Experimental study on hysteretic hehaviour of welded stainless steel box-section columns

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Outline

- Background
- Experimental program
- Test results
- Conclusions

Background

Doha International Airport

York Millennium Bridge

Beijing Botanical Garden

Beijing Olympic Business District

Singapore Double Helix Bridge

Petronas Twin Towers

Background

■ Research on Stainless Steel

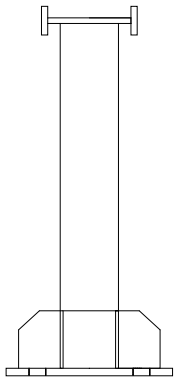
- Properties of material
- Members
- Connections
- Residual stress of section

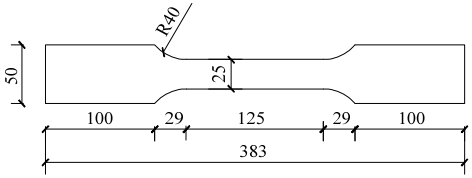
● Damage of Steel Structures in Earthquake

➢ **What about the hysteretic behaviour of welded stainless steel box-section columns?**

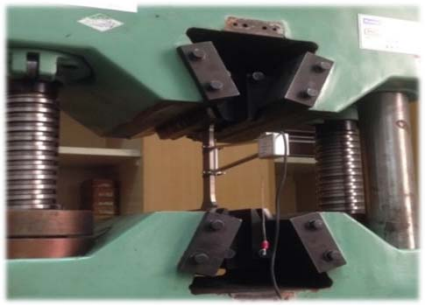
Experimental program

1. Material tests

