

June 2016 ABC-UTC Webinar Featured Presentation: Concrete Filled Steel Tube Bridge Pier Connections - An ABC Solution

Q&A Session: Questions	Responses
Design and Implementation	
What are the ideal circumstances for using a CFT? What is a typical design life?	CFT columns could be used for any ABC applications. CFT piles and shaft could be used for any project that permanent casing is allowed.
Are CFTs intended for new construction or can they be used for rehabbed/retrofitted structures?	WSDOT is considering CFT mainly for new structures. The concept could apply as a retrofit, but there may be challenges bonding the steel casing and anchoring it in connected elements such as pier caps.
What codes are referenced? Will the presentation be available for download?	AASHTO LRFD and UW Recommended specification could be downloaded from WSDOT BDM site. The presentation is available through FIU-ABC center website.
How does thermal expansion/contraction affect failure modes? Local buckling? Others too...	The steel casing should be sized to preclude local buckling at the applicable limit states. Slenderness criteria are published in the WSDOT Bridge Design Manual.
What are the minimum tolerances that you have to provide at the steel tube and the beam cap connection?	Construction tolerances should be the same as similar conventional reinforced concrete construction, such as column, piles and drilled shafts. They may vary by location, so designers should base the design on established local practices.
Construction/materials/specifications	
How to assure steel tube to fully filled by concrete? Unfilled cavity will reduce the threshold of stability for the tube	Flowable mixes are used for substructure elements in combination with non-destructive testing in wet conditions. Concrete placement work is similar to other reinforced concrete shafts and columns, except the rebar cage is omitted.
What if any thing is done to ensure composite action? Any use of low/non shrink concrete?	Provisions can be made for Cross Hole Sonic testing. Dynamic Impact Testing can be performed. Self-Consolidating Concretes free fall
Long Term Durability/Performance	
In seismic regions, these connections suppose to last the useful life of the bridge?	Yes, though exposed steel tubes require preservation measures similar to structural steel. Protective coatings and/or sacrificial steel thickness are possible measures to ensure durability.
corrosion life?	Corrosion above ground can be mitigated like any other structural steel. WSDOT would mitigate corrosion below ground and/or below water with the use of a sacrificial steel thickness. Assumed corrosion rates are available in Chapter 7 of the WSDOT Bridge Design Manual.
Just from looking at the pictures, is there any possibility of galvanic corrosion between the rebar and the steel pier?	Metalizing splash zones is an economical strategy. Intrinsic benefit of metalizing is that aquatic biological growth is prevented.
Durability of steel piles in contact with water	Corrosion above ground can be mitigated like any other structural steel. WSDOT would mitigate corrosion below ground and/or below water with the use of a sacrificial steel thickness. Assumed corrosion rates are available in Chapter 7 of the WSDOT Bridge Design Manual.
Costs	
what is the unit cost for material and installation for piers	Please see WSDOT BDM
How does the cost (material and construction) compared with the conventional RC columns?	CFT cost is similar or slightly higher than the cost of RC columns.
Please share any cost data that you can.	Please send a request with specific questions on cost data.

