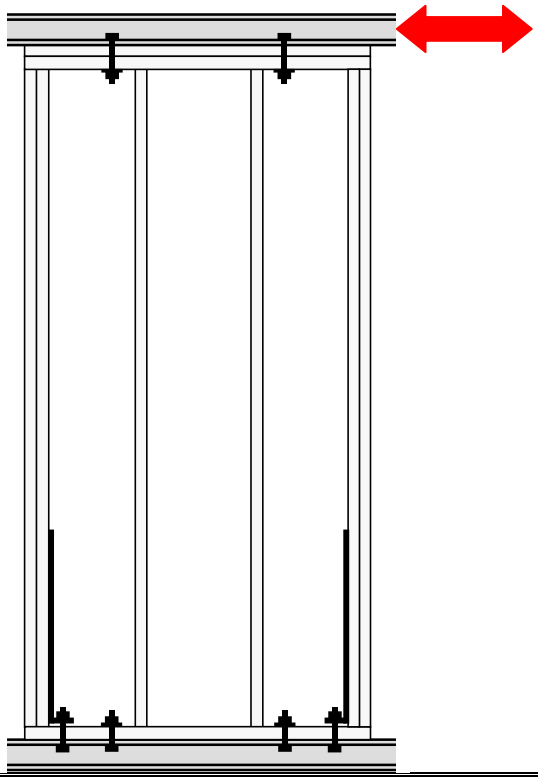
Walls 04FAc



Walls:	**04FAc1**	**04FAc2**	**04FAc3**
Manufactured:	**July 2, 1998**[1]	**July 8, 1998**[1]	**July 8, 1998**[1]
MOE data files:	4fac1s.prn	4fac2s.prn	4iac2s.prn
MOE_{plates} (10^6 psi)			
MOE_{studs} (10^6 psi)	1.68	1.37	1.27
$Density_{plates}$ (kg/m^3)			
$Density_{studs}$ (kg/m^3)	496	441	410
Date tested:	**July 28, 1998**	**July 28, 1998**	**August 2, 1998**
Time tested:	14:18	18:21	13:42
LTC files:	30alexcy	30alexcy	30alex4
Data files:	04FAc1.dat	04FAc2.dat	04FAc3.dat
Excel files:	04FAc1_data 04FAc1_UTP	04FAc2_data 04FAc2_UTP	04FAc3_data 04FAc3_UTP
Photo files:	590-598	599-609	702-717

[1] Sheathing attached with 1/2+1/4-in. edge distance.

Wall 04FAc1

Observations: The wall exhibited extremely ductile performance. It was the weakest in the series: the average peak load was 1.9 Kips (0.48 Kip/ft.). It reached the peak resistance between 1.5 and 2.4-in. amplitudes and then gradually degraded until failure occurred at 3.3-in. amplitude. The uplift and sheathing displacement measurements showed symmetrical response on both sides of the positive and negative envelopes.

Failure mode: Both end studs separated from the top plate. Sheathing unzipped from both end studs and from the bottom plate (Photo 594). Along the bottom plate: 5 sheathing nails failed in fatigue; at the left stud: 50%; at the right stud: nails pulled out of wood. At the corners, nails tend to pull out, while in the mid-span, nails fatigue.

Wall 04FAc2

Observations: The wall exhibited more rigid performance than other walls in this series and in the monotonic test series. The average peak load 2.4 Kips (0.60 Kip/ft.) was 25% higher than that of 04FAc1 wall. Similar to other walls, it reached the peak resistance between 1.8 and 2.4-in. amplitudes. However, it degraded somewhat faster and the 20% load decrease occurred during 3.0-in. phase. Again, the performance was symmetric.

Failure mode: Sheathing unzipped from the left end stud and the bottom plate, at the top-left and bottom-right corners (Photos 603-605). Along the bottom plate: 6 sheathing nails failed in fatigue; at the left stud: 7 nails; at the right stud: 3 nails (at the lower part). Other nails pulled heads through sheathing. Nails in field pulled out partly from wood. At the corners, nails pulled out. Fatigue rupture occurs at about 1 in. from the nail head.

Because of the 25% difference in strength of 04FAc1 and 04FAc2 walls, the third wall was tested.

Wall 04FAc3

Observations: The performance parameters of this wall were between the other walls in this series. The average peak load 2.1 Kips (0.53 Kip/ft.) was reached between 2.1 and 2.4-in. amplitudes. Similar to 04FAc1 wall, it degraded smoothly and the 20% load decrease occurred during 3.3-in. phase. The performance was symmetric with a lot of racking.

Failure mode: The wall exhibited slightly less rigid performance than in monotonic tests 04FAm. Shape of envelope curve is similar to monotonic test 4FAc1; it reached peak load between 1.8 and 2.1-in. displacement and failed at 3-in. amplitude. The sheathing unzipped at the top and bottom plates and along the left end stud. The end studs separated from the top plate (Photo 704, 709). Along the left stud: 3nails failed in fatigue; along the bottom plate: 3 nails failed in fatigue. Seven nails pulled out of wood at the left stud (Photo 711). The nails at the mid-span pulled heads through sheathing, at the corners- tore through the edge (Photos 714-717).

Data acquisition: The data acquisition started late during the second cycle. The load range on the UTP controller was set at 5500 lbf., while the calibration factor in the LTC file was for the 11000 lbf. range. The row load data need to be adjusted by factor 0.5.

General

Load transfer: During the first test, the end of the short distribution beam on casters lifted up from the floor on the positive stroke. This movement applied significant torque to the wall, which might have affected the wall resistance. On the negative stroke, the caster #2 bumped the floor, which created some noise in DAQ of diagonal pots. During the following tests, the short distribution beam was replaced by the long one, which eliminated the uplift problem.

Instrumentation: During 04FAc1 and 04FAc2 tests, Bolt #1 did not produce data (a lead was cut during installation). New tension bolt was installed for 04FAc3 test. Sheathing LVDT's # 1 and #4 were prone to damage when the sheathing unzipped. They need to be taken off after 3-in. amplitude. Also, the diagonal pot wires were removed before the end of the test to avoid their collapse.

Table 04FAc1. Data summary.

