Blackwell

RESIDENCE FOR THE SISTERS OF ST. JOSEPH OF TORONTO

2014 ACEC - CANADA AWARD SUBMISSION

RESIDENCE FOR THE SISTERS OF ST. JOSEPH OF TORONTO

Image 1: credit Positive Imaging Photography

PROJECT SUMMARY

Situated along the edge of the Don Valley at the corner of Broadview Avenue and O'Connor in the heart of the City of Toronto, this four-storey S-shaped residential care facility is the new home for the Sisters of Saint Joseph of Toronto. The 96,000 square feet building is situated on an assemblage of lots adjacent to the heritage-designated 19th century Taylor House. With a construction budget of $38 million, this facility is comprised of 58 residential suites a lobby, activity space, chapel, and five private hospital units. The facility The Residence for the Sisters of Saint Joseph earned the Toronto-based architectural firm, Shim Sutcliffe, the 2014 Governor General's Award in Architecture.

The Sisters of Saint Joseph of Toronto wished for a new, smaller, and greener urban home to decrease their operating costs, better suit their aging population, foster their health and welfare and collective beliefs, and be closer to their ministries and outreach programs. The vision of the architect, Shim-Sutcliffe, was to therefore design an iconic space with emphasis on

environmental sustainability and communal living whereby the relationship between nature and city was expressed in both the exterior and interior spaces of the building. Blackwell Structural Engineers designed the supporting structural system for the resulting unique building form and configuration. Pierre Koch, a principal at Blackwell and Anthony Spick, an associate, were the lead engineers on this project.

PROJECT HIGHLIGHTS

Innovation and Complexity

The unique building form and configuration envisioned by the architect to meet the Sisters' needs presented unique requirements for several innovative long span thin structural systems.

One such system is the substantial reverse-terrace[1] along the Western face of the building, featuring sections of the building overhanging the last supporting columns by 10 meters. Paramount to the architectural design was an open floor plan for natural day lighting and community interaction. The sustainable design goals of the project also necessitated large mechanical ducting immediately below the floor slabs. These two requirements eliminated more traditional reinforced concrete overhanging support systems for a flat slab structure such as post-tensioned concrete beams, deep wall beams, or thick post-tensioned slabs. While steel systems were ruled out early by other project criteria, they would have been similarly constrained.

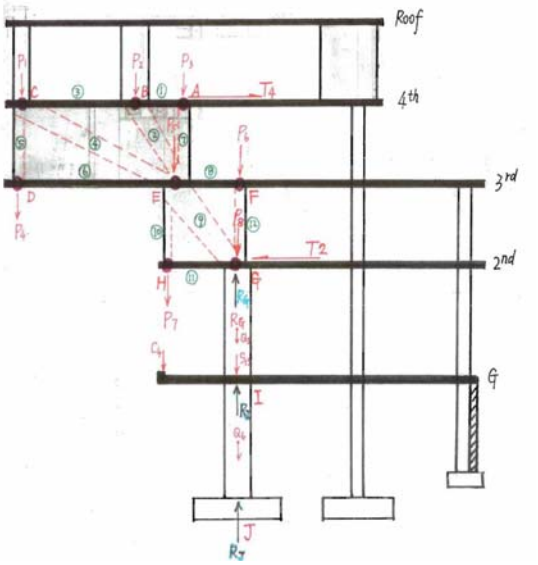
We approached this challenge with an innovative stepped wall system. At four locations along the mid-section of the building, walls are stepped progressively further south at each storey. Each wall is supported at its East corner only, resulting in a tendency of the entire system to overturn. Overturning is constrained by a connection to the floor and roof slab diaphragms at the top and bottom of each wall. The resulting in-plane slab forces are transferred to stiff but distant elevator core walls.

