

Appendix B Cyclic Connection Test Data

B.1 – Cyclic Connection Test Data

The following data corresponds to all cyclic connection tests performed during this study. Each test was analyzed for strength and stiffness properties per Chapter 3, Section 3.5.7. See Figure B.1. Test identification can be cross-referenced to Table 3.1 based on Figure B.1.

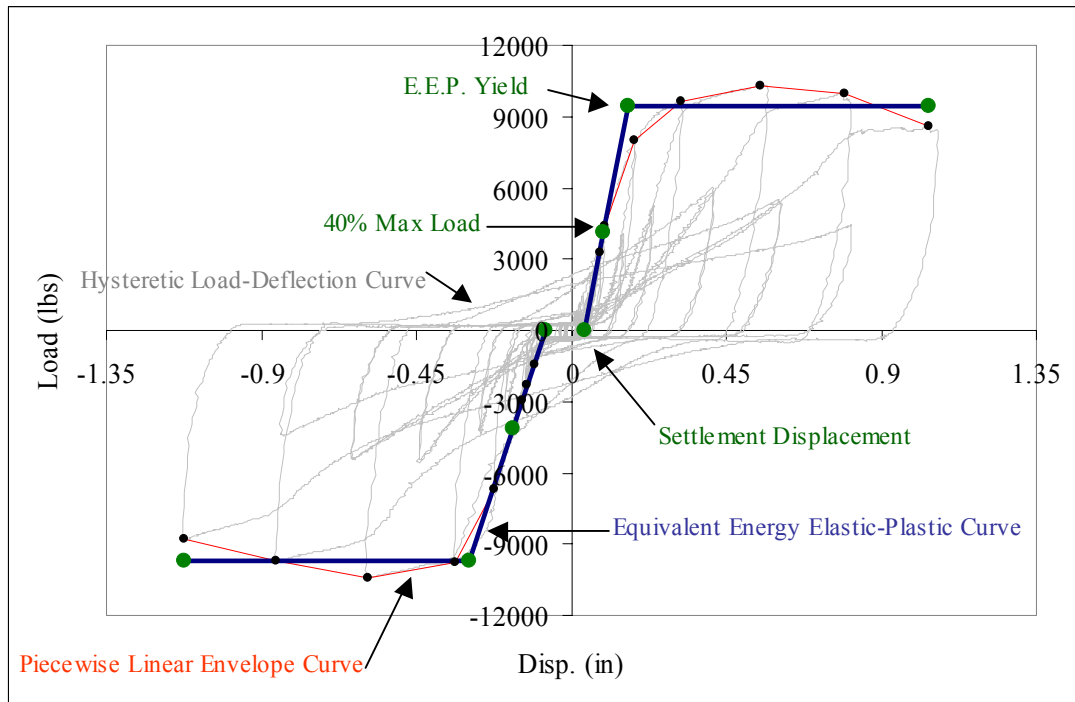
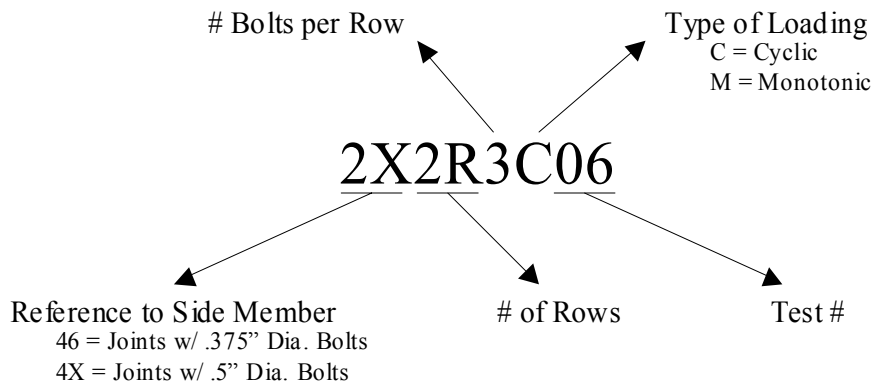


Figure B.1: Typical test identification and connection property definitions.

B.1.1 – 2X Series Cyclic

Table B.1: Connection properties, 2X1R1C Series.

