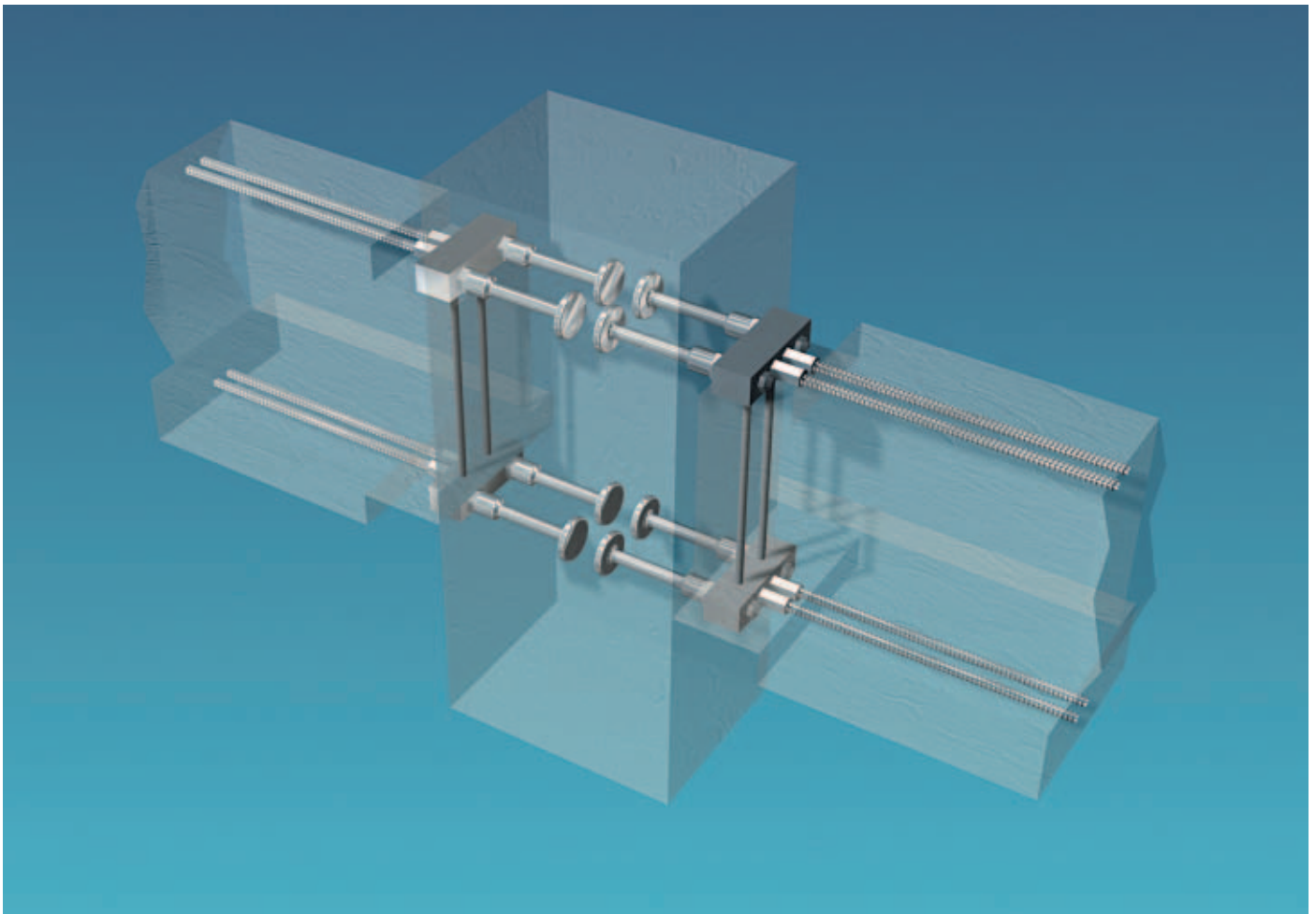


DYWIDAG DUCTILE CONNECTORS For Seismic Applications



Precast beam to column connection for use in seismic areas

DYWIDAG-SYSTEMS INTERNATIONAL

The DYWIDAG Ductile Connector makes it possible to build safe, totally precast structures in areas of moderate and high seismicity.

