Exploring Adequate Layout for Ductile Behavior of Reinforced Concrete Shear Walls Boundary Elements in Compression

PEER Internship Program – Summer 2013

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Research conducted at University of California Berkeley

1. INTRODUCTION

Reinforced concrete shear walls are structural systems that have been commonly used worldwide due to their high capacity in resisting seismic forces during an earthquake event achieving large deformations in compression and tension in a ductile manner.

Two separate shear wall boundary elements in pure compression were studied:

- Each design followed ACI 318-11 provisions.
- Specimens were modeled using OpenSees (McKenna 2000) prior to be tested at the NEES at Berkeley laboratory in Richmond Field Station using a four-million pounds universal testing machine.
- Specimens with similar geometry but different crossties detailing.

a) b)

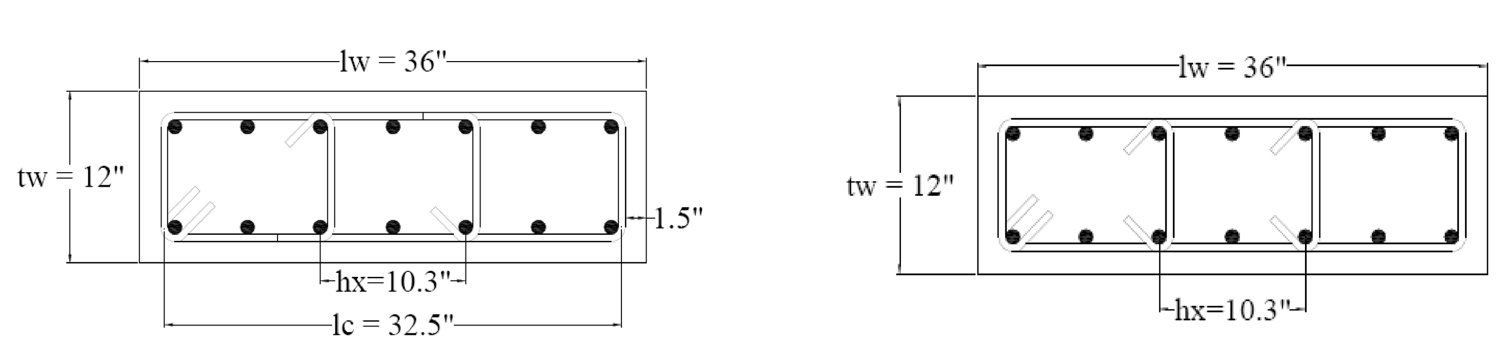

Figure 1. Reinforcement layout. a) 2012 Wall 3 b)2013 Wall 5.

2. RESEARCH MAIN PURPOSE

Evaluate current ACI 318 Building Code provision in order to approach an adequate reinforcement layout that is constructible and can provide the confinement necessary to achieve a ductile behavior desired during seismic events.

3. TEST SET UP

Displacements data collectors:

- 10 strain gages added to the longitudinal and transverse reinforcement.
- 14 external displacement transducers located at specifically levels of the walls.
- 4 displacement transducers located perpendicular to the specimen.
- Concrete strain gages attached along one face of walls.

Figure 2. stages in the instrumentation and set up process of Wall 5 test

4. RESULTS

- Wall 5 exhibited a stiffness very similar to the OpenSees models and resisted a maximum load of 2300 kips but did not continued to gain strength after yielding meaning a brittle failure.
- Wall 5 had a very similar behavior than the 2012 Wall 3 specimen. During the test, Wall 5 longitudinal rebar also buckled causing slow loss of confining force and producing the brittle failure.
- Before the peak, both specimens presented similar stiffness but right after yielding, Wall 5 showed a steeper slope while reducing strength.