Specimen	**04FAc1**	**Per unit length**	
Tie-Down Anchors		**cyclic test**	
Wall length		**4.00ft.**	**1.219m**
Date: 7-28-1998 **Time:**	14:18		
EEEP Parameters	**units**	**initial**	**stabilized**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.481 7.025	0.432 6.310
Drift at peak load, Δ_{peak}	in. mm	1.799 45.69	1.812 46.03
Yield unit load, v_{yield}	Kip/ft. KN/m	0.439 6.401	0.400 5.844
Drift at yield load, Δ_{yield}	in. mm	0.342 8.70	0.445 11.30
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.193 2.810	0.173 2.524
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.150 3.82	0.192 4.88
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.385 5.620	0.346 5.048
Drift at failure, $\Delta_{failure}$	in. mm	3.256 82.71	3.144 79.85
Shear modulus, G $@0.4v_{peak}$	Kip/in. KN/mm	10.291 1.802	7.222 1.265
Work until failure per unit length	Kip·ft./ft. KN·m/m	1.602 7.126	1.777 7.904
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.287 4.190	0.277 4.044
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.338 4.927	0.319 4.651
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.442 6.446	0.404 5.894
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	0.476 6.946	0.425 6.195
EVDR $@v_{peak}$		0.137	0.129

SEAOSC parameters		**units**	**negative**	**positive**	**average**
Yield Limit State	v_{YLS}	Kips/ft. KN/m	-0.265 -3.871	0.296 4.312	0.280 4.092
	Δ_{YLS}	in. mm	-0.302 -7.67	0.296 7.52	0.299 7.59
	G'_{YLS}	Kip/in. KN/mm	7.031 1.231	7.989 1.399	7.505 1.314
Strength Limit State	v_{SLS}	Kips/ft. KN/m	-0.475 -6.935	0.488 7.114	0.481 7.025
	Δ_{SLS}	in. mm	-2.426 -61.62	1.482 37.65	1.954 49.63
	G'_{SLS}	Kip/in. KN/mm	1.567 0.274	2.631 0.461	1.971 0.345

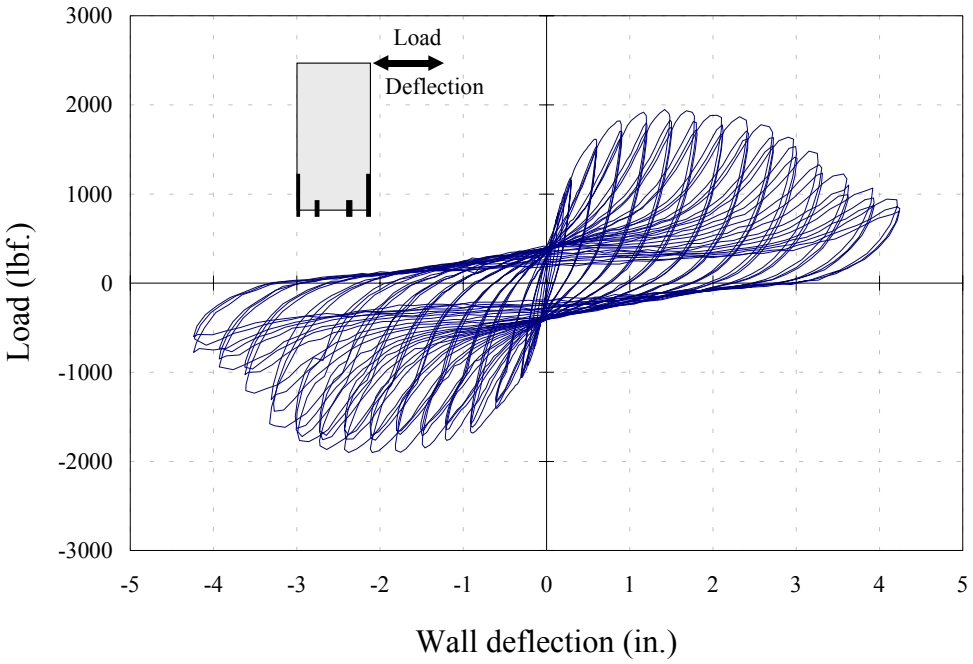


Figure 04FAc1- a. Observed load-deflection curve[1].

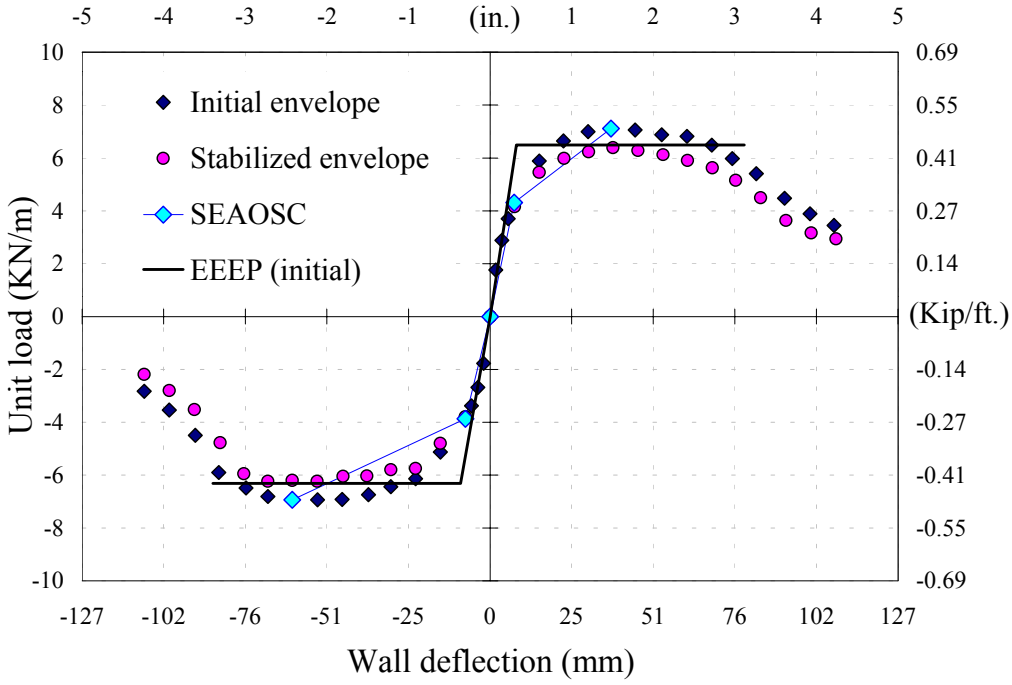


Figure 04FAc1- b. Envelopes, SEAOSC, and EEEP curves[2].