[1] Reverse-terrace seen in sketch no. 1

The length and geometry of the floor and roof slabs, and the relatively large in-plane forces generated, required further consideration. Axial creep and steel elongation were included in the deflection analysis, since the diaphragm length is such that it had a pronounced affect on overhang vertical deflections. A semi-graphical modified strut-and-tie method was used to determine the required strength of concrete and reinforcing steel sizes and layouts, due to non-orthogonal geometry and numerous openings adjacent to supporting core walls at each end. Higher strength concrete (45 MPa) was used to limit diaphragm deflections, and provide adequate strength in these sensitive end regions. Additional reinforcing was also added to limit diaphragm deflections.

Further innovative structural systems include:

- Long span cambered steel plate canopy structure[2] with up-stand fin beams and sandwich plate construction.
- Reciprocal steel frame chapel roof framing[3].
- Hung steel torsion plate chapel mezzanine framing[4].
- Post-tensioned transfer beams.
- Floor slabs hung via reinforced concrete columns, and reinforced concrete walls.



Sketch 1: Reverse-Terrace

[2] Canopy structure as seen in Image 2
[3] Chapel roof framing as seen in Sketch 2
[4] Chapel mezzanine framing as seen in Sketch 3

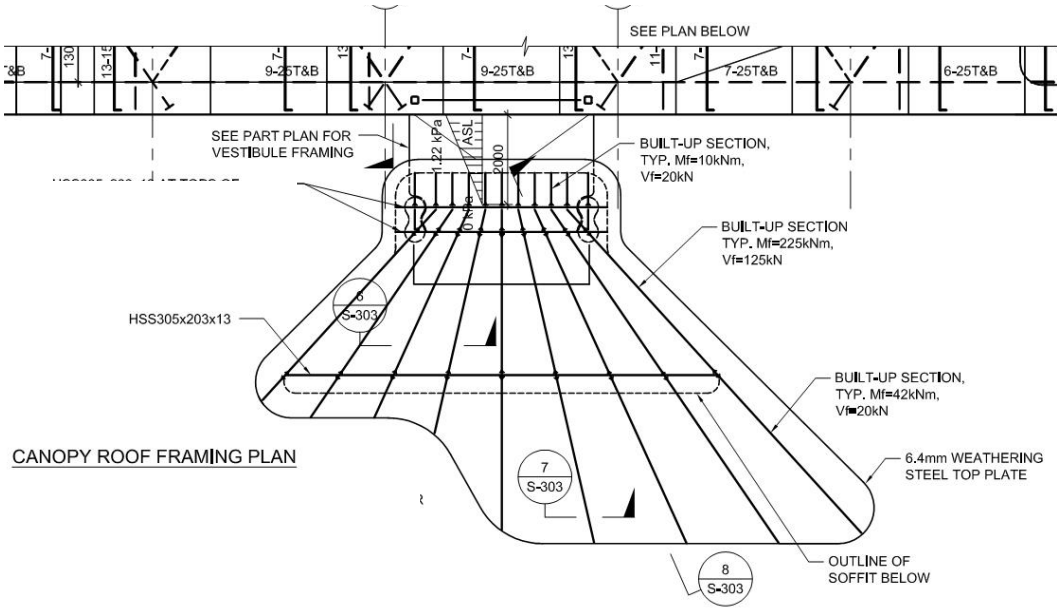
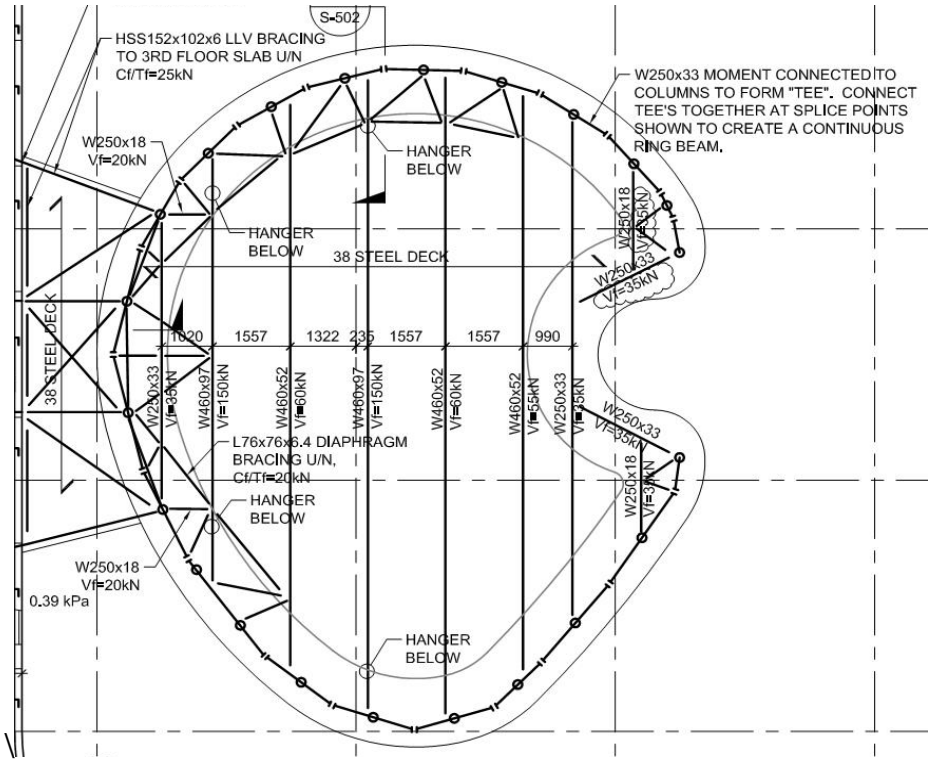
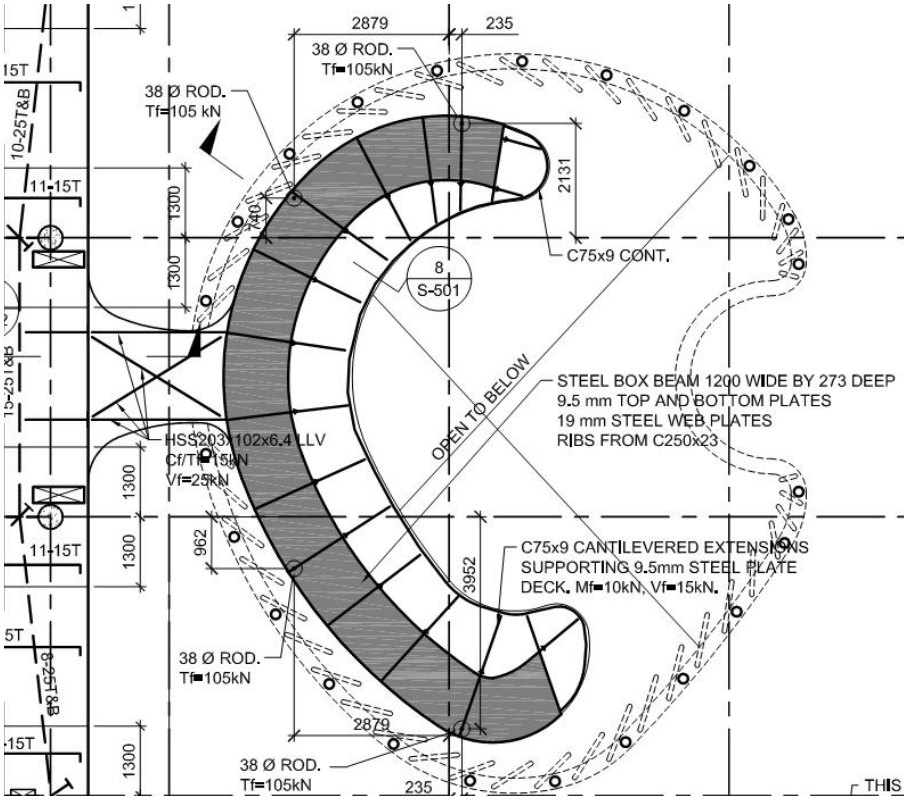


Image 2: Canopy Structure, credit Bob Gundu



Sketch 2: Chapel Roof Framing



Sketch 3: Chapel Mezzanine Framing

Social and Economic Benefits

The Residence for the Sisters of Saint Joseph of Toronto was designed to serve its members and the surrounding community through various social and economic benefits.

