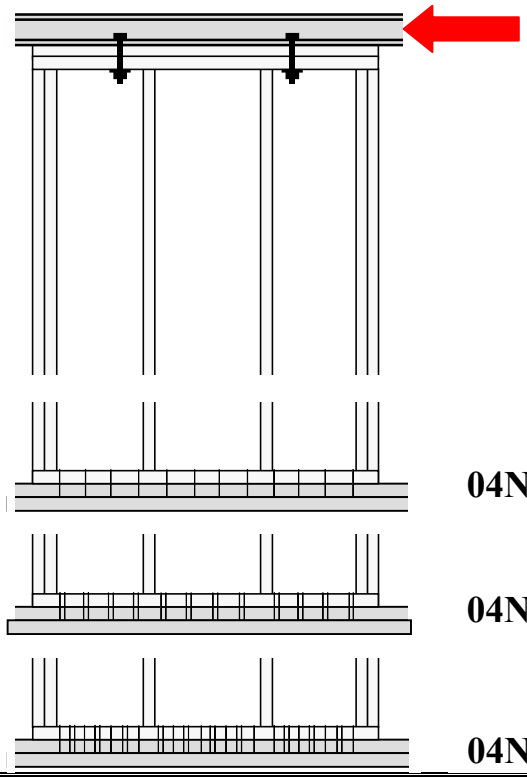
Walls 04NAm

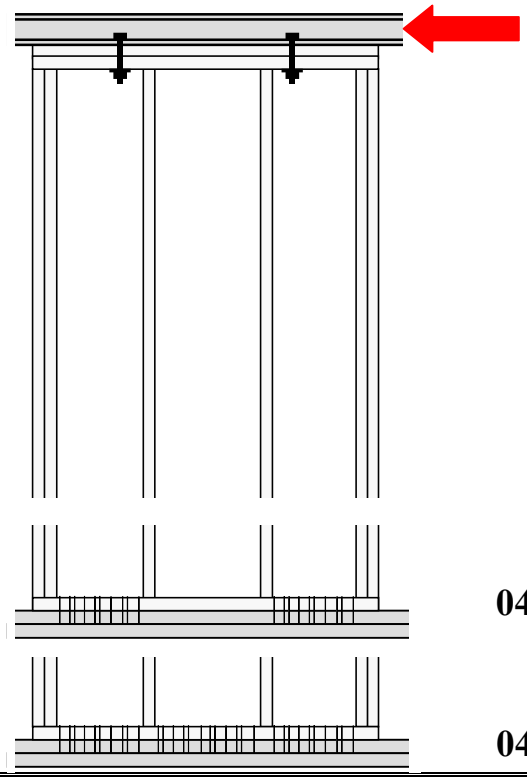


Wall:	**04NAm1**	**04NAm1r**	**04NAm1r3**
Manufactured:	**June 21, 1998**	**June 21, 1998**	**June 21, 1998**
MOE data files:	4nac1s.prn	4nac1s.prn	4nac1s.prn
MOE_{plates} (10^6 psi)			
MOE_{studs} (10^6 psi)	1.46	1.46	1.46
$Density_{plates}$ (kg/m^3)			
$Density_{studs}$ (kg/m^3)	493	493	493
Date tested:	**August 7, 1998**[1]	**August 7, 1998**[2]	**August 7, 1998**[3]
Time tested:	12:22	13:47	15:43
LTC files:			
Data files:	04NAm1.dat	04NAm1r.dat	04NAm1r3.dat
Excel files:	04NAm1_data	04NAm1r_data	04NAm1r3_data
Photo files:	791-796	797-800	801-805

[1] The bottom plate was attached to the base with 1 row of 16d nails at 3 in. o. c. one hour before the test.

[2] The test was conducted on 04NAm1 wall. The bottom plate was attached to the base with 2 rows of 16d nails at 3 in. o. c. one hour before the test. The original bottom plate and base were used.

[3] The test was conducted on 04NAm1 wall. The bottom plate was attached to the base with 3 rows of 16d nails at 3 in. o. c. one hour before the test. The original bottom plate and base were used. The sheathing was attached to with 3/8-in. edge distance



04NAm1r4

04NAm1r5

Wall:	**04NAm1r4**	**04NAm1r5**
Manufactured:	**June 21, 1998**	**June 21, 1998**
MOE data files:	4nac1s.prn	4nac1s.prn
MOE_{plates} (10^6 psi)		
MOE_{studs} (10^6 psi)	1.46	1.46
$Density_{plates}$ (kg/m^3)		
$Density_{studs}$ (kg/m^3)	493	493
Date tested:	**August 10, 1998**[1]	**August 10, 1998**[2]
Time tested:	12:47	13:58
LTC files:	alex_4m	alex_4m
Data files:	04NAm14.dat	04NAm1r5.dat
Excel files:	04NAm14_data	04NAm1r5_data
Photo files:	809-811	812-813

[1] The test was conducted on 04NAm1 wall. The bottom plate was attached to the base with nine nails at each corner (3 rows of 16d nails at 3 in. o. c.) one hour before the test. The new bottom plate and new base were used. The sheathing was attached with ¾-in. edge distance.

[2] The test was conducted on 04NAm1 wall. The bottom plate was attached to the base with 3 rows of 16d nails at 3 in. o. c. half hour before the test. The same bottom plate and the base were used.

General

Rationale: During the tests, there was no dead load applied in the wall plane. Therefore, the wall uplift resistance was provided only by the withdrawal resistance of nails attaching the wall to the base. This situation was similar to real-life practices when the walls parallel to the floor joists carry low gravity loads. During these tests, the required number of nails to prevent the specimen overturning was determined. All five tests were conducted on the same specimen because little or no damage occurred to the wall.

Data processing: During these tests, the load-deflection record was affected by the nail withdrawal. The observed load data was filtered by taking the average of 75 load readings (5 seconds). The summary tables show performance parameters determined from the recorded data (column "observed") and from the filtered data (column "filtered"). The filter helped estimating the failure point more accurately.

Wall 04NAm1

Observations: This wall was attached to the base with twelve 16d nails (one row at 3 in. o. c.). Early in the test (0.16 in.), the wall started overturning due to nail withdrawal from the base. The peak resistance was reached at approximately 0.75 in. deflection. The nail withdrawal continued gradually providing the average "yield" resistance of 0.3 Kips/ft. The wall rocked as a rigid body around the left-end corner. Sheathing displacement relative to the framing was negligible with the exception of the right-bottom corner, where the displacement reached 0.04 in.

Failure mode: The nails attaching the wall to the base withdrew (Photos 791, 792,795).

Wall 04NAm1r

Observations: This wall was attached to the base with twenty-four 16d nails (two rows at 3 in. o. c.). Similar to the first test, the wall started early overturning due to nail withdrawal from the base. The peak resistance was slightly higher and was reached later (at approximately 1.0 in. deflection). The wall rocked as a rigid body around the left-end corner until the nails withdrew from the base. Sheathing displacement relative to the framing was negligible with the exception of the right-bottom corner, where the displacement reached 0.09 in.

Failure mode: The nails attaching the wall to the base withdrew (Photos 797, 798,800).

Data acquisition: The data after 1.5 in. was not recorded.

Wall 04NAm1r3

Observations: This wall was attached to the base with thirty-six 16d nails (three rows at 3 in. o. c.). The response of this wall was significantly different from the previous tests. The 36 nails provided sufficient resistance to prevent the wall overturning. The peak resistance 628 lbf. (0.16 Kips/ft.) was reached at 1.9 in. deflection. The elastic stiffness was low due to the effect of the previous tests. Note, this wall was tested twice before and the bottom plate was not replaced. Sheathing displacement relative to the framing was negligible with the exception of the bottom plate, which separated from the sheathing similar to 04IAm walls. The degradation of wall strength was gradual. The 20% resistance reduction was observed at 2.4-in. deflection.

