Title: Case Study: Absolute World Towers, Mississauga

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Shapely Pair of Towers Challenges the Status Quo

Dubbed the “Marilyn Monroe” towers, the CTBUH 2012 “Best Tall Building Americas” award-winning project is the result of a unique public-private partnership and an international design competition, which chose a new Chinese firm doing its first work in North America. The innovative design, however, created an array of issues for the builders.

Like other suburbs in North America, the Toronto satellite community of Mississauga is quickly developing into an interdependent, urbanized area. Canada’s sixth largest and fastest-growing major city, Mississauga has a diverse economy and multicultural character, as well as a new-found status as an important city center in the Greater Toronto area (GTA). However, its rapid development into an urbanized center has been at the expense of a unique cityscape character.

The redevelopment of a major downtown intersection was seen as an opportunity to redefine Mississauga’s urban landscape through an innovative public-private partnership and internationally recognized architectural design. The project had to add something naturalistic and human to contrast with the existing backdrop of listless boxy buildings.

The winning design obeys many of the rules of the typical North-American high-rise: a central core, a straightforward and economic structure and a glass façade. However, the outcome is fundamentally different in the perception of the people. By the time of completion the result was recognized by the public and news accounts as an inspiring place to live, something more than a place that strives for simple efficiency. The buildings hope to provide residents with an emotional connection to their hometown and neighbors, and a local landmark to define the city.

A Risky Development Plan

The developers of the site, Fernbrook Homes and Cityzen Development Group, were determined to tackle the lack of a unique character when they set out to redevelop the intersection in Mississauga’s downtown core. It was determined that the best use for this important property would be a residential development. The entire project includes a master-planned community of five towers with more than 158,000 square meters, 1,850 residential units, a three-story 3,252-square meter recreation area, and retail facilities.
In a break from industry tradition, Fernbrook and Citizen sponsored an international competition to find an iconic design that would realize their vision. This was the first such design competition that the GTA had seen in more than 40 years and the Mayor and City embraced the opportunity with great enthusiasm.

Due to the prominence of the location, the City had a special interest in the redevelopment initiative. They were an active partner in shaping and realizing the development vision. In a unique spirit of partnership, the City was invited to participate on the judging panel for the project. The City and its residents were part of the decision-making process and helped identify the winning proposal. The City also worked closely with the developer throughout the construction process to manage many of the unique challenges associated with implementing the unprecedented features of the successful design. The public sense of ownership that defined this undertaking from its inception helped bring the project to realization.

The response to the competition far exceeded expectations. More than 600 expressions of interest were registered and 92 submissions received, producing an array of unique and inspiring architectural designs from a global pool of talent.

The winning design from Ma Yansong of MAD Architects clearly captured the public's imagination. The design helped create a strong partnership between the City and the developers, the architects, the contractor and the engineers. MAD's design stood out for its ability to offer a sharp contrast to the existing landscape of traditional rectangular buildings that had come to define Mississauga (see Figure 1), addressing one of the primary goals of the City and the developer.

A Distinct Shape

Winning the competition generated enormous public interest internationally, but was particularly noteworthy in China, where MAD became the first Chinese architecture office to build a significant high-rise project abroad. Suddenly a young architect from mainland China was given an international platform to showcase new ideas and design philosophy. This also offered Chinese developers a new appreciation for the potential of their domestic talent.

Fondly dubbed the “Marilyn” by local residents in homage to the curvaceous appeal of Marilyn Monroe, the Absolute World Towers parallel the twisting fluidity of natural lines found in life (see Figure 2). The flowing form offers an organic punctuation in the landscape and challenges the prevalence of commonplace development in the area.

The architect’s ambition to provide each resident a unique experience of the city resulted in two towers that have continuous balconies which widen individual viewing angles and promote community at the micro scale of a single floor. At the macro level, the cadence of the floors rising into the sky echo the modular rhythms of the human experience, while suggesting the movement of an adoring figure. Critics have praised the design’s ability to create a structure that constantly seems to change, depending on the vantage point. The design illustrates that the human spirit feels more connected to a building that offers privacy while still promoting human interaction.

“The towers’ flowing form offers an organic punctuation in the landscape and challenges the prevalence of commonplace development in the area.”

Figure 1. The Towers created a new skyline for the City. © Tom Arban

Figure 2. Absolute World Towers, Mississauga. © Tom Arban
straightforward, with restrictions limited only to the amount and size of units. This allowed the competing designers full expression and flexibility.

Eschewing the tradition of accentuated verticality in high-rises, MAD's design for the Absolute World Towers chose not to emphasize vertical lines. Instead, the design features smooth, unbroken balconies that wrap each floor of the building. In addition, at each successive level, the floor plate rotates in a range of one to eight degrees affording panoramas of the Mississauga skyline (see Figure 3). By maximizing the viewing potentials both inside and outside the buildings, the design created a medium for social interaction throughout the balconies and connected the city dwellers with naturalistic design principles.

