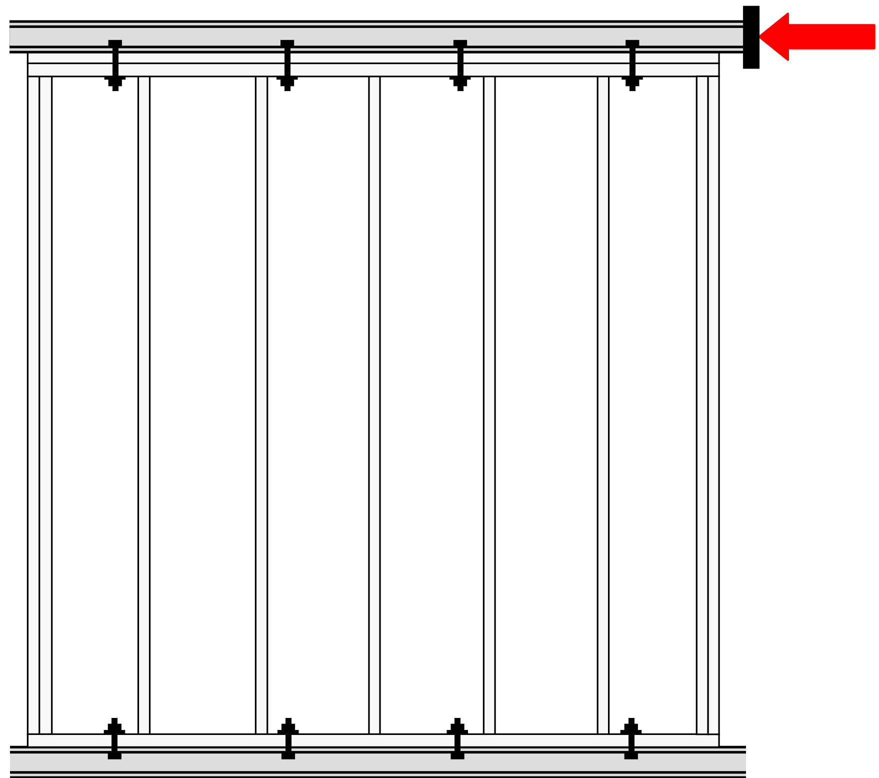
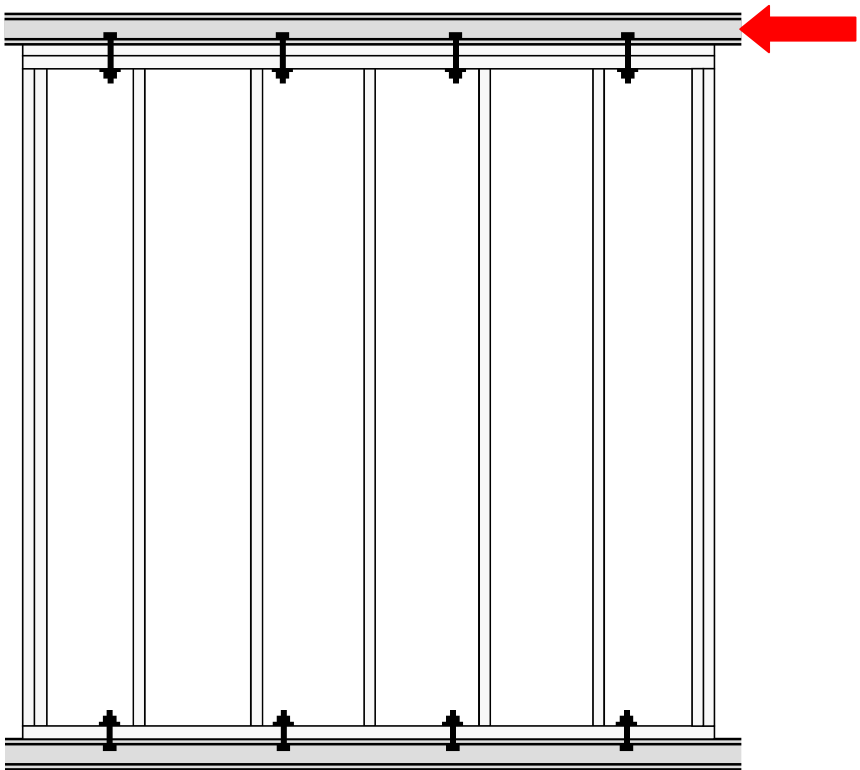
Walls 08IAm



Walls:	08IAm1	08IAm2
Manufactured:	**June 16, 1998**[1]	**June 15, 1998**[1]
MOE data files:	8iam1p.prn 8iam1s.prn	8iam2p.prn 8iam2s.prn
MOE_{plates} (10^6 psi)	1.71	1.94
MOE_{studs} (10^6 psi)	1.50	1.51
$Density_{plates}$ (kg/m^3)	491	575
$Density_{studs}$ (kg/m^3)	465	467
Date tested:	**June 26, 1998**[2]	**June 26, 1998**[3]
Time tested:	11:18	13:57
LTC files:	UTP16	UTP16
Data files:	08IAm1.dat	08IAm2.dat
Excel files:	08IAm1_data	08IAm2_data
Photo files:	255-268	269-275

1 Sheathing attached to the bottom plate with ¾-in. edge distance.
2 The load-distribution beam was tightly secured to the ram via 1 ¾-in. threaded rod and two nuts.
3 The load-distribution beam was connected to the ram via the 1 ¾-in. rod but the nuts were not tightened.



Walls:	**08IAm3**	**08IAm4**	**08IAm4r**
Manufactured:	**June 19, 1998**[1]	**June 22, 1998**[1]	**June 22, 1998**
MOE data files:	8iac1p.prn 8iac1s.prn	8nac2p.prn 8nac2s.prn	8iacp4.prn 8nac2s.prn
MOE_{plates} (10^6 psi)	1.87	2.00	1.79
MOE_{studs} (10^6 psi)	1.67	1.85	1.85
$Density_{plates}$ (kg/m^3)	588	577	536
$Density_{studs}$ (kg/m^3)	479	529	529
Date tested[3]**:**	**July 12, 1998**	**August 19, 1998**	**August 19, 1998**[2]
Time tested:	11:51	13:40	15:30
LTC files:	utp_alex	alex_8m	alex_8m
Data files:	08IAm3.dat	08IAm4.dat	08IAm4.dat
Excel files:	08IAm3_data	08IAm4_data	08IAm4_data
Photo files:	399-410	no pictures	no pictures

1 Sheathing attached to the bottom plate with 3/8-in. edge distance.

2 The bottom plate of wall 08IAm4 was replaced after test and sheathing attached to the bottom plate at 6 in. o. c. with ½-in. edge distance.

3 During these tests, the distribution beam was connected to the ram via a hinge (unlike walls 08IAm1 and 08IAm2).

Walls 08IAm1 and 08IAm2

Observations: Both walls exhibited a very similar performance. The same peak load 2712 lbf (0.339 Kips/ft.) was observed at the same deflection (1.1-in.). Then, the resistance dropped quickly. The 20% load reduction was observed at 1.7-in. deflection. The sheathing moved relative to the studs and top plate less than 0.03 in. as Figures 08IAm1-d and 08IAm2-d show. The walls rocked around the bottom-left corner without any noticeable racking. Figures 08IAm1-c and 08IAm2-c support this observation.

Failure mode: Sheathing unzipped from the bottom plate and the rest of the wall rocked away from the foundation as a rigid body as is shown in Photos 268-270. Some nails pulled out of wood (Photo 266), other nails pulled heads or tore through the sheathing edges. The end of bottom plate was split under the nails during the test (Photo 266). The rest of the wall seemed undamaged.

