

# Millennium Tower

San Francisco, CA



## Team

**Owner:**

Millennium Partners, San Francisco, CA

**Architect:**

Handel Architects LLP, San Francisco, CA

**Engineer:**

DeSimone Consulting Engineers  
San Francisco, CA

**General Contractor:**

Webcor Builders, San Francisco, CA

**Reinforcing Bar Fabricator:**

Regional Steel Corporation, Tracy, CA

**Total Project Cost:**

\$350 million

**Total Project Size:**

1,000,000 sq ft

**Photography:**

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Millennium Tower stands 645' and is the tallest reinforced concrete structure situated in a seismic zone 4 region, as well as the 4th tallest structure in the city of San Francisco. The \$350 million project is comprised of a 59-story tower and a 12-story building connected by a 3 level podium structure. The above ground structure contains approximately 900,000 sf with an additional 250,000 sf of parking and support space located below-grade. This project required a 75-foot deep excavation, which is one of the deepest in San Francisco. The tower's immense height posed many challenges and required the creative use of technologies and cutting edge innovation. Concrete, while a unique choice for this high-rise tower, is utilized most effectively to make this project a financial success for the developer. Millennium Tower demonstrates that concrete is a safe and secure building material, even in seismically challenging situations.

### UNIQUE DESIGN FEATURES

High-rise buildings usually exhibit significant higher-mode effects. This higher-mode effect significantly changes the load distribution applied to the building. A historical inverse triangular load distribution push-over analysis is the wrong approach for high-rise analysis. Our team explored other options such as multi-mode pushover analysis as described by FEMA 440 and non-linear time history analysis.

For the heavily reinforced walls, beams and columns, grade 75 ductile reinforcement is used to minimize the amount of rebar required. This solution reduced rebar tonnage by 25%, significantly reducing congestion and facilitating concrete consolidation. A robust testing procedure is implemented to gain confidence in the reinforcing steel (rebar) and the mechanical devices used with the rebar, and demonstrates to the city of San Francisco Department of Building Inspection the safety and efficacy of this solution.

### REASONS FOR CHOOSING REINFORCED CONCRETE

When the project was initially conceived in the late 1990's, it was assumed that structural steel would be selected for the project. By the time the project gained traction in 2003, two things had changed in the local industry. The first change involved high strength concrete in the local market. Utilizing advice from the local construction industry, Millennium Tower's solution ultimately specified 10,000 psi elements. The second change involved the development of new slip-form technology that allowed a concrete shear wall core to be constructed rapidly and in advance of the floor plates. This innovation changed the economics on the construction side, facilitating faster concrete construction schedules.

These developments in tandem with residential construction's preference for concrete enabled the Millennium Tower concrete solution. The use of flat plate construction reduces overall floor to floor heights, thus allowing more floors to be constructed within the given building height, which is limited by zoning regulations. All of these items, combined with the clients' preference for selling a concrete structure, led to the selection of a concrete system.