Failure mode: The sheathing separated from the bottom plate (Photos 801, 804). Sheathing nails tore through the sheathing edge. The edge distance was 3/8 in. and less (Photo 803).

Wall 04NAm1r4

Rationale: The 04NAm1r3 test showed that 36 nails attaching the specimen to the base were more than adequate to prevent the wall overturning. The 04NAm1r4 test was designed assuming that the nails closest to the corner contribute the overturning resistance the most. The specimen was attached to the base with nine nails in each corner, 3 rows at 3 in. o. c. (Photo 809). The new base and the bottom plate were applied. The sheathing was attached at 6 in. o. c. with ¾-in. edge distance.

Observations: The initial part of the load-deflection curve was steep. Apparently, the dense placement of nails provided initial overturning resistance. However, early in the test (0.17 in.), the nail withdrawal from the base started influencing the wall response. The peak resistance was reached at 0.86 in. deflection, and then the nails 'gave up'. It can clearly be seen on Figure 04NAm1r4-d. Initially, the sheathing panel was moving relative to the bottom plate, indicating the work of the sheathing nails. At the critical point (0.86 in.) the separation stopped and the bottom plate started the uplift displacement together with the rest of the wall.

Failure mode: The nails attaching the wall to the base withdrew (Photos 812, 813).

Wall 04NAm1r5

Observations: This wall was attached to the base with thirty-six 16d nails (three rows at 3 in. o. c.). It was a replication of 04NAm1r3 test. The sheathing was attached to the bottom plate with ¾-in. edge distance. The response of this wall was stiffer and stronger than in the previous tests and comparable with 04IAm walls. The peak resistance 747 lbf. (0.19 Kips/ft.) was reached at 1.35 in. deflection. Sheathing displacement relative to the framing was negligible with the exception of the bottom plate, which separated from the sheathing similar to 04IAm walls. The degradation of wall strength was gradual. The 20% resistance reduction was observed at 2.0-in. deflection.

Failure mode: The sheathing separated from the bottom plate (Photos 812, 813). Sheathing nails tore through the sheathing edge.

Table 04NAm1. Data summary.

Specimen	**04NAm1**	**Per unit length**		
Nails		**monotonic test**		
Wall length		**4.00ft.**	**1.219m**	
Date:	8-07-1998.	**Time:**	12:22	
		units	**observed**	**filtered**
Peak unit load, v_{peak}		Kip/ft. KN/m	0.101 1.481	0.092 1.339
Drift at peak load, Δ_{peak}		in. mm	1.254 31.85	1.249 31.73
Yield unit load, v_{yield}		Kip/ft. KN/m	0.081 1.183	0.083 1.209
Drift at yield load, Δ_{yield}		in. mm	0.235 5.98	0.232 5.89
Proportional limit, $0.4v_{peak}$		Kip/ft. KN/m	0.041 0.592	0.037 0.536
Drift at prop. limit, $\Delta@0.4v_{peak}$		in. mm	0.118 2.99	0.103 2.61
Unit load at failure or $0.8v_{peak}$		Kip/ft. KN/m	0.080 1.167	0.073 1.061
Drift at failure, $\Delta_{failure}$		in. mm	1.304 33.11	2.968 75.38
Shear modulus, G $@0.4v_{peak}$		Kip/in. KN/mm	2.755 0.483	2.857 0.500
Work until failure per unit length		Kip·ft./ft. KN·m/m	0.008 0.036	0.020 0.088
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)		Kips/ft. KN/m	0.062 0.901	0.060 0.879
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)		Kips/ft. KN/m	0.069 1.000	0.071 1.032
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)		Kips/ft. KN/m	0.087 1.263	0.090 1.307
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)		Kips/ft. KN/m	**0.090** **1.314**	**0.091** **1.334**

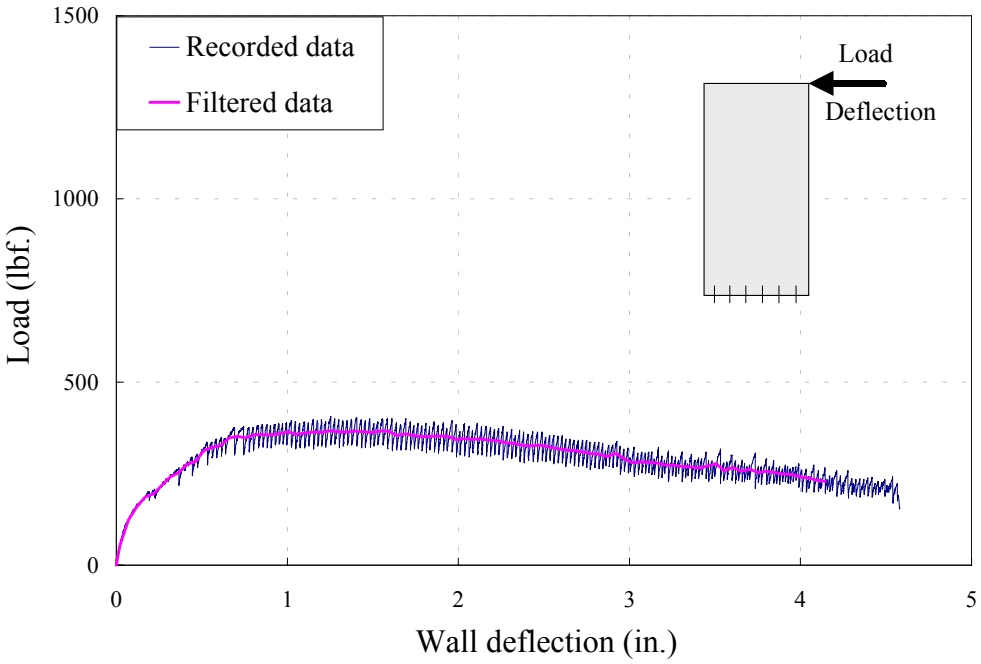


Figure 04NAm1- a. Observed and filtered load-deflection curves[1].

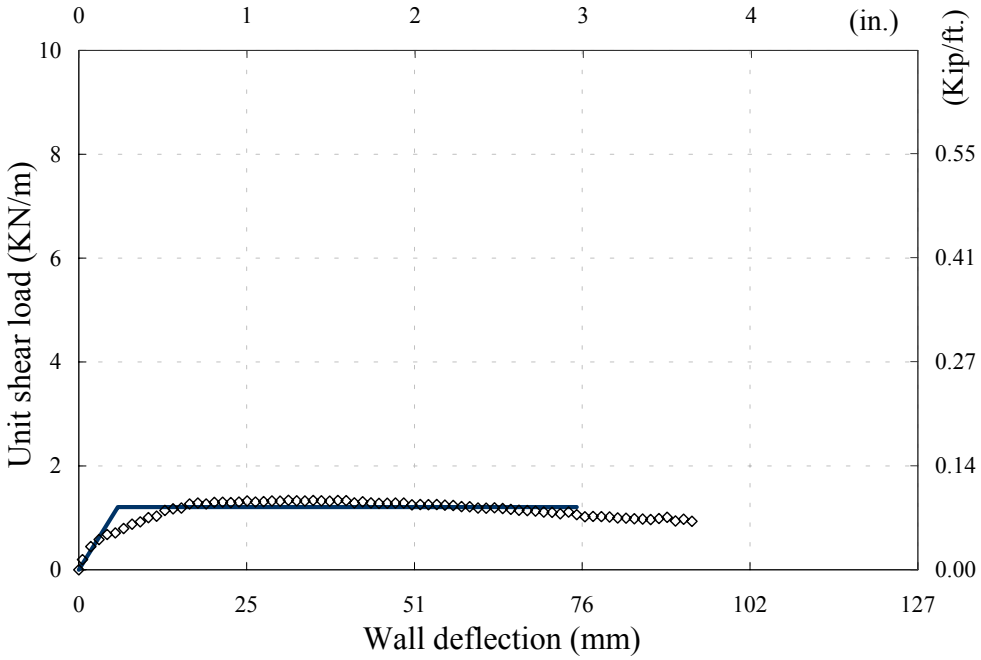


Figure 04NAm1- b. Unit load-deflection and EEEP curves[2].

