SOME RECENT RESEARCH ON CONCRETE FILLED STAINLESS STEEL TUBUALR (CFSST) STRUCTURES

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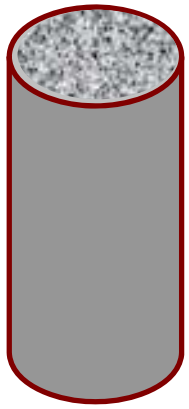
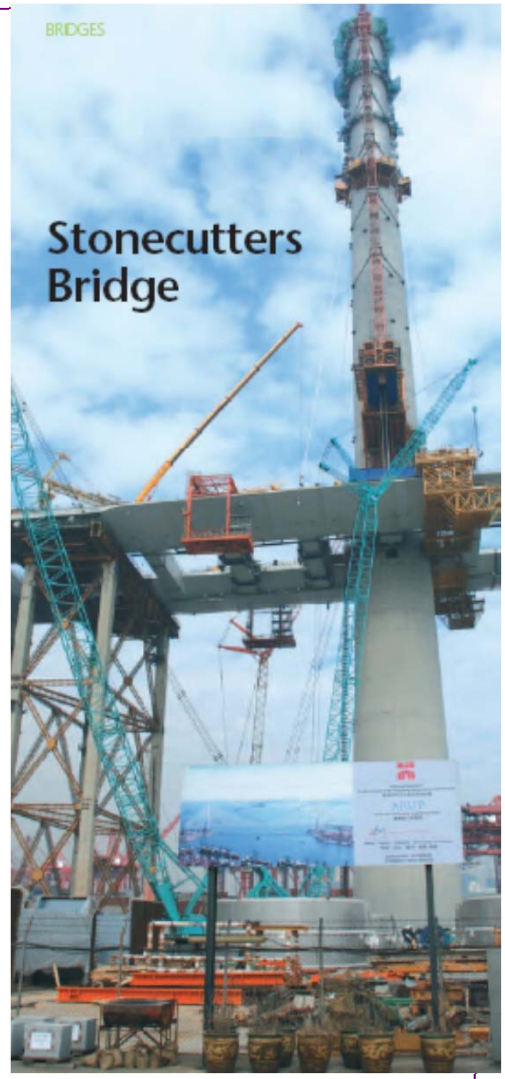
OUTLINE

1. Bond behaviour
2. Static behaviour
3. Cyclic behaviour
4. Fire performance
5. CFSST column-to-beam joints
6. Conclusions

CFSST

- Corrosion-resistant
- Aesthetic appealing
- High-ductility
- Impact resistance
- Fire resistance