Connection Properties 2X1R1C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	2737.85	2221.32	4165.53	2268.61	2515.43	2705.34	2708.29	3292.81	2699.43	2381.67	2769.63	577.63	0.21
@ Displacement (in)	0.60	0.58	1.15	0.40	0.87	0.82	0.95	0.85	0.45	0.55	0.72	0.24	0.33
Failure Load (lbs)	2190.28	1777.06	3332.42	1814.89	2012.34	2164.27	2166.64	2634.25	2159.54	1905.34	2215.70	462.10	0.21
@ Displacement (in)	0.60	0.58	1.15	0.40	0.87	0.82	0.95	0.85	0.45	0.55	0.72	0.24	0.33
40% Max (lbs)	1095.14	888.53	1666.21	907.44	1006.17	1082.14	1083.32	1317.13	1079.77	952.67	1107.85	231.05	0.21
@ Displacement (in)	0.18	0.17	0.26	0.15	0.22	0.21	0.23	0.17	0.17	0.15	0.19	0.03	0.18
Yield (lbs)	2399.57	1878.17	3332.42	1860.59	2070.07	2332.61	2278.90	2656.03	2277.61	2064.50	2315.05	432.26	0.19
@ Displacement (in)	0.30	0.29	0.43	0.24	0.37	0.37	0.39	0.27	0.29	0.26	0.32	0.07	0.21
5% Offset (lbs)	1718.17	1390.46	2092.54	1547.70	1305.11	1498.74	1442.00	1711.31	1859.22	1473.78	1603.90	240.54	0.15
@ Displacement (in)	0.26	0.26	0.33	0.23	0.29	0.29	0.31	0.22	0.27	0.23	0.27	0.03	0.13
Elastic Stiff. (lb/in)	12385.99	8638.67	9521.07	12088.00	7164.56	7730.03	7623.62	14098.11	10288.33	10478.84	10001.72	2311.37	0.23
E.E.P. Energy (lb*in)	991.05	764.79	2969.63	460.48	1334.61	1401.56	1640.18	1805.92	651.29	795.82	1281.53	740.06	0.58
Ductility Ratio	2.13	2.03	2.68	1.74	2.35	2.20	2.51	3.20	1.62	2.06	2.25	0.46	0.21
Yield Mode	II	II	II	II	II	II	II	II	II	II			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	A	B	A	A	B	B	A	B	B	A			

Table B.2: Member Properties, 2X1R1C Series.

Member Properties 2X1R1C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	12.25	12.11	11.03	10.86	13.24	11.53	13.21	17.50	14.85	12.02	12.86	2.01	0.16
S.G.	0.50	0.53	0.53	0.62	0.49	0.53	0.49	0.61	0.64	0.58	0.55	0.06	0.10
D.E. 5% Yield (psi)	4414.62	6048.69	6188.36	6477.83	4107.26	5072.51	4156.97	6071.32	5827.98	5267.83	5363.34	890.47	0.17
D.E. Capacity (psi)	4469.73	6099.57	6341.61	6484.44	4236.59	5134.59	4239.80	6268.99	6451.29	5277.73	5500.43	940.56	0.17
Member B													
M.C. (%)	11.90	14.50	11.73	13.37	13.48	13.06	13.85	14.57	11.79	14.16	13.24	1.10	0.08
S.G.	0.66	0.46	0.62	0.46	0.57	0.52	0.51	0.58	0.61	0.61	0.56	0.07	0.12
D.E. 5% Yield (psi)	7035.41	3989.87	7673.84	4447.95	5171.88	4671.24	4642.66	6269.79	7426.77	5360.77	5669.02	1334.94	0.24
D.E. Capacity (psi)	7097.30	4165.26	7673.84	4464.94	5243.09	4720.90	4748.27	6316.80	7498.45	5414.32	5734.32	1311.79	0.23

Table B.3: Hysteretic Properties, 2X1R1C Series.

