PERFORMANCE OF CONCRETE SHEAR WALL BOUNDARY ELEMENTS UNDER PURE COMPRESSION

PEER Internship Program – Summer 2013

Undergraduate Intern: Jorge Archbold, Universidad del Norte, Colombia.
Faculty Mentor: *Jack P. Moehle*, University of California Berkeley
Intern Mentor: Carlos Arteta, University of California Berkeley
Nees@Berkeley Lab – UC Berkeley

1. INTRODUCTION

Figure 1. *Wall failure after 2010 Chile Earthquake*

Reinforced concrete shear walls are one of the most widely used vertical elements to resist seismic forces around the world. Searching to optimize the design of this elements, engineers have produced walls with higher structural demands and thinner profiles. These walls are believed to be presenting an unconventional failure mechanism, which is the result of instability of boundary elements.
The behavior of this special type of walls has not been fully understood yet, therefore, a deeper study is necessary in order to generate new models to analyze and predict in a better way the performance of this walls and achieve an adequate ductile behavior.

2. MATERIALS AND METHODS

Two different specimens of boundary elements of reinforced concrete walls were tested under pure compression:

1. Each specimen was design to comply with the ACI-318 code standards.
2. The variables of interest were:
   - Vertical spacing between transversal reinforcement
   - Spacing of tied longitudinal reinforcement
   - Cross-tie orientation.
3. Each wall was compared to a numerical non-linear model created using the OpenSees software (McKenna et al, 2010).

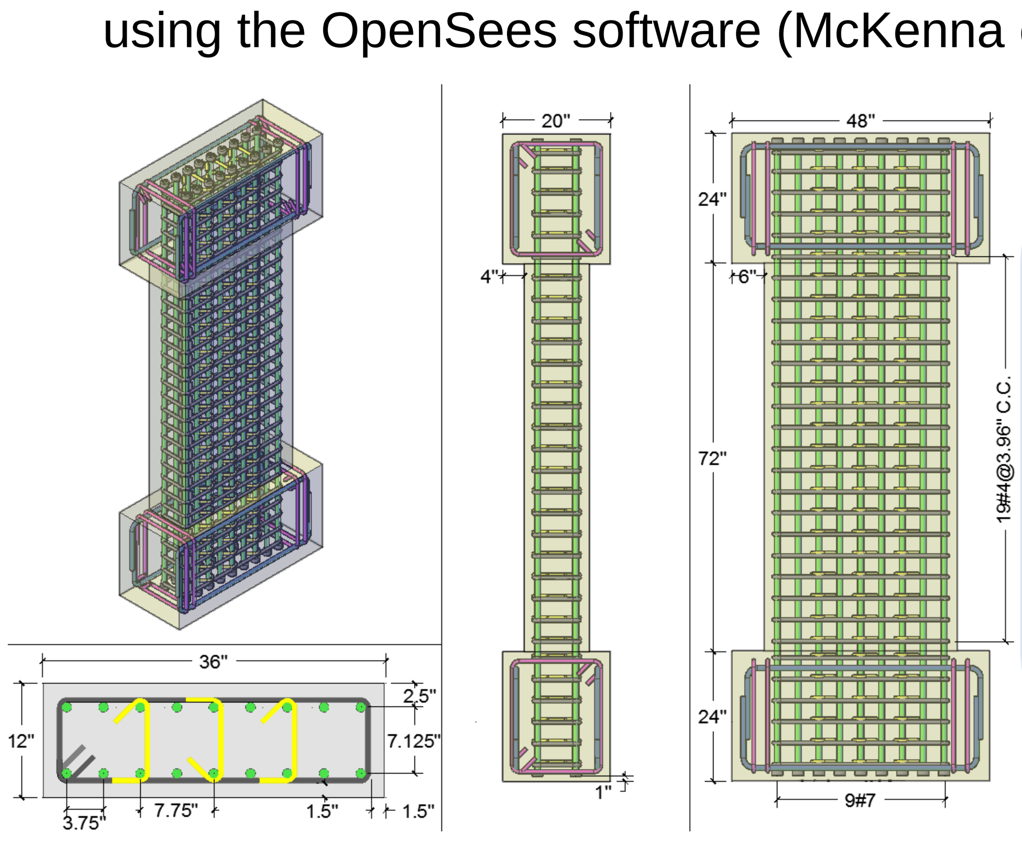

Figure 2. *Reinforcement layout.*

MATERIAL PROPERTIES:

Concrete
- Average $f'_c = 4.29\ ksi$.