Questions during webinar and Q&A Session	Responses
Is there concern about the rusting away of the steel over time and the loss of capacity.	Corrosion above ground can be mitigated like any other structural steel. WSDOT would mitigate corrosion below ground and/or below water with the use of a sacrificial steel thickness. Assumed corrosion rates are available in Chapter 7 of the WSDOT Bridge Design Manual.
Is there any concern for corrosive soils corroding the concrete and if so can this be prevented. Is there soil corrosiveness testing done and if so what type of testing prior to selection of this method of piling.	CFT may not be the best option if highly corrosive soils are known or suspected to exist. Soil can be tested for pH, chlorides, and groundwater variation. But soil corrosion rates are difficult to predict.
How is corrosion considered into design?	Corrosion above ground can be mitigated like any other structural steel. WSDOT would mitigate corrosion below ground and/or below water with the use of a sacrificial steel thickness. Assumed corrosion rates are available in Chapter 7 of the WSDOT Bridge Design Manual.
What is the design concrete cover for the cage?	Where steel casing is present, the concrete cover to rebar can be as small as constructable. WSDOT would use 1.5" where vibrated concrete is placed above ground, and 3" - 6" for unvibrated concrete placed below ground.
How is bond between shell and foundation or cap satisfy anchorage?	Not sure of the question!
Could a carbon fiber tube be used in place of a steel tube? We are achieving positive applications utilizing the carbon fiber materials.	Carbon fiber or similar could be used. This project was focused on steel tube only.
How can rebar be reduced without mechanical bond to casing?	Not sure of the question!
Can the steel for the tube be procured with improved corrosion resistant properties, similar to weathering steel?	Check with local pipe suppliers. Plate and coil used to fabricate pipe and casing can presumably be supplied in accordance with many structural material specifications. Typical weathering steel is intended to reduce atmospheric corrosion, but these materials may not be suitable for soil corrosion of buried elements.
Are transverse hoops or spiral inside the long bars?	They are typically detailed outside the longitudinal bars, but they could be detailed inside to accommodate cage fabrication preferences.
Are ties and hoops tied to long bars?	Yes, but they are only necessary for construction and placement of the reinforcing cage.
For such a short connection, is extra confinement required in the cap and foundation around the connection?	Embedded flange connections require a pier cap width of twice the CFT diameter to anchor the connection. The welded dowel concept can be used to reduce the width of a pier cap.
Is the embedded ring fabricated from bar stock that's been curved, flame cut to shape from a flat plate or some other method?	WSDOT has not specified the method of fabrication. But flame/plasma cutting to shape would seem like an economical option.
Are the results of this study available to the public?	Yes. Through WSDOT Research publications WA-RD
Can the bar heads be supplied by threaded or lapped pieces?	Yes it could, but was not tested in this research.
How was the debonding of the dowels achieved?	Not sure of the question!
Are cages supplied with additional reinforcement in regions of ductility?	No. Nothing additional in the ductility regions.
Where the rebar is welded to inside of the steel tube is there a minimum tube diameter to use for ease of access to perform/inspect the weld?	This is an important issue, but it may need to be addressed by local fabricators. WSDOT has not established a lower limit.
For the comparison of the 72" RC column and 42" CFT column P-M diagrams, it appears that the CFT column has less capacity than the RC column. What was the capacity required for the column?	Please send a request WSDOT Bridge Office.
How do you inspect the CFST pier / columns for future inspection ?	CFST will be inspected similar to steel columns for paint and corrosion. The concrete inside the CFST need not be inspected. WSDOT for long time have used this concept for concrete column retrofit with steel jacketing.

Where can I find the research / design recommendations in paper / document format ?	Research and design information could be downloaded from the references shown in the last slide. Please send a request for more information.
Can CFTs be considered a practical alternative in low-seismic regions?	Yes, many of the possible benefits of CFT construction are not tied to seismic performance.
Have you provided any type of pile protection on the steel tubes in marine environments? If so, what is recommended?	WSDOT has not specified protection other than a sacrificial steel thickness. There are projects under way with Wasington State Ferries (WSF) where the design relies on the combination of a single application of paint under construction, and a sacrificial steel thickness designed for the remaining service life.
Are the environmental conditions taken into account in determining thickness of the tubes?	Corrosion is always considered. Abrasion may also need to be considered in some cases.
What do you assume for corrosion allowance on the CFT in marine locations?	Corrosion allowances depend on the location of the CFT. Assumed corrosion rates can be found in chapter 7 of the WSDOT Bridge Design Manual.
Interested in the fatigue resistance of welded embedded ring for cyclic loading from normal live loads fatigue cycles and seismic.	Fatigue resistance was studied in this research. It could be downloaded from the research reports. Please check the last slide for references.
UHPC in the connection?	That was not considered in this research. The idea has been discussed and could be the basis for future research.
What type of finish is used on the CFT columns?	WSDOT has not used coatings since most installations have been below ground. But certainly any number of coatings could be used depending on corrosion and aesthetic needs.
What is the benefit of the rebar welded connection? It is not obvious why one would choose this option.	Embedded flange connections require a pier cap width of twice the CFT diameter to anchor the connection. The welded dowel concept can be used to reduce the width of a pier cap.
Why using the reinforcement in the CFT at all?	Reinforcement allows easier connections to some reinforced concrete elements. And it give's the designer an ability to optimize the flexural strength of a CFT a long the length of a member.
Thanks for answering my question. Didn't see the 'axial load' dashed line down there	will be added for clarity.
CFT connection at top and bottom of column has more or less drift or deflection due to EQ forces?	The drift is related to the ductility. For a similar cases the dirft of CFT and RC columns are similar.
Awesome! I would like to see the presentation in full later when I have time to watch!	Thanks
WOW Excellent presentation.... I hope FIU put it in the website very soon... Cheers	Thanks - All presentations are available through FIU website