Instrumentation: Photos 271-275 show the location of the LVDT's used for sheathing displacement measurements. Photos 256, 259-262 show locations of other instruments. The LVDT's for uplift measurements were aligned with the stud axes. Since the wall rocked around the 'toe', Channel #3 (Photo 260) produced positive displacement.

Data acquisition: The data acquisition was triggered at 0.065 in. of UTP displacement. Therefore, all other channels (including UTP load) did not record the data until 0.065 in. In further monotonic tests, the trigger was set at 0.006 in.

Load transfer

As is shown in Photo 258, load from the ram to the wall was transferred through a threaded rod (UNF 1 ¾ - 12) attached to a steel distribution beam (3 by 5 in. tube). The beam was supplied with a front plate (¾ in.) with a hole (1 7/8 in.). During the first test (wall 08IAm1), the rod was inserted in the hole and secured by nuts on both sides of the front plate. As result of rocking, uplift displacement on the right side of the wall (near load) was equivalent to its forward movement. The outside movement of the ram caused a moment at the tip of the wall, which altered loading conditions. Casters near load and away from load drew a track on the floor at about 45-degree angle to the axis of the top plate. Obviously, such movement caused friction that increased resistance of the wall in direction of loading. Second caster was near the top left corner of the wall and mostly rotated around its vertical axis. As seen on Figure 08IAm1-a, the resistance of the wall started growing after translation exceeded 2.5 inches. This can be attributed to bending resistance of the rod attaching the ram to the distribution beam.

During the second test (wall 08IAm2), the nuts were not tightened, which allowed free rotation of the rod in the hole of the front plate. The load-drift curve shows that the moment was most likely eliminated in this test and there was no load increase at large displacements. However, in cyclic tests, the problem would not be eliminated. With smaller walls, the error in load measurement might exceed the wall capacity. Therefore, it was decided to replace the rigid joint by a hinge using a rod end bearing and a pin. All further tests were conducted with the hinged connection between the ram and the beam.

To minimize the friction of casters against the floor during the test, plastic pads with a layer of grease were laid on the concrete floor under the casters in further tests.

Walls 08IAm3 and 08IAm4

Rationale: Walls 08IAm1 and 08IAm2 were manufactured with ¾-in. edge distance, and there was effect of load transfer conditions on the wall performance. Two additional tests were conducted on the walls with 3/8-in. edge distance and proper load transfer.

Observations: Walls 08IAm3 and IAm4 exhibited a very similar performance of each other. The average peak load 2208 lbf (0.276 Kips/ft.) was observed at the same deflection (1.0-in.). Then, the resistance dropped almost at once: the 20% load reduction was observed at 1.25-in. deflection. The sheathing moved relative to the studs and top plate less than 0.03 in. as Figures 08IAm3-d and 08IAm4-d show. The walls rocked around the bottom-left corner without any noticeable racking. Figures 08IAm1-c and 08IAm2-c support this observation.

Failure mode: Sheathing unzipped at the bottom plate(Photo 408). Until capacity was reached, the bottom plate bent as a cantilever between the right end stud and the first shear bolt due to the work of sheathing nails. Once capacity was reached, the sheathing nails at the corner snapped through the edge. Load-drift curves have a sudden drop at this point. After that event, the sheathing unzipped progressively. Photo 405 shows the position of sheathing after the test. It shows that the sheathing rotated around the nail furthest away from the load. The rest of the wall seemed undamaged.

Instrumentation: Photos 400-402 show the location of the LVDT's used for stud uplift measurements. For convenience of installation, the LVDT's were attached at the base and aligned with the outer edges of the end studs. Therefore, the 'uplift' #3 was negative.

Photos 409 and 410 show tracks produced by casters during the test.

Data acquisition: Load range on UTP controller was setup at 5500 lbs.

Wall 08IAm4r

Rationale: The inadequate edge distance (Photo 399) was one of the major reasons for the poor performance of walls 08IAm3 and 08IAm4. Since wall 08IAm4 seemed undamaged after the test, it was decided to repeat the test on this wall. The bottom plate was replaced and the sheathing was attached at ½-in. edge distance. The wall was tested one hour after the repair.

Observations: The performance of this wall was between 08IAm1 and 08IAm3 walls. The peak load 2275 lbf. (0.284 Kips/ft.) was reached at 1.25-in. deflection and suddenly dropped at 1.45-in. deflection. Qualitatively, this response was not significantly different from the wall 08IAm4.

Table 08IAm1. Data summary.

Specimen **08IAm1**	**Per unit length**	
Shear Bolts	**monotonic test**	
Wall length	**8.00ft.**	**2.438m**
Date: 6-26-1998.	**Time:**	11:18
	units	**08IAm1**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.339 4.947
Drift at peak load, Δ_{peak}	in. mm	1.072 27.24
Yield unit load, v_{yield}	Kip/ft. KN/m	0.290 4.235
Drift at yield load, Δ_{yield}	in. mm	0.209 5.32
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.136 1.979
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.098 2.49
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.269 3.918
Drift at failure, $\Delta_{failure}$	in. mm	1.661 42.19
Shear modulus, G $@0.4v_{peak}$	Kip/in. KN/mm	11.085 1.941
Work until failure per unit length	Kip·ft./ft. KN·m/m	0.038 0.167
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.232 3.392
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.272 3.981
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.332 4.867
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	**0.279** **4.080**

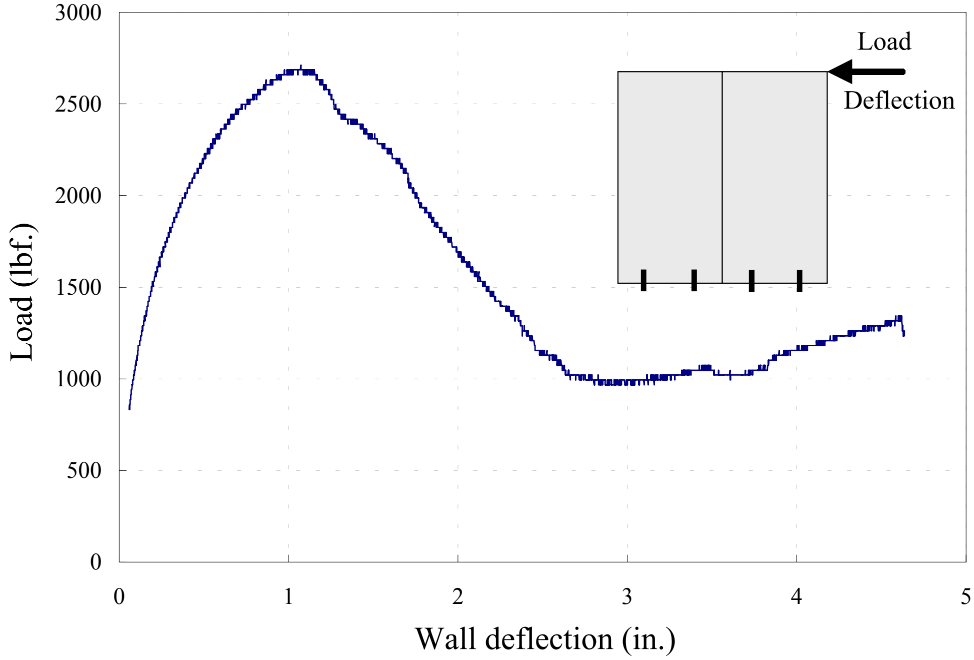


Figure 08IAm1- a. Observed load-deflection curve[1].

