INTERFACE STRENGTH BETWEEN ROUGHENED PRECAST COLUMN AND FOOTING

PEER Summer Internship Program 2013

Matt Brosman, University of Florida, mbrosman@ufl.edu

Faculty Mentors: Dr. Marc Eberhard and Dr. John Stanton

Graduate Mentors: Bryan Kennedy and Jeff Schaefer

BACKGROUND & MOTIVATION

The use of precast bridge elements is a major component of Accelerated Bridge Construction, a growing initiative to reduce construction-related delays and build bridges faster.[1]

A new precast column with a socket-type connection that performs well seismically has been developed at the University of Washington.[2] Precast columns are erected on-site, and the footing is then cast in place.

Figure 1: Current roughening detail

The current method of roughening (Fig. 1) is costly and difficult to reproduce. A new method of roughening using in-form concrete retarders has been proposed (Fig. 2):

Figure 2: Proposed roughening detail

1. The retarder is painted on the form where needed
2. Concrete is poured and allowed to set
3. An outer layer of cement paste remains soft, and can be brushed off
4. Coarse aggregate is exposed, creating a rough exposed aggregate surface
5. Footing can now be cast around the precast roughened column

TESTING PROTOCOL

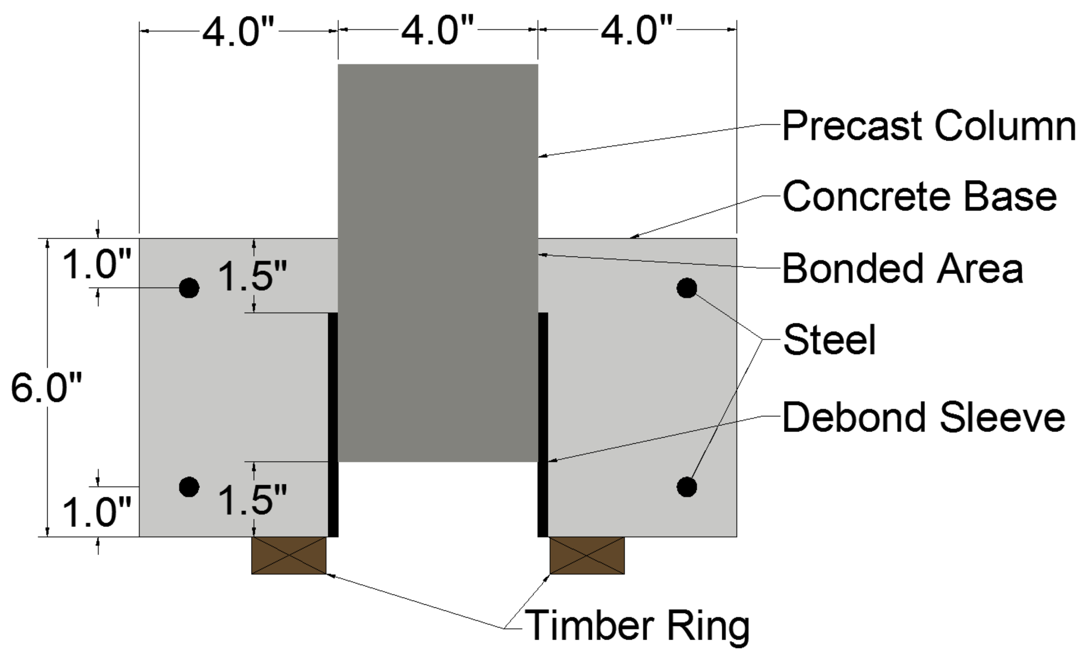

Figure 3: Model of specimen

Figure 4: Specimen prior to casting

- Six different finishes/construction methods were tested
- Mechanically roughened specimens made using caulk and plastic wire
- Multiple bond areas, steel configurations, and support conditions were examined
- Instrumented with two linear potentiometers and load cell
- Loaded axially to a displacement of 1 in.
- Shear strength normalized by $\sqrt{f'_c}$ of base concrete

