January 2016 ABC-UTC Graduate Student Seminar: Novel Bridge Column Connections for Use in ABC

Q&A Session

Featured Presentation #1 by Mostafa Tazarv, Ph.D.: Application of Advanced Materials and New Detailing for ABC Column Connections	
Indicate cases when you model these materials /structures in finite elment analysis modeling.	Please refer to Ch 6 and 7 of : Tazarv, M. and Saiidi, M.S. (2014) "Next Generation of Bridge Columns for Accelerated Bridge Construction in High Seismic Zones," Center For Civil Engineering Earthquake Research, Department of Civil and Environmental Engineering, University of Nevada, Reno, Nevada, Report No. CCEER-14-06, 400 pp. http://wolfweb.unr.edu/homepage/saiidi/caltrans/NextGen/PDFs/CCEER-14-06-Tazarv-Saiidi.pdf
Application to high seismic areas.	A bridge was built in Seattle using SMA and ECC.
What have you provided for corrosion resistance?	Corrosion of advanced materials is usually better than the conventional materials. In the case of couplers, code minimum cover requirements should be met.
Can plastic hinge form in the region that coupler is located with heavy confinement reinforcement? Is there any difference between the type of plastic hinge that forms in a given region of column with or without coupler?	Yes. Couplers reduce the displacement capacities but plastic hinge will form. An equation was developed to modify the plastic hinge of columns with couplers. Please refer to: Tazarv, M. and Saiidi, M.S. (2016) "Seismic Design of Bridge Columns Incorporating Mechanical Bar Splices in Plastic Hinge Regions," Engineering Structures, DOI: 10.1016/j.engstruct.2016.06.041, Vol. 124, pp. 507-520.
What problems have contractors reported, if any, when using pocket type connection?	A survey of State DOTs showed that the quality of grout as well as the flow in pocket connections need special care.
When using pocket type connection some of the reinforcements in the cap beam have to be pushed to side and bars are bundled. What challenges does this create in the field?	Special care should be on the minimum spacing of reinforcement, bar bundling requirements, and the grout flow.
What is the most popular connection type in ABC application to connect the column to cap beam in seismic regions?	Based on a survey of State DOTs, mechanical splices, grouted duct, and Pocket/socket connections are the most common type for ABC column connections.

If damage is above or below coupler then plastic hinge does not form in the coupler area?	Yes, based on the mechanical properties of the coupler, the length of plastic hinge may reduce. Please refer to: Tazarv, M. and Saiidi, M.S. (2016) "Seismic Design of Bridge Columns Incorporating Mechanical Bar Splices in Plastic Hinge Regions," Engineering Structures, DOI: 10.1016/j.engstruct.2016.06.041, Vol. 124, pp. 507-520.
Featured Presentation #2 by Ali Mehrsoroush, Ph.D.: Earthquake-Resistant Precast Pin and Moment Bridge Column Connections	
Indicate cases when you model these materials /structures in finite elment analysis modeling.	Analytical studies of the pipe pins under lateral loading and direct tension were conducted using ABAQUS to determine the validity of the modeling assumptions based on the correlation between the experimental and analytical results. To understand and quantify the effects of key parameters on the behavior, capacity, and failure mode of pipe pins, a comprehensive parametric study was conducted using the validated FE model. More information is available *Mehrsoroush and Saiidi (2014). *Mehrsoroush, A., & Saiidi, M. (2014). *Experimental and Analytical Seismic Studies of Bridge Piers with Innovative Pipe Pin Column-Footing Connections and Precast Cap Beams* (Report No. CCEER-14-07). Reno, NV: Center for Civil Engineering Earthquake Research, Department of Civil and Environmental Engineering, University of Nevada, Reno. (http://wolfweb.unr.edu/homepage/saiidi/caltrans/BasePins/PDFs/CA14-2281-Ali%20Mehrsoroush.pdf)
Application to high seismic areas.	Top pipe pin connections have already been implemented in several bridge structures in California, including the approach ramps of the replacement of the San Francisco-Oakland Bay Bridge and selected pier columns of the new Benicia Martinez Bridge. However, the base pipe pins are yet to be used in practice.
Can this study be extended to pier walls or is it only for columns?	Yes, this study can be expanded to pier walls. In an early study, *Frosch (1999) used pipes in wall panels to transfer shear between concrete elements. *Frosch, R. J. (1999). Shear transfer between concrete elements using steel pipe connection. *Structural Journal* , 96(6), 1003-1008.

When using pipe connection how do you dissipate the input seismic energy along traffic direction?	The seismic energy is dissipated mainly at the plastic hinge region of columns. However, impact of the pipes, friction at column-footing interface, and elongation of tension member in pipe pins contribute slightly to the overall energy dissipation of the system. More information can be found in *Mehrsoroush and Saiidi (2016). *Mehrsoroush, A., & Saiidi, M. S. (2016). Cyclic Response of Precast Bridge Piers with Novel Column-Base Pipe Pins and Pocket Cap Beam Connections. *Journal of Bridge Engineering* , 21(4), 04015080.
When using pocket connection in practice, do you have to change the dimensions of the cap beam because of using pocket connection versus other ABC connection types?	There are six different types of pocket connections (*Tazarv and Saiidi 2015). In the case that column is constructed as a precast member and extended into the pocket, the cap beam bottom reinforcements should be clustered to the sides. Therefore, width of the cap beam needs to be increased slightly to meet the code requirements for spacing of longitudinal bars. *Tazarv, M. and Saiidi, M.S. (2014). *Design and Construction of Precast Bent Caps with Pocket Connections for High Seismic Regions* (Report No. CCEER-15-06). Reno, NV: Center for Civil Engineering Earthquake Research, Department of Civil and Environmental Engineering, University of Nevada, Reno. (http://wolfweb.unr.edu/homepage/saiidi/USDOT/PDFs/CCEER-15-06-TazarvSaiidiCapBeamPockets-01-20-2016.pdf)
Axial compression load can reduce the ductility. Could you elaborate effect of not applying axial compression load during your two column test?	To investigate the behavior of the pipe pins under simultaneous tension and shear and to allow them to undergo uplift forces, no external vertical loads were applied on the pier cap. The bent model achieved a displacement ductility of nine, which was far beyond the code requirements. Because columns were pinned at the base, increasing the axial load on the columns could not significantly affect the displacement ductility capacity of the bent.
Is there any disadvantages in using pipe pin connection?	No, there is not. Contrary to conventional rebar hinges used widely in practice, base pipes are designed as capacity protected elements to remain elastic and damage-free during seismic events. Moreover, the level of transferred moment to footing is substantially smaller than that of rebar hinges, which accordingly reduces the costs.
Where do you form plastic hinge when using pipe pin connection?	Due to stability, once pipe pins are incorporated at one end of bridge columns, the other end should be linked to adjoining member using rigid connections.