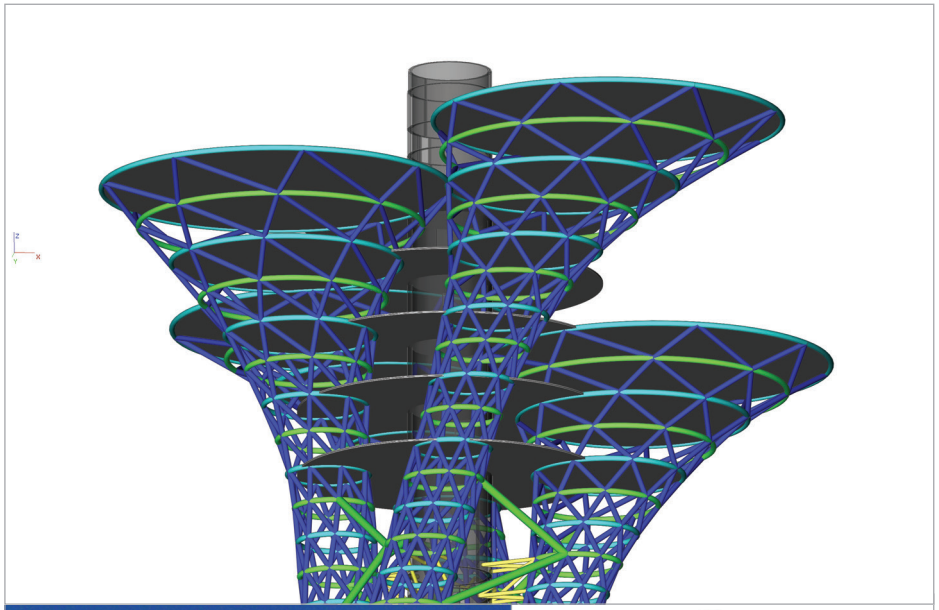
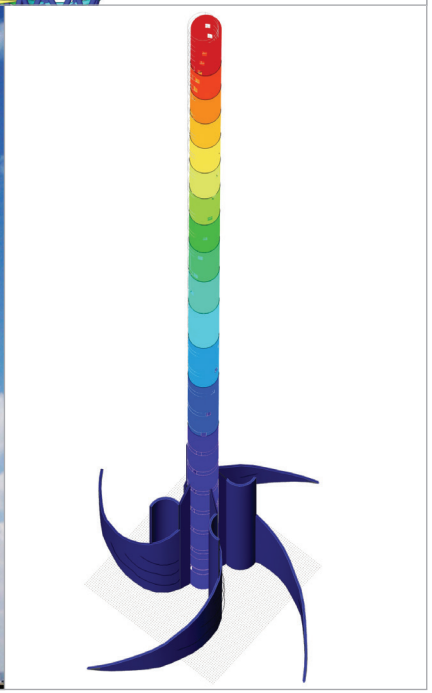
Taiwan Tower - Taichung City, Taiwan





Software: Scia Engineer

Project Description

The Taiwan Tower in Taichung City, Taiwan, is a direct result of the Taiwan Tower International Design Competition. The project guidelines included a construction budget of $220 million, as well as specific required architectural features, such as a base level city museum and observation decks, a restaurant and an environmental monitoring station at the top levels. In addition, the tower was required to be the tallest building in central Taiwan, with a minimum height requirement of 300 m.

Primary Structural System

The primary structural system for the tower consists of 4 steel framed tubes 7 m in diameter which spiral around an 8 m circular concrete core. Each tube is composed of round steel pipes in a diagrid pattern that rotates around the core, completing a full 360 degrees of rotation over 240 m of rise in elevation.

At both the top and base of the structure the 4 tubes flare out to allow for occupied space. The base contains 5 occupied floors, while the top contains 7 occupied floors. Both the top and bottom are designed using composite slabs on a steel beam and girder system with large spans which accommodate open areas below.

Lateral System

As a result of the building's height, the lateral system was required to resist typhoon level winds of +499.2 kg/m^2 and -748.8 kg/m^2 at the top of the tower. Under this lateral loading, the central concrete core transfers forces to the exterior tubes through a series of small outrigger trusses which are placed at a 12 m vertical interval for the full height of the tower. These outrigger trusses allow the structural system to utilize the exterior tubes to their full potential under all loading conditions and greatly increase the lateral stiffness of the structure as compared to a core only system. The torsion induced on the core was offset by a continuous truss which connects the tubes to each other and allows the four individual tubes to work as a single unit.

Foundation System

All vertical and lateral load resisting elements will terminate at a mat slab on a drilled pier foundation system.

Repetitive & Modular Design

Although in geometrical terms the tower is complex and unusual, the majority of the structural system is repetitive and designed to be modular. The spiraling tubes are designed to be fabricated in 3- or 6-meter sections, either on or off site and lifted into place. The tower core lends itself to a common climbing form work system. These characteristics allow for a more easily constructed structure.

Design Approach & Scia Engineer

Because of the tight project schedule (completed submission in 4 weeks) and the complexity of the exposed steel structure, the design team chose to utilize Scia Engineer. Scia Engineer's flexibility in 3D modeling allowed for the structure to be modeled, analyzed and designed for gravity loads, seismic loads, including dynamic analysis and winds loads, all within Scia Engineer. After the model was optimized, it was then exported to the architect via IFC (Industry Foundation Class). Using this OpenBIM workflow enabled the design team to create a unique and collaborative 3D workflow that integrated the architecture and engineering. Ultimately, this workflow allowed the team to manage design changes and work iteratively towards the final design, while also abiding by the project's tight deadlines.

M.I. Flamer & Associates

Contact Mark Flamer P.E.
Address 45 W. Mendocino Ave
Willits CA 95490 - United States
Phone +1 707-456-9023
Email mark@flamerassoc.com

M.I. Flamer & Associates

M.I. Flamer & Associates is primarily involved in consulting work that provides firms with assistance in the modeling and analysis of complex or unusual structural systems using state-of-the-art finite element analysis software, including Scia Engineer. M.I. Flamer & Associates has over 15 years of experience in the design and construction industry and has worked on many projects throughout the United States. The company has recently increased its efforts in the software engineering market, with the goal of leveraging its AEC experience to create software for the design of smarter, more efficient buildings.

Project information

Owner	Taichung City Government
Architect	Douglas Muir, RA BArch, NCARB
General Contractor	TBD
Engineering Office	M.I. Flamer & Associates
Location	Taichung City, Taiwan
Construction Period	01/2014 to 12/2016 (project is in bidding phase)

Short description | **Taiwan Tower**

The Taiwan Tower is a new landmark structure in Taichung City, Taiwan, that includes a street level museum and observation decks, a restaurant and an environmental monitoring station at the top levels of the 366 m tower. The primary structural system for the tower consists of 4 steel framed tubes 7 m in diameter which spiral around an 8 m circular concrete core and are designed to be fabricated in 3 or 6 meter sections. The circular concrete core transfers lateral load to the exterior tubes through a series of small outrigger trusses. These outrigger trusses allow the structural system to utilize the exterior tubes to their full potential, while increasing the structures lateral stiffness. The design team utilized Scia Engineer for modeling and advanced analysis such as dynamics. The software was also used as the hub for the team's OpenBIM design approach which utilized the IFC model exchange in order to create an iterative and collaborate design process.