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

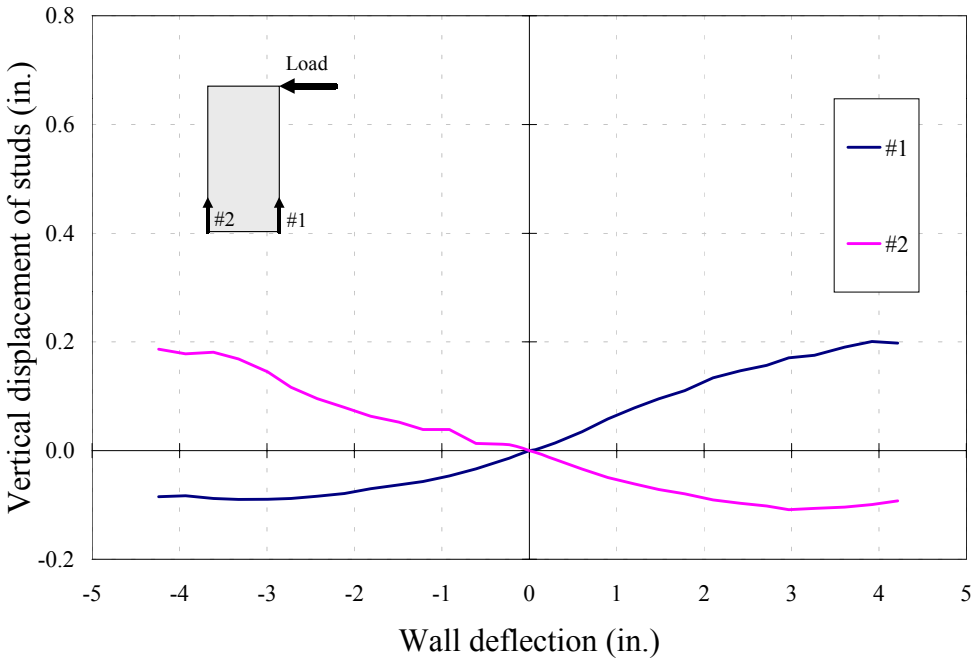


Figure 04FAc1- c. Vertical displacement of studs (initial envelope).

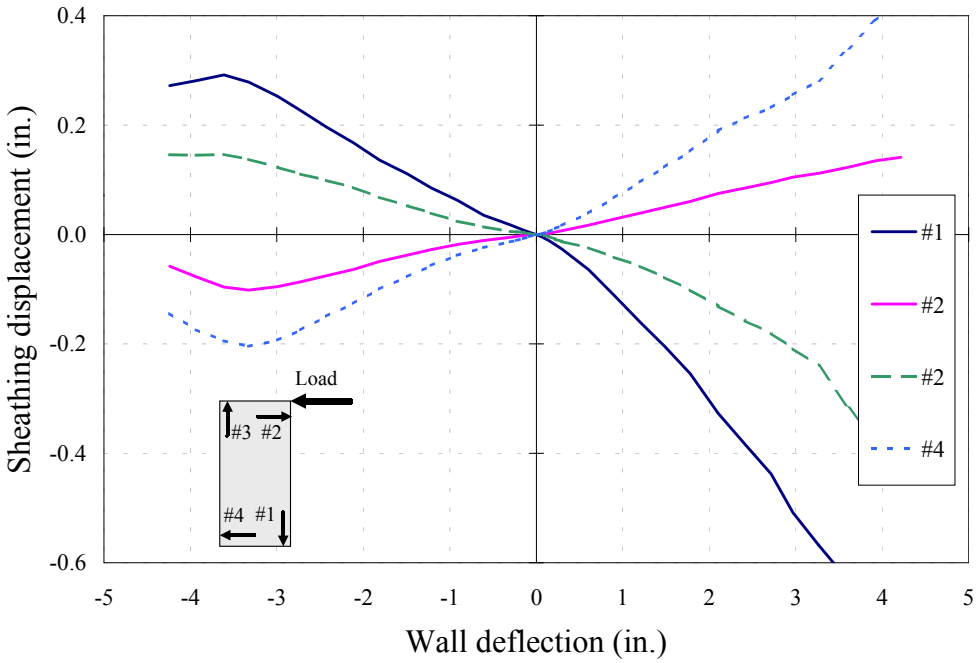


Figure 04FAc1- d. Sheathing displacement (initial envelope).

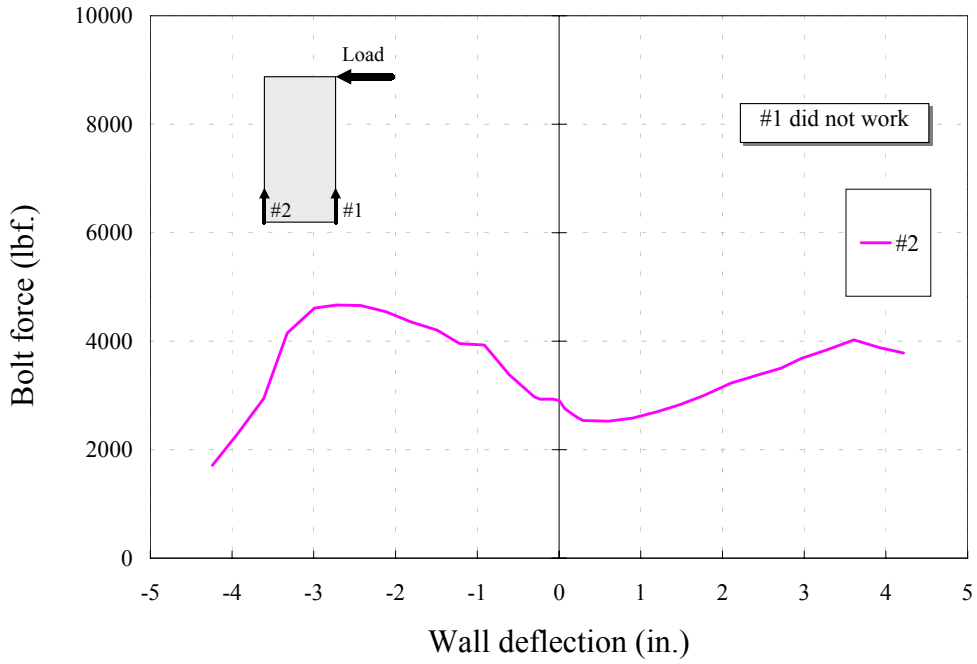


Figure 04FAc1- e. Forces in anchor bolts (initial envelope).