Bond behaviour

Surface roughness measurement

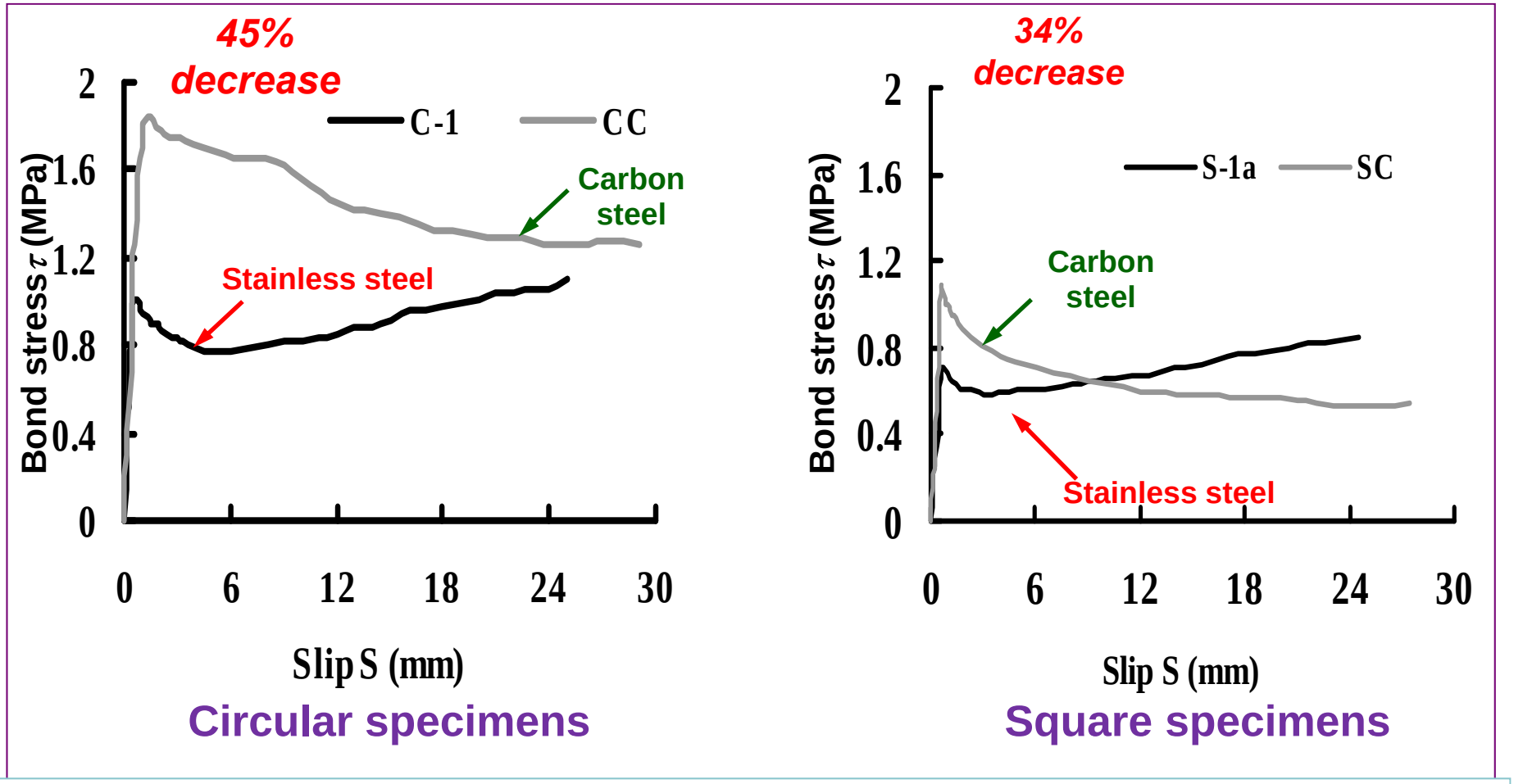
Circular CS **Square CS**

R_a=8.56 μm **R_a=4.77 μm**

Circular SS **Square SS**

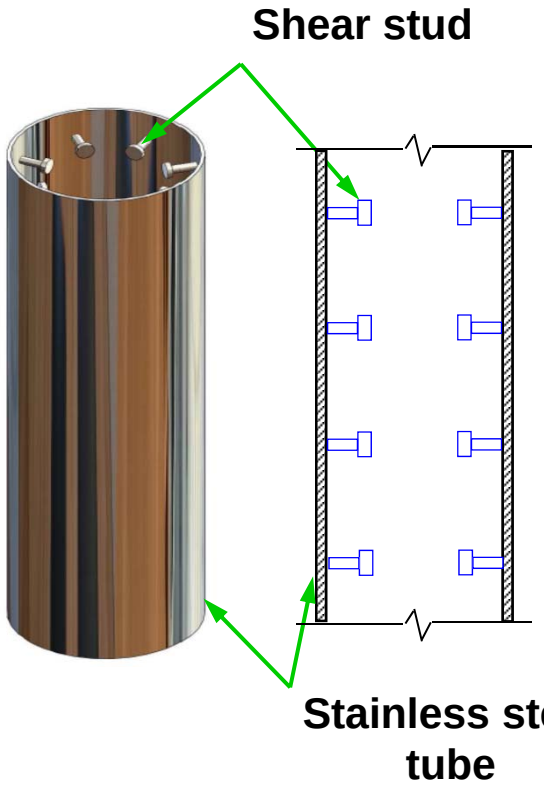
R_a=0.93 μm **R_a=2.6 μm**

Bond behaviour

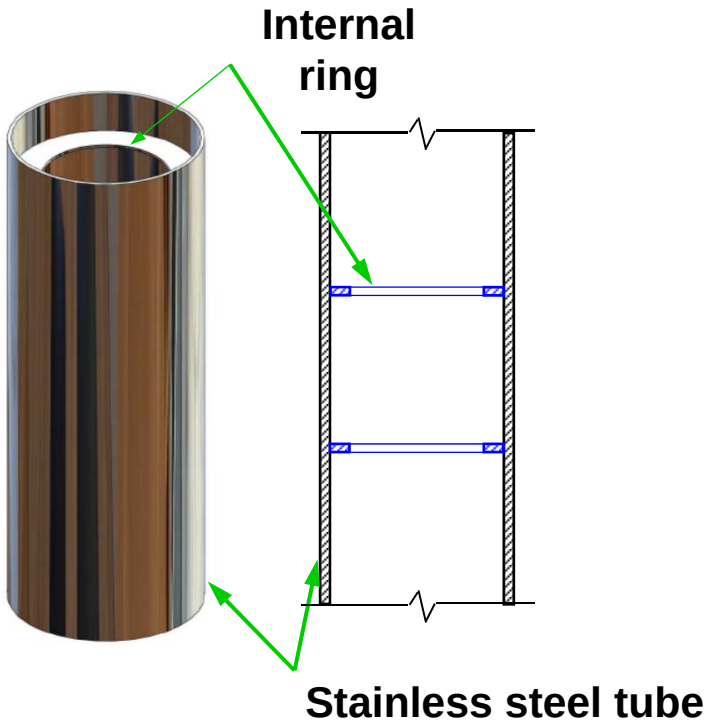


- Tao Z, Song TY, Uy B, Han LH . Bond behavior in concrete-filled steel tubes. Journal of Constructional Steel Research, 2016
- Song TY, Tao Z, Han LH, Uy B . Bond behavior of concrete-filled steel tubes at elevated temperatures. Journal of Structural Engineering ASCE, 2017.