Hysteretic Connection Properties 2X1R1C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	50.84	18.42	0.36	0.01	0.02	1.57	-14.04	9.53	0.68	-0.03	0.01	0.33
Primary2	55.27	22.04	0.40	0.01	0.04	3.05	-45.52	56.91	1.25	-0.04	0.03	0.66
Primary3	309.48	213.45	0.69	0.10	0.01	0.05	-446.48	171.40	0.38	-0.12	0.00	0.02
Primary4	974.54	405.14	0.42	0.16	0.00	0.03	-947.35	175.59	0.19	-0.18	0.01	0.03
Primary5	1407.13	515.53	0.37	0.21	0.01	0.03	-1349.64	208.71	0.15	-0.24	0.01	0.03
Primary6	2186.74	758.58	0.35	0.37	0.01	0.04	-2199.00	266.75	0.12	-0.42	0.01	0.02
Primary7	2505.67	867.45	0.35	0.52	0.06	0.11	-2408.28	272.63	0.11	-0.59	0.02	0.04
Primary8	2479.51	1088.88	0.44	0.71	0.13	0.18	-2350.78	626.62	0.27	-0.80	0.09	0.12
Primary9	1927.06	1299.84	0.67	0.88	0.10	0.11	-1865.14	840.12	0.45	-1.00	0.09	0.09
Primary10	1298.21	1149.50	0.89	1.25	0.14	0.11	-1474.38	444.39	0.30	-1.34	0.15	0.11
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	2.01	0.53	0.26	0.66	0.24	0.37	0.55	0.25	0.45	514.19	3722.58	7.24
Primary2	2.84	0.85	0.30	2.19	1.46	0.67	0.32	0.26	0.80	1526.98	7940.34	5.20
Primary3	21.97	7.17	0.33	41.56	10.82	0.26	0.09	0.02	0.28	3466.78	884.20	0.26
Primary4	85.92	16.92	0.20	160.66	30.97	0.19	0.09	0.00	0.05	5734.09	1188.75	0.21
Primary5	168.89	28.21	0.17	307.71	47.71	0.16	0.09	0.00	0.04	6160.03	1005.60	0.16
Primary6	674.70	83.60	0.12	871.78	106.94	0.12	0.12	0.00	0.03	5518.30	770.85	0.14
Primary7	936.25	117.44	0.13	1365.19	181.28	0.13	0.11	0.01	0.06	4429.01	576.45	0.13
Primary8	1515.70	352.66	0.23	1874.37	738.09	0.39	0.14	0.03	0.21	3166.23	514.52	0.16
Primary9	1633.99	476.17	0.29	1849.73	1176.73	0.64	0.16	0.05	0.33	1961.78	815.70	0.42
Primary10	1867.68	480.04	0.26	1775.84	868.25	0.49	0.18	0.05	0.29	1100.53	632.12	0.57

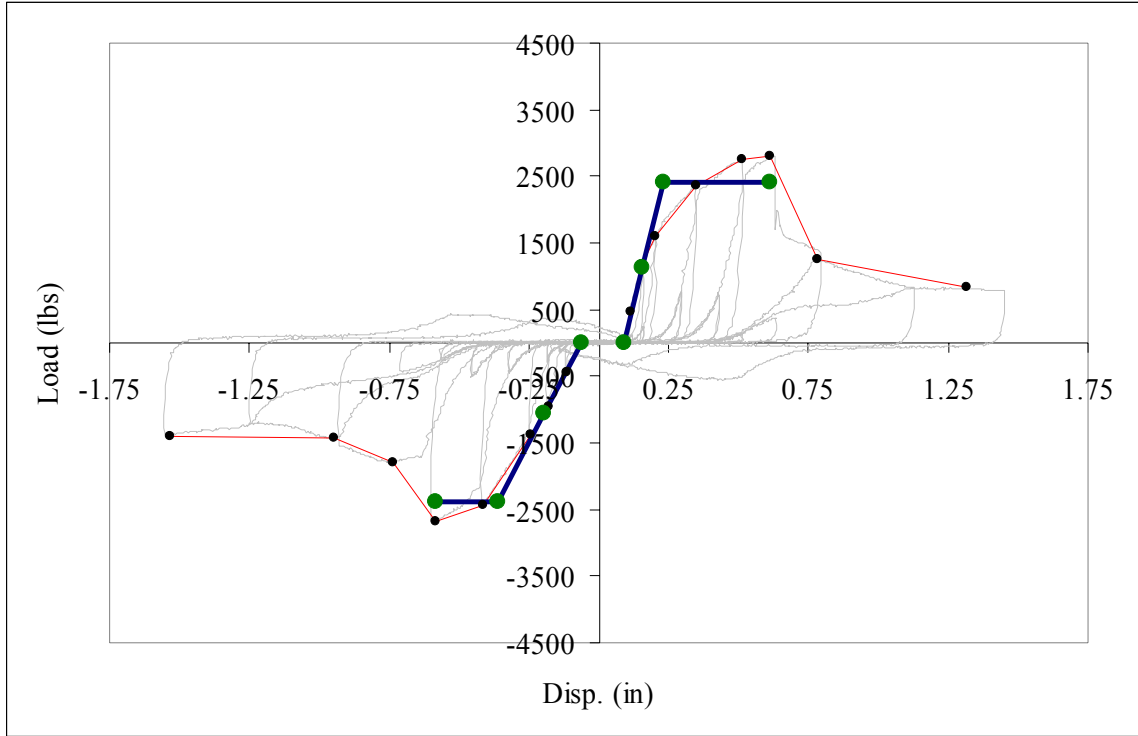


Figure B.2: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C01.

