



■ Commercial Buildings

Reference Details:

Owner Third and Mission Associates Inc., Irvine, CA, USA +++

Design Architect Elkus/Manfredi, Boston, Massachusetts, USA

+++ **Architect of Record** Kwan Henmi, Architecture and Planning, San Francisco, USA +++

Structural Engineer Robert Englekirk Consultant Engineers, Los Angeles, CA, USA

+++ **General Contractor** Pankow Residential Builders II, Ltd., Altadena, CA, USA

+++ **Precast Subcontractor** Mid-State Precast, L.P., Corcoran, CA, USA

DSI Services Supply of 300 DYWIDAG Multistrand Systems 19-15.2 mm and more than 2,100 DDC[®]. DYWIDAG Ductile Connector Assemblies.



The Paramount Building - A 39-story high record in Downtown San Francisco

128-m tall residential apartment tower with retail and parking space built with new technologies for construction in seismic zones, San Francisco, CA, USA

The Paramount Building located in Downtown San Francisco, across from the famous Moscone Center further enriches the city's world-renowned skyline. At 39 stories and 128 m high it is the tallest concrete structure in addition to being the tallest concrete framed building in seismic zone 4 (a double record).

The building has about 500 luxury apartments and retail stores at the lower levels with underground parking space. The last level includes an outdoor recreation deck area.

Unique to this building is the fact that the structure incorporates two, technologically new systems that proved to be very effective for seismic zones: the contractor's Precast Hybrid Moment-Resisting Frame (PHMRF) and the DYWIDAG Ductile Connector (DDC[®]). These systems were installed above the eighth floor. PHMRF system is a system predominantly used for multiple bay frames. It uses a combination of the DYWIDAG Unbonded Multistrand Post-Tensioning System and grouted reinforcing steel to connect precast beams and columns. Prestressing steel strands (270 ksi ultimate strength) are inserted into one precast duct per beam and anchorages are placed inside the precast columns. Stressing of the tendon is done at the column face.

Post-tensioning tendons with straight-line configuration connect as many as seven bays in a row, or around the corner. The cornering aspect is unique to this project. This technique makes it possible to stress two perpendicular frames simultaneously. Mild steel reinforcing is installed above and below the post-tensioning tendons in grouted ducts. The reinforcing steel is ductile and will deform plastically during earthquake but the post-tensioning tendon's elastically will

pull frame back to its place.

PHMRF was tested in the five-story PRESS building at the University of California, San Diego in September 1999. Additional testing was performed at the University of Washington. It is interesting to mention that while buildings are designed normally for drifts of 2 to 2.5 %, test results show that PHMRF system could sustain drifts of 3.5 to 4 % with loss less than 30 % of the ultimate strength.

The DYWIDAG Ductile Connector (DDC[®]) was also tested for high seismic zones and has ICBO approval. It can be used for connection of columns to footing and columns to beams in precast buildings. At the Paramount Building DDC[®]s connect precast columns to cast in place beams by threading DYWIDAG Threadbar (120 ksi yield) into a special forged ductile rod. This was done for shorter bays where the system proved to be more economical. Special steel ductile rod is placed inside the column and has the ability to take the entire seismic load without damaging surrounding concrete. Special detail connection prevents bolt misalignment and speeds-up the construction process. The entire construction was completed in a 26-months schedule and the superstructure was completed in only 16 months. This made it possible for tenants to occupy the premises by October 26, 2001.

Hybrid Moment Resisting and DDC[®] systems have been used successfully in other parking structures and office buildings built in California. In June 2002, a jury of peers judging the 2002 PCI Design Awards Program bestowed upon the structure the Harry H. Edwards Industry Advancement Award.

Source: Robert Englekirk Ph.D., P.E., S.E. article published in PCI Journal July-August, 2002