Bond behaviour



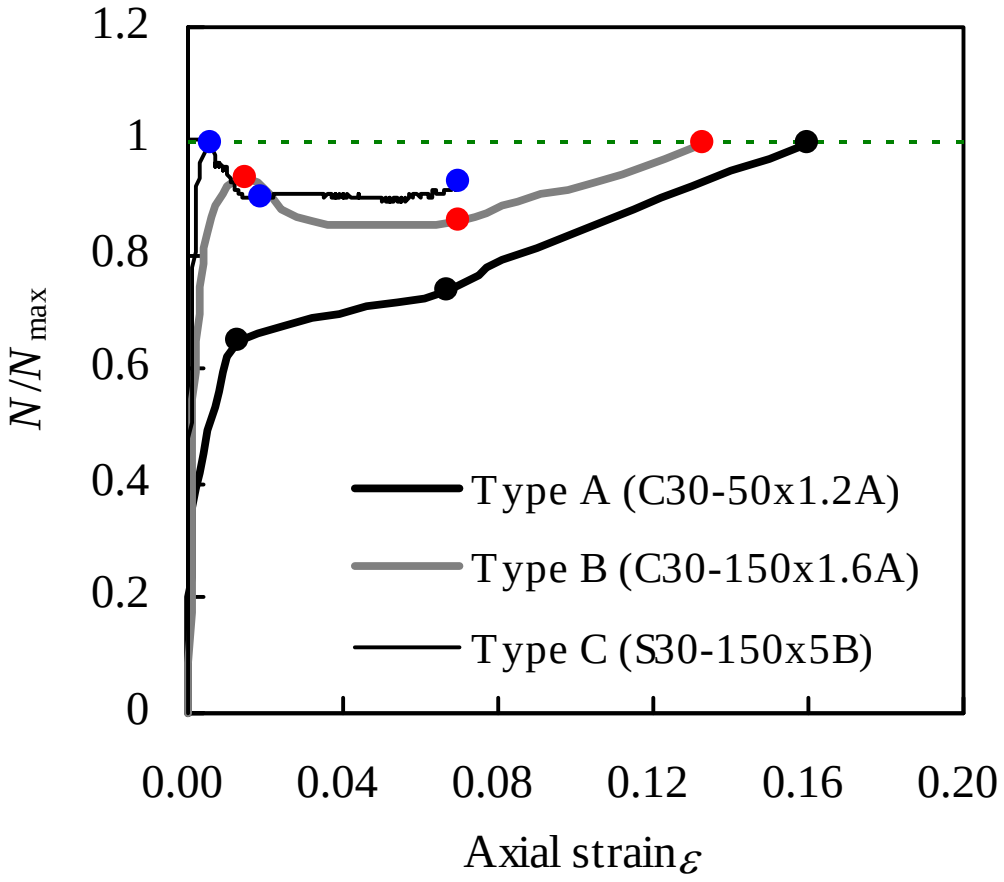
Shear studs



Internal rings

Static behaviour

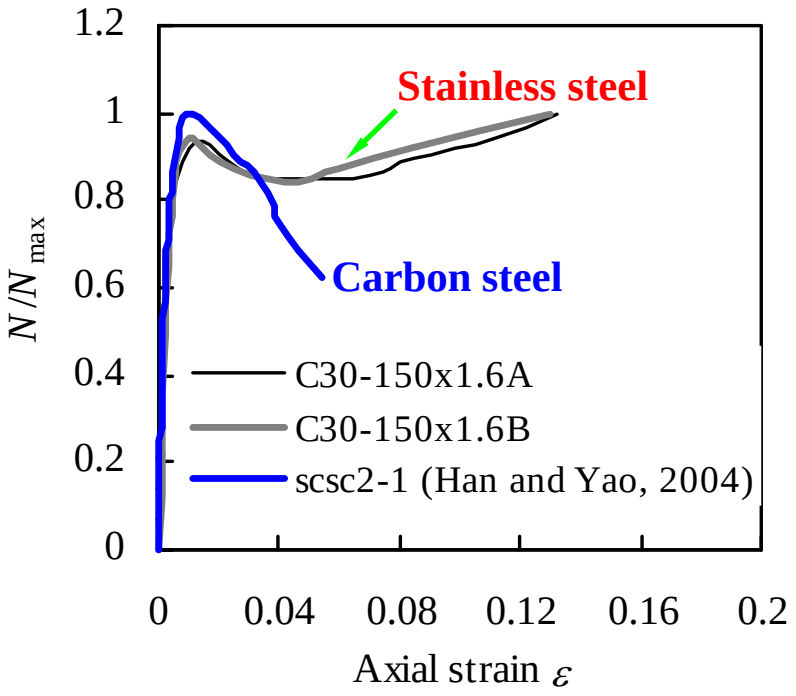
N-ε curves for stub columns



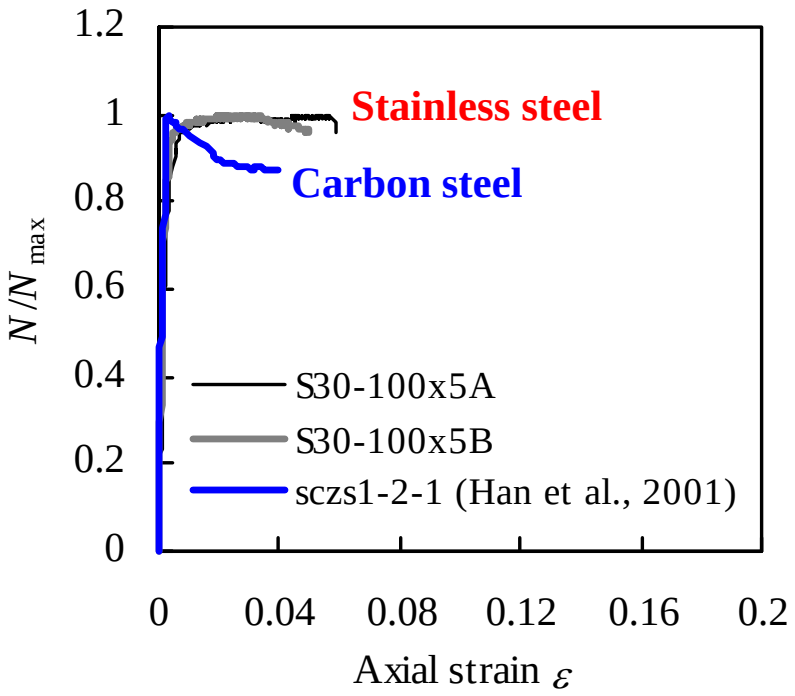
- Uy B, Tao Z, Han LH. Behaviour of short and slender concrete-filled stainless steel tubular columns. Journal of Constructional Steel Research, 2011