Reinforcing Steel
- Average f_y= 67.86 ksi
- Average f_{su}=92.23 ksi
- Average ε_{su}=0.1676

INSTRUMENTATION USED:

- 10 Steel Strain Gages.
- 5 Concrete Strain Gages.
- 18 Displacement Transducers.
- 8 Wire Pots.

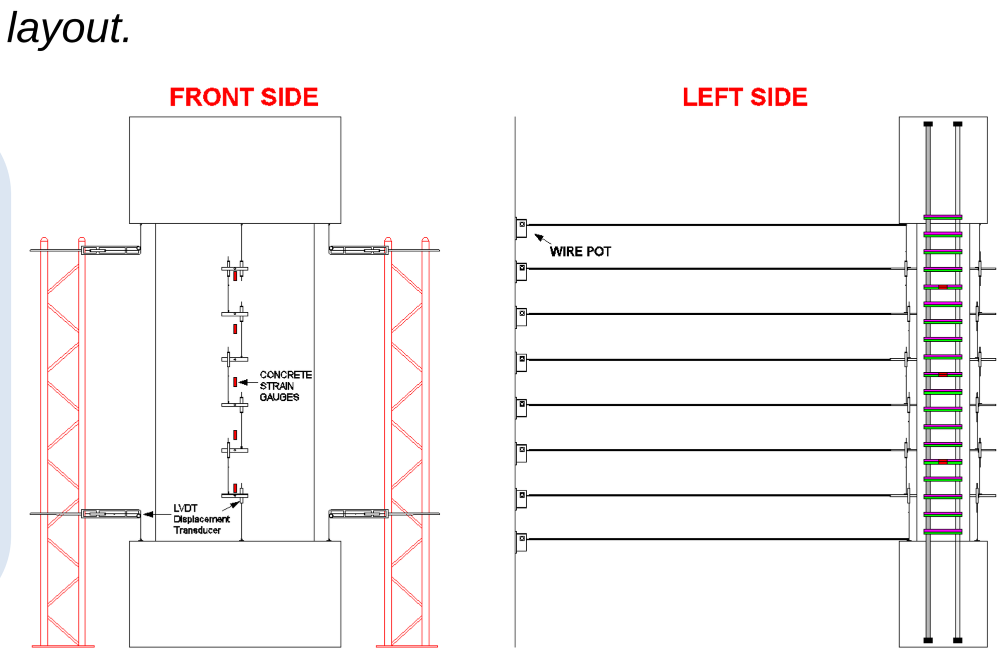

Figure 3. *Layout of the instrumentation used during testing.*

3. RESULTS

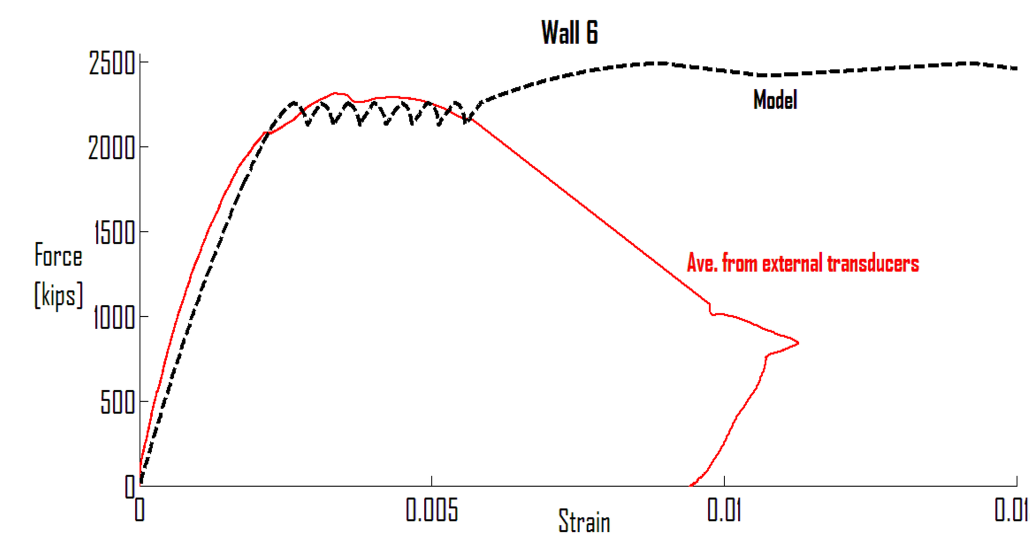

Figure 4*. Comparison of Structural response of Wall 6 and the predicted model.*

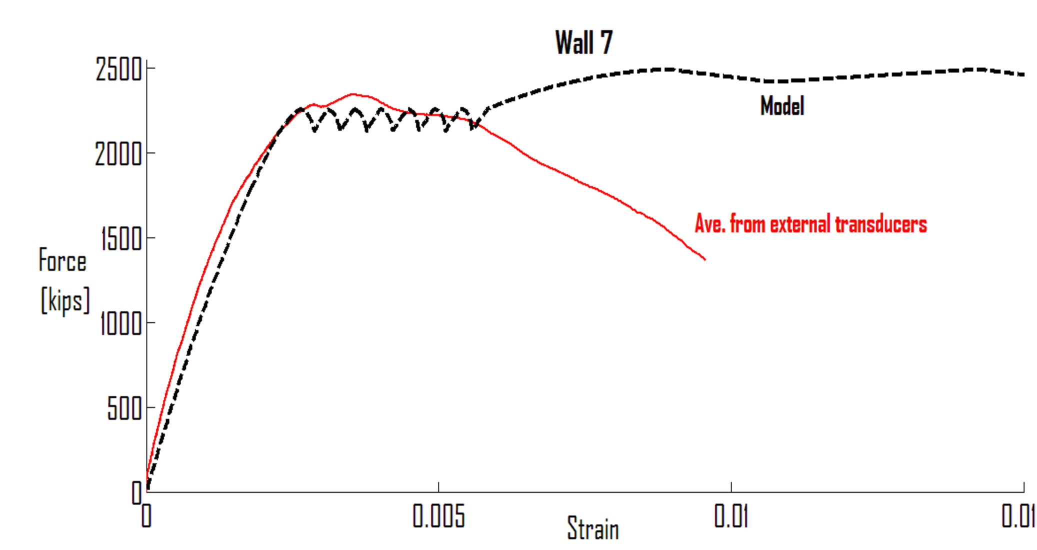

Figure 5*. Comparison of Structural response of Wall 7 and the predicted model.*

Figure 6*. Wall 7 after failure. Brittle failure can be attributed to buckling of the longitudinal rebar.*

FINDINGS:

- Wall 6 and Wall 7 reached a peak load of 2318 Kips and 2343 Kips, respectively.
- Both specimens presented similar behavior before the failure was reached.
- None of the specimens continued gaining strength, exhibiting a non-ductile performance.

4. CONCLUSIONS

- **ACI code does not provide correct design provision for this special type of shear walls.**
- **Cross-tie orientation within boundary elements does not appear to be a critical variable in order to achieve ductile performance.**
- **The problem, does not seems to be related to the vertical spacing between transversal reinforcement neither.**
- **Further research is needed in order to acquire a better understanding of the performance of this shear walls.**

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