Building an Idea

Many observers questioned whether the MAD design could actually be built. The unique features of this type of rotating structure had never before been subjected to Ontario building code requirements and there was no precedent for the construction challenges.

From the outset, local architectural and engineering firms were engaged to refine the design and ensure it would meet all local standards without compromising the initial design intent. While the lead time for most projects was normally three to four months before excavation was scheduled to commence, in the case of Absolute World, the preparatory period was extended to 12 months. This type of extensive pre-planning ensured the project was kept on schedule by anticipating potential issues.

While consultants always play a major role in the construction of any project, in this case their role was even more significant. The rotating design meant that every floor was unique. Meeting these challenges required extensive collaboration among all the construction disciplines throughout the process.

In addition, there was some initial concern that the unique layouts would limit the ability to market and sell residential units in the tower. However, the interest generated by the competition and the public's participation in the final selection helped the developers easily sell out the apartments in a few days. The developer had taken a significant gamble in committing to deliver a design developed out of a competition, but the results provided evidence that design does matter in the
marketplace and a unique design can sell at a premium.

Given the initial response, the developer requested that the architect produce a design for a second tower. Ma Yansong was adamant that a second tower should be complimentary, but not a duplicate of the first tower. The second building’s design used the same technique of rotating floor plates, but featured different angles to create a different, but related form (see Figure 4).

The first and tallest tower starts to twist from below and increases its rotation initially by 1 degree to a maximum of 8 degrees rotation per floor for a total cumulative floor plate rotation of 209 degrees. The building’s vertical middle section, or its “hip,” represents the maximum eight degree rotation. For the second tower, the rotation was 4 degrees for every floor for a total cumulative floor plate rotation of 200 degrees.

While the two towers look similar, they are very different. In addition to different angle rotations, the buildings also have different façade treatments. While the first tower is more transparent, the second tower is more opaque. This distinguishes the two towers and allows them to seem to interact with each other.

The addition of a second building actually strengthened the original concept. As the architect observed, a single tower could have been viewed as a sculptural piece, but the addition of a second tower transformed the development into a true urban space.

An Economy of Structure

The torsional form of the towers is underpinned with a surprisingly simple and inexpensive structural solution. The two residential towers are supported by a grid of concrete load-bearing walls. The bearing walls extend and contract in response to the sectional fluctuation created by the rotation of the floors (see Figure 5), while the balconies consist of cantilevered concrete slabs. In order to ensure the elegant edge profiles are as thin as possible, there is a thermal break in the slabs at the exterior glazing, so that the insulation need not wrap the entirety of the balconies. Meanwhile, the dynamically fluid shaping of the towers, naturally aerodynamic, adeptly handles wind loading and ensures comfort throughout all the balconies. In addition to providing every resident with a livable exterior place to enjoy views of Mississauga, the balconies also naturally shade the interior from the higher angle summer sun while soaking in the lower angle winter sun, reducing air conditioning costs (see Figure 6).

For the construction team, Absolute World’s creative architectural design resulted in a number of construction challenges and opportunities for innovation. The design presented complex issues involving thermal transfer, forming and concrete usage. Innovative construction solutions and engineering design were required to realize the vision and achieve results within budget and on schedule.

A key feature of the buildings’ design is the presence of continuous wrapping balconies on every floor (see Figure 7). The balconies are also an integrated part of the curved and rotating design of the overall structure. This groundbreaking design presented unique challenges relating to the transfer of cold and heat, both horizontally and vertically. While balconies can create thermal challenges in traditionally shaped structures, in the Absolute World the curved and rotating design of the building compounded the challenges.

The horizontal thermal transfer concerns required a break in the concrete slabs that would still accommodate the unique design features. The rotating floor plates also caused additional vertical thermal transfer issues. As the floor plates rotated, the window lines did not align as in traditional building structures and this created another set of transfer issues.

A number of potential solutions were considered but dismissed for being excessively costly or risking construction delays. The team was also not prepared to consider a solution that would compromise the balcony feature for any of the suites.

The solution was eventually found in an innovative two-pronged approach: thermal breaks were utilized to minimize the horizontal thermal transfer, and an internal bulkhead, along with an external insulated soffit, was utilized to minimize the vertical thermal transfer. The thermal breaks were formed in such a way that it allowed for sections in the slab up to 50 millimeters in width and varying lengths up to 1,200 millimeters. The void that resulted from this approach was later finished with fire stopping, smoke seal and waterproofing.

In implementing these solutions, The construction company, Dominius, developed a new and innovative proprietary process. Not
"The solution was eventually found in an innovative two-pronged approach: thermal breaks were utilized to minimize the horizontal thermal transfer and an internal bulkhead, along with an external insulated soffit, was utilized to minimize the vertical thermal transfer."

only were transfer issues minimized to within acceptable levels, but the integrity of the original design was protected.