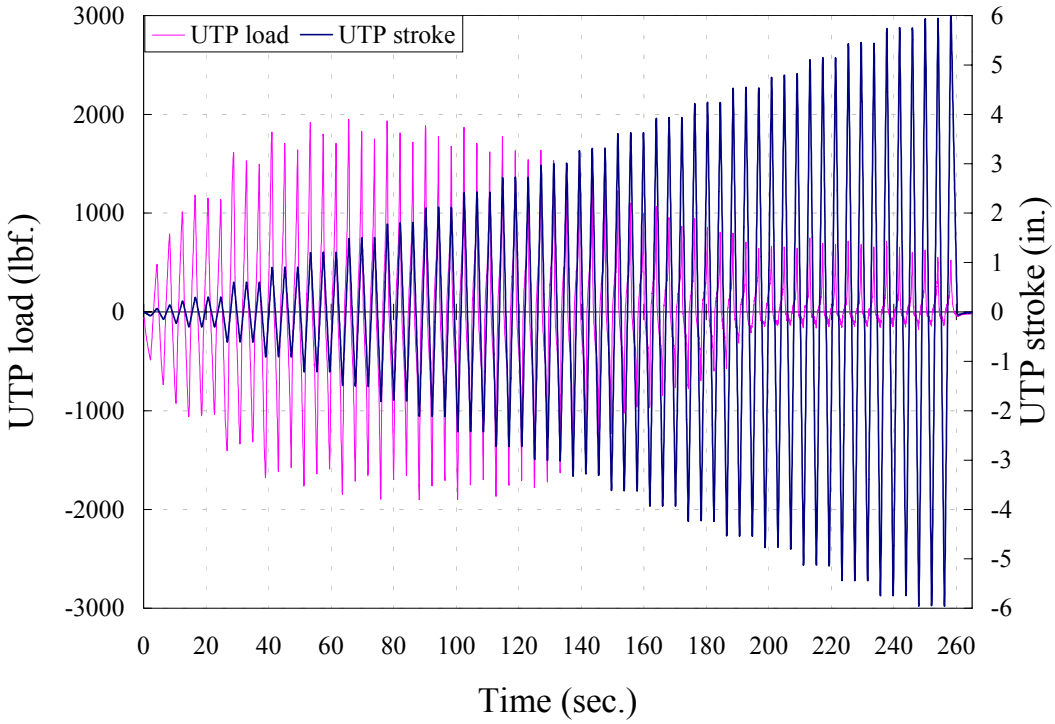


Figure 04FAc1- f. Load- and displacement-time record.

Table 04FAc2. Data summary.

Specimen	**04FAc2**	**Per unit length**	
Tie-Down Anchors		**cyclic test**	
Wall length		**4.00ft.**	**1.219m**
Date: 7-28-1998 **Time:**	18:21		
EEEP Parameters	**units**	**initial**	**stabilized**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.599 8.734	0.527 7.696
Drift at peak load, Δ_{peak}	in. mm	1.961 49.82	1.803 45.80
Yield unit load, v_{yield}	Kip/ft. KN/m	0.541 7.897	0.485 7.075
Drift at yield load, Δ_{yield}	in. mm	0.461 11.70	0.499 12.67
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.239 3.494	0.211 3.078
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.204 5.18	0.217 5.51
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.479 6.987	0.422 6.157
Drift at failure, $\Delta_{failure}$	in. mm	2.939 74.65	2.788 70.81
Shear modulus, G $@0.4v_{peak}$	Kip/in. KN/mm	9.401 1.646	7.781 1.363
Work until failure per unit length	Kip·ft./ft. KN·m/m	1.449 6.446	1.609 7.159
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.311 4.543	0.301 4.398
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.382 5.579	0.363 5.302
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.525 7.655	0.481 7.025
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	0.589 8.593	0.525 7.666
EVDR $@v_{peak}$		0.125	0.115

SEAOSC parameters		**units**	**negative**	**positive**	**average**
Yield Limit State	v_{YLS}	Kips/ft. KN/m	-0.295 -4.301	0.312 4.546	0.303 4.424
	Δ_{YLS}	in. mm	-0.305 -7.74	0.299 7.59	0.302 7.66
	G'_{YLS}	Kip/in. KN/mm	7.739 1.355	8.340 1.460	8.036 1.407
Strength Limit State	v_{SLS}	Kips/ft. KN/m	-0.591 -8.632	0.603 8.800	0.597 8.716
	Δ_{SLS}	in. mm	-1.814 -46.06	2.414 61.32	2.114 53.69
	G'_{SLS}	Kip/in. KN/mm	2.609 0.457	1.998 0.350	2.260 0.396

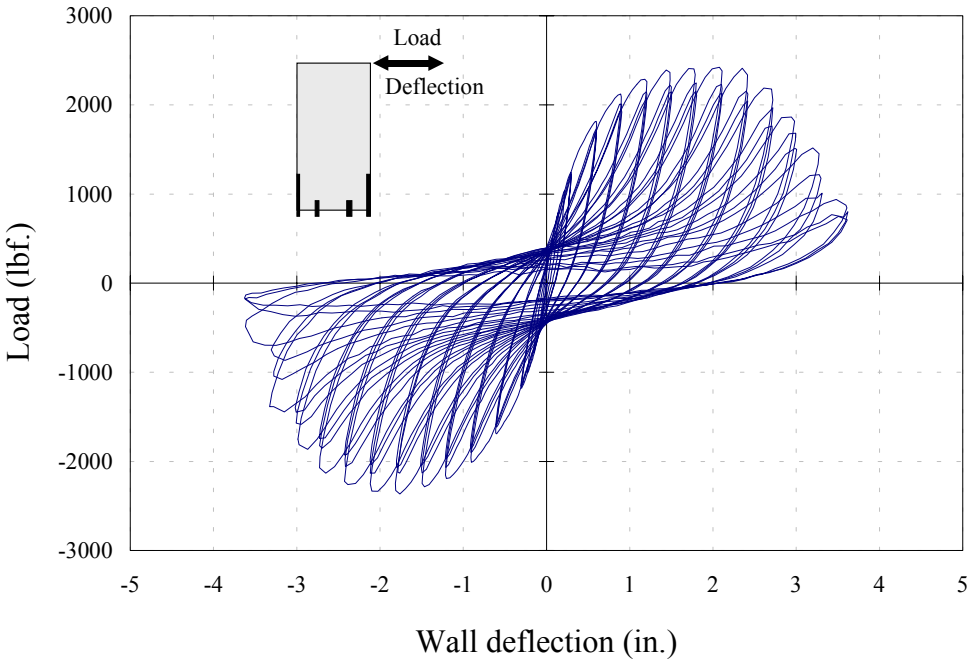


Figure 04FAc2- a. Observed load-deflection curve.

