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Infinity Tower

Dubai, UAE

Dubai Infinity Tower Twists for Spectacular Views

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In a distinctive application of architectural expressions through structural form, the Infinity Tower twists a full 90 degrees from its base to its crown, 305 meters (1,000 feet) above the ground, through a series of incremental plan rotations at each level. The architects proposed the twisting geometry of the Tower as a means to maximize the views at different elevations. Near the base of the Tower, the Marina is the primary view. Ascending up the Tower, views to the Gulf take precedence and the building geometry is a response to this topography.

The 73 story cast-in-place reinforced concrete Infinity Tower consists of 122,000 m^2 (1,312,500 ft^2) of residential and amenity space, as well as 12 levels of parking including 6 parking levels below grade. Currently under construction and scheduled to open in 2011, Infinity Tower will stand as an iconic centerpiece for the Dubai Marina.

The Tower is founded upon a 3 meter thick reinforced concrete mat foundation which is supported by ninety-nine 1.2 meter diameter bored, cast-in-place reinforced concrete piles extending approximately 30 meters below the mat foundation. The piles transfer the Tower loads to the subgrade primarily through side friction. The subgrade consists of loose sands and sandstone bands overlaying cemented marine deposits and calcareous silt limestone/siltstone.

The lateral load resisting system for the Tower consists of a combination of a moment-resisting perimeter tube frame and a circular central core wall, connected by the two-way spanning reinforced concrete flat plate slabs at each level acting as rigid diaphragms. This system maximizes the effective structural 'footprint' of the Tower by utilizing a significant amount of the vertical reinforced concrete for lateral load resistance.

The design philosophy for the Tower is based upon the exterior form of the building as a direct expression of the structural framework. The engineers studied a series of options for the perimeter frame in order to create the unique twisting geometry of the Tower. Ultimately it was determined that there were distinct advantages to stacking the columns. Each column slopes in one direction, and is offset over the column below, in order to generate the twisting building form. As the perimeter columns ascend from story to story, they lean in or out, in a direction perpendicular to the slab edge. At every level, the columns shift in position along the spandrel beams so that each column maintains a consistent position

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Owner / Project Managers: Cayan Investment & Development

Architect/Engineer: Skidmore, Owings & Merrill LLP, Khatib & Alami CEC LLC

General Contractor: Arabtec Construction LLC

Concrete Supplier: Unimix LLC & Austrian Arabian Ready Mix

Formwork Supplier: BRM Construction LLC & MFE Formwork Technology (formerly Mivan Formwork)

at each floor relative to the tower envelope. The corner columns and the six (6) interior columns twist as they ascend.

In order for the Infinity Tower to be realized as a viable, built structure, the seemingly complex building form must ultimately be derived from a structure which is easy and efficient to construct, and which leads to practical architectural floor layouts. The system as described above offers significant construction simplification through formwork repetition, which directly impacts the construction cycle time. Also, this system leads to residential floor layouts which are repetitive at each level despite the twisting nature of the building form.

The circular central core walls, which ascend purely vertically, are cast using a slip-forming system operating through incremental but not continuous advancement, in order to remain ahead of, but in phase with the construction of the perimeter frame of the Tower. The circular nature of the central core walls made slip forming an attractive option in order to avoid the potential difficulties in adjustment of the formwork panels towards the inside of the circular core walls as would be the case with jump-form operations. The perimeter concrete tube frame (columns and spandrel beams) and slabs are cast using an interlocking metal formwork system by MFE (Mivan) Formwork. The perimeter column stacking configuration means that the forms are identical at each story, simplifying the formwork erection operation. A construction cycle time of 6 to 7 days per story is consistently being achieved

Due to the unique twisting geometry of the Tower, the structure has a natural tendency to undergo additional horizontal 'twist' movement under gravity loads, a significant portion of which results from the self-weight of the cast-in-place structure. Additional movement is expected during construction and over the life of the structure due to creep and shrinkage effects of the cast-in-place concrete. In order to understand the potential movement of the structure, a detailed analysis was performed taking into account the anticipated construction sequence, and time dependent variables; such as creep, shrinkage, and variation in concrete material properties. A comprehensive and continuous building movement surveying program has been implemented in order to track the behavior of the Tower during construction. This information is used by the engineers in order to confirm the expected behavior of the structure, and by the contractor in order to plan for the appropriate construction alignment compensation.

Cast-in-place reinforced concrete was selected as the primary construction material for this project primarily due to its ideal mass and stiffness characteristics, which aid in the reduction of wind-induced movement of the Tower, a governing factor in the design of tall, slender towers. In addition, cast-in-place concrete is a cost-effective and practical option for construction in Dubai.

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