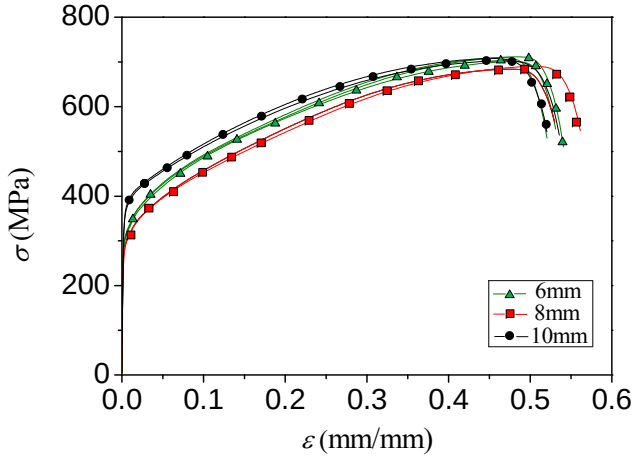




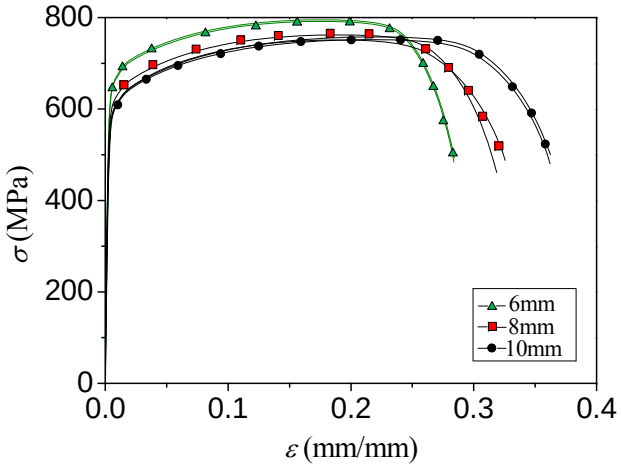
a. Dimension of tensile coupons



b. Test configuration of tensile test



c. Austenitic stainless steel

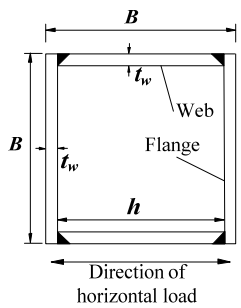


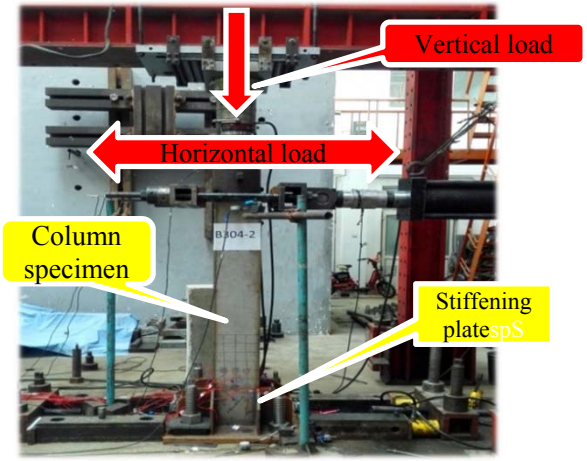
d. Duplex stainless steel

Experimental program

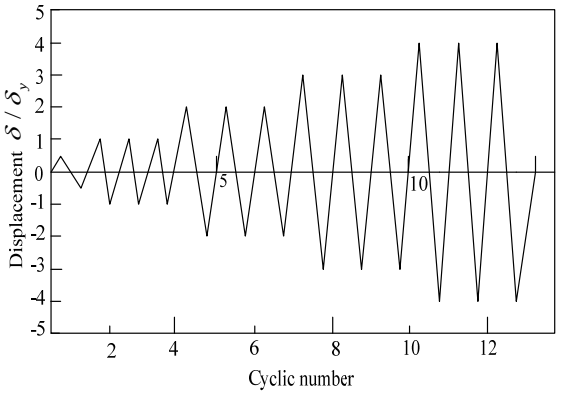
2. Specimen cyclic loading test

Table1 Measured geometry of specimens and axial-load ratios

Cross-section	Specimens	B / mm	t_w /mm	h/t_w	$[h/t_w]$	N_0	N(KN)
	B304-1	280.0	9.60	26.0	35.3	0.2	443
	B304-2	279.0	7.85	33.0	35.3	0.2	357
	B304-3	280.0	7.85	33.0	35.3	0.4	714
	B304-4	281.0	5.82	44.7	35.3	0.2	270
	B2205-1	200.5	9.70	18.0	23.8	0.2	684
	B2205-2	198.0	7.70	23.0	23.8	0.2	553
	B2205-3	198.0	7.70	23.0	23.8	0.4	1106
	B2205-4	198.5	5.75	31.3	23.8	0.2	419