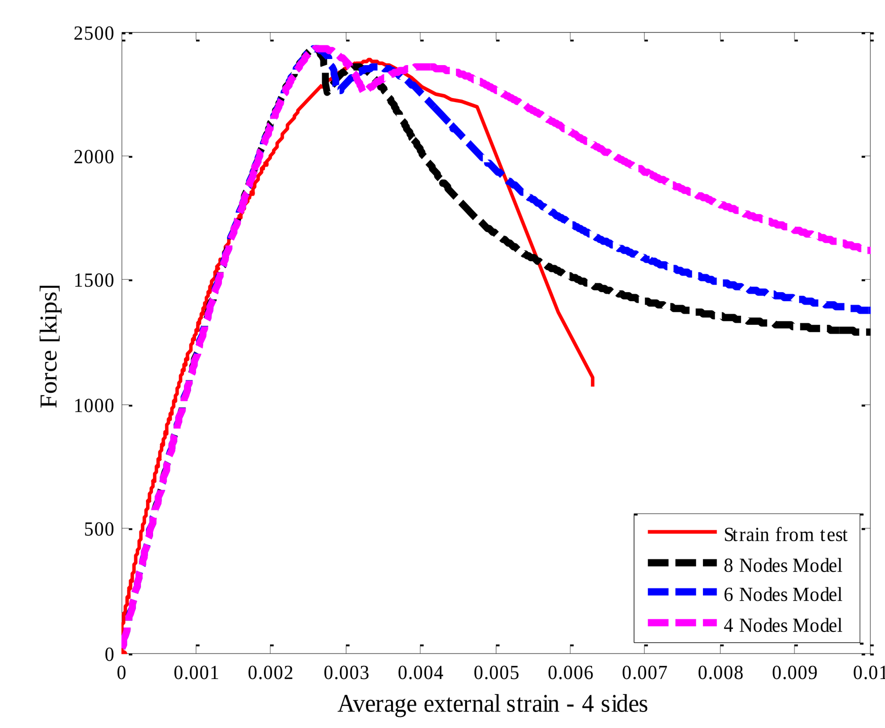

Figure 3. Comparison of Wall 5 predicted and actual testing results.

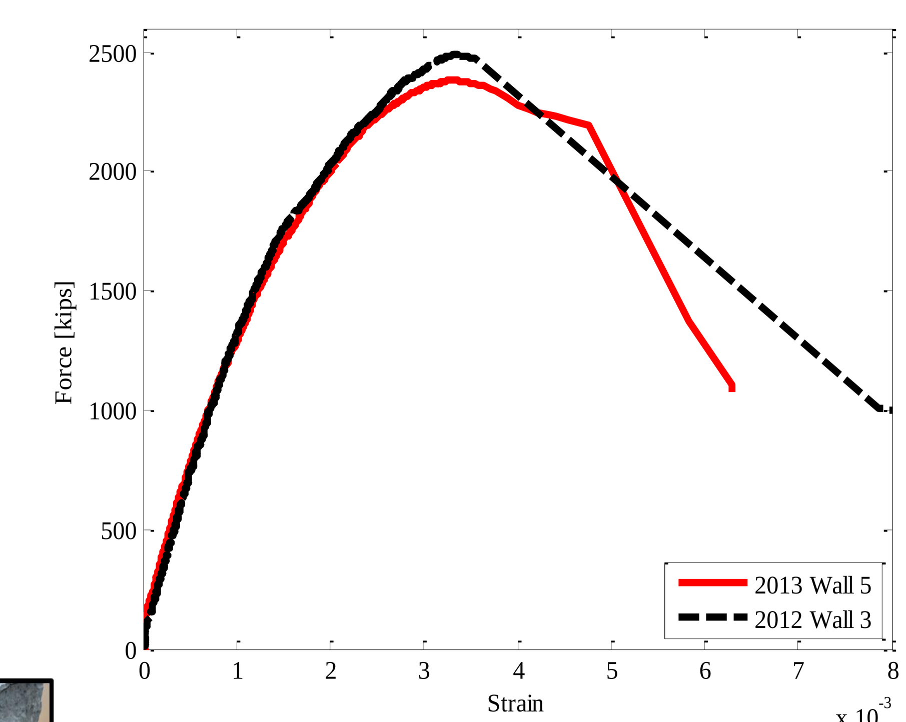

Figure 4. Comparison of 2012 Wall 3 and 2013 Wall 5 test results.

Figure 5. 2013 Wall 5 failure after being tested at NEES Laboratory in Richmond Field Station.

5. CONCLUSIONS

- Cross ties anchored with 135-degree hooks at both ends on the transverse reinforcement did not provide more confinement to the concrete core.
- The concrete core did not gained strength showing a brittle failure and so the walls tested did not have the ductile response desired according to the ACI 318 code standards.
- Further investigation needs to be done in order to find the adequate layout that can provide the confinement required in these type of structures and to improve the current code standards.

Acknowledgments

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