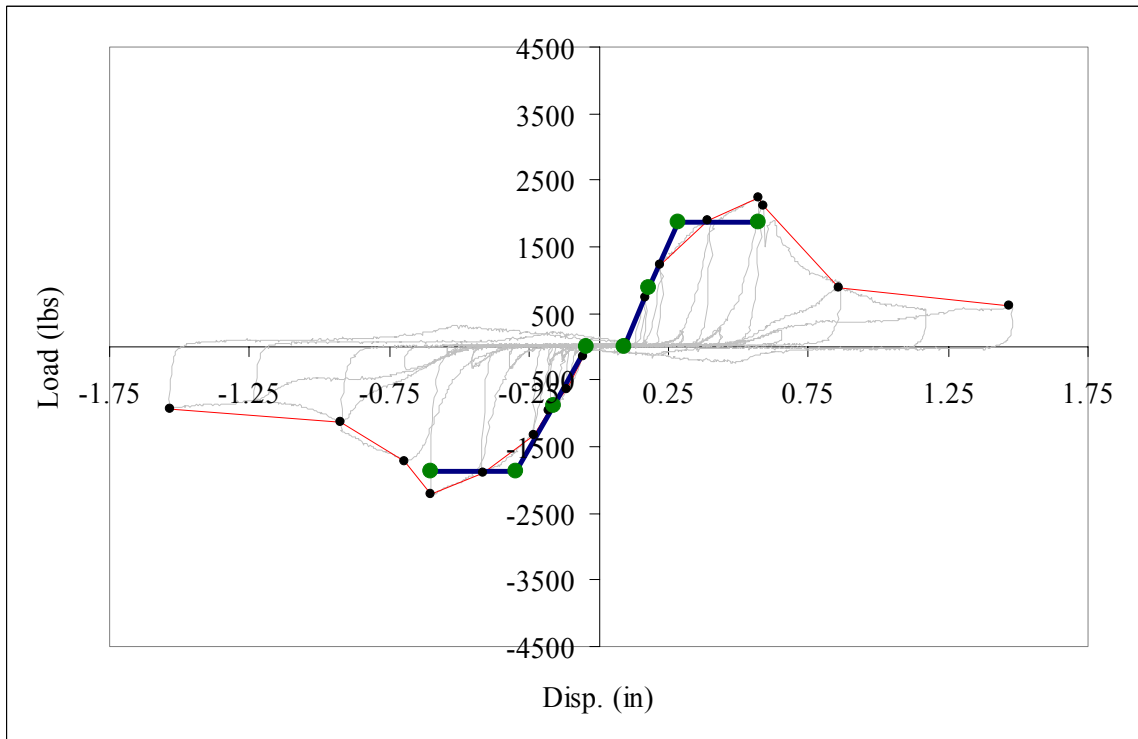


Figure B.3: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C02.