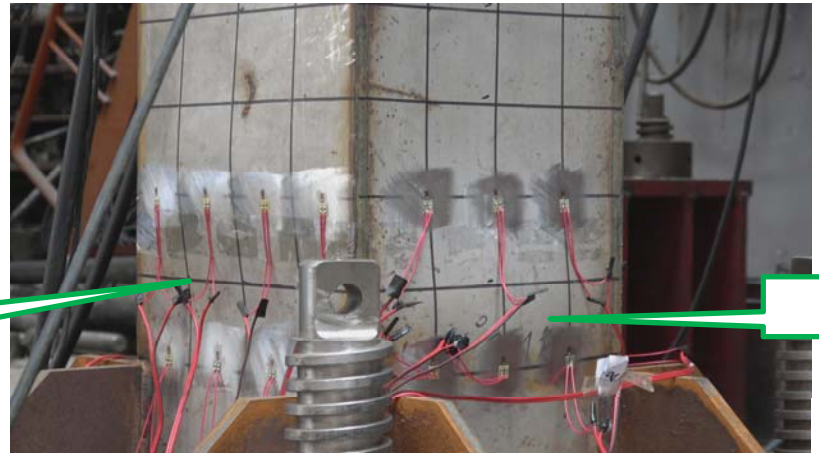
a. Test photo



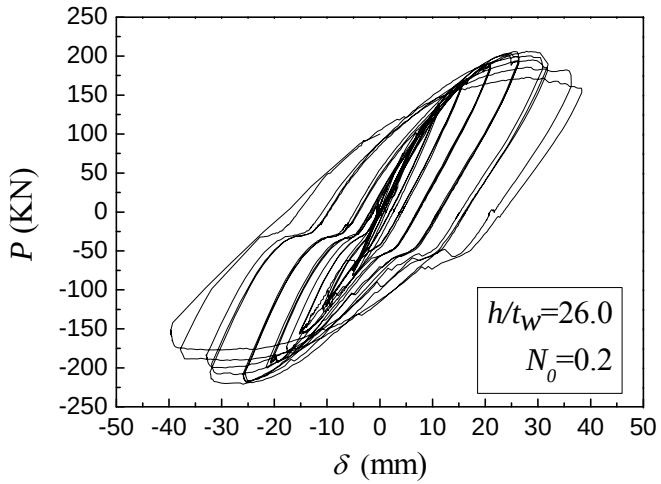
b. Cyclic loading protocol

Test results

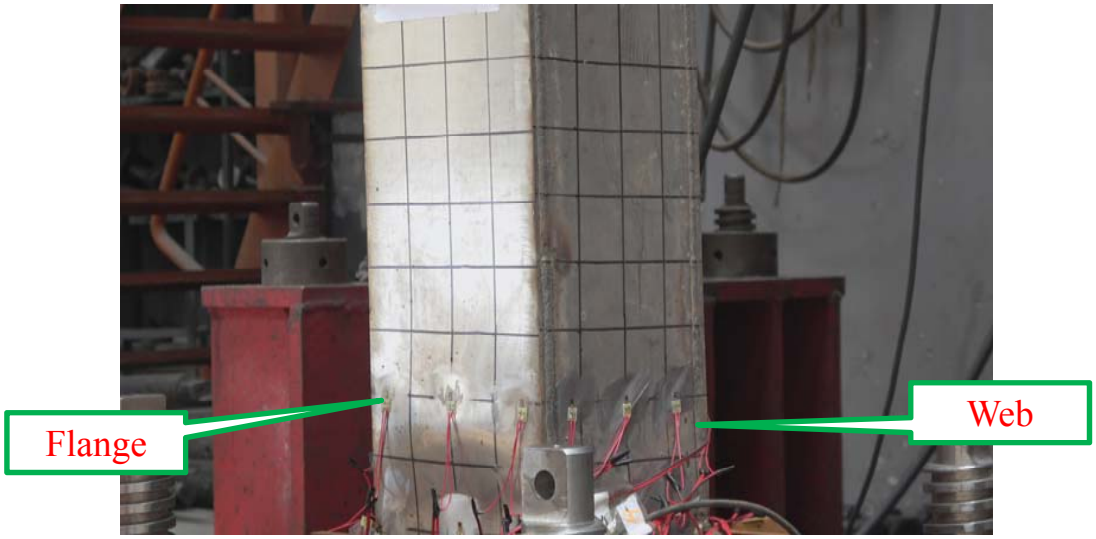
1. Test phenomena, failure mode and hysteresis curves