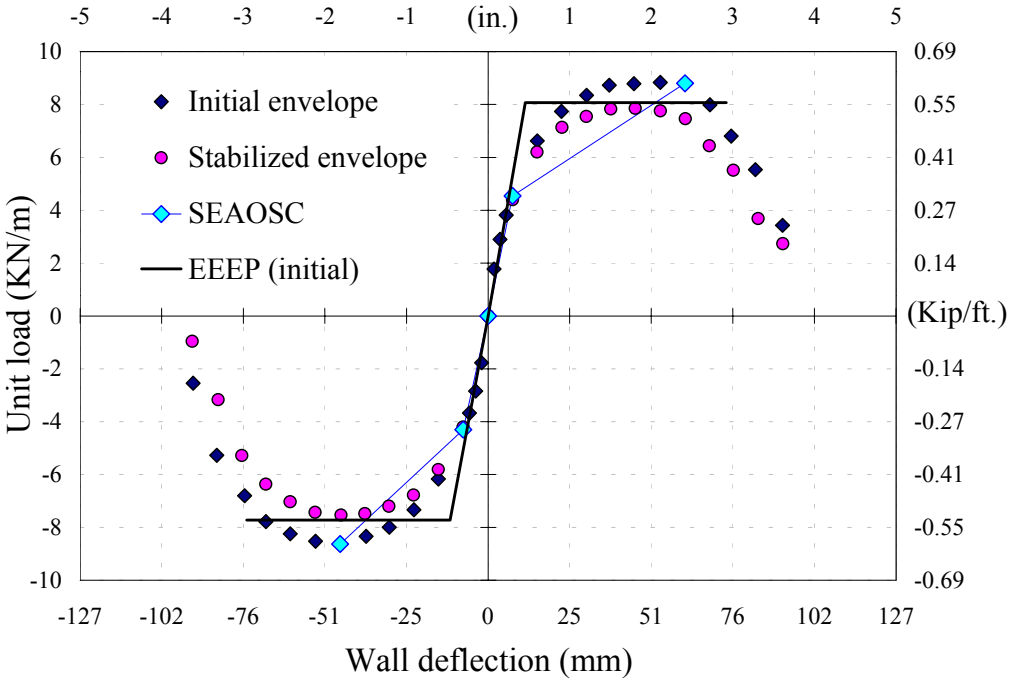


Figure 04FAc2- b. Envelopes, SEAOSC, and EEEP curves.

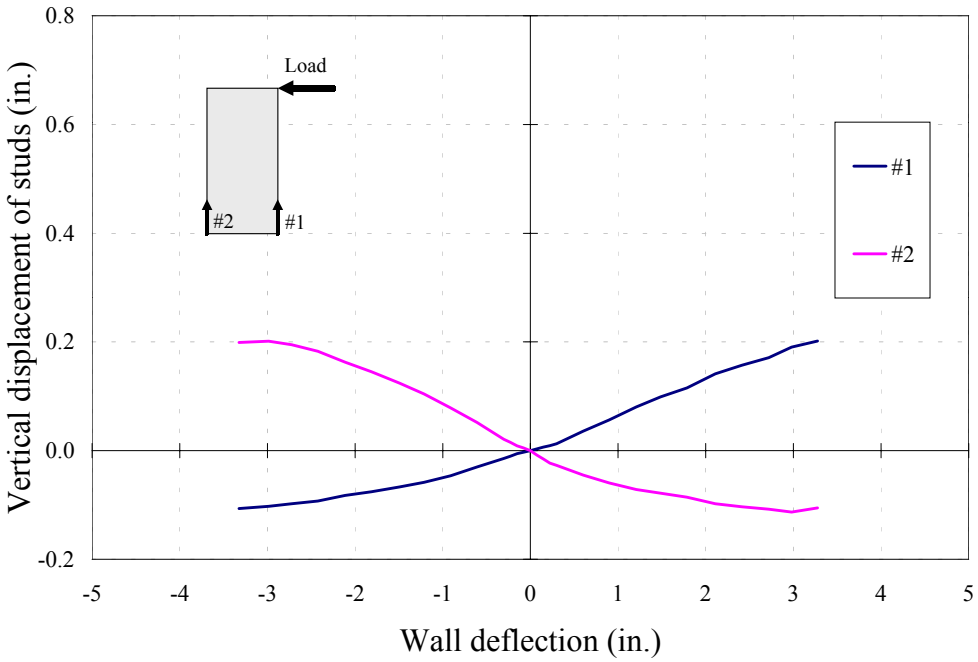


Figure 04FAc2- c. Vertical displacement of studs (initial envelope).

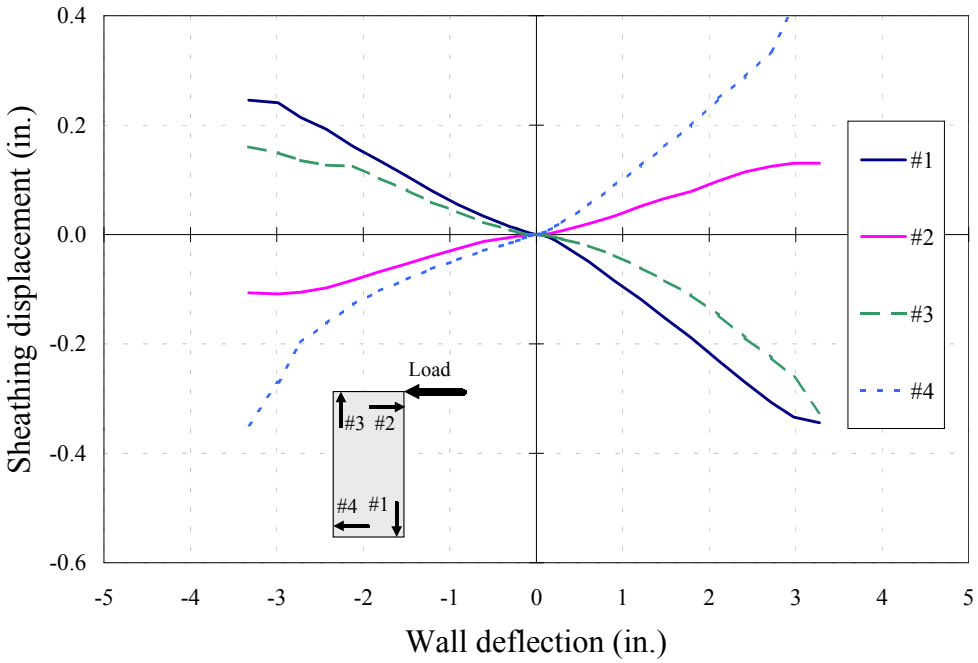


Figure 04FAc2- d. Sheathing displacement (initial envelope).

