



CYCLIC TESTS OF FULL-SCALE LIGHT-FRAMED WOOD CONSTRUCTION

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Introduction

Lots of studies in wood frame shear wall (WFSW) research area focused on the performance of the single piece of wall. While, in the field, the wood frame shear walls always work as a component in the complete structural system, of which boundary conditions are different from that of the single piece of walls.

There were nine full-scale light-framed wood construction specimens tested to study the effects of the upper storey and the vertical load on the performance of the wood frame shear wall in the first storey, as well as to understand the performance of wood frame shear wall in the complete structure.

Test program

Test specimen

Nine symmetric specimens were divided into three groups according to different opening size in the wood frame shear wall in the first storey. In each group, the wood frame shear walls in the first storey were grouped into three types, namely, WFSW-A, WFSW-B, WFSW-C. All the test specimens are shown in fig.1.

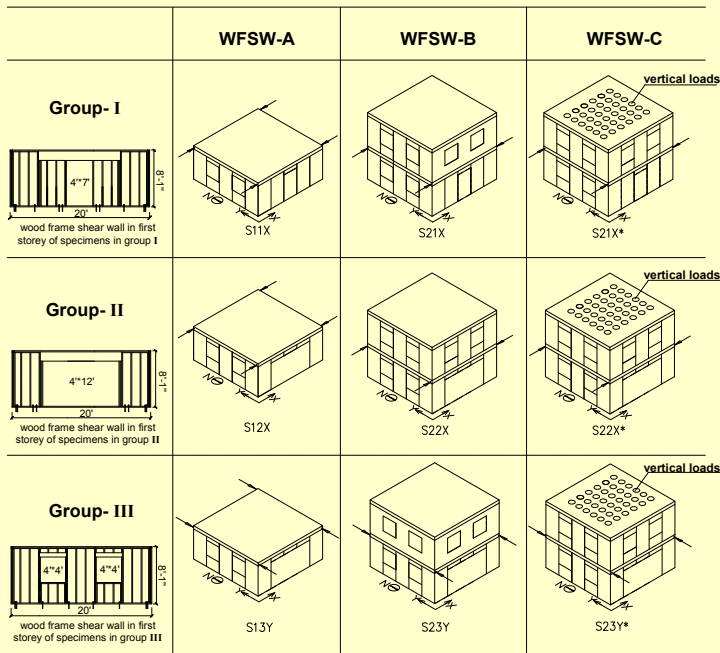


Fig. 1. Sketch of the nine specimens

Load protocol and instrumentation

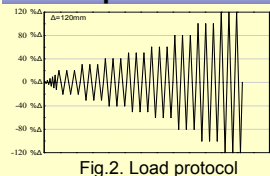


Fig. 2. Load protocol

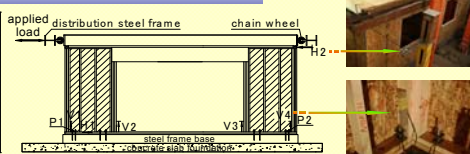


Fig. 3. Instrumentation of wood frame shear wall in S12X

Test setup

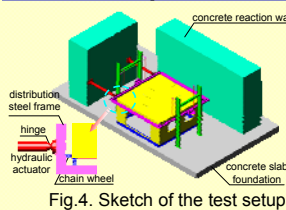


Fig. 4. Sketch of the test setup



Fig. 5. Photos of the specimens

Results

Failure modes



Fig. 6. Nail connection failure modes

Global hysteresis response

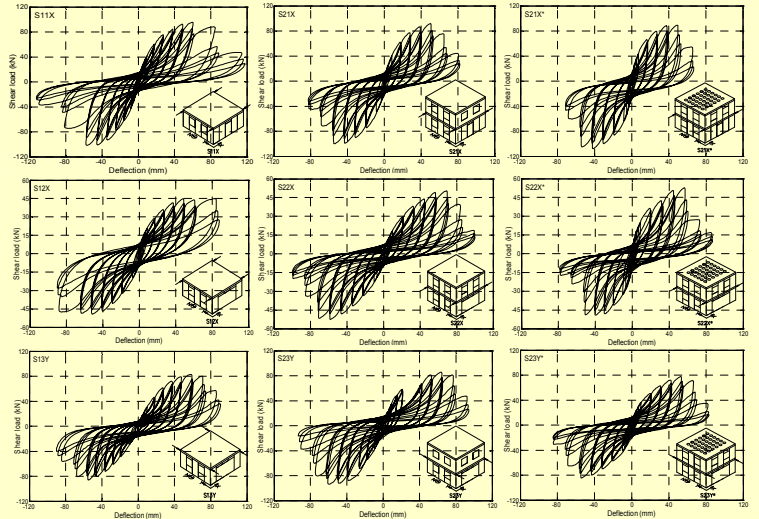


Fig. 7. Hysteresis curves of the nine test specimens

Wall performance parameters

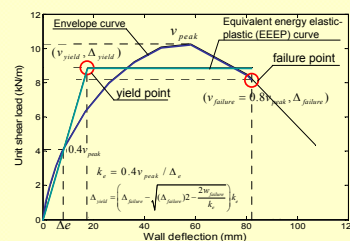


Fig. 8. Performance parameters definition

Table.1. Uplift of studs (Unit: mm)

Group	Wall	Maximum uplift/Uplift under peak load			
		V1	V2	V3	V4
I	WFSW-A	5/4.3	8.5/7	13.3/7.9	4.9/2.5
	WFSW-B	3.2/1.4	10.7/8.1	8.2/5.9	1.8/0.5
	WFSW-C	2.7/0.9	2.6/2.5	6.2/4.8	3.9/0.7
II	WFSW-A	4.5/3.2	24.1/24.1	21.6/19.5	7.9/1.9
	WFSW-B	3.5/1.2	11.5/10.6	11.2/9.8	3.1/1.3
	WFSW-C	9.9/6.8	15.8/6.3	11.1/7.1	11.3/8.9
III	WFSW-B	7.9/7.1	4.4/1	3.8/1.1	3.4/1.9
	WFSW-C	5.5/3.4	5/2.6	1.4/1.4	6.1/5.2

Table.2. Performance parameters based on the definition in Fig.8

	Group I			Group II			Group III		
	WFSW-A	WFSW-B	WFSW-C	WFSW-A	WFSW-B	WFSW-C	WFSW-A	WFSW-B	WFSW-C
V_{peak} (kN/m)	10.26	9.99	10.21	9.81	10.61	10.57	11.73	12.45	11.29
$\Delta_{failure}$ (mm)	82.15	63.02	57.46	84.15 ^a	78.77	59.22	76.86	77.66	67.22
V_{yield} (kN/m)	8.86	8.69	8.94	8.87	9.16	9.07	10.28	10.70	9.44
Δ_{yield} (mm)	17.48	14.25	9.28	15.59 ^b	21.55	9.33	25.40	20.29	15.10
k_e (kN/m/mm)	0.51	0.61	0.96	0.57	0.43	0.97	0.40	0.53	0.63

Conclusion

Results showed that the effects of the upper storey with the vertical load on the performance of wood frame shear wall were to: (1) increase the elastic stiffness, (2) reduce the ultimate deflection and yield deflection, and (3) make the uplift of the studs at the end of walls and beside the openings small and uniform along the wall in the first storey. While the upper storey or the vertical load had little effect on the shear strength of wood frame shear wall. The test results indicated that in the lower storey the number of hold-downs can be reduced to some extent in seismic design.

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