B304-1



Test results



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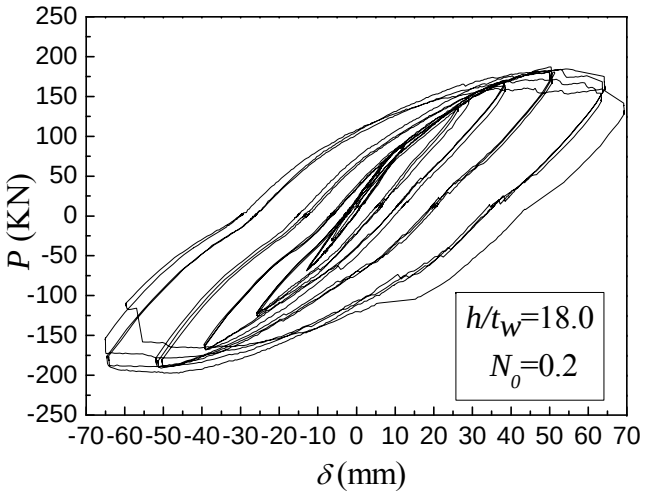
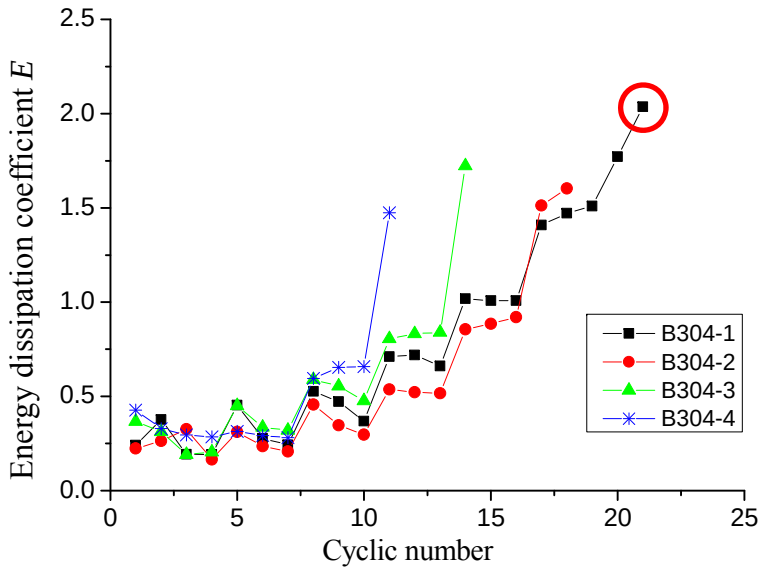
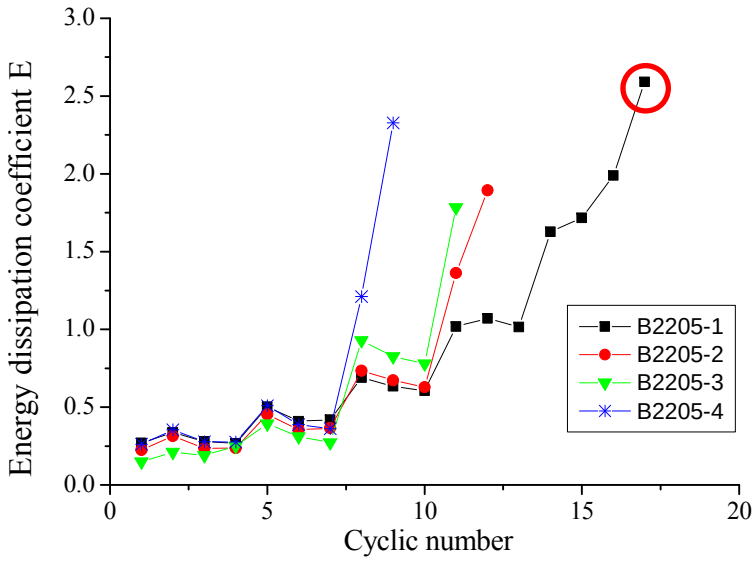