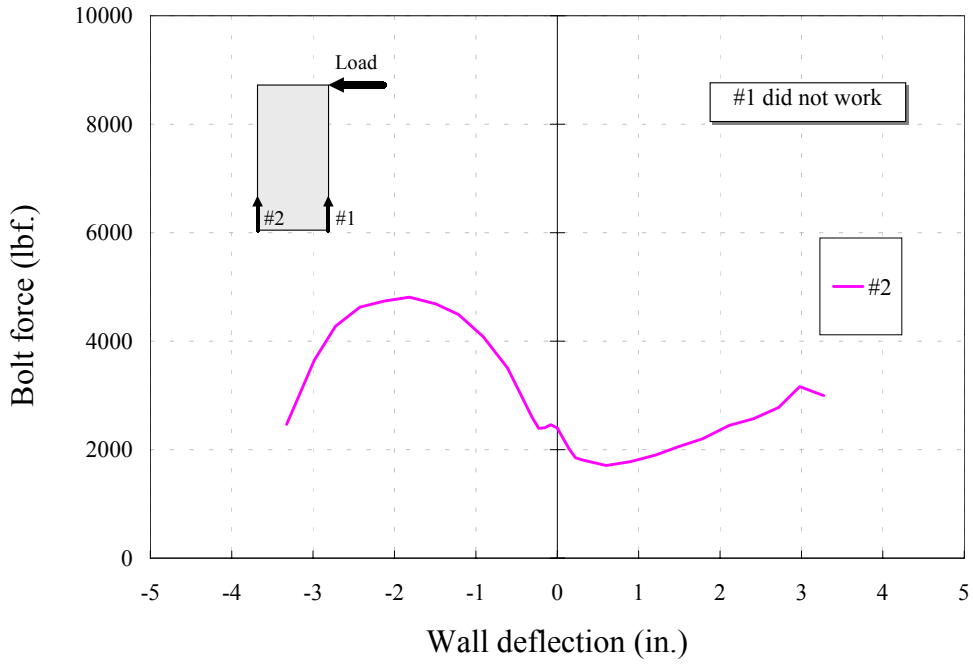


Figure 04FAc2- e. Forces in anchor bolts (initial envelope).

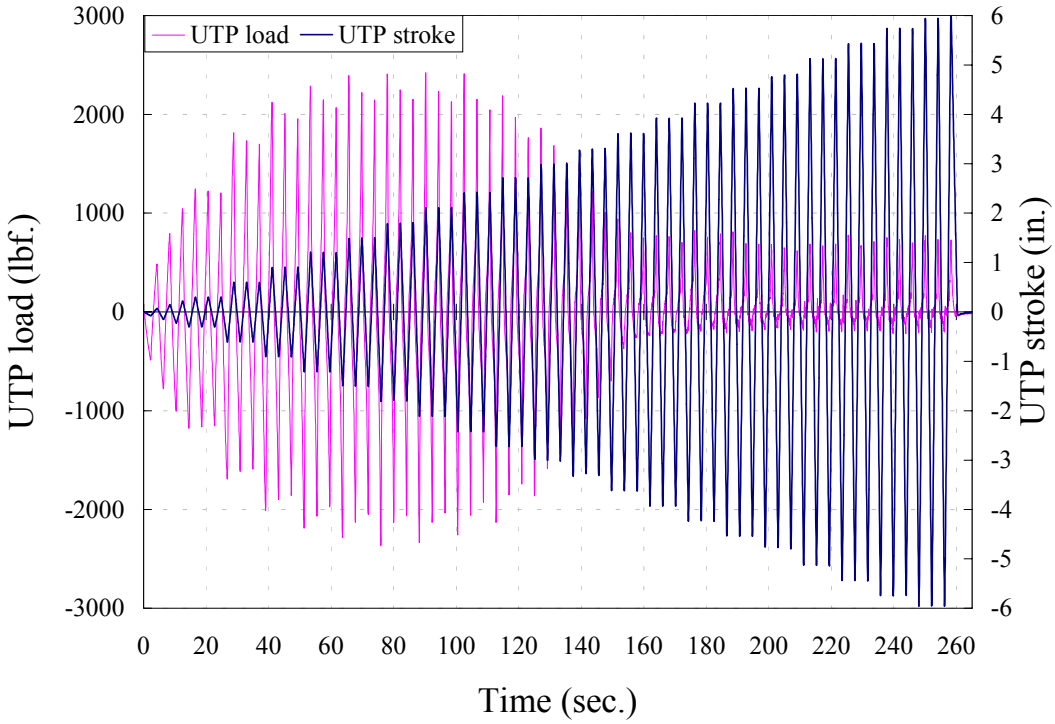


Figure 04FAc2- f. Load- and displacement-time record.

Table 04FAc3. Data summary.

Specimen	**04FAc3**	**Per unit length**	
Tie-Down Anchors		**cyclic test**	
Wall length		**4.00ft.**	**1.219m**
Date: 8-02-1998 **Time:**	13:42		
EEEP Parameters	**units**	**initial**	**stabilized**
Peak unit load, v_{peak}	Kip/ft. KN/m	0.533 7.775	0.472 6.888
Drift at peak load, Δ_{peak}	in. mm	2.262 57.45	1.963 49.86
Yield unit load, v_{yield}	Kip/ft. KN/m	0.483 7.047	0.434 6.333
Drift at yield load, Δ_{yield}	in. mm	0.482 12.25	0.500 12.70
Proportional limit, $0.4v_{peak}$	Kip/ft. KN/m	0.213 3.110	0.189 2.755
Drift at prop. limit, $\Delta@0.4v_{peak}$	in. mm	0.213 5.41	0.217 5.52
Unit load at failure or $0.8v_{peak}$	Kip/ft. KN/m	0.426 6.220	0.378 5.510
Drift at failure, $\Delta_{failure}$	in. mm	3.227 81.96	3.105 78.88
Shear modulus, G $@0.4v_{peak}$	Kip/in. KN/mm	8.015 1.404	6.947 1.217
Work until failure per unit length	Kip·ft./ft. KN·m/m	1.710 7.605	1.884 8.380
Unit load, $v_{1/300}$ @ 0.32 in. (8.13 mm)	Kips/ft. KN/m	0.276 4.022	0.269 3.924
Unit load, $v_{1/200}$ @ 0.48 in.(12.19 mm)	Kips/ft. KN/m	0.338 4.931	0.323 4.715
Unit load, $v_{1/100}$ @ 0.96 in. (24.38 mm)	Kips/ft. KN/m	0.467 6.808	0.427 6.232
Unit load, $v_{1/60}$ @ 1.6 in. (40.64 mm)	Kips/ft. KN/m	0.522 7.620	0.466 6.793
EVDR $@v_{peak}$		0.135	0.127

SEAOSC parameters		**units**	**negative**	**positive**	**average**
Yield Limit State	v_{YLS}	Kips/ft. KN/m	-0.379 -5.525	0.274 3.997	0.326 4.761
	Δ_{YLS}	in. mm	-0.609 -15.48	0.299 7.59	0.454 11.53
	G'_{YLS}	Kip/in. KN/mm	4.970 0.870	7.333 1.284	5.748 1.007
Strength Limit State	v_{SLS}	Kips/ft. KN/m	-0.532 -7.760	0.534 7.789	0.533 7.775
	Δ_{SLS}	in. mm	-2.423 -61.54	2.101 53.36	2.262 57.45
	G'_{SLS}	Kip/in. KN/mm	1.756 0.307	2.033 0.356	1.884 0.330