ADVANTAGES

- Fast Erection
- Single Trade Erection
- No Temporary Bracing
- ICBO Approved
- No Welding
- All Bolted
- No Structural Grouting

- ▶ The DYWIDAG Ductile Connector (DDC)₁ is manufactured from high quality steel especially selected for its excellent ductility and resistance to large strain reversals.
- ▶ The DDC makes it possible for beam-column joints and column-footing joints of totally precast structures to develop the flexural capacity and a hysteretic behavior which is superior to that of monolithic connections.
- ▶ The required inelastic response of the connection is provided totally by the DDC steel elements at the beam-column interface. This allows the use of very high strength reinforcing bars in the beam which eliminates steel congestion.
- ▶ All reinforcing steel bars and elements are made continuous through the beam-column joints by threaded connections which eliminates the risk of bond-slip failures.
- ▶ Vertical shear force transfer across the beam-column interface is guaranteed either by torqued high strength threaded connections or passively provided by flexurally induced friction.
- ▶ Little or no repairs required after a moderate earthquake.

DESIGN

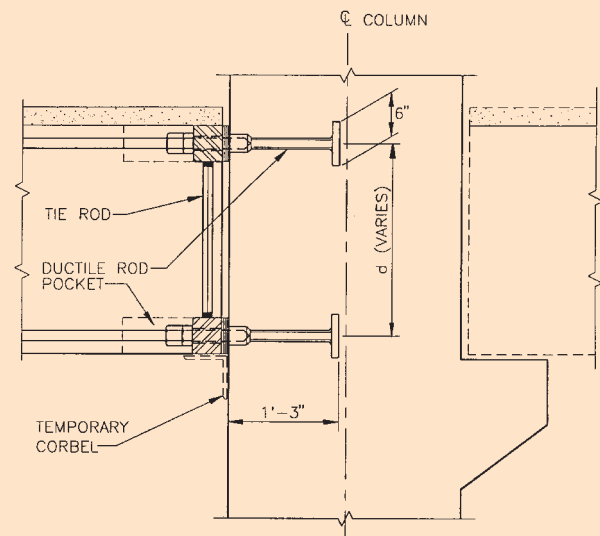
Ductile frames are designed using normal concrete design and analysis techniques, with the DDC replacing the longitudinal beam reinforcing.

A 706 Reinforcing	DDC Standard Configuration
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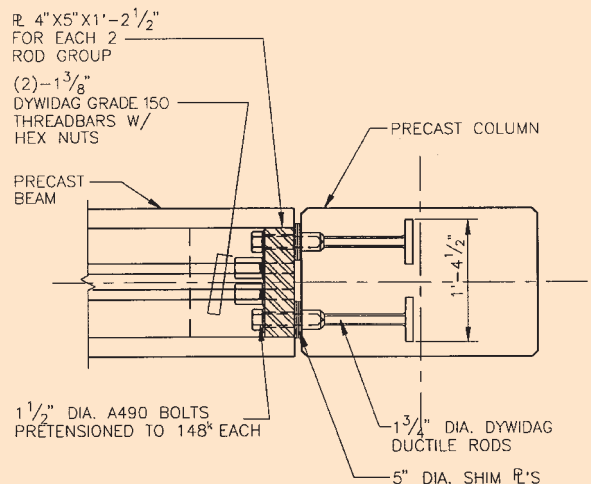
6 # 8 bars (T&B)
12 #8 bars (T&B)

One DDC
Two DDC's

A DDC assembly consists of the elements necessary to connect one beam end to a column as shown in the details below. Each DDC assembly has a yield strength $T_y = 282$ kips for negative and positive moments.



Elevation



Plan View



Wiltern Parking Structure, Los Angeles, CA

FIRST APPLICATION OF THE DYWIDAG DUCTILE CONNECTOR:

The innovative solution for safe totally precast construction in seismic zones.