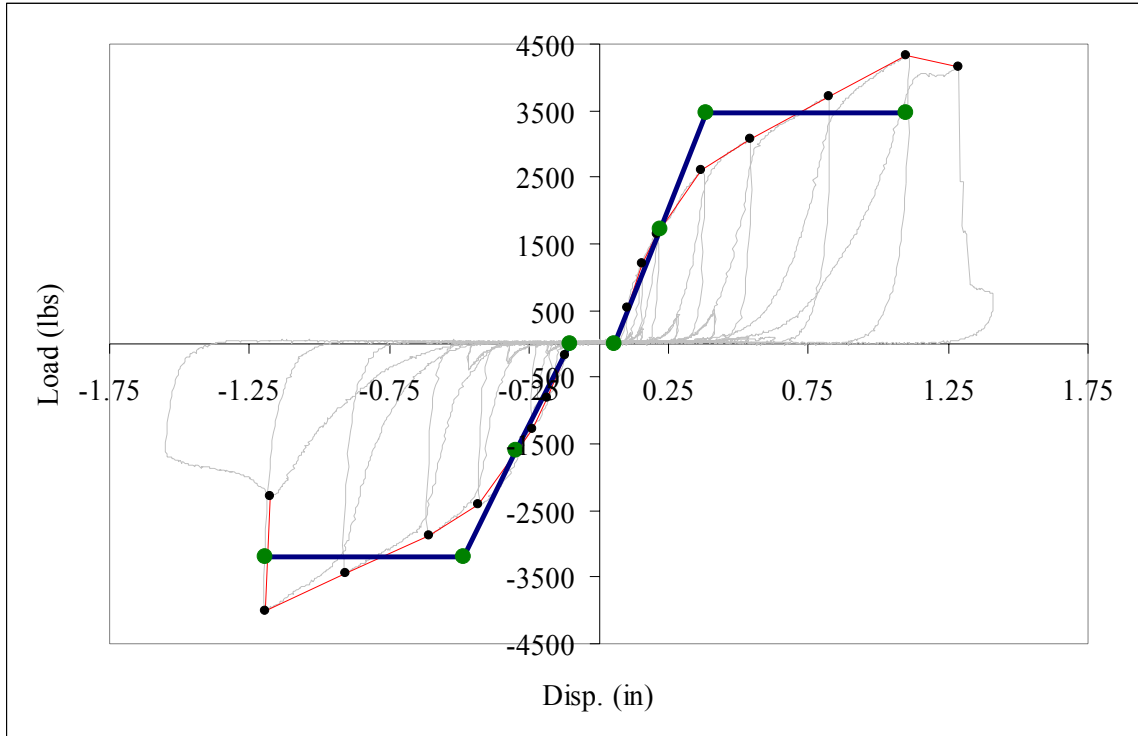


Figure B.4: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C03.

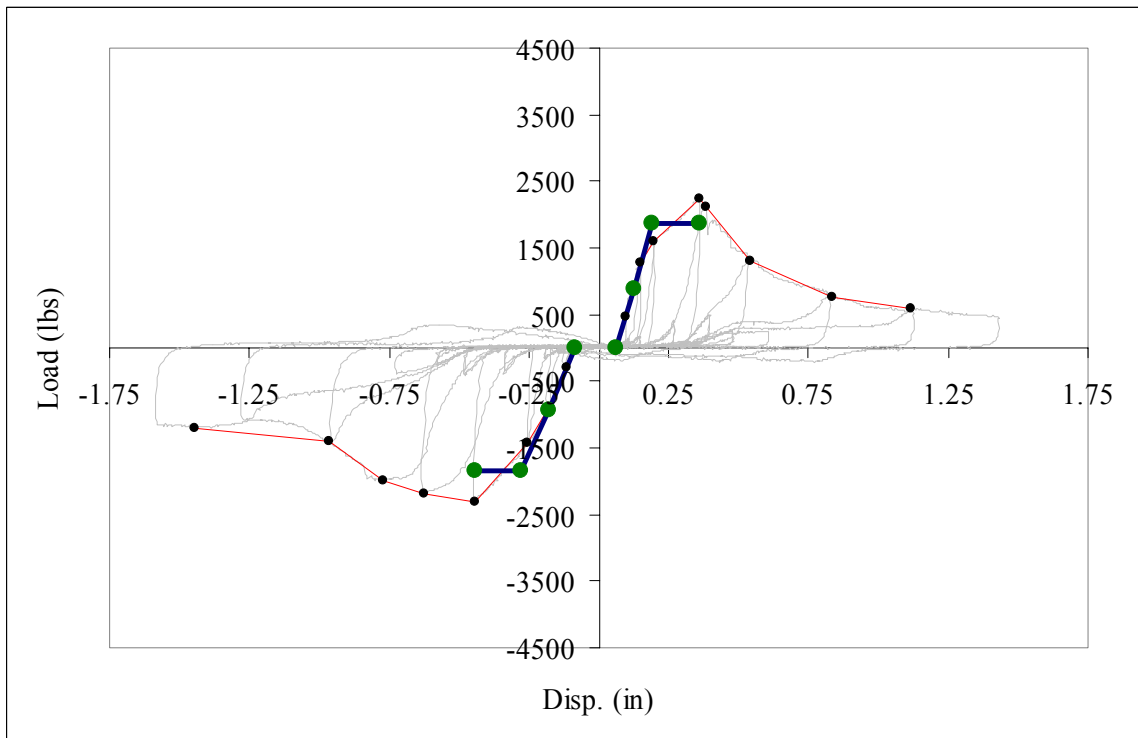


Figure B.5: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C04.