Static behaviour

Comparison between carbon and stainless steel

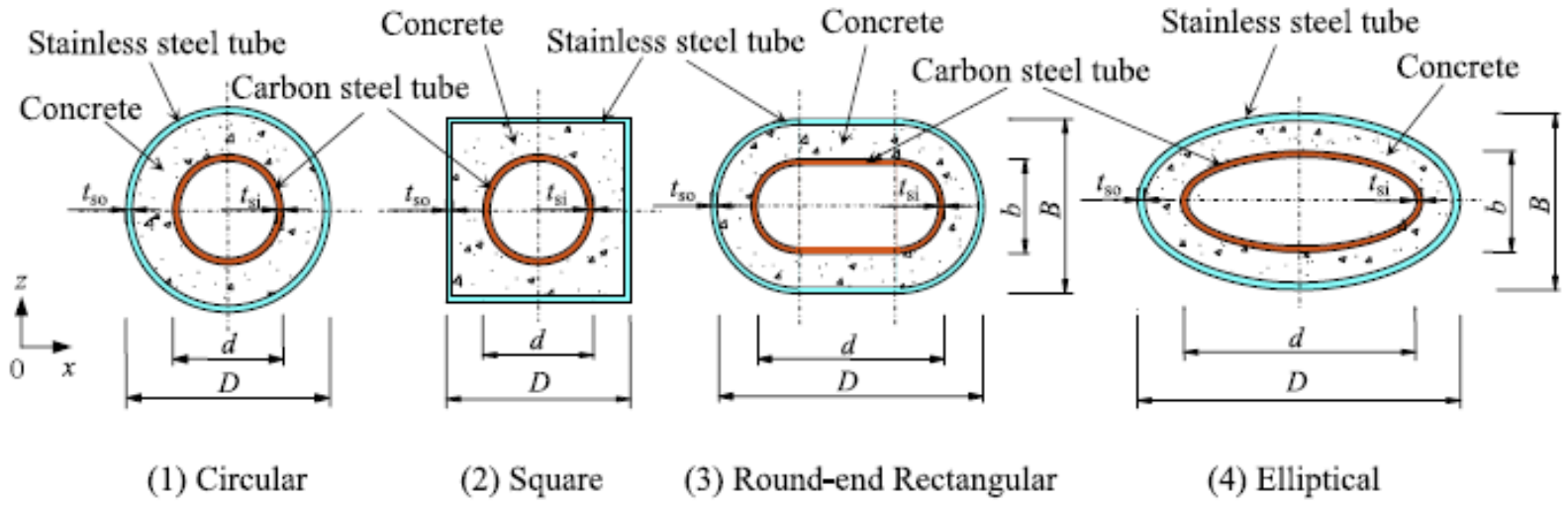


Circular CFST



Square CFST

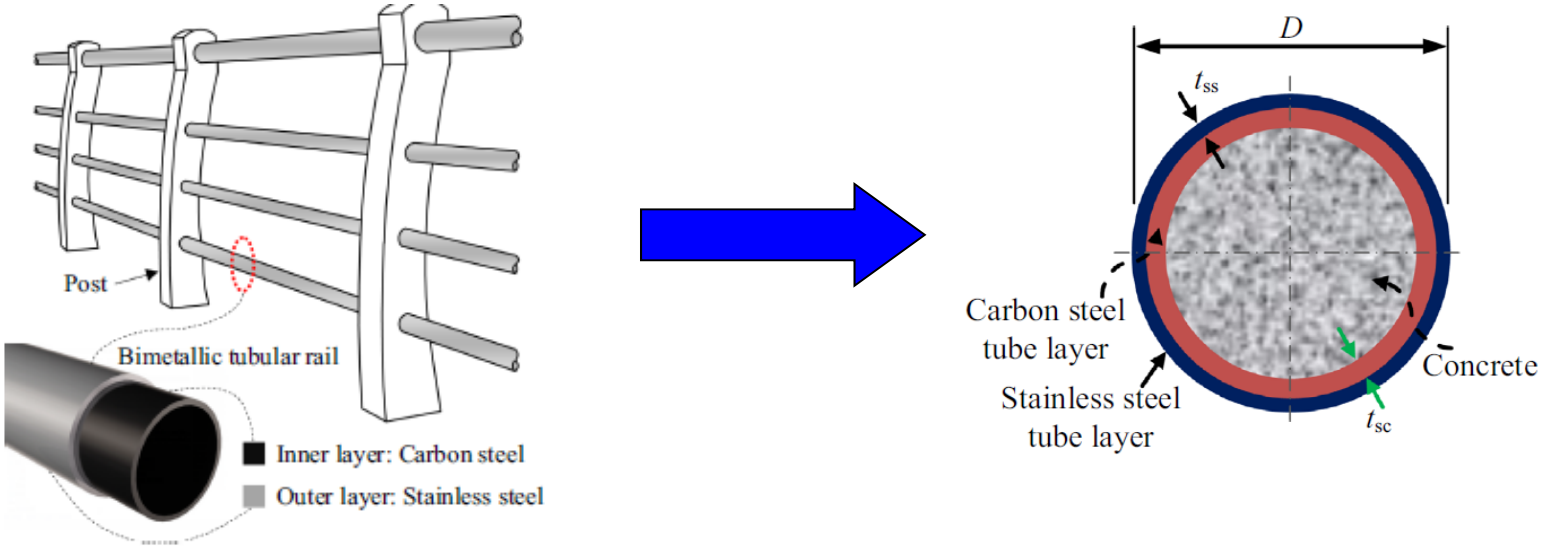
Innovative stainless steel composite columns



Stainless steel-concrete-carbon steel DST sections

◆ Han LH, Ren QX, Li W. Tests on stub stainless steel-concrete-carbon steel double-skin tubular (DST) columns. Journal of Constructional Steel Research, 2011.

