Fluid AND Flexible

BY CHRISTOPHER E. CAREY, SR.

Photos: Courtesy of Schuff

The ability to roll with the punches helped one fabricator keep this multi-building project moving onward and upward.

BRICKELL CITY CENTRE is making quite the imprint on Downtown Miami.

With the first phase opening early next year, BCC will occupy 9.1 acres in the heart of downtown, comprising 5.4 million sq. ft of office, residential, hotel, retail and entertainment space and a two-level underground parking garage.

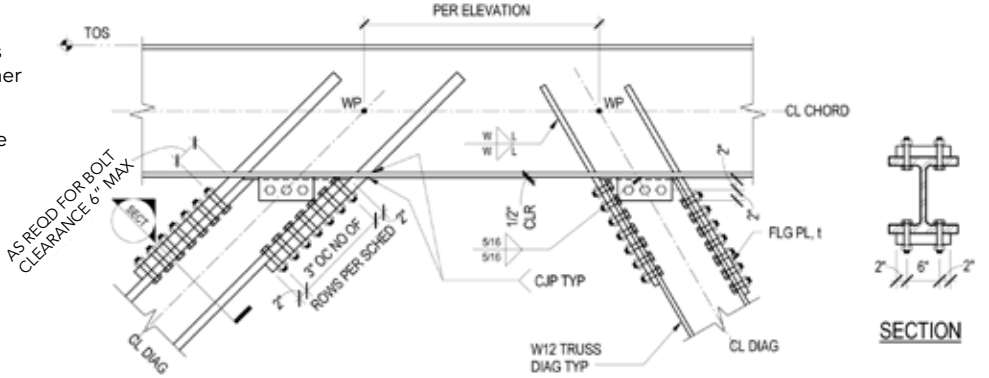
The complex is broken up into three separate podiums (east, north and west). Each block includes one 43-story residential building (two are condo towers while one is a hotel) with varying amounts of steel framing—all include five-story, steel-framed podiums—and the east and west blocks also include one completely steel-framed 15-story office building apiece. The blocks are connected via two one-story steel-framed pedestrian bridges that cross over the streets at level two, and the buildings and bridges collectively contain 12,000 tons of structural steel. Flowing between the buildings is another steel element, the climate ribbon—an undulating, angular glass-and-steel canopy that harnesses the wind through the areas it covers (see the sidebar for more).

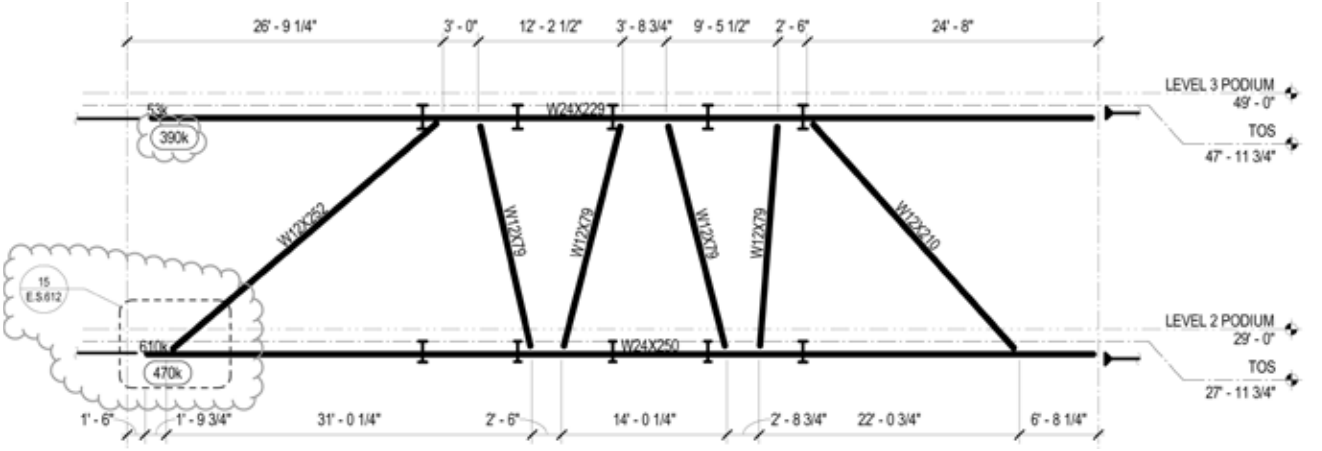
Due to the size and complexity of the project, fabricator Schuff Steel divided the Tekla 3D model into three separate parts correlating with the three city blocks. In order to overcome the challenge of having to regularly update the model, a "master interface" model was created for all three blocks/models. Schuff checked the model on a weekly basis to ensure coordination among all three blocks was being achieved as the project was being erected, moving counterclockwise through each building, podium and truss span bridge, starting with the east block and ending with the west.