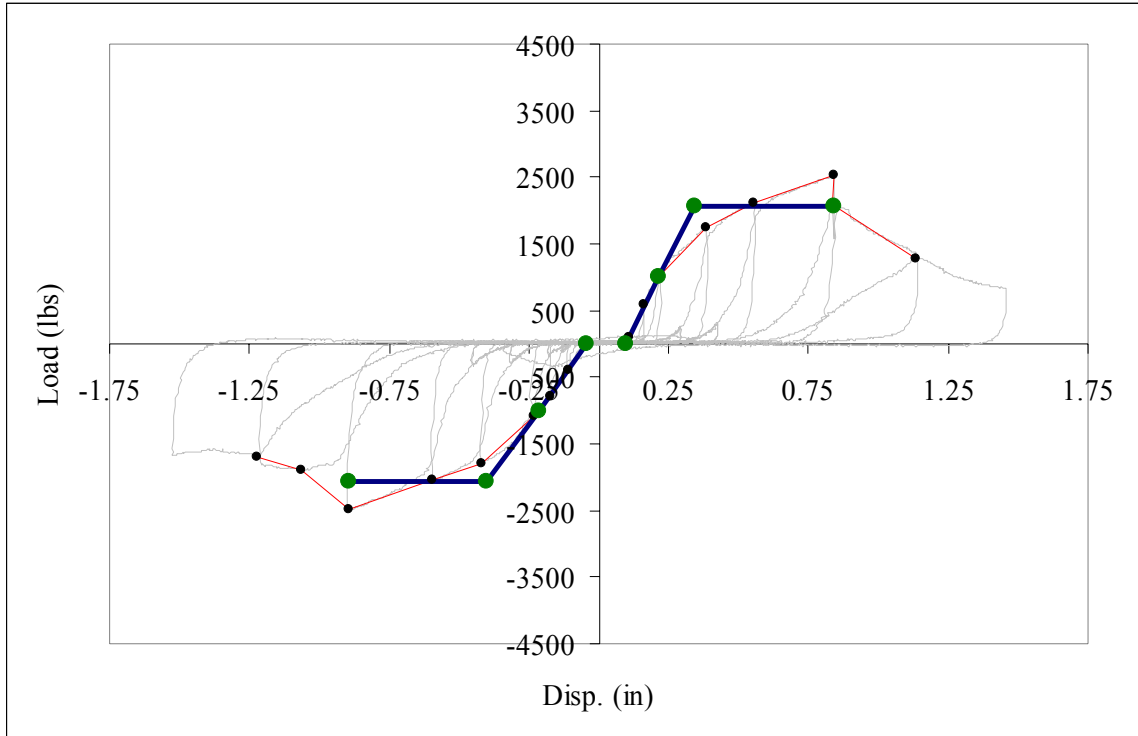


Figure B.6: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C05.

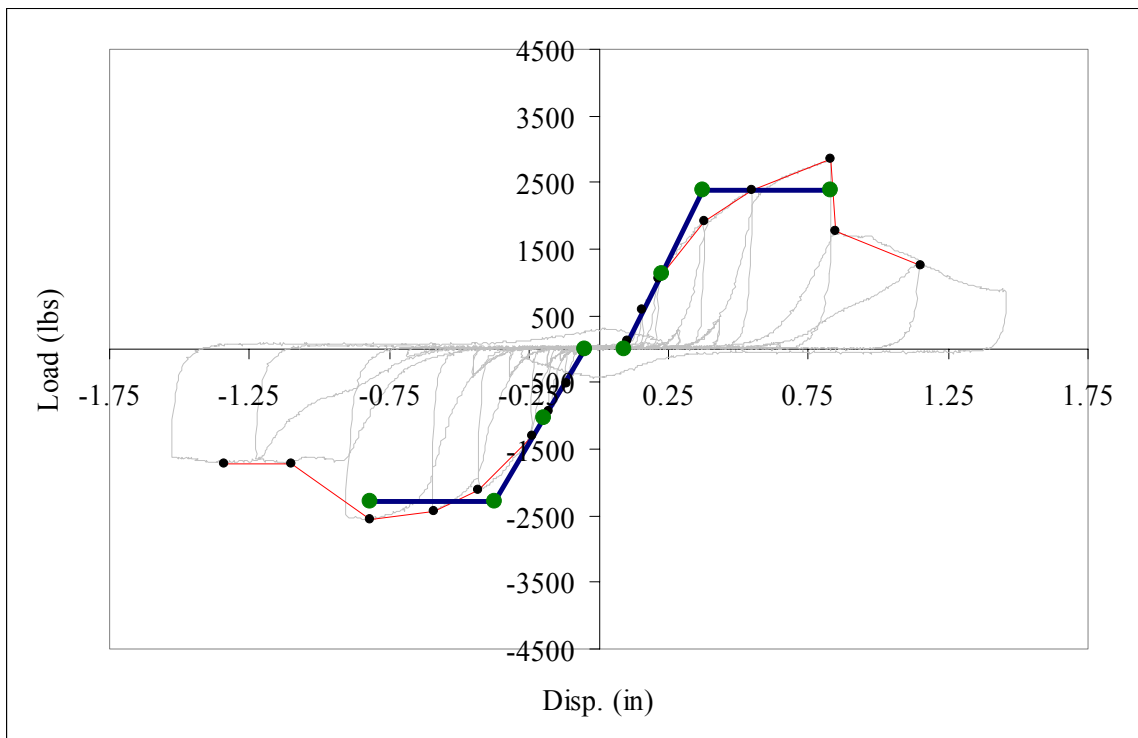


Figure B.7: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C06.