The location is easily accessible via public transit routes as it is located in downtown Toronto. This makes the city more accessible to the Sisters, staff, and visiting public and allows for reduced parking requirements for both occupants and staff. The unique site of the building is set back from the street creating a large landscape that is visually and physically inviting to the public. In addition, the substantial investment in mature planting species benefits the people of the neighborhood through improvements in public green space and urban design.

The building was designed with a number of ground water re-entry strategies, including roof collected rainwater storage cisterns for watering and maintenance, green roofs, permeable pavers on driveways, and bio-swales to capture excessive water run-off. These strategies significantly reduce water into the municipal storm water system which results in significant cost savings for the City of Toronto.

The materials used in the construction of the building have economic benefit as they were chosen for their extended life cycle properties. Through the use of reinforced concrete, brick, steel and quality curtain wall and glazing systems, the structure of the building is expected to last a minimum of 100 years.

Environmental Benefits

Environmental sustainability was paramount to the Sisters' vision of the building and it informed the decision making throughout each stage of the project, from design through to construction.

Through the utilization of a single loaded corridor and narrow building section with operable windows throughout, day lighting and natural ventilation are maximized throughout the building, allowing for passive cooling during the summer. Automation and user information sensors provide further energy efficiency.

The concrete floors throughout the building function as passive heat sinks. A geo-thermal based heating and cooling system is integrated with the in-floor heating and cooling loops as well as the forced air heat pumps and building air handlers.

Collected rainwater is filtered and stored in an underground cistern for watering of plants and maintenance on site. Double hose bibs are located around the building and marked as either cistern water or potable water. All water fixtures are low flow, and the sinks in public toilets are automatically controlled to turn on and off. Domestic water is pre-heated by solar panels before it reaches the boiler to reduce the amount of energy necessary to heat the water. Driveway paving consists of permeable pavers. Bioswales are used to control surface runoff when required.

Material specific sustainability measures include the design for adaptive reuse, material efficiency through build ability (flying forms were used for most of the building) and structural system choice (post-tensioned beams and stepped wall solutions), adaptive reuse and preservation of the heritage building, and specification of supplementary cementing materials.

The combination of these elements is intended to significantly reduce the carbon footprint while improving occupant comfort and reducing operating costs.

Image 3: credit Bob Gundu

Meeting the Client's Needs

The Sisters mission statement mandated an ecological approach to physical, social and economic well-being of all people. In this project, sustainability extends beyond the physical requirements of creating a green building and includes the longer-term evolution of the Sisters as an organization and its ability to thrive.

The impetus for the project was the fact that the Sisters of Saint Joseph of Toronto was diminishing in size and required to reduce the size of their residence. The Sisters sought to re imagine the way they lived that would better suit their aging population, the relationship to their ministries and outreach programs, and their physical location in the city. These factors combined made the downtown location and the redevelopment of the specific site ideal. The owner's requirement for a green building which fostered the health and welfare of each Sister while supporting their collective beliefs helped determine a number of design strategies including the predominant use of the single loaded corridor and its effect on building depth, natural day lighting, and natural ventilation.

The design of the new residence for the Sisters is organized along a single loaded corridor that forms the backbone of this sustainable building. Built to strict sustainability guidelines, the new residence for the Sisters achieves operational savings as well as long-term life cycle savings. The individual suites for each Sister serve as a home within a larger home supporting the needs of each Sister while fostering the core values and beliefs of the Sisters.

Blackwell would like to recognize the following engineers and drafters for their truly outstanding efforts on this uniquely innovative and challenging project: David Bowick, Pierre Koch, Anthony Spick, Michael Robbins, Shannon Hilchie, Kerry Zhang, Eric Chung, Belinda Wong, Grazyna Czarnecka, Dorota Pawluck, and Greg Sawka.

Image 4: credit Bob Gundu