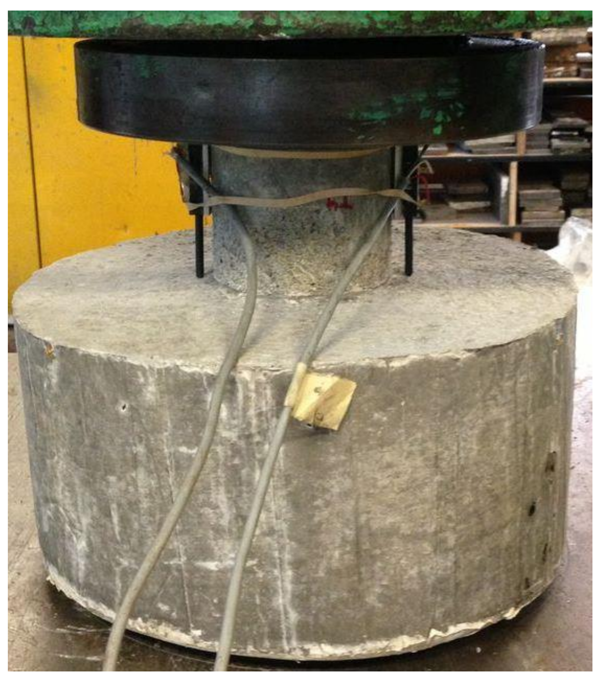

Figure 5: Specimen prior to testing

RESULTS

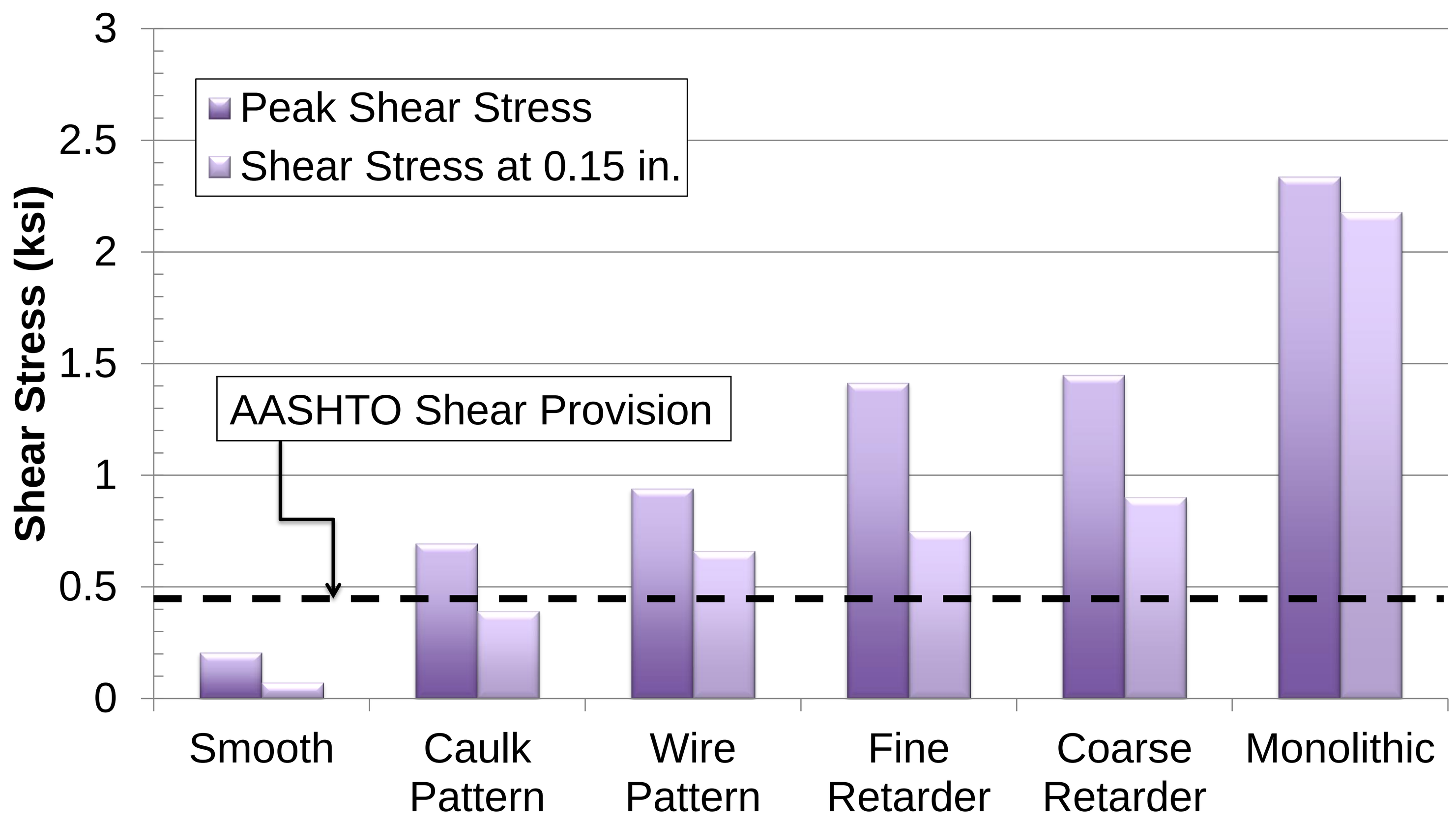

Figure 6: Comparison of shear stresses of different specimen types to each other and AASHTO Shear Provision (normalized to f'_c = 2.5 ksi)

1. Retarders stronger than mechanical
2. Brittle response at peak shear stress
3. Doubled bonded area ≠ doubled load capacity
4. Top steel needed for confinement
5. All rougheners satisfy AASHTO