Innovative stainless steel composite columns

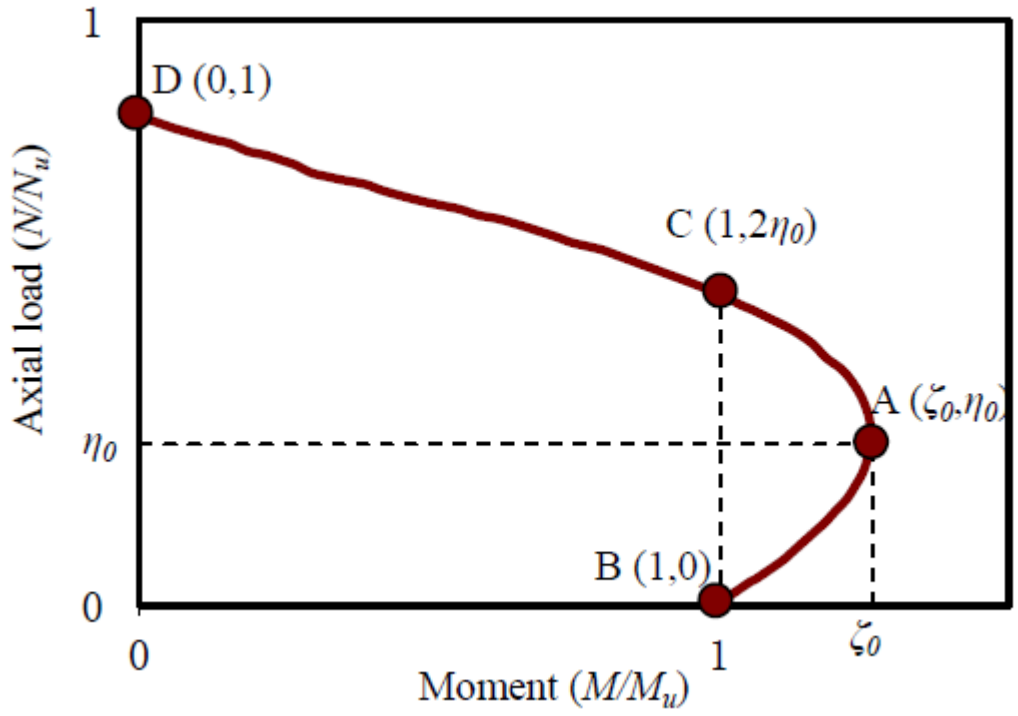


Concrete-filled bimetallic tubes

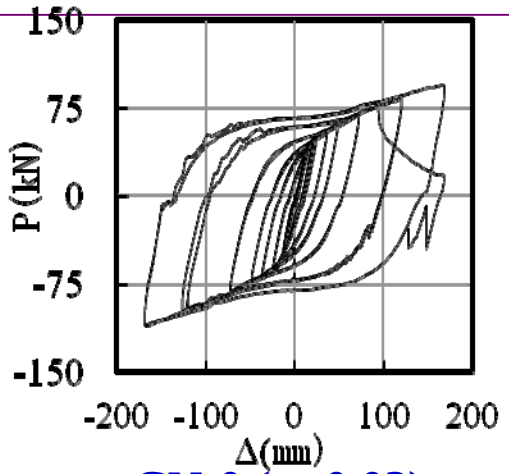
- Ye Y, Han LH. Concrete-filled bimetallic tubes under axial compression: Experimental investigation. Thin-Walled Structures, 2017.
- Ye Y, Han LH. Concrete-filled bimetallic tubes (CFBT) under axial compression: Analytical behaviour. Thin-Walled Structures, 2017.

Design of CFSST

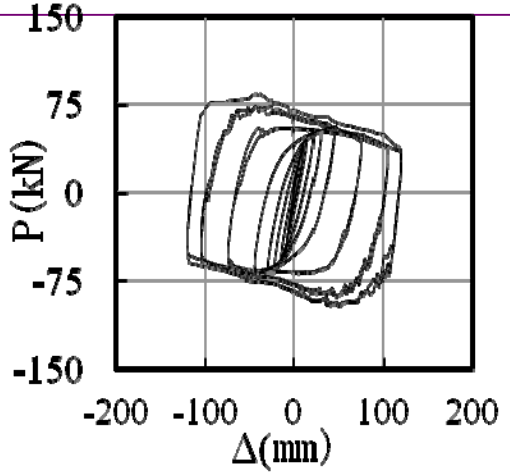
Typical moment versus axial load interaction curve of CFSST columns



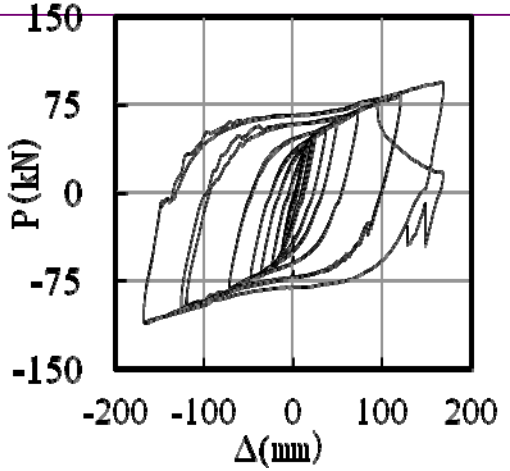
Cyclic behaviour



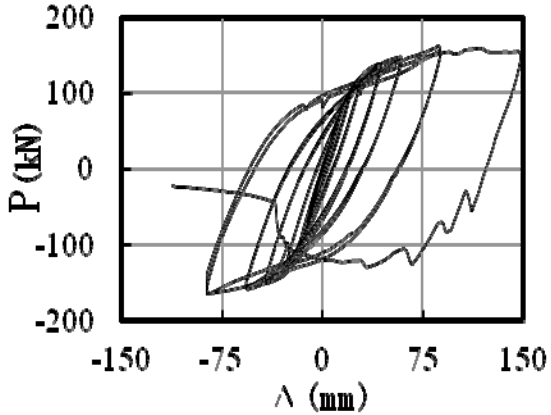
CN-0 (n=0.02)