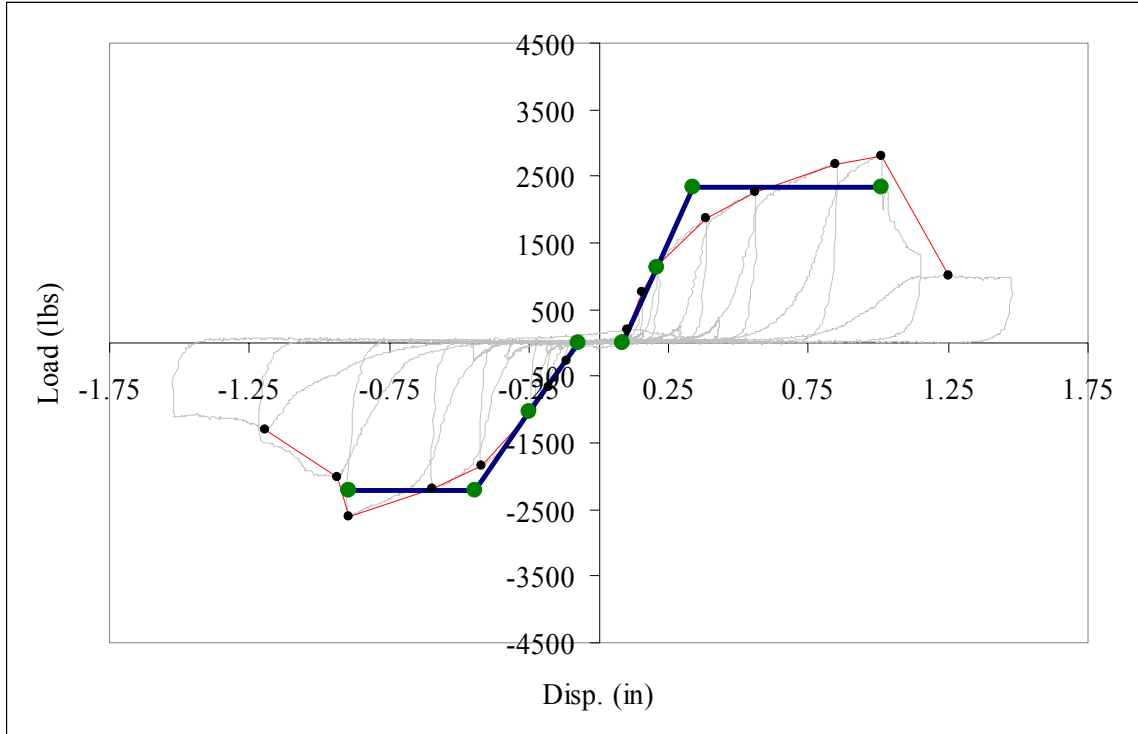


Figure B.8: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C07.