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

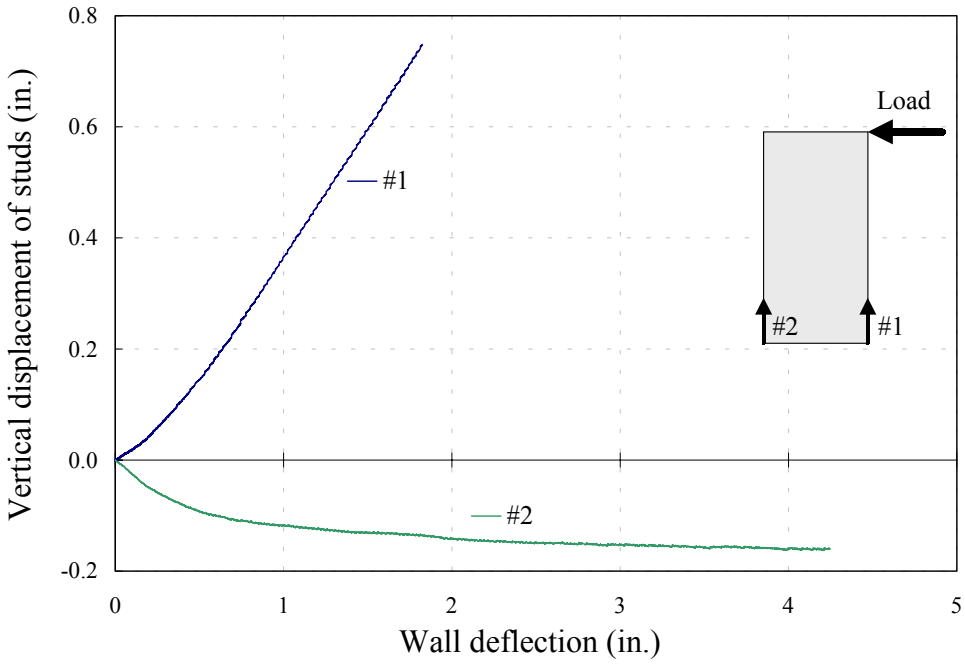


Figure 04NAm1- c. Vertical displacement of studs.

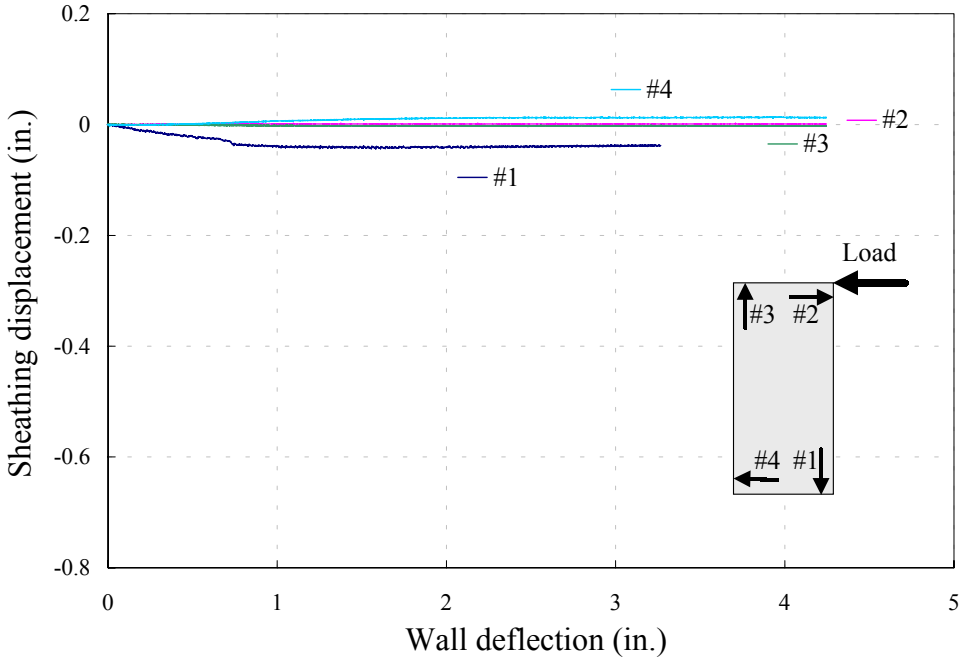


Figure 04NAm1- d. Sheathing displacement.

Table 04NAm1r. Data summary.

Specimen **04NAm1r**		**Per unit length**		
Nails		**monotonic test**		
Wall length		**4.00ft.**	**1.219m**	
Date:	8-07-1998.	**Time:**	13:47	
		units	**observed**	**filtered**
Peak unit load, v_{peak}		Kip/ft. KN/m	0.132 1.919	0.122 1.773
Drift at peak load, Δ_{peak}		in. mm	1.436 36.46	1.354 34.38
Yield unit load, v_{yield}		Kip/ft. KN/m	0.105 1.529	0.102 1.495
Drift at yield load, Δ_{yield}		in. mm	0.382 9.71	0.346 8.79
Proportional limit, $0.4v_{peak}$		Kip/ft. KN/m	0.053 0.768	0.049 0.709
Drift at prop. limit, $\Delta@0.4v_{peak}$		in. mm	0.192 4.87	0.164 4.17
Unit load at failure or $0.8v_{peak}$		Kip/ft. KN/m	0.123 1.791	0.119 1.733
Drift at failure, $\Delta_{failure}$		in. mm	1.500 38.10	1.449 36.81
Shear modulus, G $@0.4v_{peak}$		Kip/in. KN/mm	2.194 0.384	2.368 0.415
Work until failure per unit length		Kip·ft./ft. KN·m/m	0.011 0.051	0.011 0.048
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)		Kips/ft. KN/m	0.062 0.901	0.062 0.902
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)		Kips/ft. KN/m	0.081 1.175	0.076 1.115
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)		Kips/ft. KN/m	0.115 1.675	0.109 1.591
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)		Kips/ft. KN/m	**N/A** **N/A**	**N/A** **N/A**