A project of this size involved more challenges than can be covered here. However, when it came to the steel package, the primary challenge was coordination. Some of the more interesting ones included scheduling issues with the retail area escalators, construction limitations based on crane locations, shear wall coordination of the condominium towers and late changes to some of the retail spaces.

Christopher E. Carey, Sr. (christopher.carey@schuff.com) is a senior project manager with Schuff Steel Company – Southeast Division.

- The entire complex incorporates several high-rises, all tied together with the climate ribbon.
- It's broken up into three separate podiums, each including one 43-story residential building.
- A typical truss diagonal-to-chord connection detail.
- A truss elevation detail.

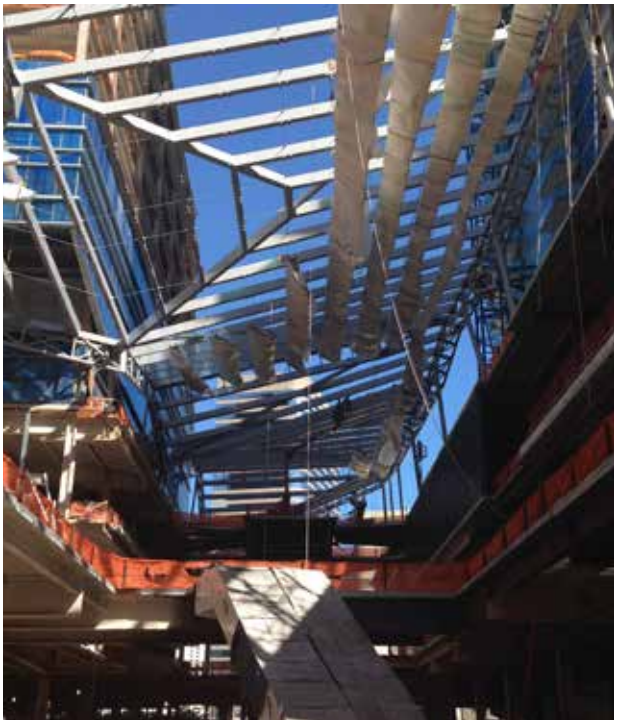


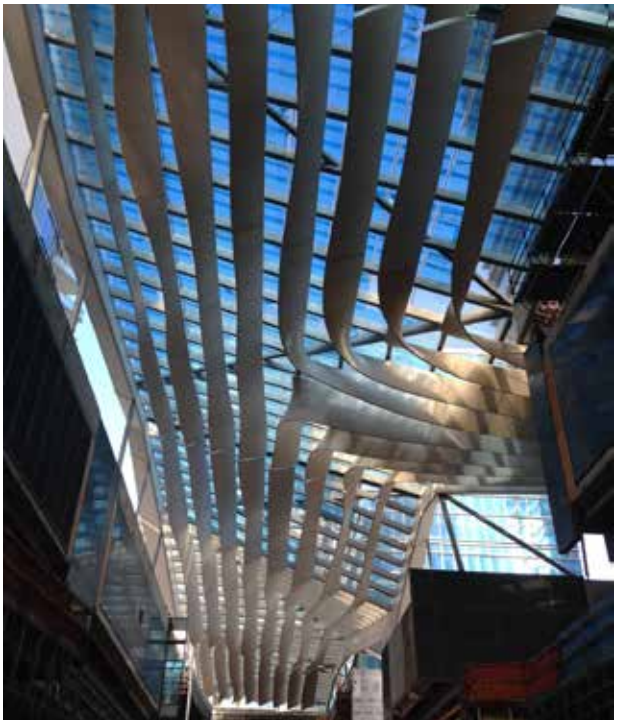


Matters of Location

The escalators located throughout the low-rise, open-air retail portion of the project could be credited with escalating tension. During the design of the low-rise structures, with the building elevations and escalator locations in flux, models arrived late. This required Schuff to incorporate the design changes on the shop floor without affecting the steel delivery schedule. Models of the escalators, once imported into the primary master interface model, proved invaluable as a design-assist service to resolve the required steelwork adjustments to integrate the escalators. In spite of the evolving design, the team was able to meet the schedule.

Location challenges were also present when it came to the tower cranes. Due to stringent site restrictions, the project's 10 tower cranes were not positioned in the most ideal locations for steel erection. Steel delivery and erection packages therefore needed to accommodate this rigid construction scenario. In addition, laydown area was at a premium and required load-listing the delivery trucks for steel to be used that day only. Because of this, multiple revisions to the steel packages were required to accommodate the locations of tower cranes. To address fabrication and erection schedule impacts, most of these revisions needed to be coordinated with Schuff's fabrication team. A critical tool on this project was Schuff's integrated bar-coding system, which helped get the steel to its appropriate location on the vast site.





Changing the Climate

Covering 150,000 sq. ft of space and housing a series of escalators and pedestrian walkways at Brickell City Centre is the "climate ribbon." Located three to five stories above street level, the glass-and-steel (mostly HSS) overhang creates an open-air microclimate for the low-rise shopping areas below, providing shade from the sun, collecting rainwater for reuse and harnessing the breeze off Biscayne Bay for a steady airflow of six to nine knots to lower the temperature by 15 °F to 20 °F.

