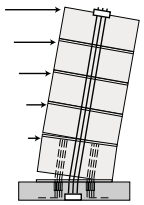
HYBRID PRECAST WALL SYSTEMS
FOR SEISMIC REGIONS



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January 31, 2011

Industry Meeting Resolutions

Meeting Date: January 24, 2011
Meeting Venue: Tele-Conference
Attendance: W. Korkosz, D. Dieter, M. McGinnis, Y. Kurama, B. Smith

The following resolutions were made during the meeting:

Results from Specimen #4 (Hybrid Wall)

- The performance of Specimen #4 was reviewed with specific focus on comparing the measured behavior of the hybrid wall with both the ACI ITG-5.1 validation criteria and the measured behavior of the previously tested emulative wall (Specimen #3).
- The hybrid specimen satisfied all validation criteria (i.e., strength loss, energy dissipation, etc.) with the exception of horizontal shear-slip at the foundation-to-base-panel joint, where the wall exceeded the maximum allowable slip of 0.06 inches during the negative loading direction of the 2.30% validation drift series. The maximum values of slip in the positive and negative directions of loading to 2.3% drift were 0.03 and 0.11 inches, respectively. This amount of slip did not negatively affect the performance of the wall.
- The hybrid specimen did not exhibit the excessive and detrimental axial heightening behavior that was observed in the emulative specimen due to the lack of PT steel.

Action Plan for Specimen #5: Panel Openings

- Specimen #5 will be a hybrid wall that incorporates panel openings. The 1st and 2nd story openings will be included in the specimen (while the 3rd and 4th story openings will not be included) to accurately model the distribution of the panel forces across the panel-to-panel joint and into the base panel.
- Two rectangular openings will be designed in each of the 1st and 2nd story wall panels, with each opening located between the confined concrete regions at the ends of the wall and the PT ducts near the center of the wall.
- The full-scale wall openings will be approximately 3-ft wide by 5-ft tall and located approximately 2-ft to 3-ft (full-scale) above the bottom of each panel.
- All other design parameters (i.e., panel geometry, ED bar and PT steel areas, etc.) in Specimen #5 will remain similar to the previous hybrid specimens.

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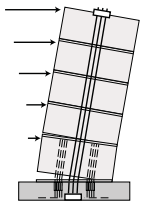

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- A conceptual wall opening lay-out drawing will be created by B. Smith and distributed to W. Korkosz and D. Dieter for review.

Action Plan for Specimen #5: Panel Reinforcement Design

- A preliminary design of the steel reinforcement needed around the panel openings will be performed by B. Smith using ABAQUS finite-element analysis (FEA). If possible, a simplified design procedure utilizing a strut-and-tie model will also be developed based on the results from the FEA.
- The preliminary reinforcement design and calculations will be reviewed by W. Korkosz.

Action Plan for Specimen #5: Reinforcement Detailing

- Several reinforcing details implemented in Specimen #4 will also be utilized in Specimen #5. These details include:
  (a) E.D. bars cast into the base panel with the full development length of the bars projecting beyond the bottom of the panel and grouted into corrugated metal ducts cast inside the foundation beam;
  (b) one additional confinement hoop placed within the cages located at the toes of the base panel (note that the formalization of this potential detailing requirement will need to be further discussed by the panel);
  (c) closed hoops placed at the bottom of the base panel around the E.D. bars and the PT ducts as well as at the bottom of the upper panel around the panel-to-panel reinforcement.
- Unlike Specimen #4, the distributed horizontal No. 3 bars at the bottom of the base panel will be placed through the confinement cages at the ends of the base panel to limit cover concrete spalling. In Specimen #4, this reinforcement was placed on the outside of the confinement cages, which may have contributed to additional spalling due to the separation of the ends of the bars from the core concrete.
- All other reinforcement details (including the relative placement of the confinement hoops and intermediate ties) in Specimen #5 will remain similar to previous hybrid specimens. In Specimen #4, the longer legs of the confinement hoops (i.e., legs along the wall length) bowed out slightly during the later cycles of the test, thus reducing the confinement effectiveness of the hoops. This was possibly because the hooked ends of the intermediate tie spanning each hoop in the transverse direction did not engage the hoop steel [note that the transverse ties did engage the longitudinal (vertical) panel reinforcement]. This detailing, while not ideal, will be left unchanged as it would be very difficult for the hooked ends of the transverse ties to engage the hoop steel.

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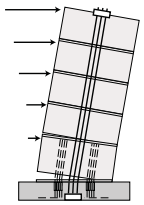

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Action Plan for Specimen #5: Fiber-Reinforced Grout

- Before the erection of Specimen #5, further discussion will be needed on the strength of the fiber-reinforced dry-pack joint grout. In the previous specimens, the grout strength was targeted at about 1 ksi lower than the unconfined strength of the base panel concrete. This was done in an attempt to create a softer "bed" for the base panel to roll on. However, in practice, joint grout is typically selected to have similar strength as the unconfined panel concrete since trying to achieve a 1 ksi difference between the concrete and the grout strength would be difficult to control.
- Post-test analyses of Specimen #5 showed that considerably better correlation with the measured behavior of the wall (e.g., strength, PT forces, contact depth) is achieved if the strengths of the unconfined concrete, confined concrete, and joint grout at the wall base are all capped at the strength of the weakest of these three materials (since the weakest material governs the maximum stresses that can be transferred at the base of the wall). This finding will be incorporated in the design and analysis of the future specimens.

Action Plan for Specimen #6

- Ideally, casting of the remaining two wall specimens should take place in two installments to allow for any unforeseen detailing modifications to be made between the specimens. Thus, the proposed casting schedule is to cast Specimen #5 during Spring 2011 followed by Specimen #6 during Summer 2011. This casting schedule will be discussed in greater detail with K. Baur in the near future.
- Specific design parameters for Specimen #6 will be decided after the determination of the casting schedule and/or the testing of Specimen #5. Wall panels with openings, ordinary confinement detailing, and/or a second emulative wall may be incorporated in the design of Specimen #6.

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