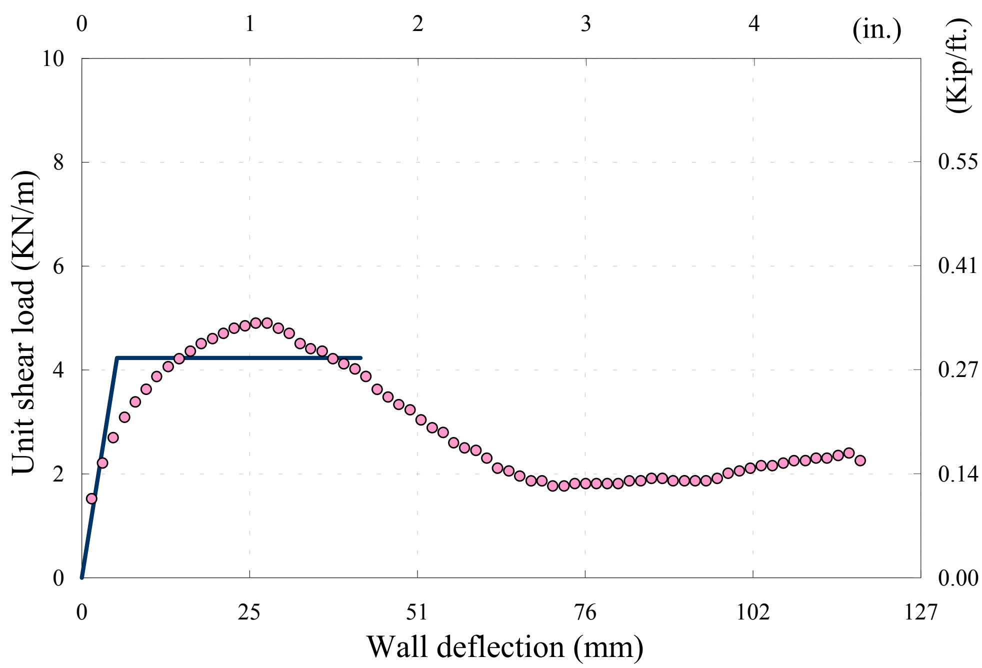


Figure 08IAm1- b. Unit load-deflection and EEEP curves[2].

[1] The scale of the graph varies between test series.
[2] The scale of the graph is uniform between test series for comparison purposes.

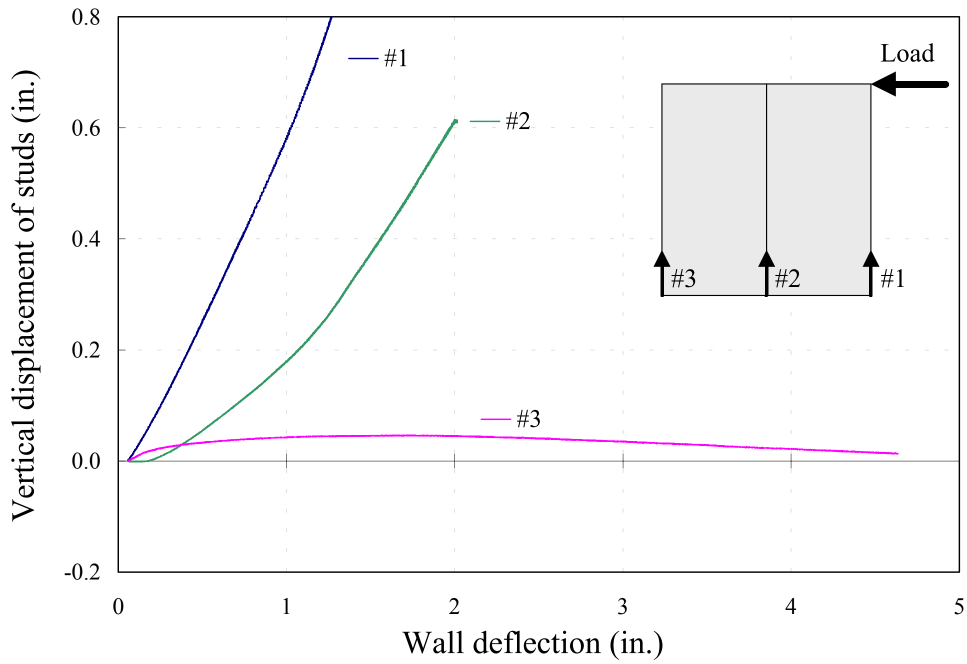


Figure 08IAm1- c. Vertical displacement of studs.

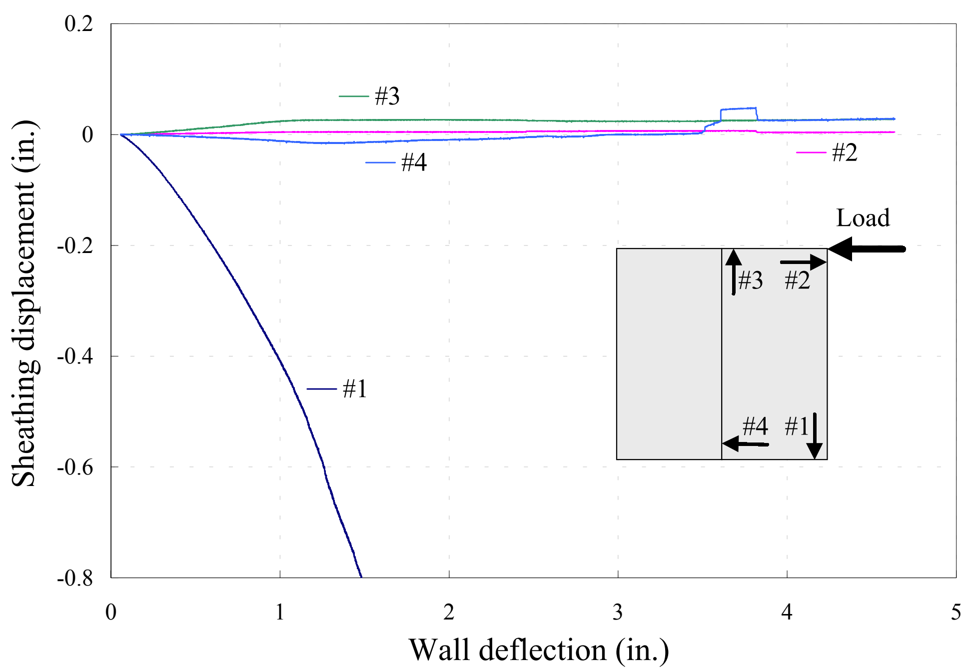


Figure 08IAm1- d. Sheathing displacement.

Table 08IAm2. Data summary.