Test results

2. Energy dissipation capacity



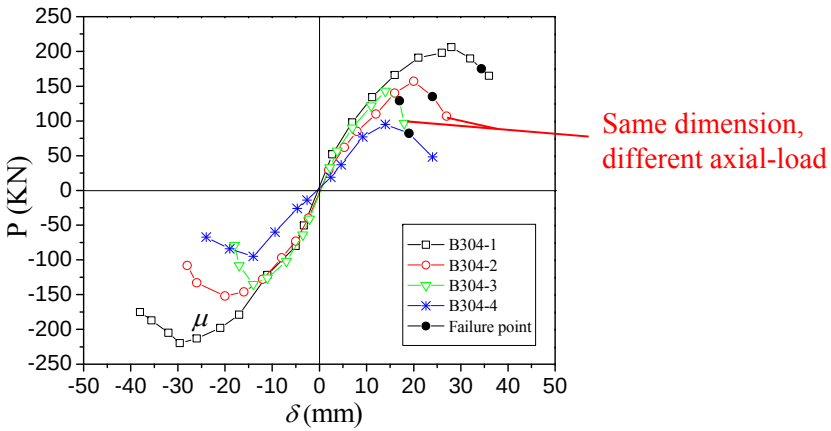
a. austenitic stainless steel specimens



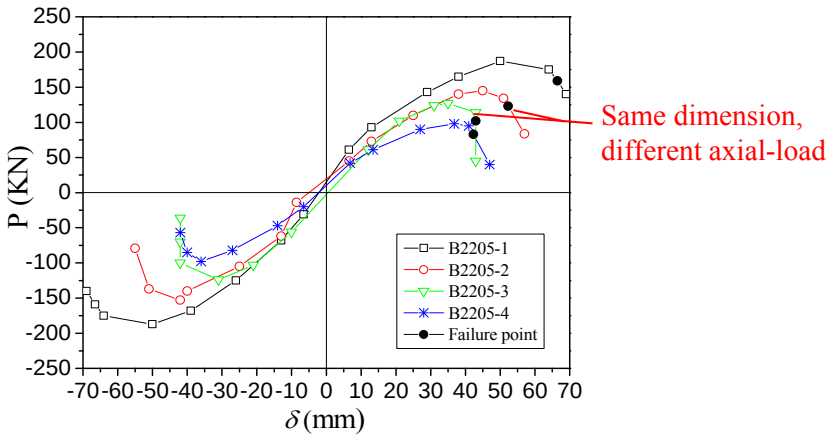
b. duplex stainless steel specimens

Test results

3. Skeleton curve and ductility



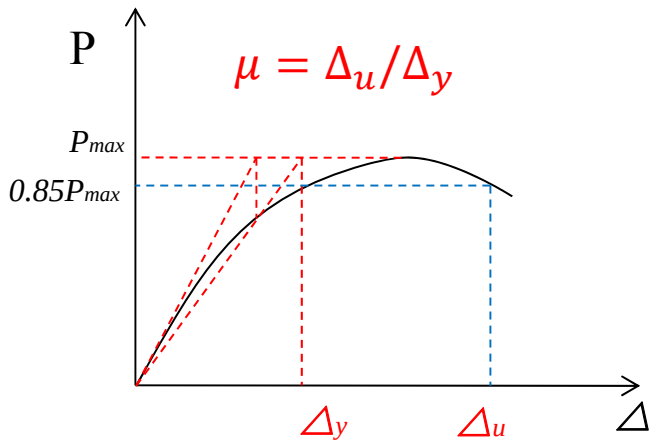
a. austenitic stainless steel specimens



b. duplex stainless steel specimens

Table 2 Peak load, deformation and ductility coefficient

Specimens	P_{max}/KN	Δ_y/mm	Δ_u/mm	μ
B304-1	206	17.23	34.4	1.995
B304-2	157	15.58	24.0	1.540
B304-3	143	12	15.9	1.325
B304-4	95	12.7	19.0	1.496
B2205-1	187	36.84	66.5	1.805
B2205-2	145	34.25	52.3	1.527
B2205-3	127	31.06	43.0	1.387
B2205-4	98	28.5	42.3	1.489



c. Typical $P - \Delta$ skeleton curve

Conclusions

- The welded box-section stainless steel columns have good seismic performance and energy dissipation capacity, the plasticity development of the specimen is sufficient, and the hysteretic curve of the specimen is plump.

- For the specimens with the same axial-load ratio, as width-to-thickness ratio increases, local buckling occurs at a lower displacement level, and the displacement levels corresponding to the maximum bearing capacity and failure load are both smaller.

- All the specimens showed local buckling first at flange and then at web when subjected to cyclic horizontal load. The range of buckling was within 0.87B to 1.13B and the position of the buckling center with the maximum local deformation was 0.40B to 0.51B from the edge of the stiffening plate.

- With an increase of width-to-thickness ratio or axial-load ratio, the plumpness of hysteric curve, energy dissipation capacity, ductility of specimens and maximum bearing capacity decreased. In addition, the larger width-to-thickness ratio or axial-load ratio is, the faster the bearing capacity and rigidity degenerate.

Thank you for your attention!