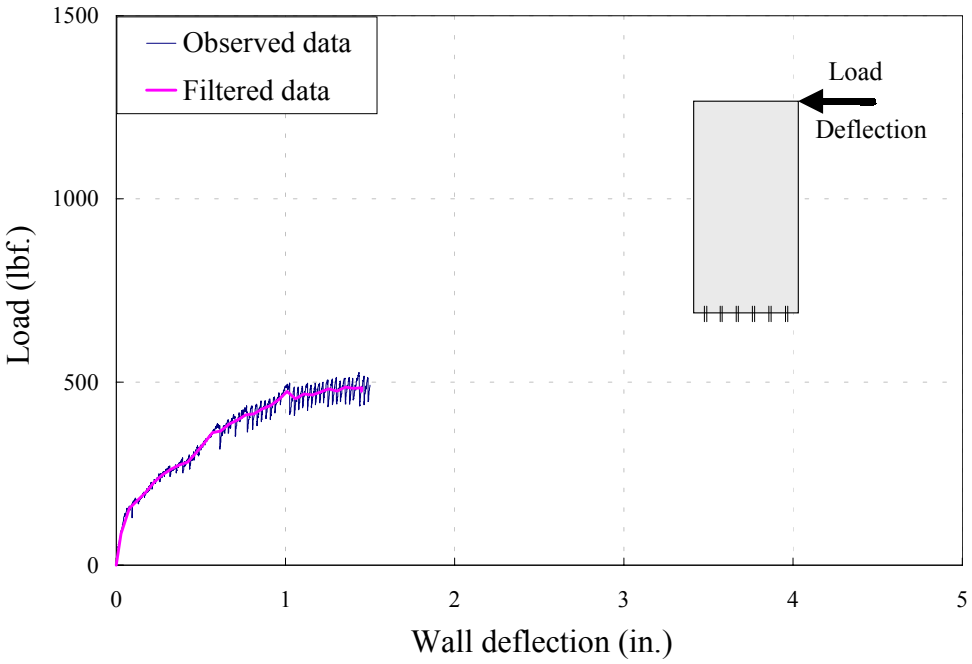


Figure 04NAm1r- a. Observed and filtered load-deflection curves.

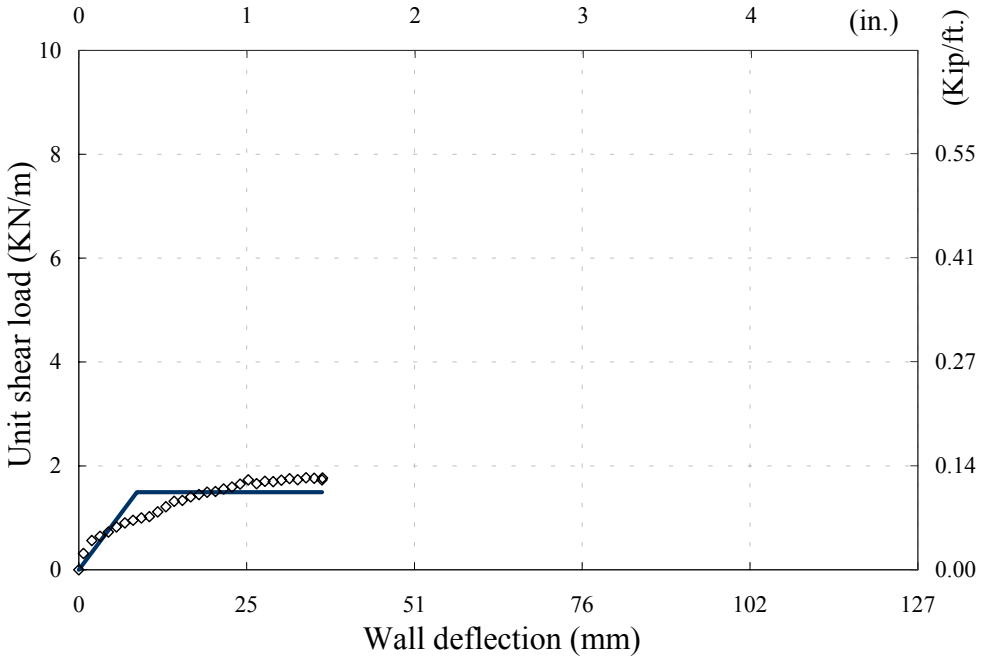


Figure 04NAm1r- b. Unit load-deflection and EEEP curves.

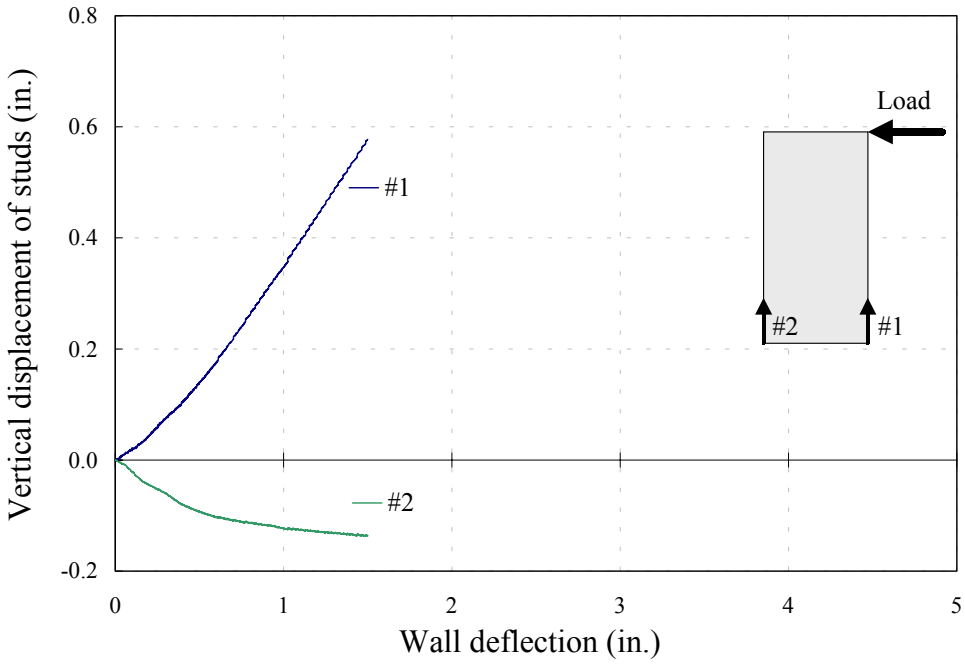


Figure 04NAm1r- c. Vertical displacement of studs.

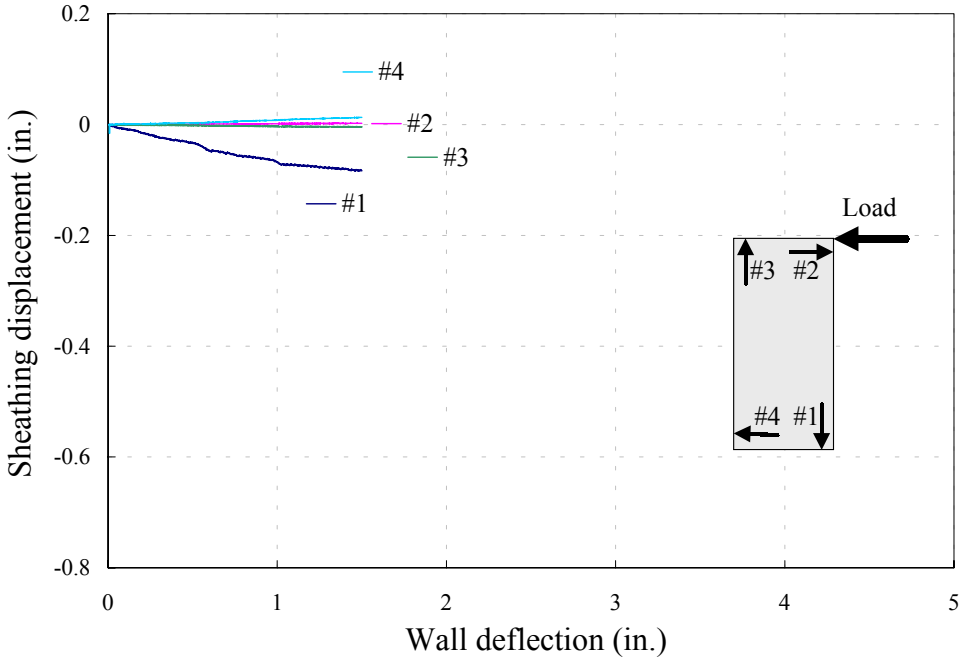


Figure 04NAm1r- d. Sheathing displacement.