Of course, the breeze isn't always gentle in Miami, a city that has some of the highest wind loads in the country. As a result, the connection design loads in the lateral framing were quite large. The climate ribbon is framed with wide-flange members using 3-in. cap plates, plus more than two miles of HSS. While Schuff acted as the connection engineer, the overall framing schemes and member selection were dictated by the structure's manufacturer. Schuff had to account for intricate connections to address the assigned axial loads, applied by the climate ribbon forces, in the W-shapes: 200 kips to 967 kips with average of 450 kips. In addition, 4-in. cap plates were used to address the wind loads of the ribbon so that the roof wouldn't fly away in the event of a hurricane.

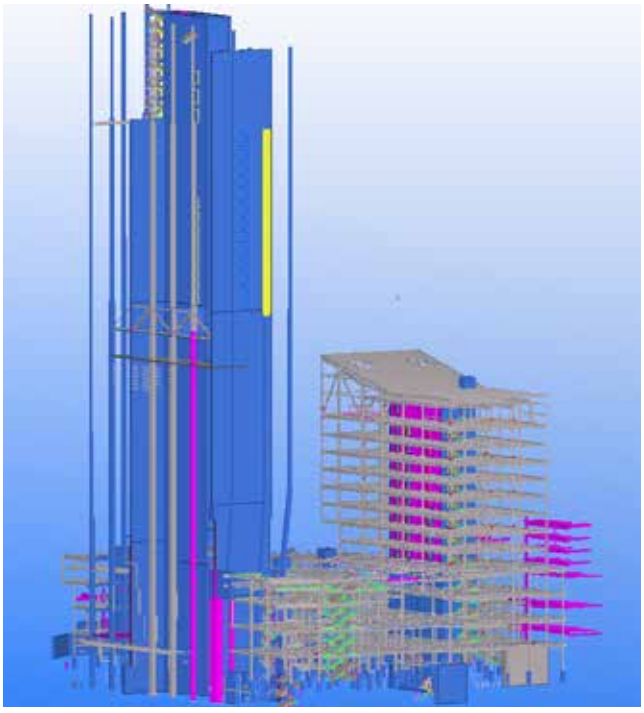
The climate ribbon concept is new to the United States. Developed by an international, multi-disciplinary team including Cardiff University of Wales, Carnegie Mellon, architect Arquitectonica and designer Hugh Dutton Associés of Paris—and built by German firm Gartner—this is its first domestic incarnation. The innovative design resulted in multiple iterations of the interface connections and engineered loads over the course of the project. As the project progressed further into the fabrication and erection phases, any load increases were carefully coordinated with all team members to minimize cost impacts. The design, fabrication and erection teams worked closely, holding weekly model updates and coordination meetings with the general contractor, Americaribe Moriarty Joint Venture, to ensure a successful project.

▲ The project collectively incorporates 12,000 tons of structural steel.

Shear Coordination

Another coordination challenge came in the form of the east hotel building's shear wall. Due to the location of the steel trusses used to support the shear wall (90 ft long and 18 ft high) from level 21 (elevation 259 ft) to level 23 (elevation 279 ft), the large members (W14×605 Grade 65, with the longest piece being 64 ft) within these trusses were detailed and fabricated as single pieces and then welded together in the field. Schuff pre-assembled a complete truss in the shop to ensure that member fit-up would not cause any issues once the material arrived on-site. Coordination with the erector was paramount, particularly due to the high elevation of the trusses and the short amount

▼ Steelwork in the east tower and office building.



▼ A 400-kip connection in the climate ribbon.

The east-to-north pedestrian bridge over the roadway through the complex.

of time (four weeks) allocated to having the trusses erected and welded. Schuff reviewed every joint to ensure that field welding could be achieved using their practices in the field. In all cases pre- and post-heating was required for 12 to 36 hours due to the flange thicknesses to ensure the integrity of the connections.

The retail space yielded yet more last-minute alterations. Designed well after the initial structural design was completed, and with steel detailing well underway, the retail space included significant design changes, such as the addition of a two-story multiplex theater in the west block.

Coordination challenges are expected on any project, and certainly on a project of this size and scope. Implementing a "communication and common sense" approach from design to fabrication to erection ensured that the steel package was one of the biggest assets in an immense complex. ■

Owner
Swire Properties

General Contractor
Americaribe Moriarty Joint Venture

Architect
Arquitectonica

Structural Engineer
Magnusson Klemencic Associates

Steel Team

Fabricator
Schuff Steel Company – Southeast Division

Erectors

East Tower
Steel City Services, LLC

North and West Towers
Peterson Beckner Industries, Inc.

Detailer
BDS VirCon

Laydown area was at a premium and required load-listing the delivery trucks for steel to be used that day only.

The west block's 15-story office building.