The unique design properties of the building also required an innovative concrete forming method. Traditional fly tables were not appropriate for this construction because they would have resulted in large unsupported panels when the rotation of the floor plate was more than two degrees. The formwork partner, Premform, needed to develop a new forming method that would allow for configuration changes, while maintaining structural integrity. This had to be accomplished without compromising safety. PERI had never before designed a system that was required to climb and also move in relation to a varying rotation.

Premform’s solution teamed two main features – an EFCO climbing elevator formwork system and a modified Peri’s SKYDECK drop head system with a modified rail climbing system (RCS) (see Figures 8 and 9). The climbing elevator formwork system contributed to project efficiency and allowed for faster turnaround on the main central core of the building, avoiding schedule delays. The modified SKYDECK provided the ability to form the constantly changing floor plate by allowing panels to be carried out immediately after the slab concrete reached the required strength (see Figure 10). This revolving process permitted panels to be used immediately for the next cycle and created efficiencies.

Since the SKYDECK system is not traditionally used above grade, a specialized enclosure system was required around the formwork to ensure safety. A modified RCS system worked in conjunction with the SKYDECK system. The enclosure simplified the heating requirements for the concrete slabs during winter pours as it enclosed two floors below the deck currently under construction. The result was..."
greater efficiency and fewer lost days due to weather constraints.

Through these innovations, the construction team was able to achieve a cycle time from floor to floor that could match those of traditional systems for conventional building designs.

Concrete Considerations

The last major innovation in the construction of this building related to the use of the concrete. Although the building was unique in its design, it was still required to meet all structural requirements for a residential condominium, creating another set of challenges.

First, the traditional concentric loading of columns was not appropriate for the unique design of the building. The structural engineer, Sigmund Soudack and Associates, was presented with the challenge of finding an alternative that utilized sufficient rebar and concrete while still allowing for livable spaces. The final structural design included heavy reinforcement at the bottom of the tower (see Figure 11) using 35M bars. However, this design did not allow for use of traditional methods to consolidate the concrete. The final concrete specification called for 70 Mpa in 90 days. Testing demonstrated that these levels were achieved in only 28 days. The concrete performed at rates much higher than expected. The product’s performance required the concrete finishers to adapt to an accelerated schedule because the concrete reached a finished state more rapidly than traditionally expected.

Dominus opted for the use of concrete pumps to alleviate unnecessary crane usage and hoisted concrete with the traditional bucket method. For the columns, builders prefabricated many of the column supports in a staging area and then hoisted them into place. These techniques contributed to speed and efficiency in the construction cycle.

A New Urbanism

The end result of the process created a new form of urbanism based on partnership and innovation. All aspects of the Absolute World Towers project challenged the boundaries of conventional industry norms and practices. The initial design competition allowed dynamic new ideas and design philosophies to come forward. The engagement of the City contributed to shaping and realizing the development’s vision, consistent with the City’s own aspirations. The resulting architectural design broke free from conventional thinking and introduced a natural form back into the city’s (sub)urban experience, made possible by a series of design and construction innovations. The result is a distinct type of urbanism and a curvy new shape for future cities.

Absolute World Towers Project Data

| Location: Hurontario St. & Burnhamthorpe Rd. |
| Building Function: Residential |
| Absolute World 56 |
| Height to Architectural Top: 176 m |
| Stories: 56 |
| Total Area: 45,000 m² |
| Total Cumulative Floor Plate Rotation: 209°, min. 1 to a max. of 8° rotation per floor |
| Absolute World 50 |
| Height to Architectural Top: 158 m |
| Stories: 50 |
| Total Area: 40,000 m² |
| Total Cumulative Floor Plate Rotation: 200° (consistent 4° rotation per floor) |
| Owners/Developers: Fernbrook Homes & Cityzen Development Group |
| Design Architect: MAD |
| Architect of Record: Burkia Architects |
| Structural Engineer: Sigmund Soudack & Associates Ltd. |
| MEP Engineer: ECE Group Ltd.; Stantec |
| Concrete Engineer: Coffey Geotechnics |
| Contractor: Dominus Construction Group |
| Forming Contractor: Premform |
| Material Suppliers: Innocon; Gilbert Steel Ltd. |
| Landscape Architect: NAK Design |
| Interior Designer: ESQAPE Design |

Note: More detailed information on Absolute World Towers as the CTBUH Best Tall Building Americas 2012 can be found in Best Tall Buildings 2012, which can be purchased online at CTBUH Webshop: https://store.ctbuh.org

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**THEY SAID**

“The Absolute Towers stretch the limits of paired sculptural form to create a marker on the skyline for a regional center.”

Richard Cook, CTBUH 2012 Awards Chair / Cook+Fox Architects.