Specimen **08IAm2**	**Per unit length**	
Shear Bolts	**monotonic test**	
Wall length	**8.00ft.**	**2.438m**
Date: 6-26-1998.	**Time:**	13:57
	units	**08IAm2**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.339 4.947
Drift at peak load, Δ_{peak}	in. mm	1.093 27.76
Yield unit load, v_{yield}	Kip/ft. KN/m	0.287 4.192
Drift at yield load, Δ_{yield}	in. mm	0.248 6.31
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.136 1.979
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.117 2.98
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.269 3.918
Drift at failure, $\Delta_{failure}$	in. mm	1.895 48.15
Shear modulus, G $@0.4v_{peak}$	Kip/in. KN/mm	9.256 1.621
Work until failure per unit length	Kip·ft./ft. KN·m/m	0.042 0.189
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.205 2.998
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.248 3.637
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.326 4.768
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	**0.302** **4.424**

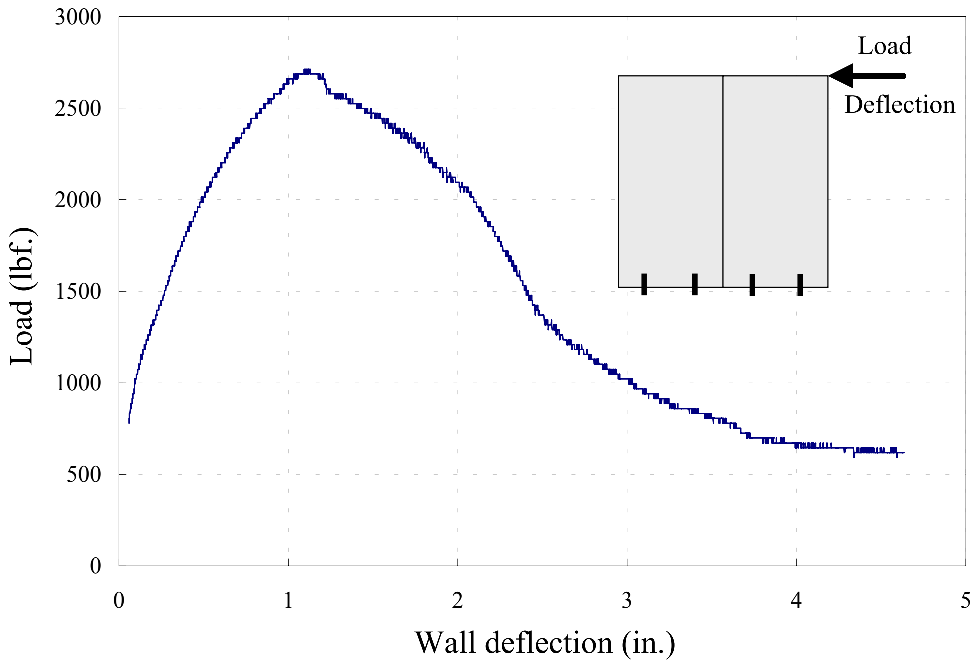


Figure 08IAm2- a. Observed load-deflection curve.

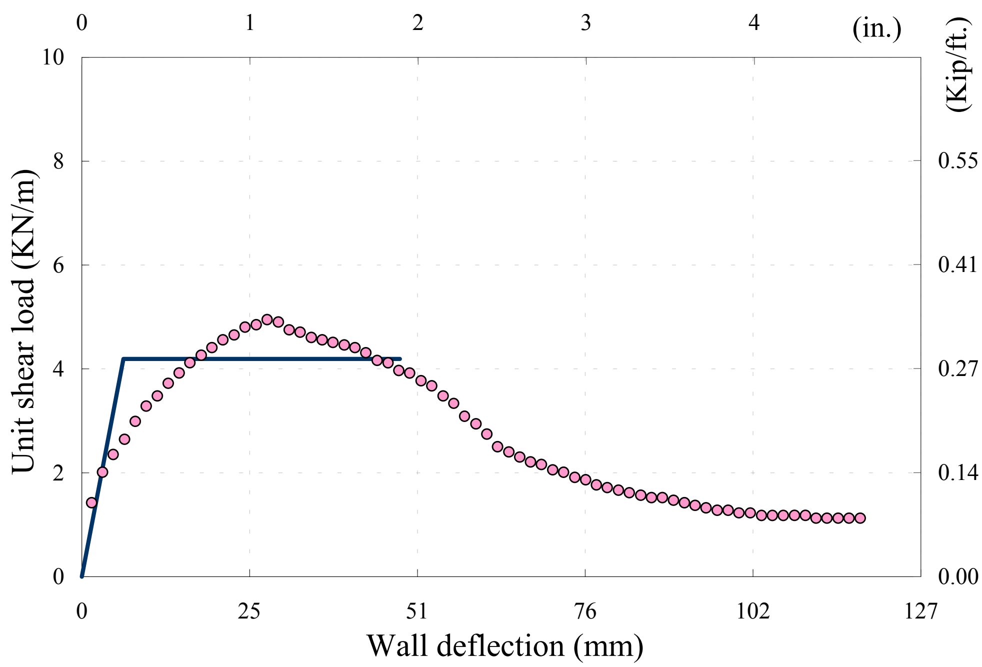


Figure 08IAm2- b. Unit load-deflection and EEEP curves.

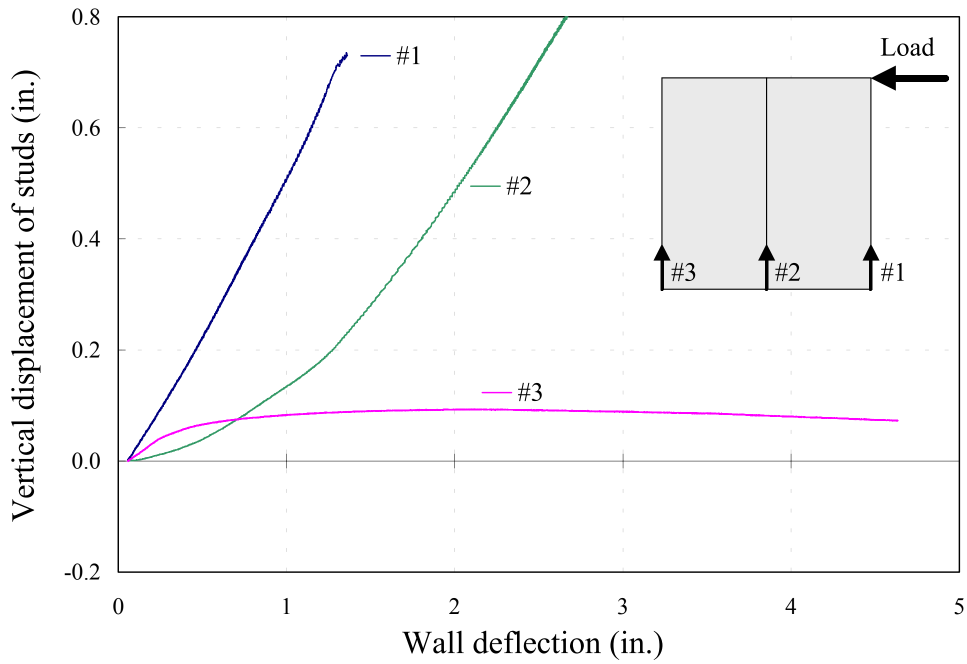


Figure 08IAm2- c. Vertical displacement of studs (initial envelope).

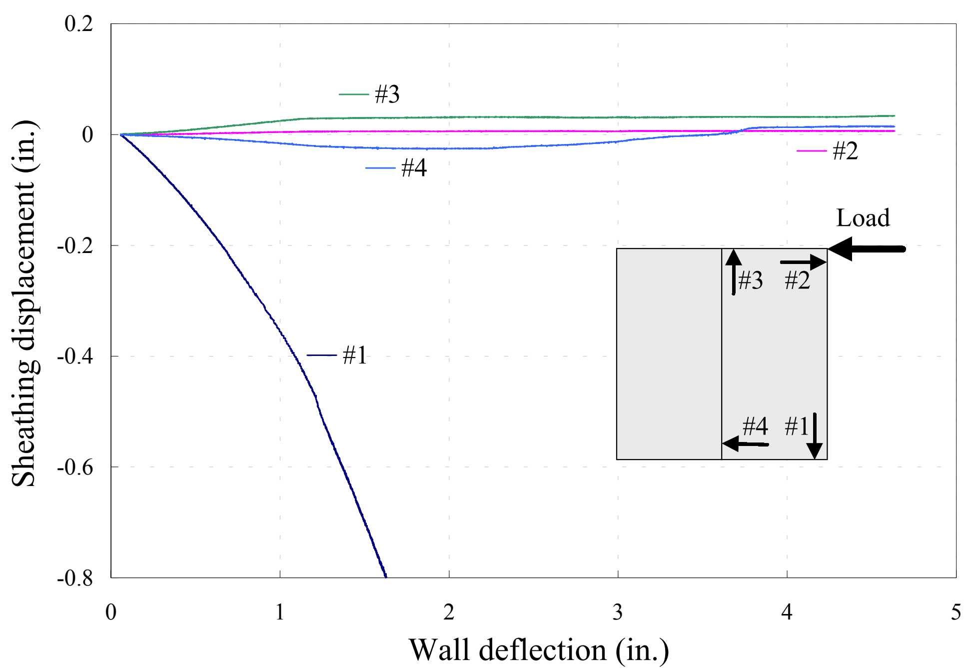


Figure 08IAm2- d. Sheathing displacement.