CN-3 (n=0.3)



CN-6 (n=0.6)



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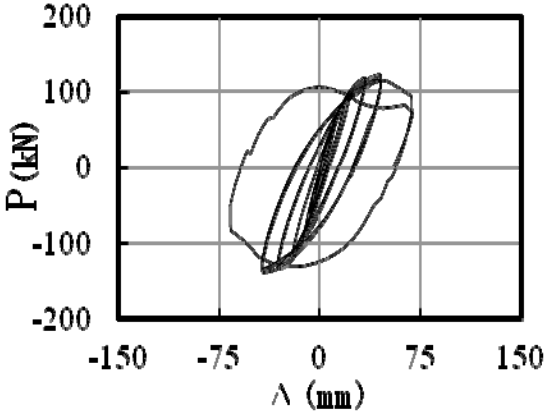
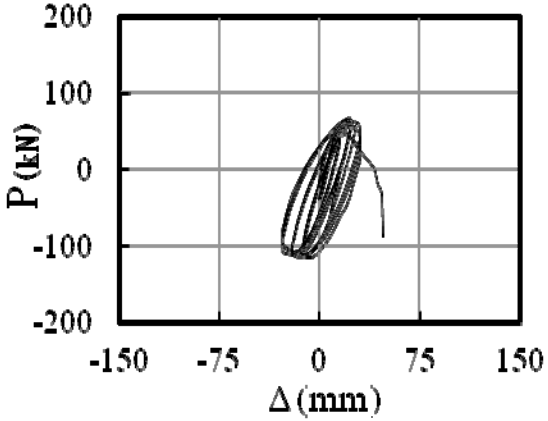


SN-3 (n=0.3)

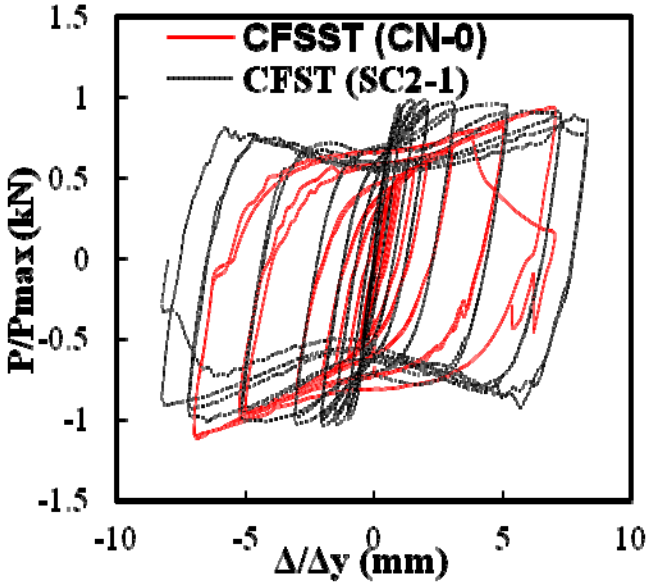


SN-6 (n=0.6)

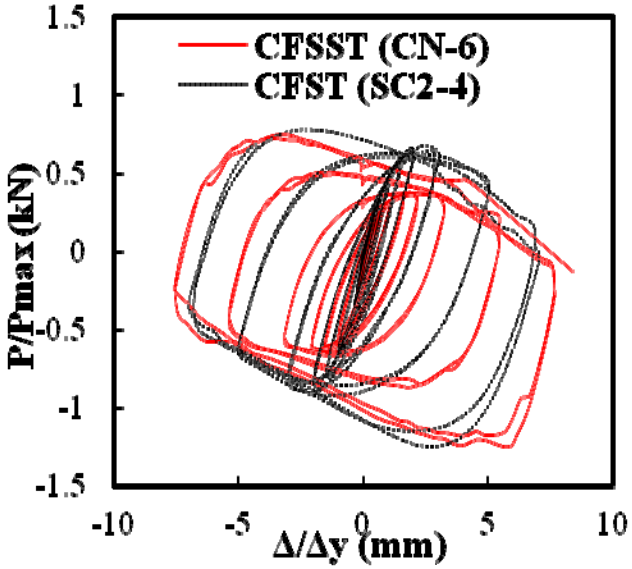
◆ Liao FY, Han LH, Tao Z, Rasmussen KJR . Experimental behavior of concrete-filled stainless steel tubular columns under cyclic lateral loading. Journal of Structural Engineering ASCE, 2017.

Cyclic behaviour

Comparison of *P*– *Δ* hysteretic curves between stainless steel and carbon steel composite columns

