

Experimental Study on the Contribution of GWB to the Lateral Performance of Wood Shearwalls

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1. INTRODUCTION

Final project-goal is to investigate the seismic response of light wood frame buildings (LWFBs) with gypsum wall board (GWB).

Objectives of this experimental study are to:

- investigate the structural behaviour of GWB shearwalls with various parameters (**panel orientation, panel joint taping and double-layer GWB**)
- provide information for the numerical simulation of shearwalls and LWFBs including GWB under earthquake actions

2. TEST PROGRAM

● Materials:

- Framing members: 38 x 89 mm Spruce-Pine-Fir (SPF)
- Sheathing Panels: 12.5mm OSB and 15.9mm Type X GWB
- Fasteners: 10d & 16d common nails, #6 & #10 drywall screws

● Twelve shearwall assemblies (Table 1) with the same dimensions of 2440 mm x 2440 mm were fabricated.

Table 1. List of shearwall test specimens GWB taping

No.	Sheathing	Fastener	Orientation*	Loading*
SW-M1	OSB	8d	V	M
SW-M2	GWB	#6	V	M
SW-01	OSB	8d	V	C
SW-02	OSB	8d	H	C
SW-03	GWB	#6	V	C
SW-04	GWB	#6	V(Taping)	C
SW-05	2×GWB	#6, #10	V	C
SW-06	GWB	#6	H	C
SW-07	OSB + GWB	8d + #6	V	C
SW-08	OSB + GWB	8d + #6	V(Taping)	C
SW-09	OSB + 2×GWB	8d + #6, #10	V	C
SW-10	OSB + GWB	8d + #6	H	C

Note: * - H & V stand for 'Vertical' & 'Horizontal' panel orientation, respectively; * - M & C represent "Monotonic" & "Cyclic".



Fig. 1. Test Setup

● Specimens were tested according to **ASTM E564 & E2126**, Fig 1.

3. RESULTS

Test results (Table 2) was analysed in accordance with the equivalent energy elastic-perfectly-plastic (EEEP) curve given in **ASTM E2126** (Fig. 2).

Table 2. Test results of shearwalls under monotonic and cyclic loading

No.	K_v (kN/mm)	F_v (kN)	Δ_v (mm)	F_{max} (kN)	Δ_{Fmax} (mm)	Δ_u (mm)	μ
SW-M1	1.19	21.0	17.6	23.9	96.1	131.8	7.5
SW-M2	2.26	11.8	5.2	13.4	51.4	80.9	15.5
SW-01	1.24	18.4	14.9	21.1	68.5	93.8	6.3
SW-02	2.43	12.2	5.4	14.2	41.0	70.7	13.9
SW-03	2.39	9.0	3.8	10.5	29.6	47.9	12.8
SW-04	2.19	10.2	4.6	12.2	28.8	37.2	8.0
SW-05	2.95	22.4	7.6	25.3	35.3	64.7	8.5
SW-06	1.87	6.7	3.6	7.6	25.1	45.4	12.6
SW-07	2.67	25.8	9.7	29.7	53.3	82.0	8.5
SW-08	2.01	22.4	11.2	26.6	43.7	60.8	5.4
SW-09	3.19	33.1	10.5	38.3	44.3	61.5	5.9
SW-10	2.83	17.9	6.3	20.7	38.8	88.8	14.0

Note: μ is the ductility ratio, which is Δ_u divided by Δ_v .