Table 04NAm1r4. Data summary.

Specimen **04NAm1r4**	**Per unit length**		
Nails	**monotonic test**		
Wall length	**4.00ft.**	**1.219m**	
Date: 8-10-1998.	**Time:**	12:47	
	units	**observed**	**filtered**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.137 1.999	0.127 1.852
Drift at peak load, Δ_{peak}	in. mm	0.820 20.84	0.761 19.34
Yield unit load, v_{yield}	Kip/ft. KN/m	0.112 1.636	0.112 1.629
Drift at yield load, Δ_{yield}	in. mm	0.138 3.50	0.140 3.56
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.055 0.800	0.051 0.741
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.067 1.71	0.064 1.62
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.097 1.412	0.099 1.442
Drift at failure, $\Delta_{failure}$	in. mm	0.823 20.91	2.038 51.76
Shear modulus, G $@0.4v_{peak}$	Kip/in. KN/mm	6.504 1.139	6.380 1.117
Work until failure per unit length	Kip·ft./ft. KN·m/m	0.007 0.031	0.018 0.081
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.108 1.576	0.105 1.534
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.112 1.627	0.117 1.705
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.112 1.635	0.119 1.734
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	**0.124** **1.803**	**0.111** **1.613**

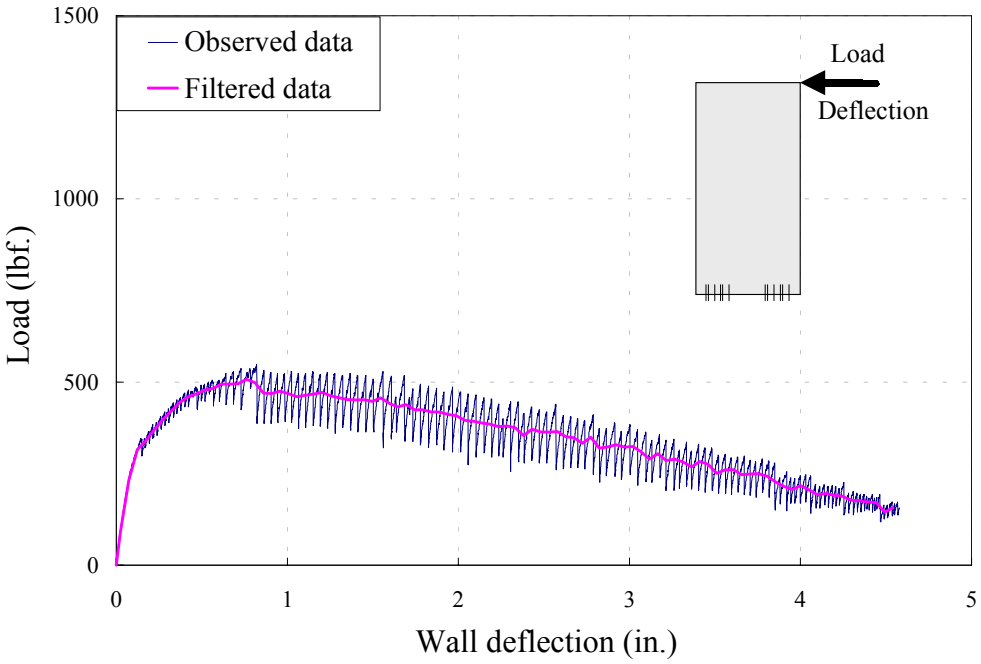


Figure 04NAm1r4- a. Observed and filtered load-deflection curves.

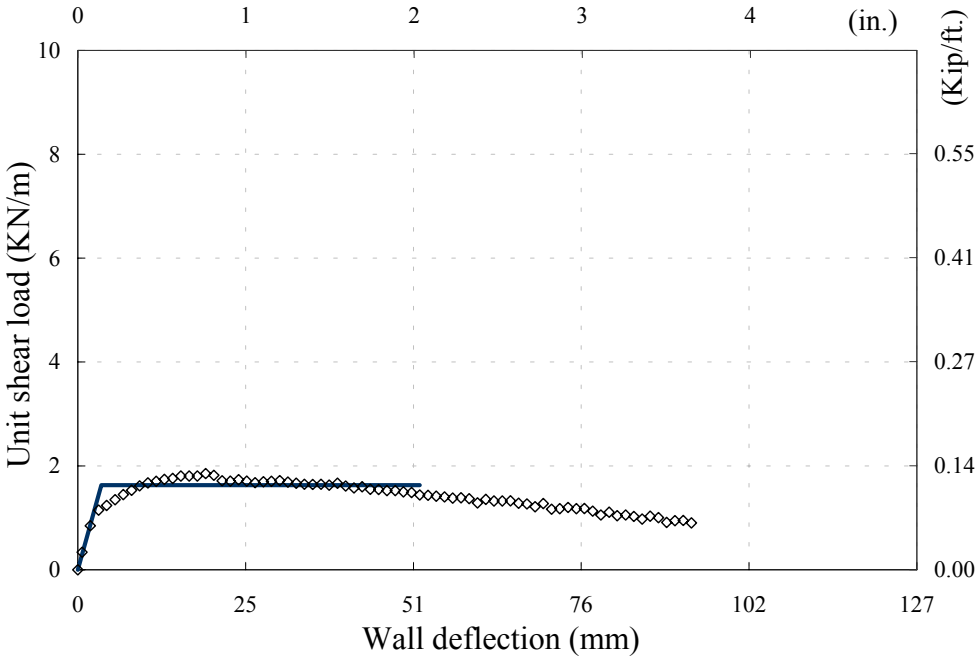


Figure 04NAm1r4- b. Unit load-deflection and EEEP curves.

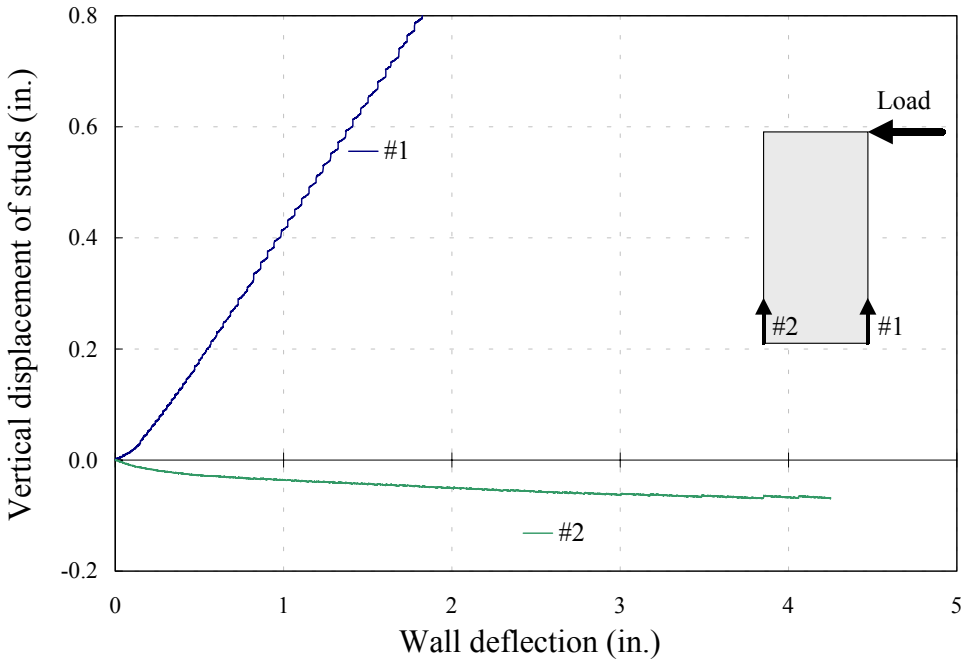


Figure 04NAm1r4- c. Vertical displacement of studs.