Table 08IAm3. Data summary.

Specimen **08IAm3**	**Per unit length**	
Shear Bolts	**monotonic test**	
Wall length	**8.00ft.**	**2.438m**
Date: 7-12-1998.	**Time:**	11:51
	units	**08IAm3**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.279 4.071
Drift at peak load, Δ_{peak}	in. mm	0.987 25.08
Yield unit load, v_{yield}	Kip/ft. KN/m	0.247 3.608
Drift at yield load, Δ_{yield}	in. mm	0.360 9.13
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.112 1.629
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.162 4.12
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.223 3.249
Drift at failure, $\Delta_{failure}$	in. mm	1.245 31.63
Shear modulus, G $@0.4v_{peak}$	Kip/in. KN/mm	5.501 0.963
Work until failure per unit length	Kip·ft./ft. KN·m/m	0.022 0.098
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.166 2.433
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.220 3.225
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.278 4.065
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	**0.126** **1.849**

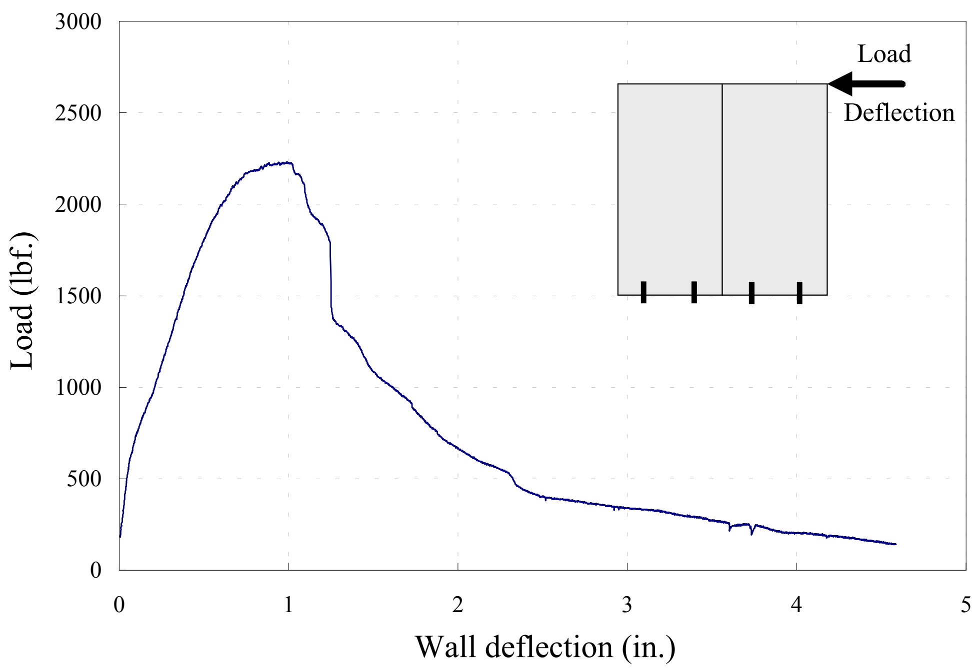


Figure 08IAm3- a. Observed load-deflection curve.

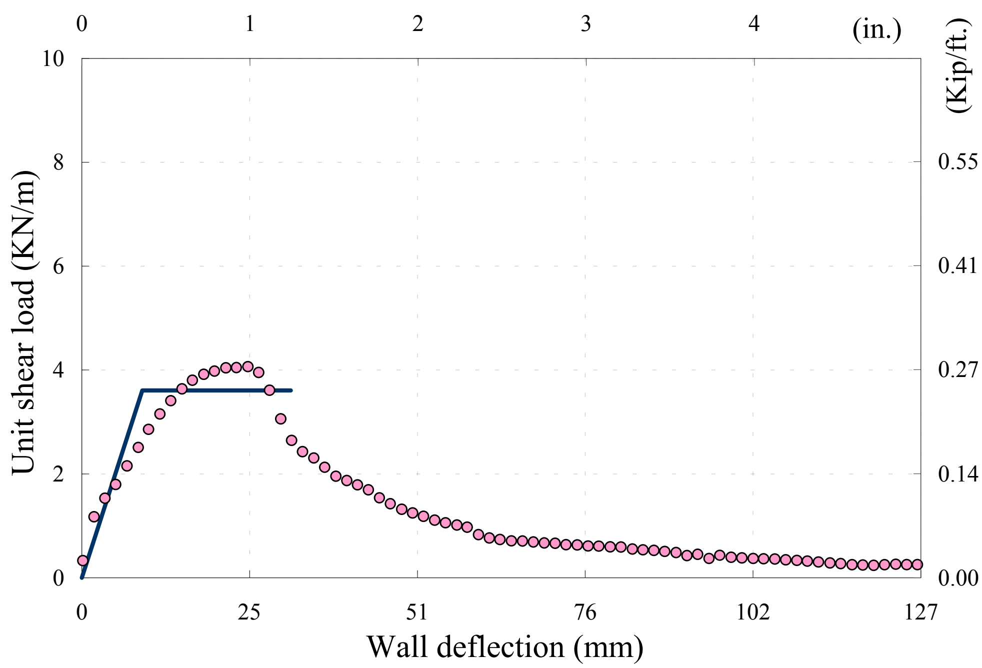


Figure 08IAm3- b. Unit load-deflection and EEEP curves.

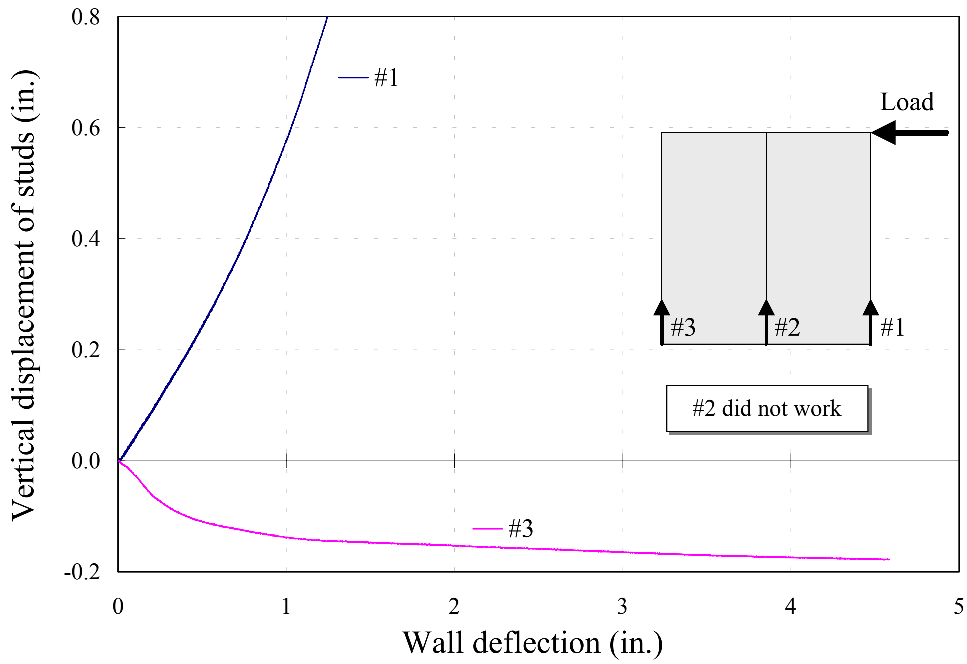


Figure 08IAm3- c. Vertical displacement of studs.