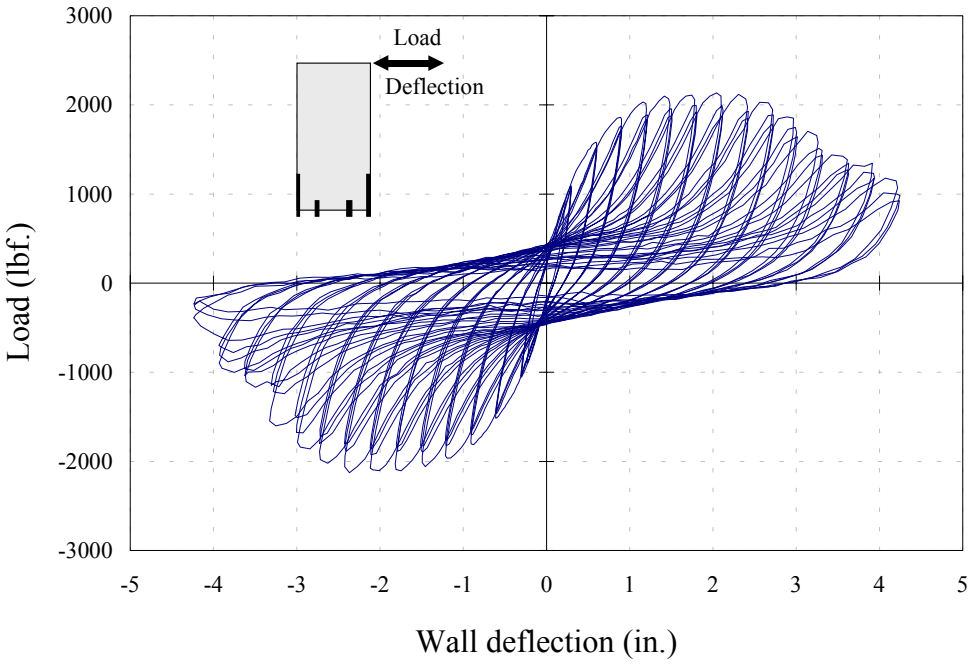


Figure 04FAc3- a. Observed load-deflection curve.

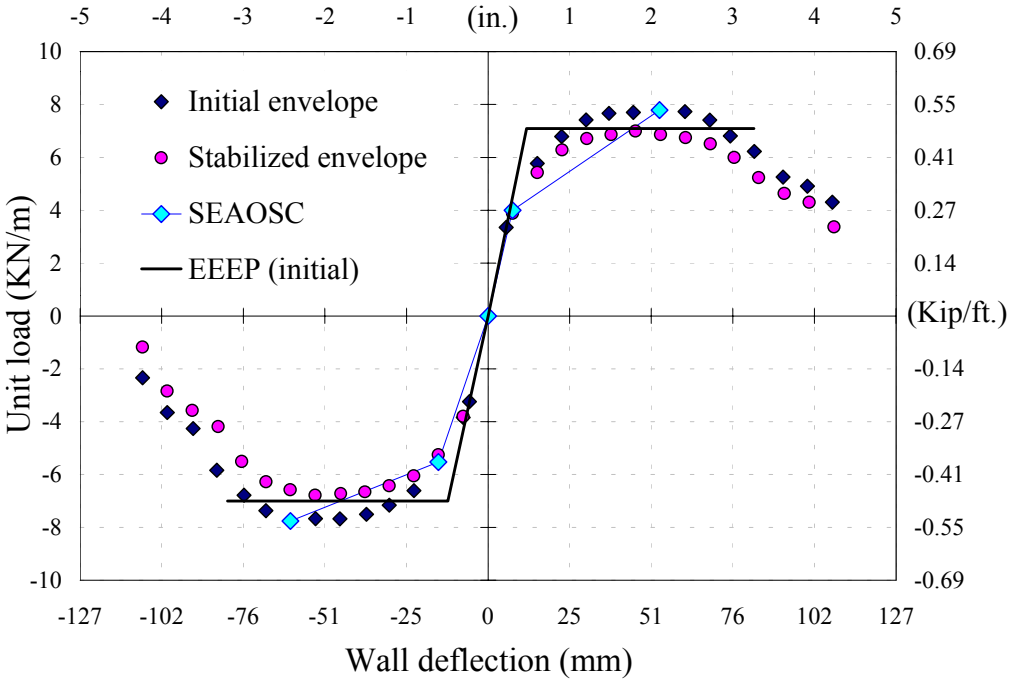


Figure 04FAc3- b. Envelopes, SEAOSC, and EEEP curves.

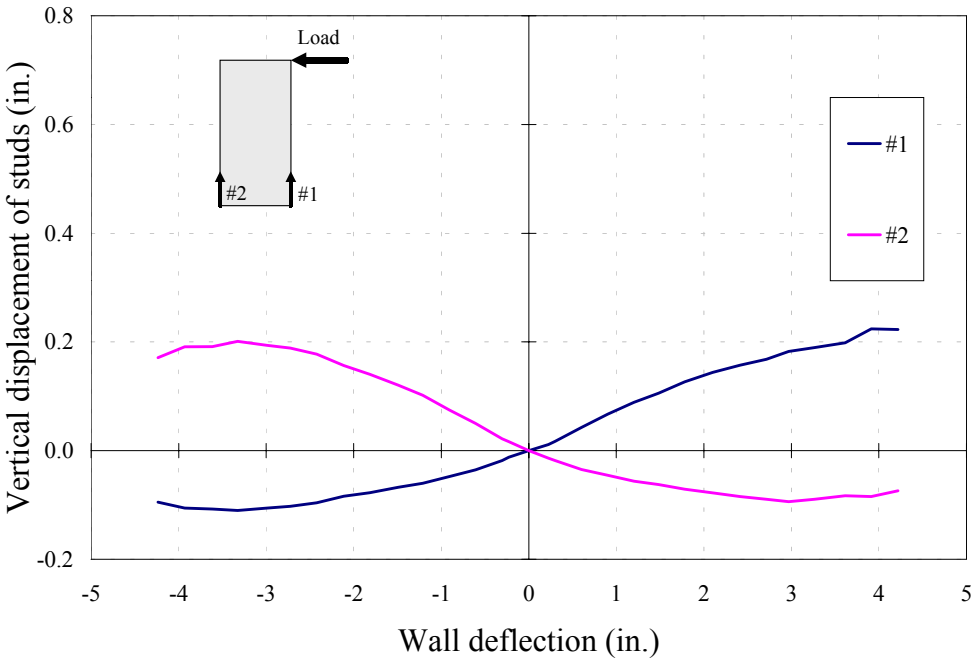


Figure 04FAc2- c. Vertical displacement of studs (initial envelope).