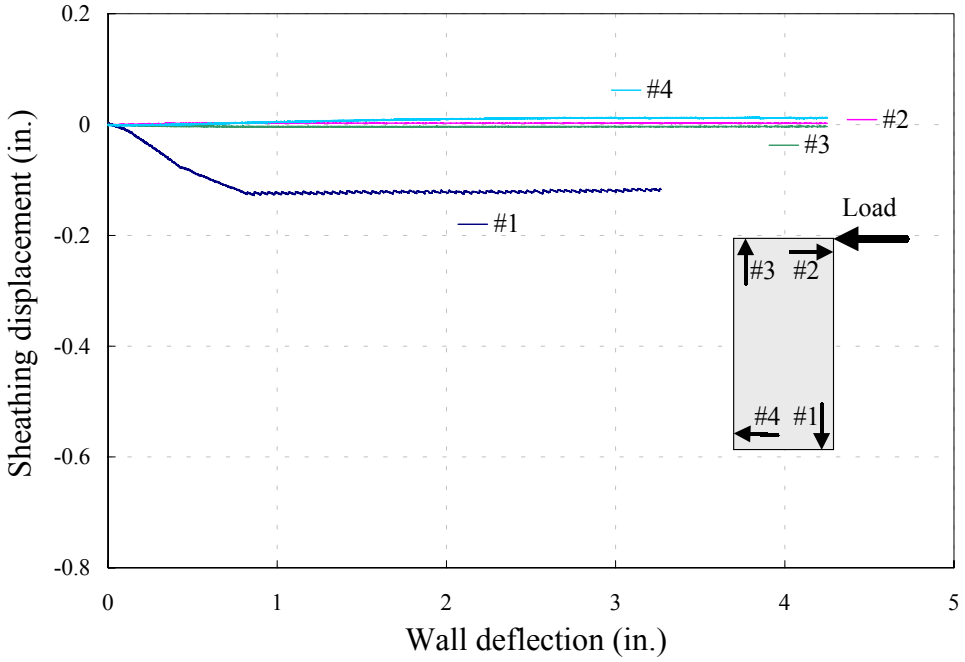


Figure 04NAm1r4- d. Sheathing displacement.

Table 04NAm1r3. Data summary.

Specimen **04IAm1r3**	**Per unit length**	
Nails	**monotonic test**	
Wall length	**4.00ft.**	**1.219m**
Date: 7-07-1998.	**Time:**	15:43
	units	**04IAm1r3**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.157 2.291
Drift at peak load, Δ_{peak}	in. mm	1.878 47.70
Yield unit load, v_{yield}	Kip/ft. KN/m	0.133 1.938
Drift at yield load, Δ_{yield}	in. mm	0.545 13.84
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.063 0.916
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.258 6.55
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.125 1.831
Drift at failure, $\Delta_{failure}$	in. mm	2.443 62.06
Shear modulus, G $@0.4v_{peak}$	Kip/in. KN/mm	1.949 0.341
Work until failure per unit length	Kip·ft./ft. KN·m/m	0.024 0.107
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.066 0.960
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.075 1.098
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.122 1.784
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	0.151 2.204

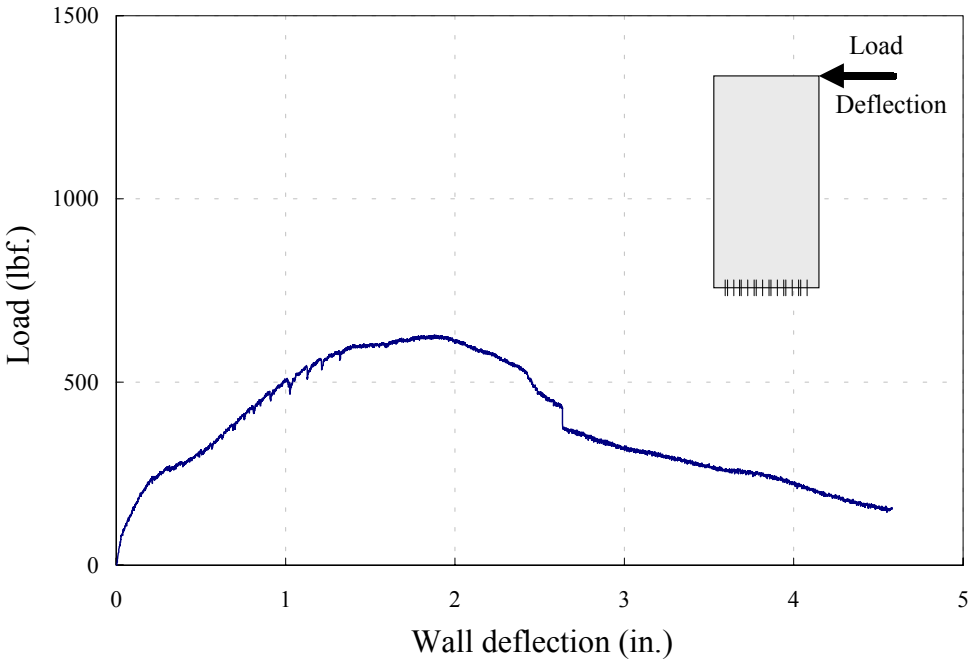


Figure 04NAm1r3- a. Observed load-deflection curve.

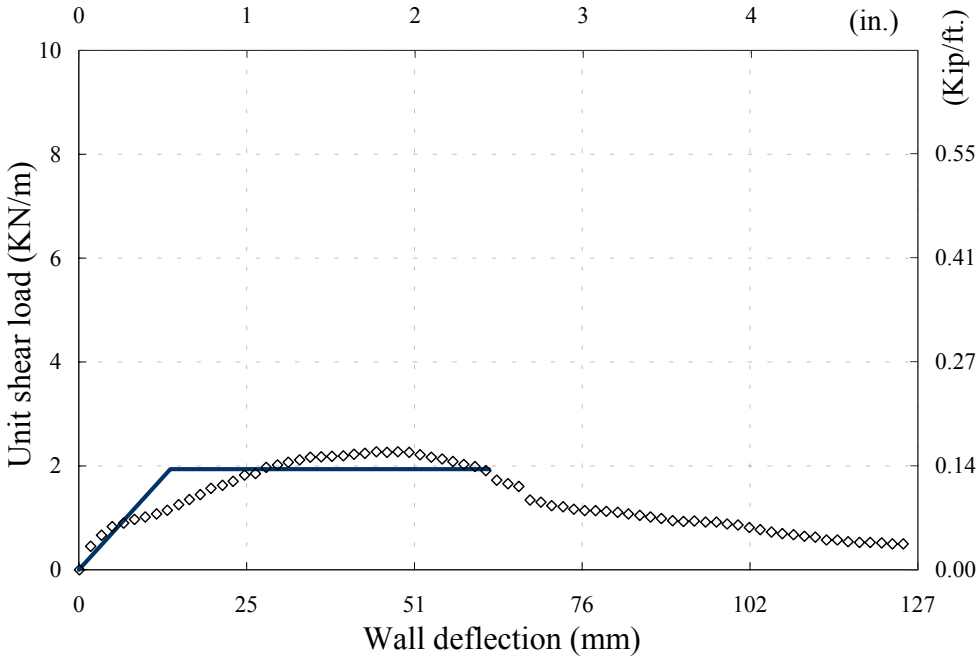


Figure 04NAm1r3- b. Unit load-deflection and EEEP curves.