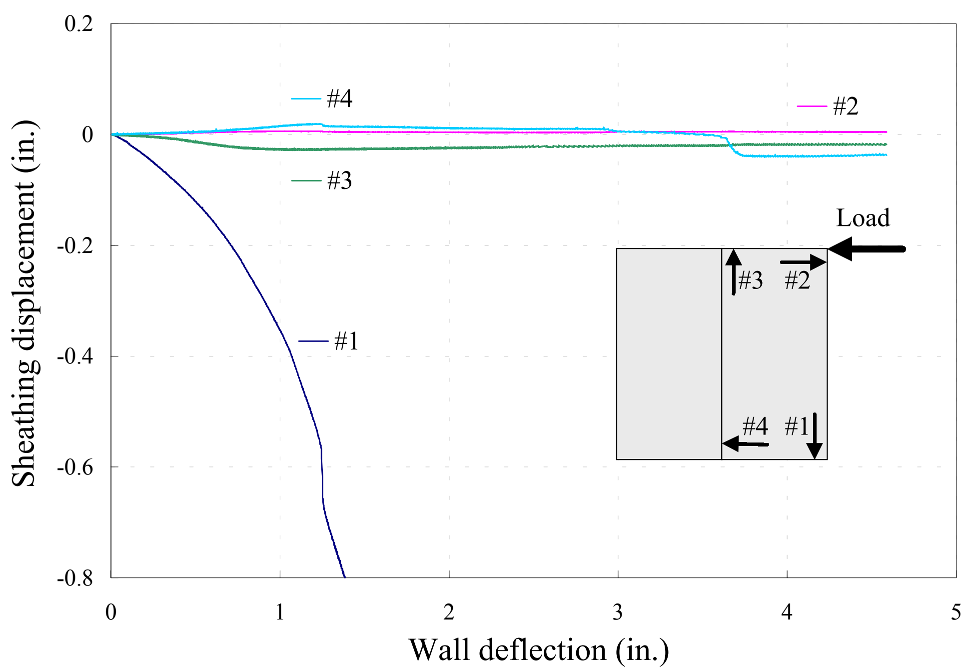


Figure 08IAm3- d. Sheathing displacement.

Table 08IAm4. Data summary.

Specimen **08IAm4**	**Per unit length**	
Shear Bolts	**monotonic test**	
Wall length	**8.00ft.**	**2.438m**
Date: 8-19-1998.	**Time:**	13:40
	units	**08IAm4**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.273 3.982
Drift at peak load, Δ_{peak}	in. mm	1.037 26.34
Yield unit load, v_{yield}	Kip/ft. KN/m	0.229 3.339
Drift at yield load, Δ_{yield}	in. mm	0.313 7.96
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.109 1.593
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.149 3.79
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.218 3.174
Drift at failure, $\Delta_{failure}$	in. mm	1.248 31.70
Shear modulus, G @$0.4v_{peak}$	Kip/in. KN/mm	5.845 1.024
Work until failure per unit length	Kip·ft./ft. KN·m/m	0.021 0.093
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.161 2.354
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.200 2.931
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.268 3.917
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	**0.148** **2.164**

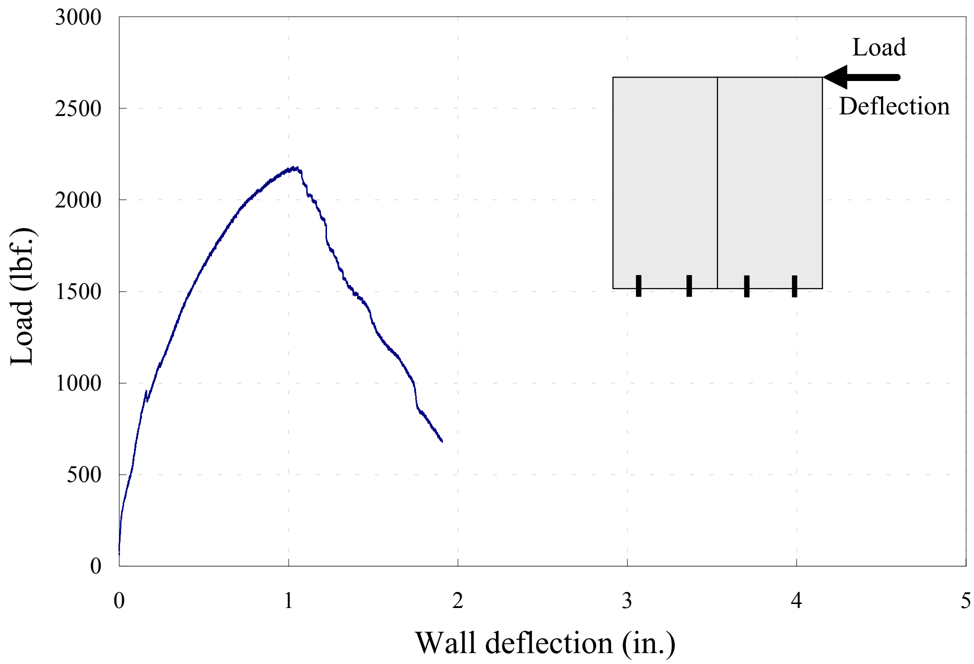


Figure 08IAm4- a. Observed load-deflection curve.

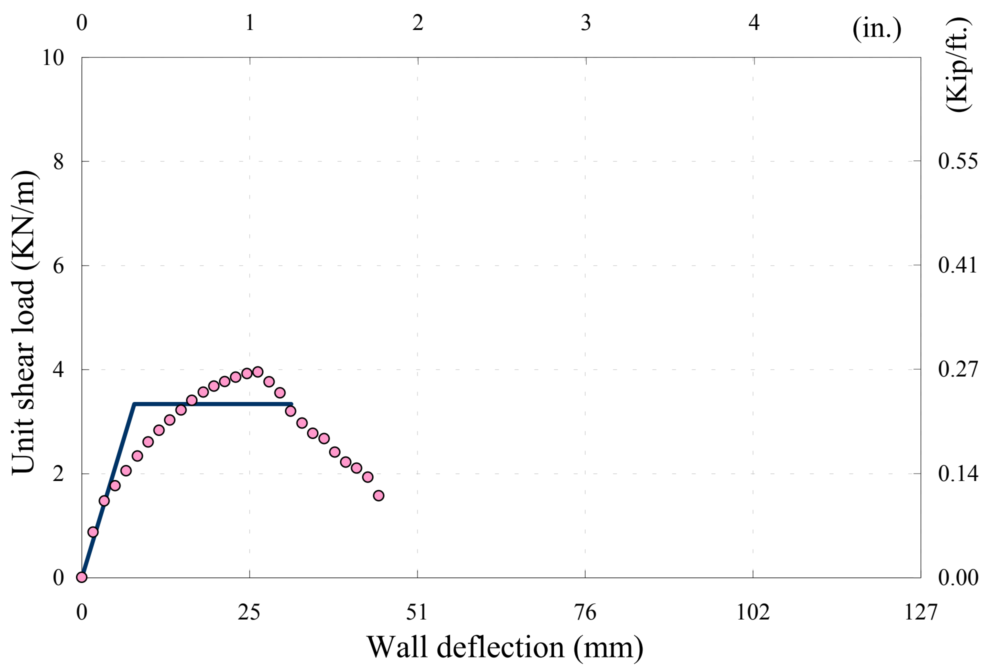


Figure 08IAm4- b. Unit load-deflection and EEEP curves.