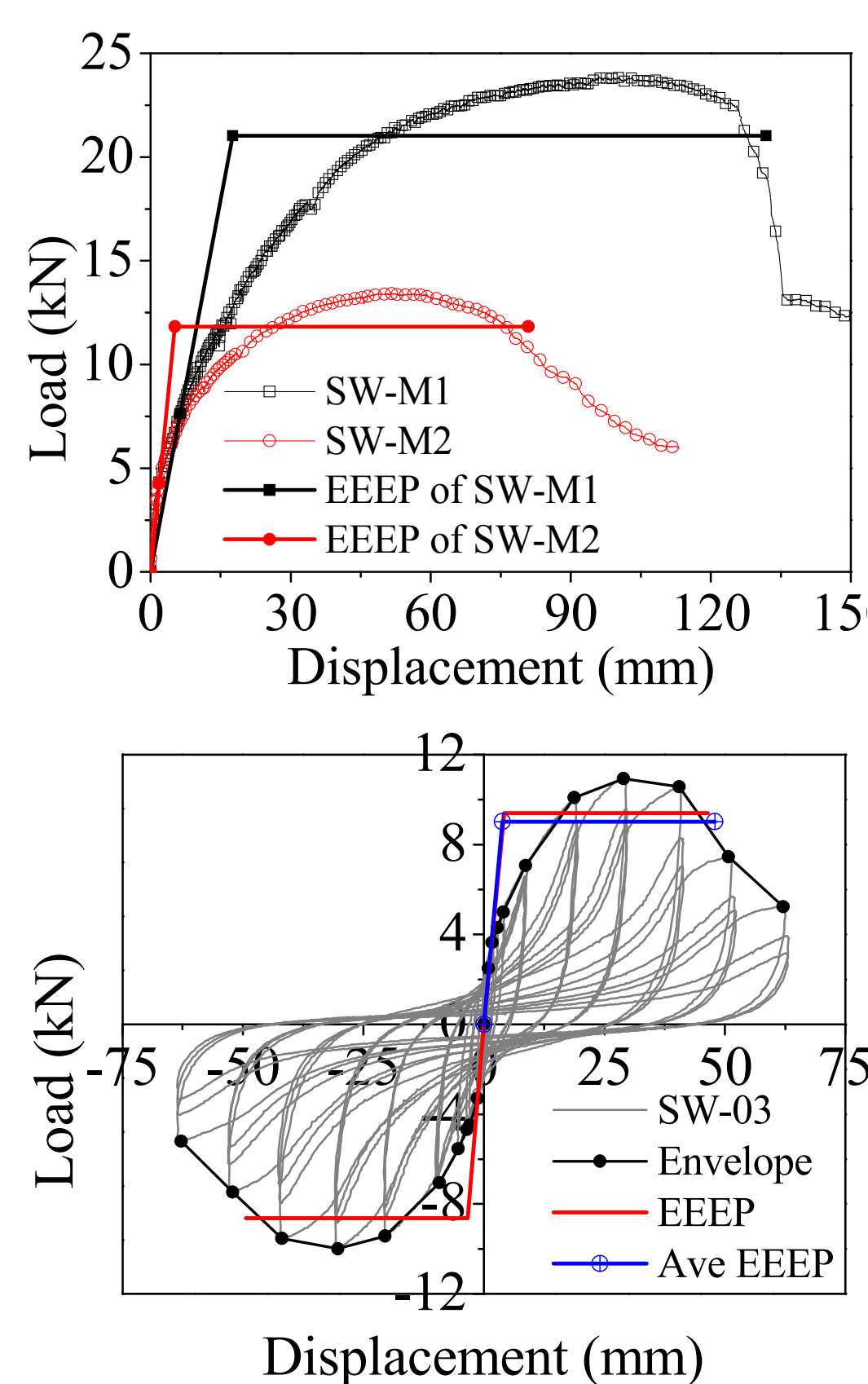


Fig. 2. Load-displacement curves

4. DISCUSSIONS

● Performance of Shearwalls

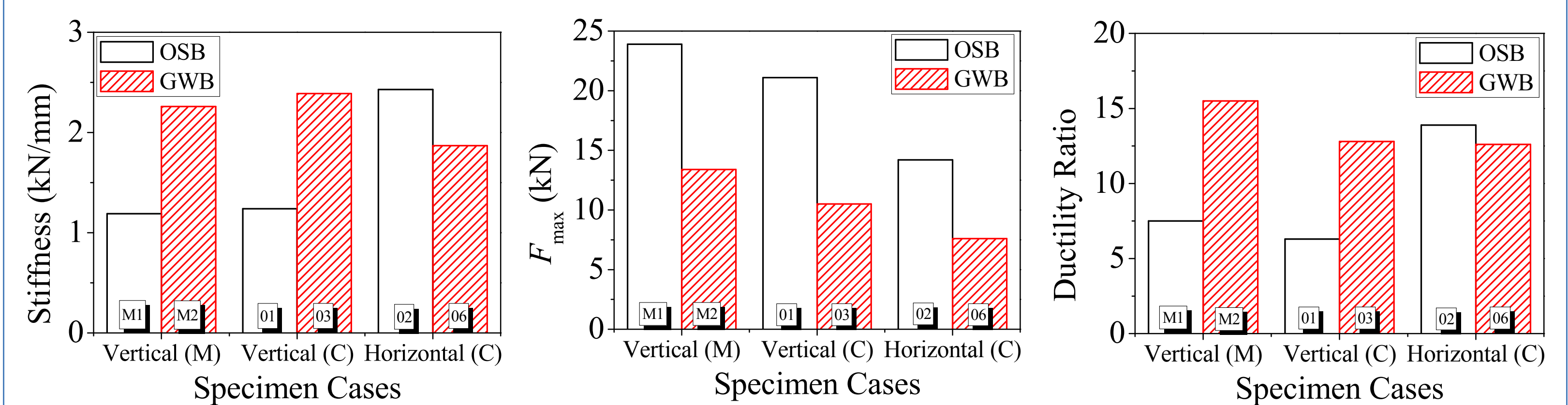


Fig. 3. Performance comparison of shearwalls

- Cyclic loading increases the stiffness but decreases the strength and ductility ratio of shearwalls.
- Shearwalls with OSB possess higher strength and lower stiffness and ductility ratio compared with those with GWB.