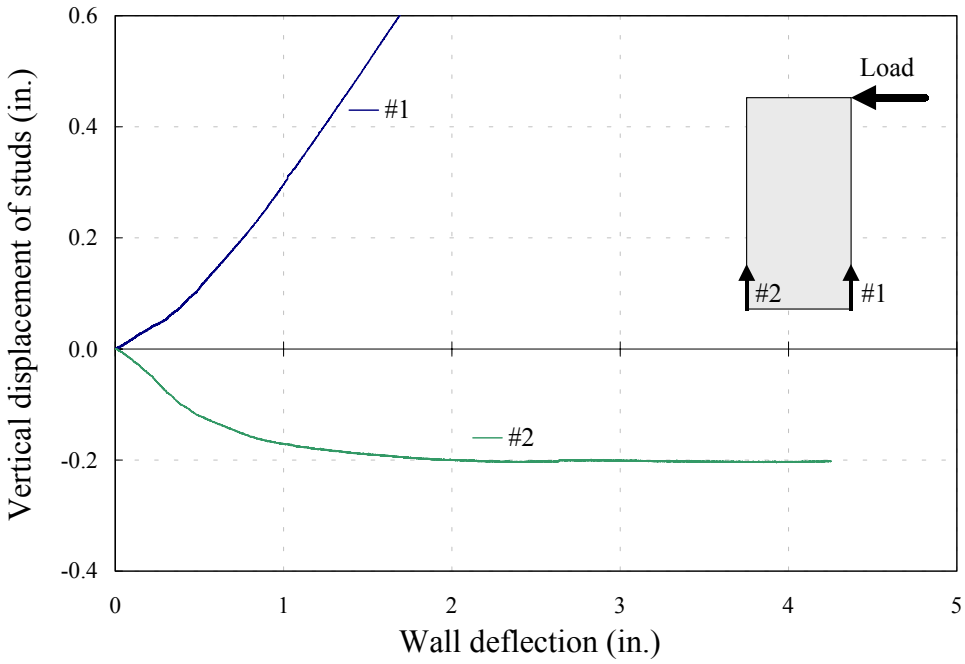


Figure 04NAm1r3- c. Vertical displacement of studs.

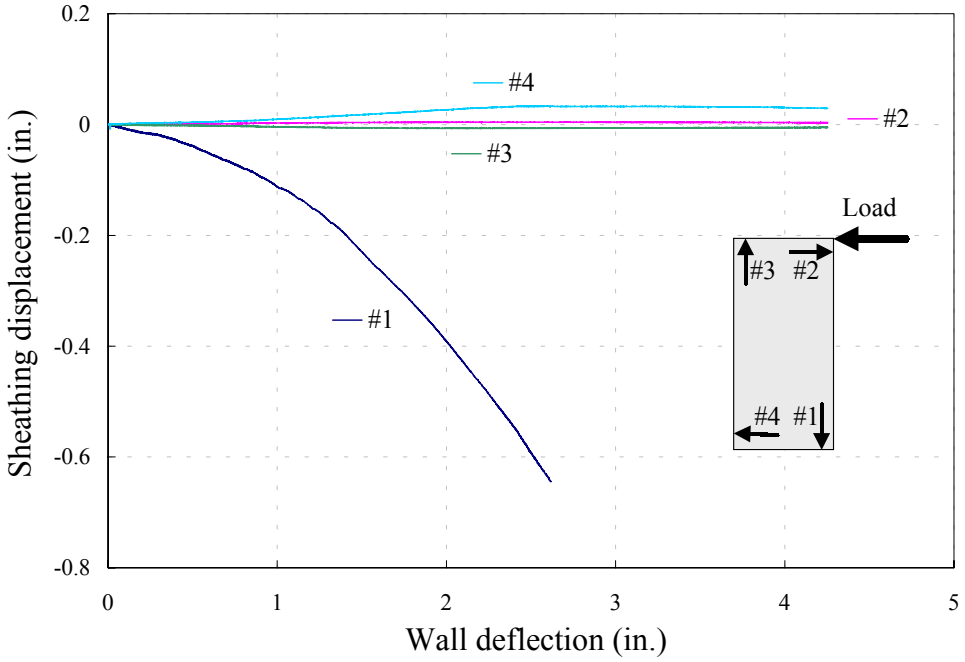


Figure 04NAm1r3- d. Sheathing displacement.

Table 04NAm1r5. Data summary.

Specimen **04NAm1r5**		**Per unit length**		
Nails		**monotonic test**		
Wall length		**4.00ft.**	**1.219m**	
Date:	8-10-1998.	**Time:**	13:58	
		units	**observed**	**filtered**
Peak unit load, v_{peak}		Kip/ft. KN/m	0.187 2.725	0.180 2.633
Drift at peak load, Δ_{peak}		in. mm	1.356 34.45	1.346 34.20
Yield unit load, v_{yield}		Kip/ft. KN/m	0.165 2.411	0.162 2.367
Drift at yield load, Δ_{yield}		in. mm	0.403 10.25	0.399 10.13
Proportional limit, $0.4v_{peak}$		Kip/ft. KN/m	0.075 1.090	0.072 1.053
Drift at prop. limit, $\Delta@0.4v_{peak}$		in. mm	0.182 4.63	0.177 4.51
Unit load at failure or $0.8v_{peak}$		Kip/ft. KN/m	0.146 2.127	0.142 2.073
Drift at failure, $\Delta_{failure}$		in. mm	1.787 45.39	2.083 52.90
Shear modulus, G $@0.4v_{peak}$		Kip/in. KN/mm	3.276 0.574	3.254 0.570
Work until failure per unit length		Kip·ft./ft. KN·m/m	0.022 0.097	0.025 0.113
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)		Kips/ft. KN/m	0.112 1.627	0.108 1.573
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)		Kips/ft. KN/m	0.133 1.941	0.134 1.950
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)		Kips/ft. KN/m	0.170 2.478	0.172 2.517
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)		Kips/ft. KN/m	**0.174** **2.540**	**0.171** **2.501**

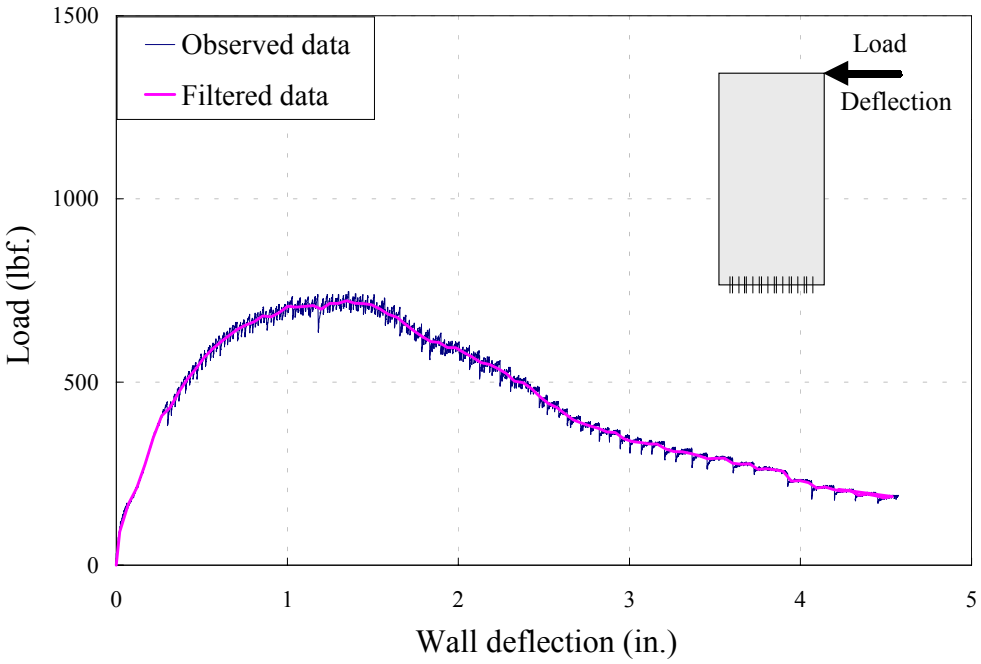


Figure 04NAm1r5- a. Observed and filtered load-deflection curves.

