Dubai Tower Doha

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Summary

Dubai Tower Doha is a 438 metre tall tower building, including a 36 metre spire, currently under construction in Doha, Qatar. The estimated date of completion is 2010. The tower provides accommodation for retail, office, hotel and residential uses over 90 levels above ground and five levels of basement car parking. The project architect, structural engineer and MEP services engineer is Robert Matthew Johnson Marshall (RMJM). Hyder Consulting is sub-consultant for the structural design of the tower.

At completion, Dubai Tower Doha will be amongst the world's ten tallest buildings.

Keywords: Dubai Tower Doha, tall building, high strength concrete, robustness, precast

1. Introduction

Dubai Tower Doha is a 438 metre tall tower building, including a 36 metre spire, currently under construction in Doha, Qatar. The lateral stability of the tower is provided by the high strength reinforced concrete core in conjunction with composite steel and concrete outriggers and perimeter belt trusses at plant-rooms. The perimeter columns are a combination of high strength reinforced concrete and concrete filled steel tubes. The tower floors above Level 8 are comprised of pre-cast slab units, with a structural topping, supported by perimeter composite steel edge beams. The progressive set-back for floors above Level 41 is supported by a series of steel raking trusses. The tower foundations comprise of a pile supported raft.

With concrete cylinder design strengths up to 80MPa adopted in the design of reinforced concrete core walls and columns, concrete filled steel tubes outside current code slenderness limits, significant lateral loads to meet robustness requirements, complex load transfer paths due to column eccentricities and progressive floor set-back and architectural wall openings, new techniques for analysis and design were adopted outside normal engineering practice. An extensive review of international design standards and published papers was carried out to select the appropriate document for guidance on the above design challenges.

2. Key Aspects of Tower Design

2.1 Foundations

The tower foundation is a pile supported raft. The reinforced concrete raft is 3.5 metres thick with 28 day design cylinder strength (f'c) of 60MPa. The tower and podium raft was constructed in one continuous pour over ten days. The tower raft is supported by 191 bored cast in place 1.5m diameter piles.

https://doi.org/10.2749/222137908796292056

2.2 Tower Column Design

2.2.1 Basement Columns

The basement tower columns are reinforced, high strength concrete (HSC) columns with cylinder design strength (f'c) of 80MPa.Based upon an extensive review of current international design standards and reports, draft Australian Concrete code DR05252 was adopted.

2.2.2 Office Tower Columns

The tower office columns from Ground Floor to the underside of Level 54 are concrete filled thin steel tubes with f'c of 80MPa. Based upon a review of current design reports, O'Shea and Bridge concluded through experimental research the provisions of Eurocode 4 were still applicable to HSC with f'c up to 80MPa and diameter to thickness ratio up to 120 for Grade 355 steel tube.

2.2.3 Residential Tower Columns

The residential columns above Level 54 are reinforced columns with a design strength f'c of 60 MPa with a pair of hot rolled I sections laced together to form the shape of the blade column. The steel sections are designed to temporarily support the floor structure without the immediate requirement to encase the steel sections.

2.3 Tower Core Design and Lateral Resisting System

The lateral stability of the tower is provided by the high strength reinforced concrete core in conjunction with composite steel and concrete outriggers and perimeter belt trusses at plant-rooms. The perimeter columns are engaged in the wind frame by the outriggers.

2.3.1 Tower Core Wall Design

The tower core walls from Raft to Level 55 are reinforced, HSC walls with design strength f'c of 80MPa. The draft Australian Standard DR05252 was adopted for the design of the core walls and the basis for this was similar to high strength concrete column design discussed previously.

2.3.2 Outriggers and Perimeter Trusses

The tower outriggers and perimeter trusses are located in plant room levels at Level 21/23, 52/54 and 85/86. The composite box sections, filled with concrete strengths up to f'c of 80 MPa and steel plates up to 40 mm thick, were designed to Eurocode 4.

2.4 Tower Floor System

2.4.1 Structural Floor Framing

The tower floors above Level 8, except the plantroom slabs, comprise of hollow core pre-cast slab units, with a structural topping, supported by perimeter composite steel edge beams.

2.4.2 Column Transition Rectification Forces

Due to the progressive step back of the floor plates above Level 41, the horizontal realignment induces significant vertical eccentricities into the tower columns. The induced push-pull forces are resisted by both the internal tie steel beams and diaphragm action of the structural topping.

2.5 Construction Movement Prediction

The time dependent effects of creep, shrinkage and loading sequence for both the reinforced core and the tower columns were assessed.

2.6 Conclusion

When completed, Dubai Tower Doha will be amongst the world's ten tallest The structural design challenges included design outside the scope of current international design codes, complex load transfers and selection of structural systems to simply the construction of the building.