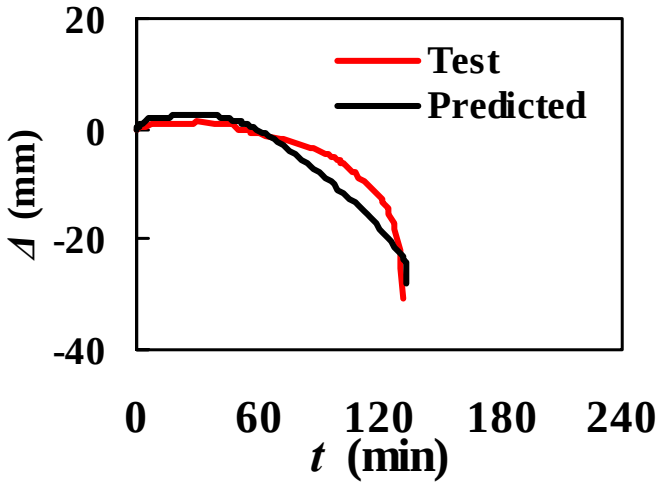


n=0.02



n=0.6

Fire performance

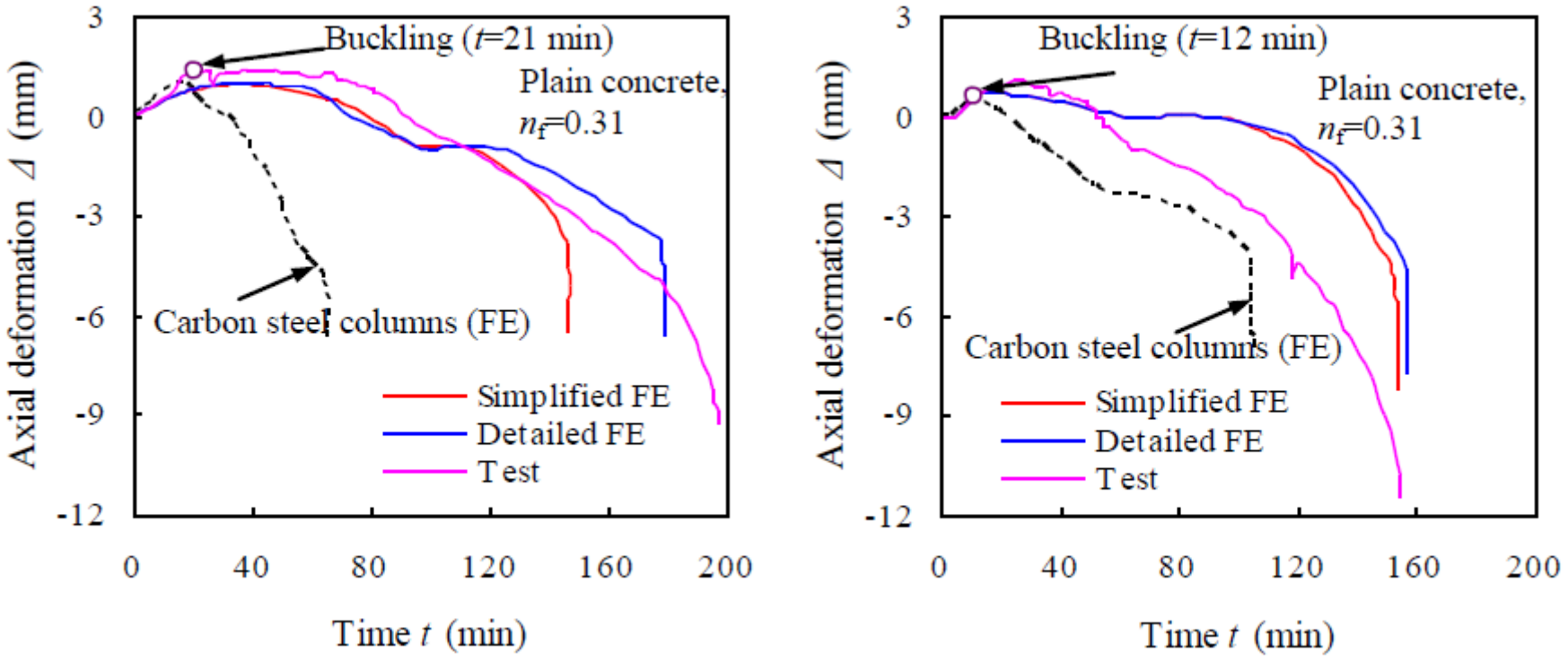


- **Five full-scale CFSST columns in standard fire test conditions, where the largest cross-sectional dimension was 630 mm.**
- **Two design tables were proposed to predict the fire resistance of CFSST columns.**

◆ Han LH, Chen F, Liao FY, Tao Z, Uy B . Fire performance of concrete filled stainless steel tubular columns. Engineering Structures, 2013