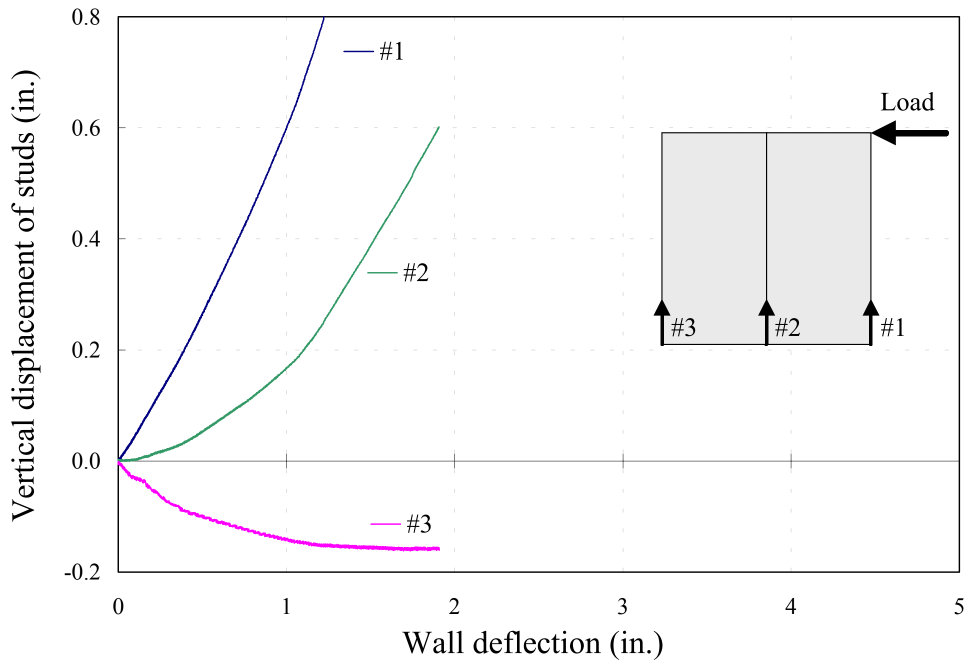


Figure 08IAm4- c. Vertical displacement of studs (initial envelope).

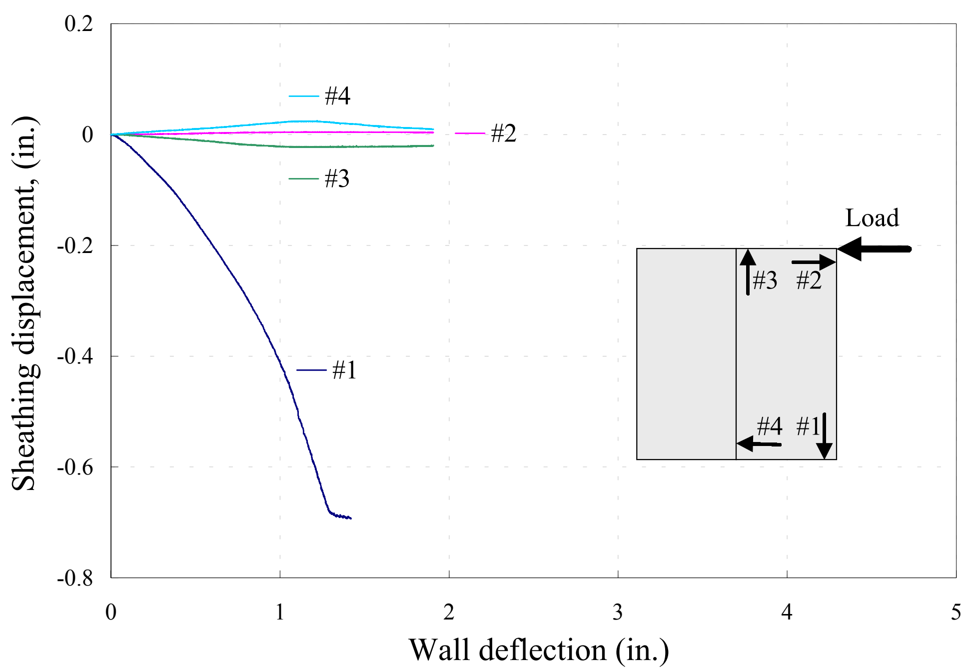


Figure 08IAm4- d. Sheathing displacement.

Table 08IAm4r. Data summary.

Specimen	**08IAm4r**	**Per unit length**	
Shear Bolts		**monotonic test**	
Wall length		**8.00ft.**	**2.438m**
Date:	8-19-1998.	**Time:**	15:30
		units	**08IAm4r**
Peak unit load, v_{peak}		Kip/ft. KN/m	0.284 4.150
Drift at peak load, Δ_{peak}		in. mm	1.245 31.63
Yield unit load, v_{yield}		Kip/ft. KN/m	0.247 3.603
Drift at yield load, Δ_{yield}		in. mm	0.324 8.24
Proportional limit, $0.4v_{peak}$		Kip/ft. KN/m	0.114 1.660
Drift at prop. limit, $\Delta@0.4v_{peak}$		in. mm	0.149 3.79
Unit load at failure or $0.8v_{peak}$		Kip/ft. KN/m	0.227 3.311
Drift at failure, $\Delta_{failure}$		in. mm	1.456 36.98
Shear modulus, G $@0.4v_{peak}$		Kip/in. KN/mm	6.091 1.067
Work until failure per unit length		Kip·ft./ft. KN·m/m	0.027 0.118
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)		Kips/ft. KN/m	0.171 2.502
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)		Kips/ft. KN/m	0.210 3.077
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)		Kips/ft. KN/m	0.271 3.967
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)		Kips/ft. KN/m	**0.210** **3.071**

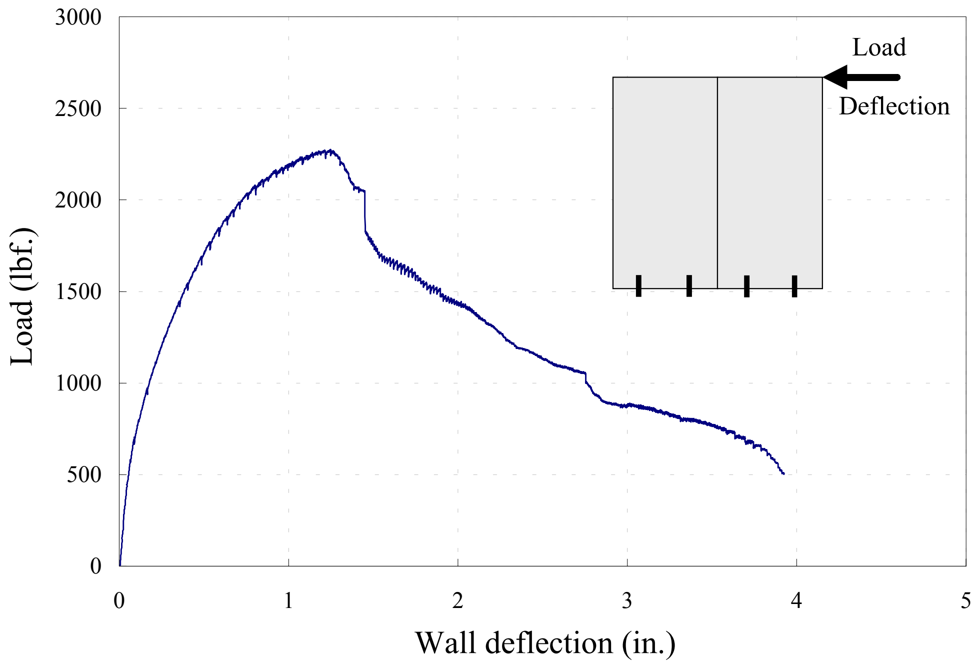


Figure 08IAm4r- a. Observed load-deflection curve.