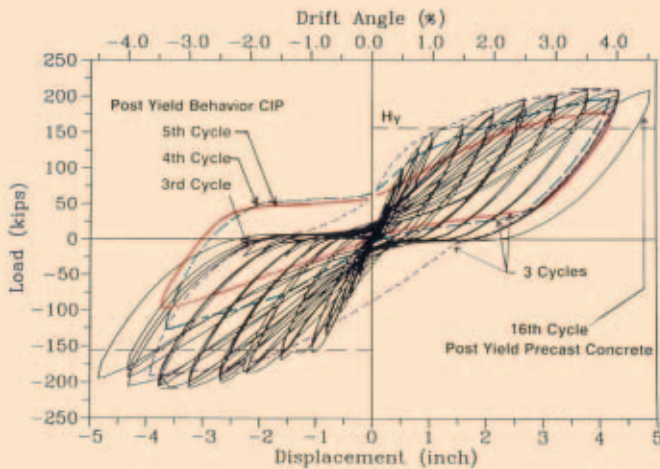
The Wiltern Center parking structure consists of four 191 x 210 ft. floors with a total area of 160,000 sq. ft. Eight ductile frames are evenly distributed throughout each floor plate. The entire load resisting system of standard precast concrete members was precast offsite and assembled merely by bolting the beams to the columns.

The erection process was simple. Precast columns were placed over temporary guide studs inserted into the ductile rods that were cast into the footing. Shims were set to plumb the column at the appropriate height, then the bolts were manually tightened. Once the columns were in place, precast beams were lowered into position. Two bolts were placed at the bottom of the beam and tightened using a calibrated torque wrench once the beam was properly aligned. The total erection time for each frame was between 5 and 8 hours, and the entire precast concrete system required only 16 working days to be completed.

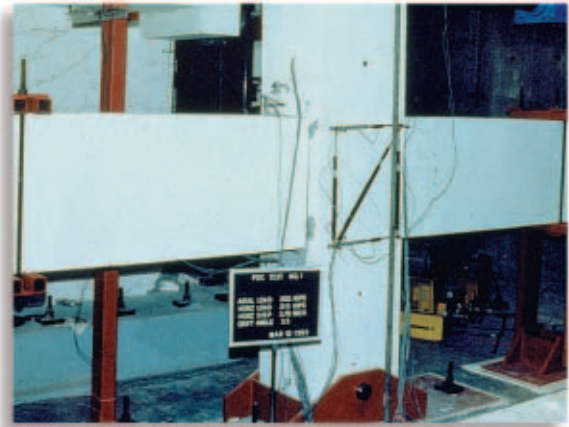


EXPERIMENTAL VERIFICATION

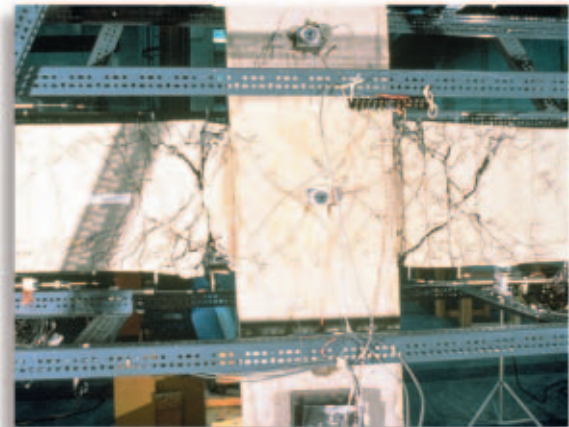
LOAD-DISPLACEMENT HISTORY OF BEAM COLUMN ASSEMBLY WITH PRECAST DUCTILE CONNECTORS (Black Loops)



The DDC System has the ability to deform to a story-drift of over 4% without a significant loss of strength.



Crack pattern of precast concrete frames assembly at 3.5% story drift.



Crack pattern of cast-in-place frame assembly at 3.5% story drift.

DDC Hysteresis loops - UCSD test

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