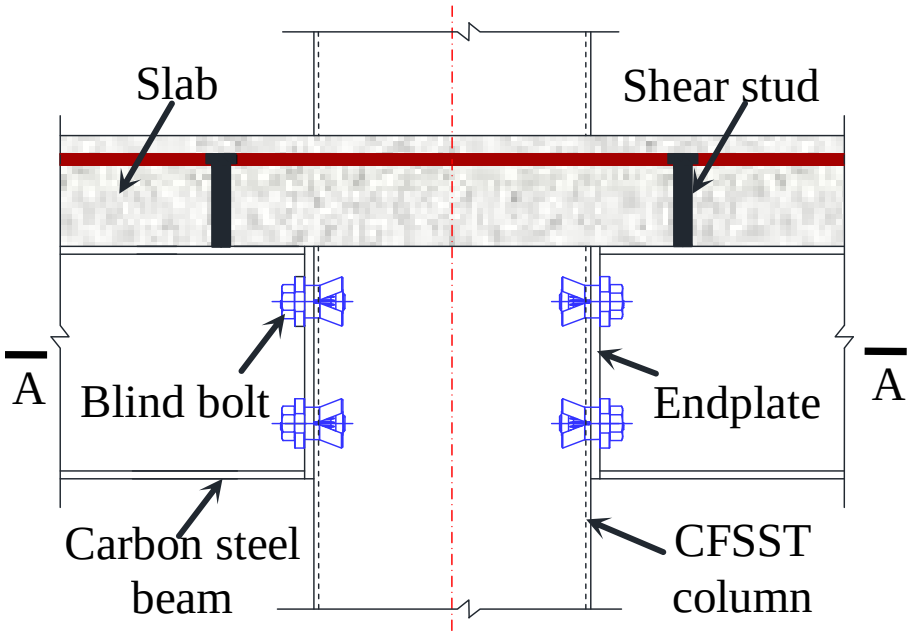
Fire performance

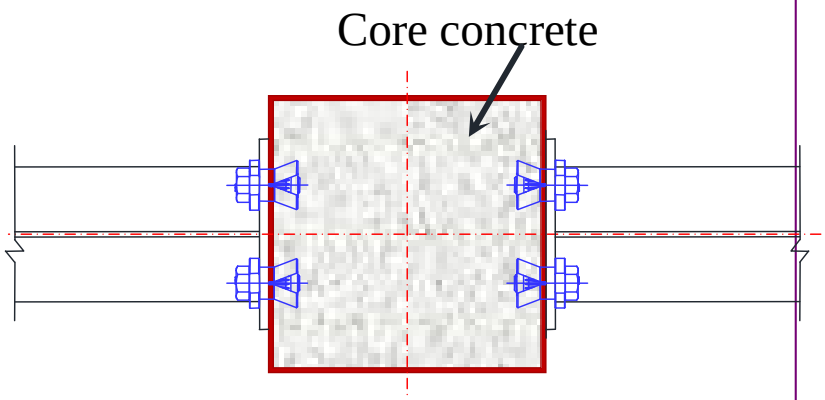
Comparison of axial deformation versus time curves



◆ Tao Z, Ghannam M, Song TY, Han LH. Experimental and numerical investigation of concrete-filled stainless steel columns exposed to fire. Journal of Constructional Steel Research, 2016

CFSST column to beam joints



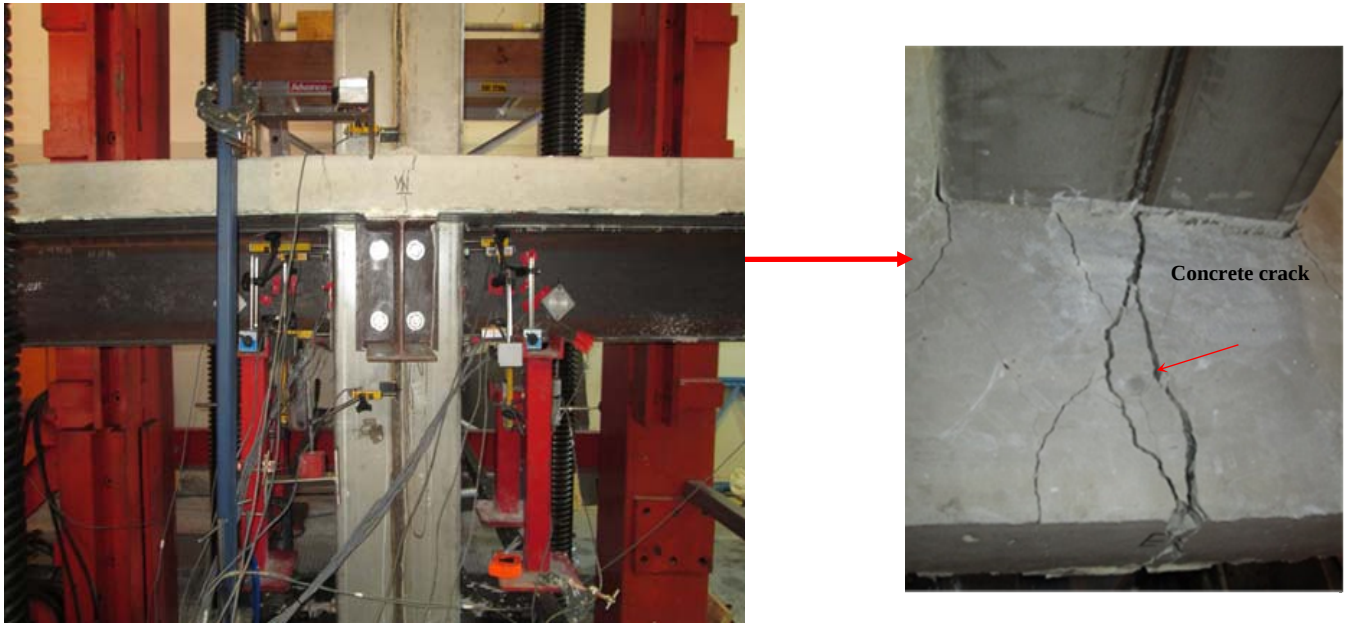


Section A-A

◆ Tao Z, Hassana MK, Song TY, Han LH . Experimental study on blind bolted connections to concrete-filled stainless steel columns. Journal of Constructional Steel Research, 2017.

Concrete-filled stainless steel tubular (CFSST) column to carbon steel beam joints with blind-bolted connections

CFSST joint tests at ambient temperatures



Joints with slab (SB1-1)

CFSST joints in fire

Beam failure mode

Column failure mode

◆ Song TY, Tao Z, Razzazzadeh A, Han LH, Zhou K . Fire performance of blind bolted composite beam to column joints. Journal of Constructional Steel Research, 2017.

Conclusions

1. **CFSST columns generally show improved ductility, higher energy dissipation ability, and superior fire performance.**

2. **The bond strength between the steel tube and core concrete of a CFSST is 32-69% lower than that of a CFST due to the smoother surface of the stainless steel.**

3. **The existing codes for CFST columns, such as AS5100, AISC, DBJ/T and EC4, underestimate the load-carry capacity of CFSST columns.**

4. **The feasibility of connecting CFSST columns to carbon steel beam by blind bolts has been examined, and the results showed that the composite joint exhibited favourable performance both at ambient temperature and in fire.**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Thank You!


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Thank You!


Thank You!