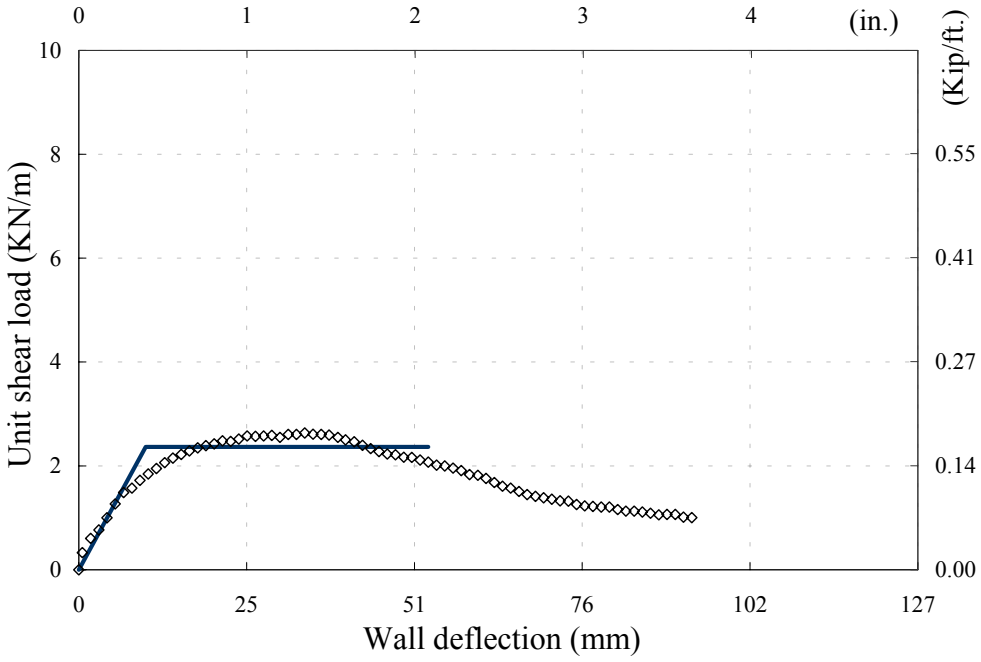


Figure 04NAm1r5- b. Unit load-deflection and EEEP curves.

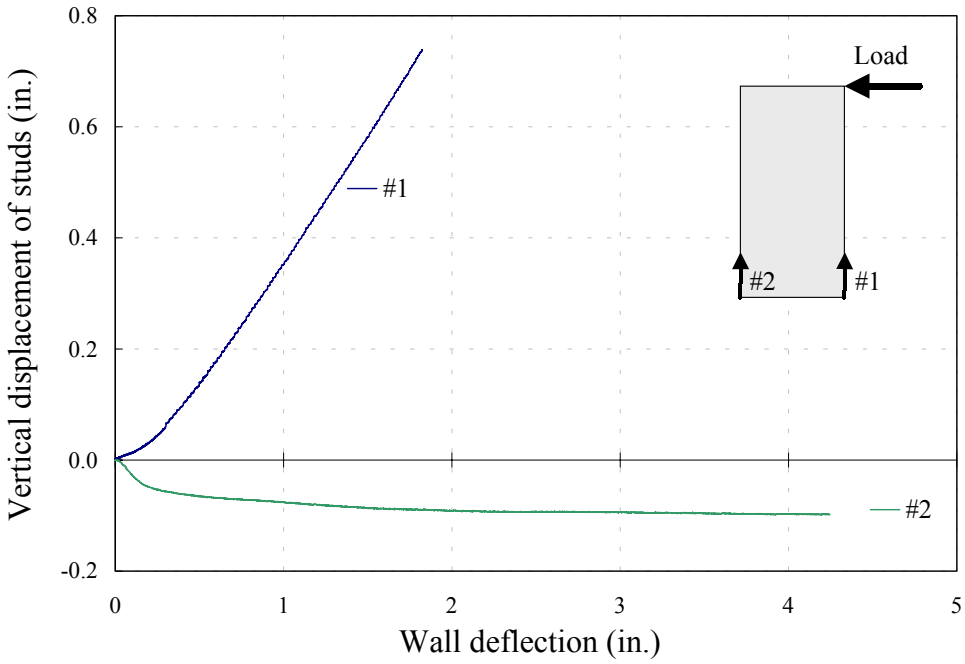


Figure 04NAm1r5- c. Vertical displacement of studs.

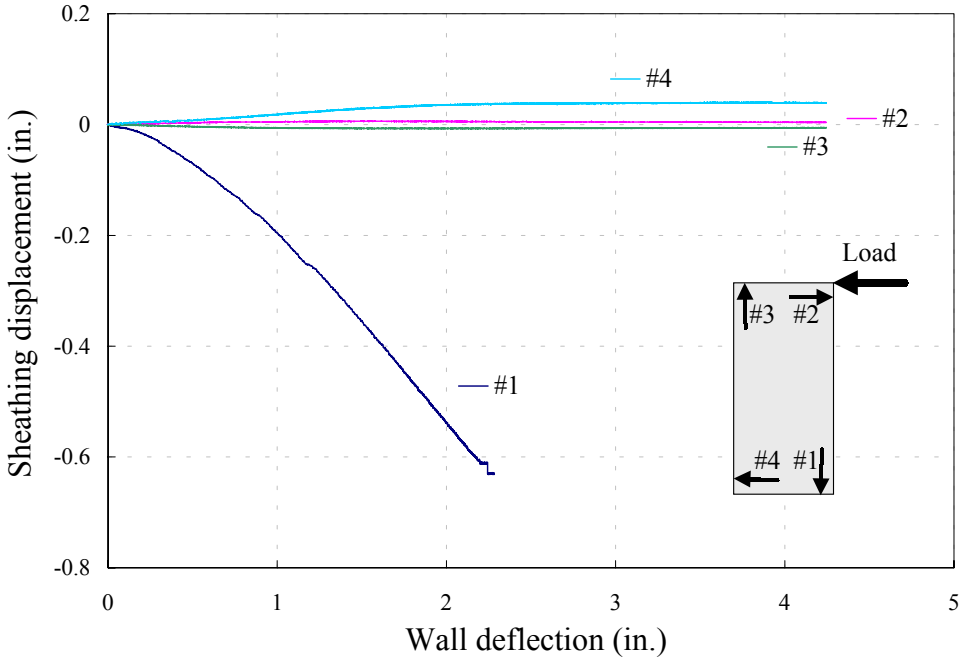


Figure 04NAm1r5- d. Sheathing displacement.