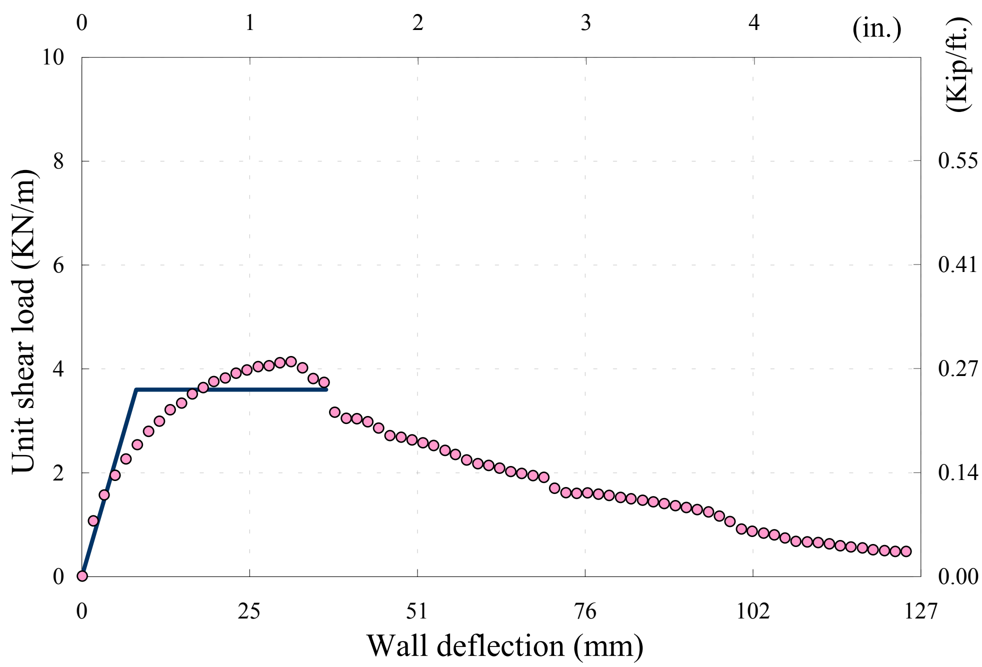


Figure 08IAm4r- b. Unit load-deflection and EEEP curves.

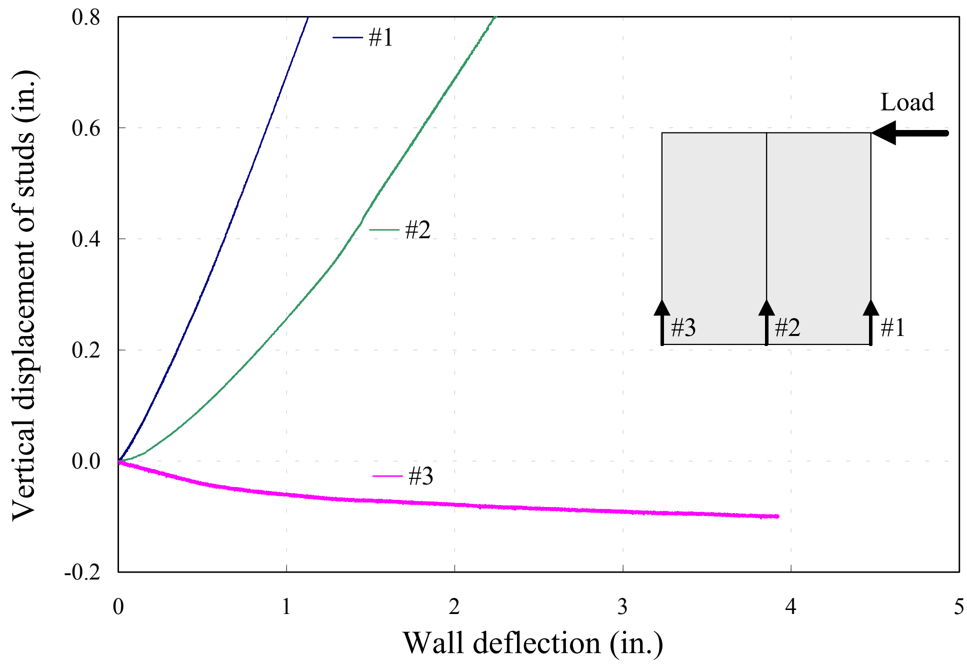


Figure 08IAm4r- c. Vertical displacement of studs (initial envelope).

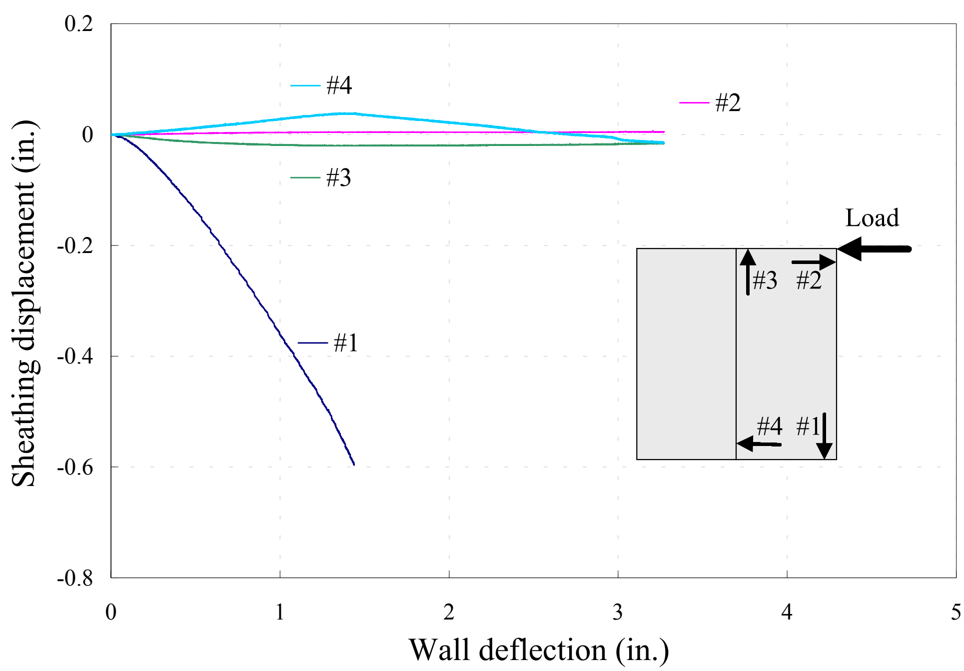


Figure 08IAm4r- d. Sheathing displacement.