at the edge. The slab also cantilevers towards the back wall of the auditorium, where it supports the entrance hallways.



Owner:	Canadian Opera House Corporation
Architect of Record:	Diamond And Schmitt Architects Incorporated
Engineer of Record:	Halcrow Yolles
General Contractor:	PCL Constructors Canada Inc.
Concrete Supplier:	Canada Building Materials
Formwork Contractor:	Structform International Limited
Reinforcing Steel:	Harris Rebar
Formwork Supplier:	Aluma Systems Inc.
Additional Participants:	• Crossey Engineering Ltd. • Mulvey + Banani International Inc. • Wilson Ihrig and Associates Inc. • Iron Workers Local 721 • Carpenters Local 27 • Liuna Local 506

Project Facts:

- Opened June 2006
- Cost $102 million
- 15,000 m^2 in size
- Seats 2,000
- 200 parking spaces

OCCDC

(Continued from Page 1)

The 3rd level mezzanine and higher levels are each built from folded concrete plates supported by cranked cantilever concrete beams. The cantilevered beams taper to a thin slab at the edge of each balcony and the folds in the slab match the steps in the seating area of the balconies.

Parking:

Incorporating sufficient parking for the venue was an important consideration for the project. To maximize useable parking space, the stage tower and auditorium walls do not continue to the foundation level. Rather, a series of reinforced concrete upstand transfer beams were incorporated above the parking level. These beams support the acoustic isolation pads required for controlling noise (see below), and create a column grid to maximize parking capacity.

Acoustic considerations:

Given its intended use, acoustic performance was one of the Centre's critical design characteristics. Built at the crossroads of University Avenue and Queen Street, designers and acousticians worked diligently to isolate noise and vibrations from vehicles, streetcars, the subway, and even helicopters servicing local hospitals. The cacophony of urban life is controlled by separating the entire hall, orchestra pit and stage tower from the remaining structure on a series or rubber isolation pads. A continuous isolation joint at all floor levels further separates the hall from the remaining structure to dampen sound transmission. Concrete played an important roll in sound control, by simplifying the isolation pad design, and providing sufficient mass to ensure that sound transmission through the pads was not possible.

Interior noise from mechanical systems was subdued through the use of a large plenum between the basement and orchestra level floors. The concrete slabs provided a clean, flat soffit for efficiently and silently directing air to special sleeves for circulation to seating areas throughout the hall. Overall, the building's acoustic design achieved its goal of an N-1 sound isolation rating.

2006 Ontario Concrete Award winning project for Structural Design Innovation

In 2000, the Ontario Cast-In-Place Concrete Development Council (OCCDC) was formed to aid the owner/ developer, architect/engineer and design-build contractor in the decision-making process of choosing the best construction material for the framing system of new cast-in-place structures.

OCCDC promotes the benefits of reinforced concrete as the construction material of choice based upon the following advantages:

- *fast-track construction*
- *costs savings*
- *structural advantages*
- *environmental considerations*
- *local economy benefits*

The Members of the OCCDC incude (alphabetical order):

Aluma Systems Inc.
Carpenters District Council of Ontario
Concrete Forming Association of Ontario
Ironworkers District Council of Ontario
LIUNA–Ontario Provincial District Council
Ontario Formwork Association
PERI Formwork Systems Inc.
Ready Mixed Concrete Association of Ontario
Reinforcing Steel Institute of Ontario

365 Brunel Road, Unit #3
Mississauga, Ontario L4Z 1Z5
Tel: 905-507-1122
Fax: 905-890-8122
Email: buildings@occdc.org