● Effect of Panel Orientation

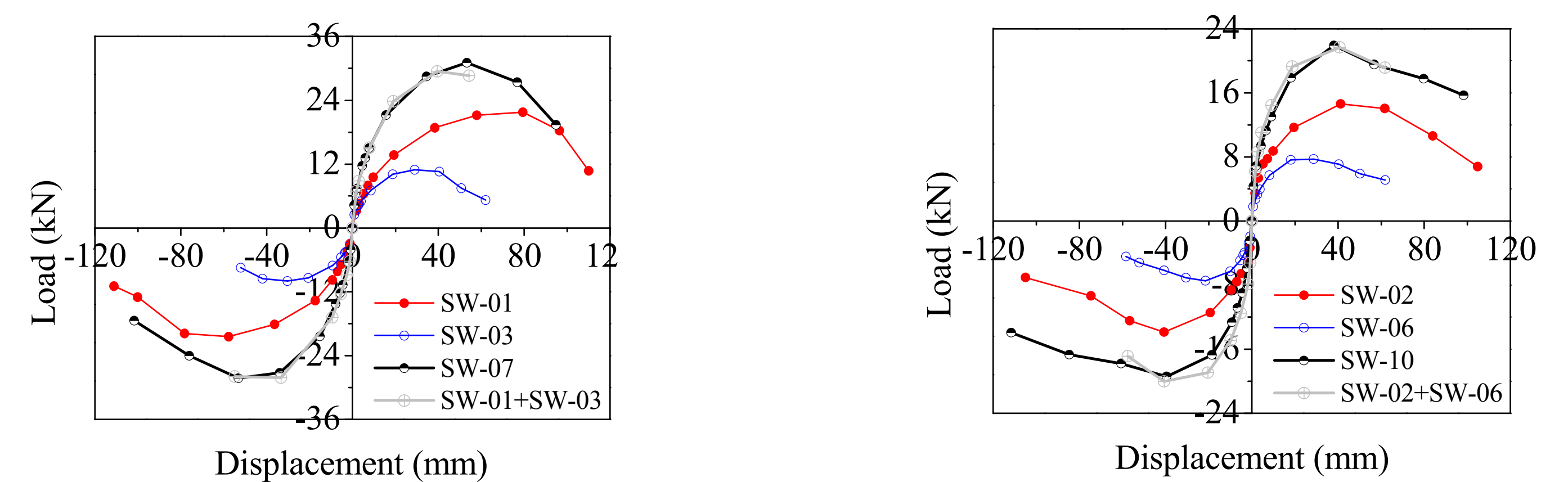


Fig. 4. Envelope curves of specimens with single GWB without taping

- Shearwalls sheathed with OSB oriented vertically possess higher strength and lower stiffness and ductility ratio, while shearwalls sheathed with vertically oriented GWB have higher or similar structural performance, in comparison with parallel shearwalls with sheathing panels oriented horizontally.

- The lateral resistance of shearwalls sheathed with OSB and GWB on opposite faces can be estimated by summing those of shearwalls with OSB or GWB alone.

● Effect of Panel Joint Taping & Double-Layer of GWB

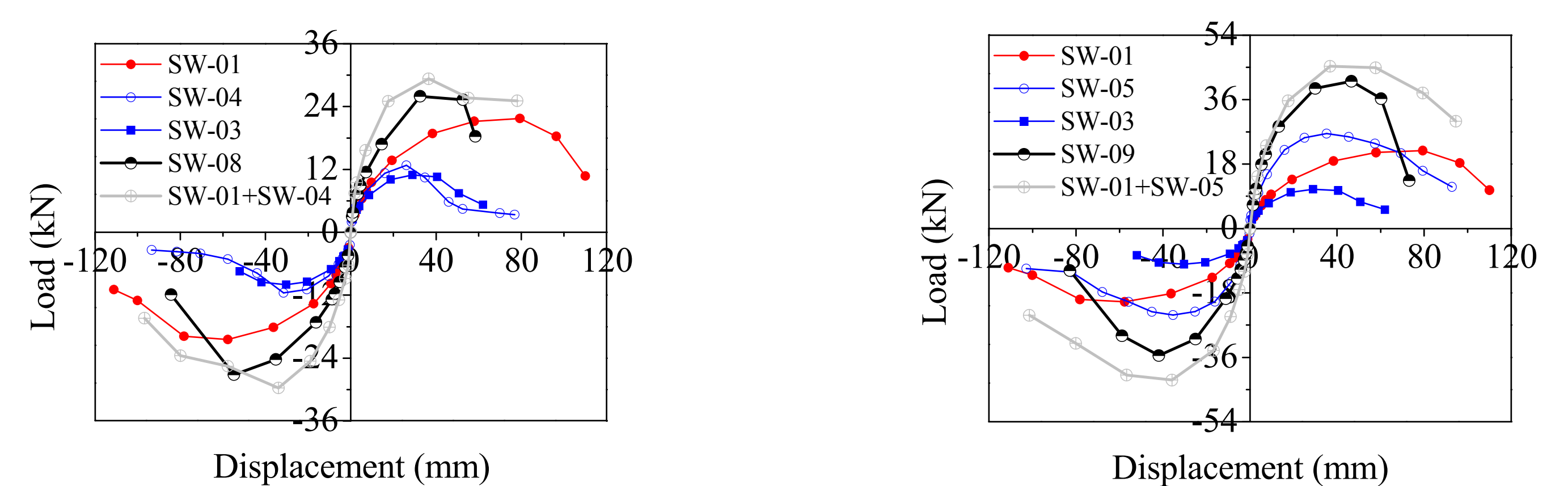


Fig. 5. Envelope curves of specimens with taping or double-layer GWB

- Either panel joint taping or double-layer GWB increases the strength and decreases the ductility ratio of shearwalls. However, double-layer GWB increases the stiffness of shearwalls whereas taping of panel joint does the opposite.

- For shearwalls with panel joint taping on GWB or double-layer GWB, the lateral resistance cannot be estimated by summing those of shearwalls with OSB and single- or double-layer GWB alone.