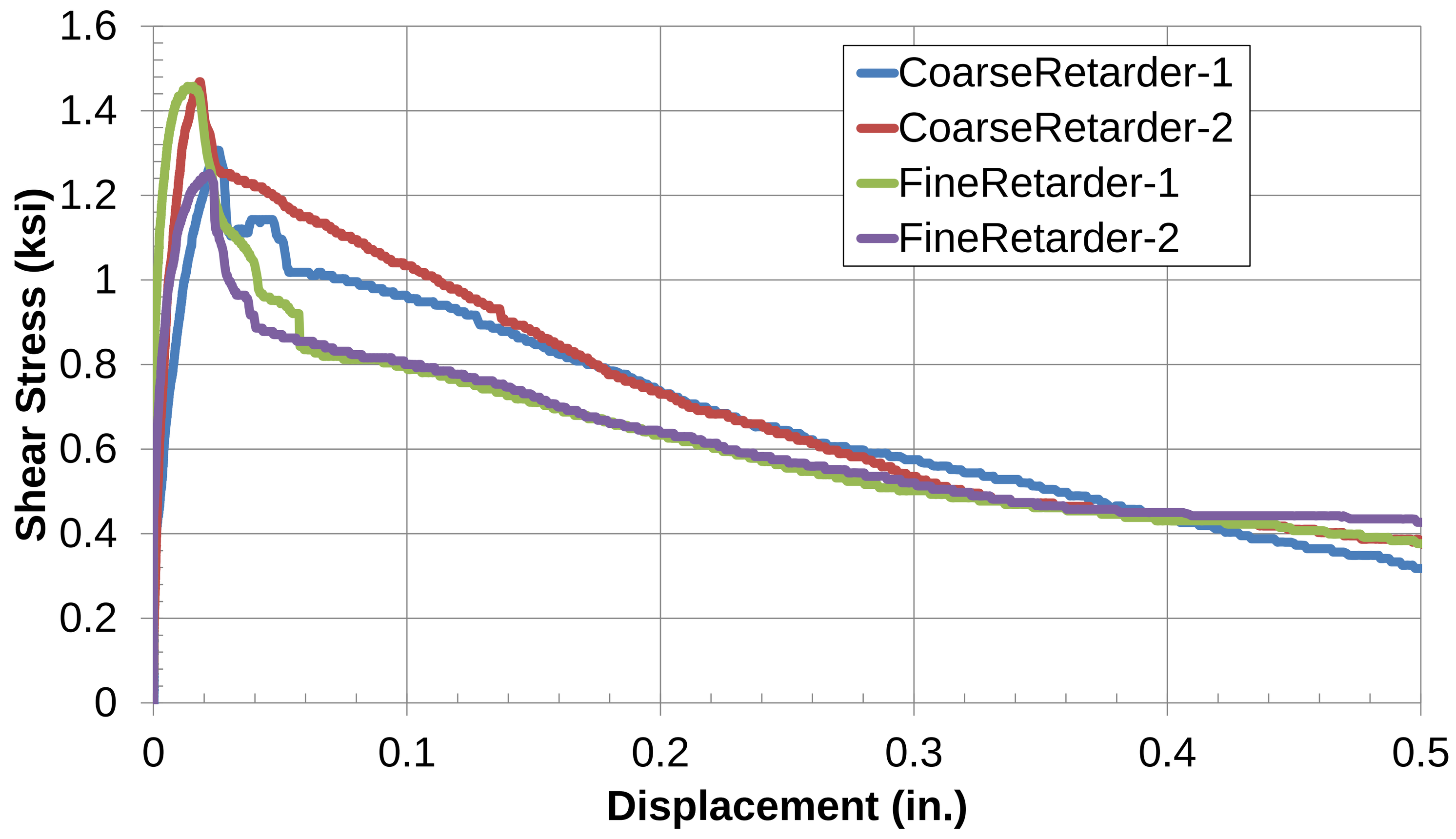

Figure 7: Example of data output. Note how groups of identical samples (red and blue, and green and purple) behave similarly after ~0.1 in.

CONCLUSIONS

- Chemical retarder applications were effective and easy to implement
- Smooth columns don't provide adequate shear resistance
- Mechanical roughening specimens were difficult to scale due to aggregate size and geometric restrictions
- More testing needs to be done at a larger scale

ACKNOWLEDGEMENTS

Thank you to PEER and the NSF for providing me funding and allowing me the opportunity to perform this research. I would also like to thank my graduate mentors, Bryan Kennedy and Jeff Schaefer, as well as my faculty mentors, Marc Eberhard and John Stanton, for their daily support and guidance. Thank you to Travis Thonstad for assisting with instrumentation and Spencer Livermore for assisting with materials testing. Thank you to Heidi Tremayne for organizing and managing the summer program. Finally, a very special thank you to David Lam, my research partner, without whom this research would not have been possible.

1 Khaleghi, B. (2010). "Washington State Department of Transportation Plan for Accelerated Bridge Construction." *Transportation Research Record: Journal of the Transportation Research Board*, 2200, 3-11.
2 Haraldsson, O. (2013). "Seismic Resistance of Socket Connection between Footing and Precast Column." *Journal of Bridge Engineering*, 18(9)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

PEER Internship Program: UC Berkeley ▪ City of San Francisco ▪ UC Davis ▪ U Washington

The PEER Internship Program is funded from a REU Site Award from the National Science Foundation.
More information can be found at http://peer.berkeley.edu/education/internships.html

PEER