8-22-2015

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DOI: 10.5703/1288284315718

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Recommended Citation

ECT Team, Purdue, "Post-Tensioned Concrete Shear Wall" (2015). *ECT Fact Sheets*. Paper 9.
<http://dx.doi.org/10.5703/1288284315718>

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POST-TENSIONED CONCRETE SHEAR WALL

THE NEED

The post-tension concrete shear wall by Tipping Mar will replace the conventional concrete shear wall in earthquake prone areas in many instances, depending on the height and scale of the building.

THE TECHNOLOGY

A post-tensioned concrete shear wall can be described as a conventional concrete shear wall in which about 50% of the vertical reinforcing bars are replaced with an equivalent amount of high strength cable that is tensioned after the wall is constructed. The aim of replacing mild steel reinforcing with post-tensioned cables in a concrete shear wall is to allow the self-centering of a building after an earthquake occurs. Conventional reinforced concrete shear walls do not act similarly. They will not self-center once the rebar yields causing a permanent inter-story drift in a building after an earthquake. Re-centering after an earthquake is a unique feature of post-tensioned walls that is extremely beneficial in cases of earthquakes. This is an added advantage over conventional systems which rely on yielding and where building may suffer deformations after earthquakes of large magnitudes. This also adds to the life cycle of the building. This characteristic is an important part of comprehensive, sustainable design strategies to reduce earthquake losses and material waste in seismically active areas. Pre-stressing can reduce the quantity of vertical mild steel reinforcement in the walls by fifty percent or more compared to conventional construction. This results in more efficient material use and reduced congestion.

THE BENEFITS

The addition of the post-tensioned cables modifies the design, detailing, and behavior of the wall as follows:

1. Allows the mild steel reinforcing to yield during a seismic event yet has sufficient restoring force to bring the wall back to plumb following the seismic event. Simply put, the wall will self-center.
2. The yielding of the mild reinforcing steel during a seismic event provides added damping to the structure improving its performance.

3. Increases the overall stiffness of the wall improving seismic performance. Allows the engineer to set the performance level of the structure by controlling the drift limits via the amount of post-tensioning used.
4. Reduces mild steel congestion improving construction efficiency.

FIGURE 1 PT CONCRETE WALL

STATUS

The concept was developed at Tipping Mar and first used to seismically strengthen an existing seven story concrete building located in Berkeley, CA in 2005. Since that time, the system has been used as the lateral bracing system in six buildings and will be used in three other buildings which have not yet started construction.

FIGURE 2 BROWER URBAN CENTER

One of these buildings is the Brower Center urban mixed-use development building in California with an area of 225,000 sq. ft and a cost of \$15.3 million. Post-tensioning was used in this building which was

proven to lead to cost reductions, benefits in performance, higher resistance to loads and its self-centering behavior. The pictures below show the building from the outside and its structure as well. The system will be become an industry standard in earthquake prone areas and used in many future buildings.

FIGURE 3 STRUCTURE OF THE BUILDING

BARRIERS

Not known

POINTS OF CONTACT

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REVIEWERS

Peer reviewed as an emerging construction technology

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PUBLISHER

Emerging Construction Technologies, Division of Construction Engineering and Management, Purdue University, West Lafayette, Indiana