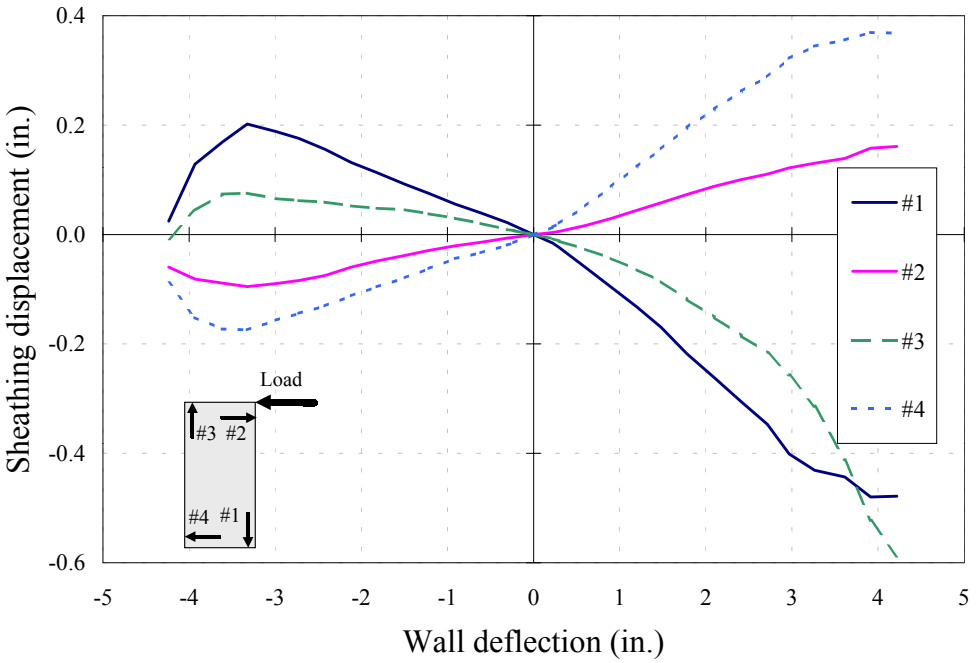


Figure 04FAc3- d. Sheathing displacement (initial envelope).

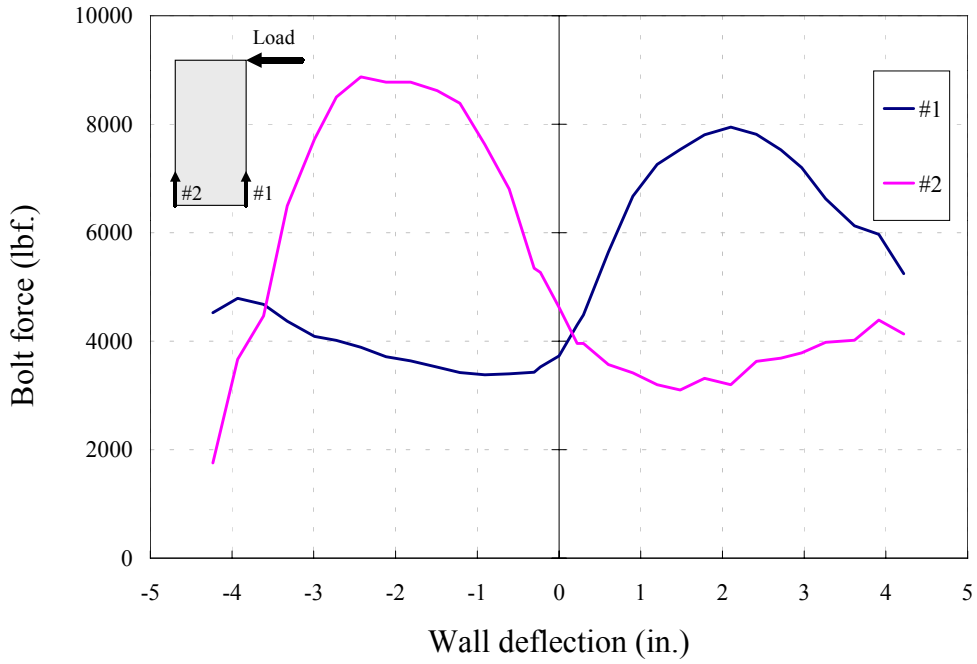


Figure 04FAc3- e. Forces in anchor bolts (initial envelope).

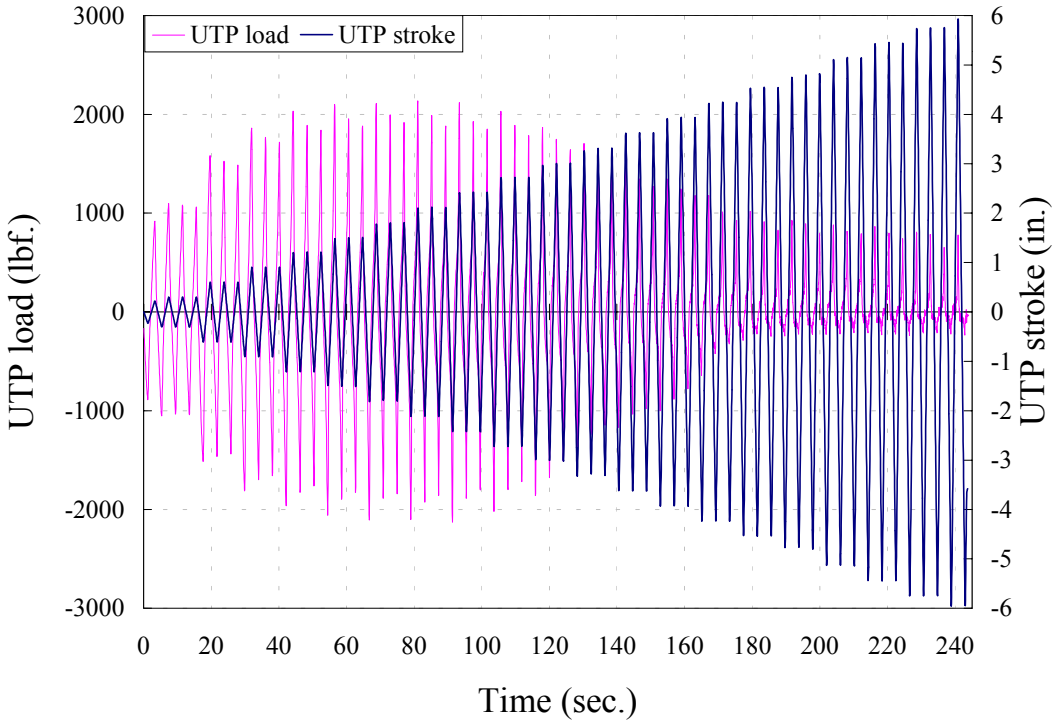


Figure 04FAc3- f. Load- and displacement-time record.