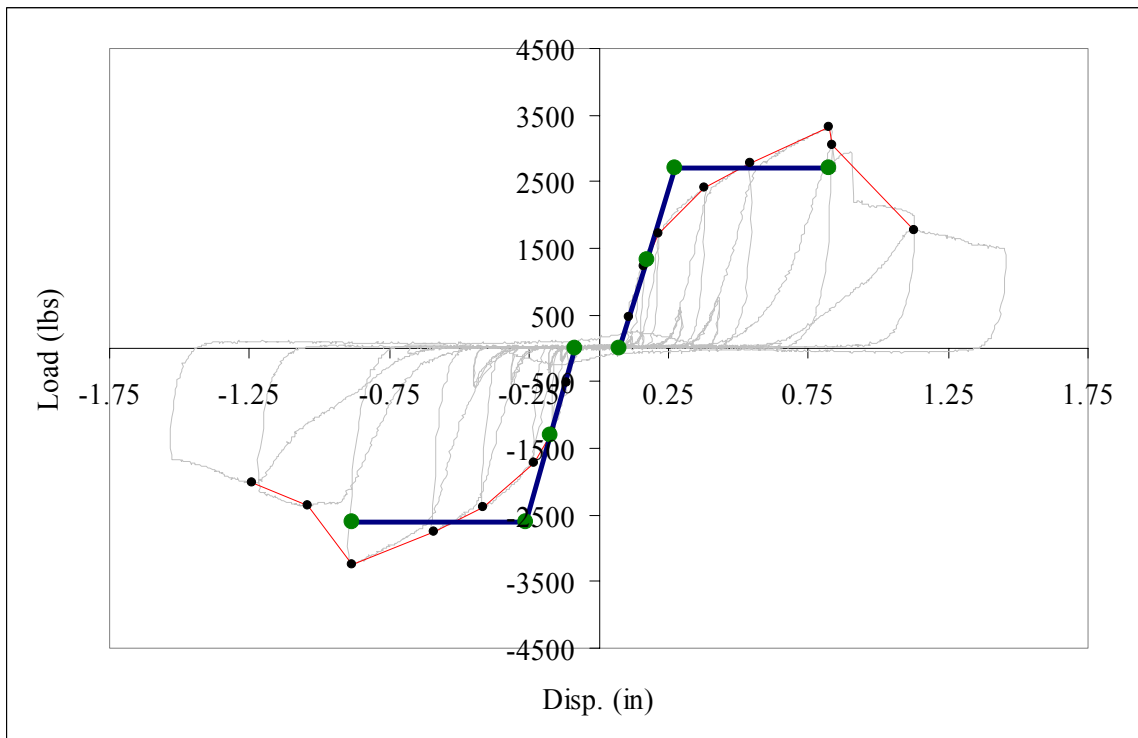


Figure B.9: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C08.

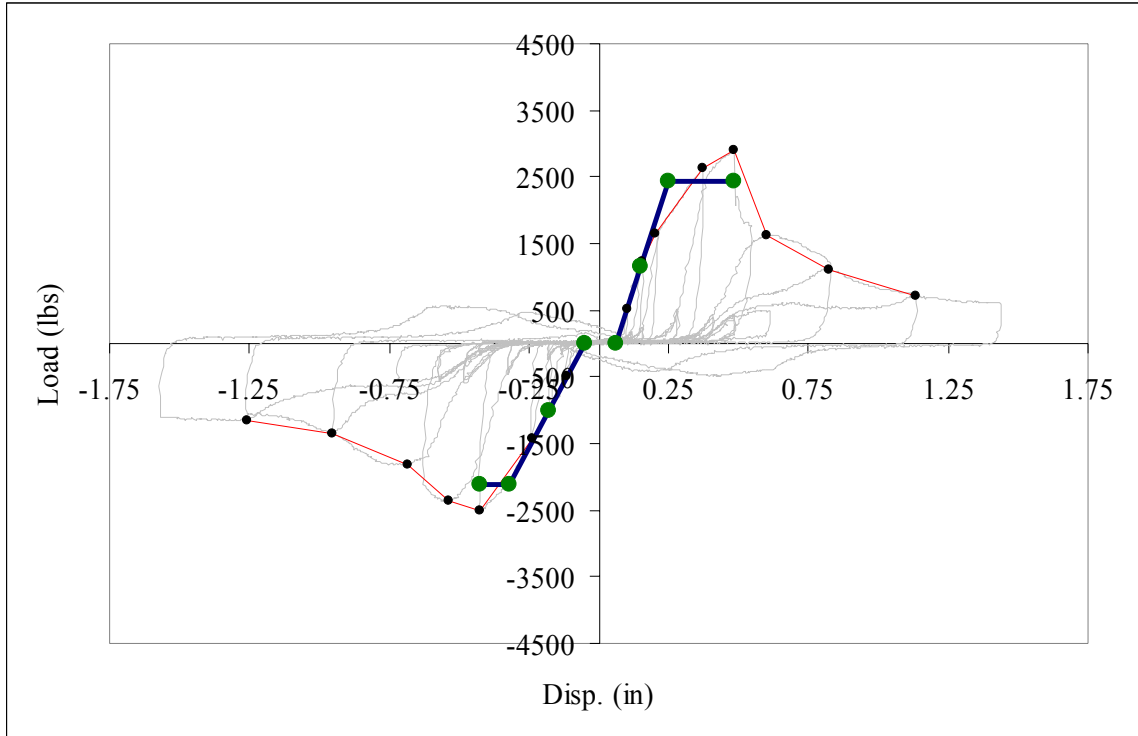


Figure B.10: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C09.

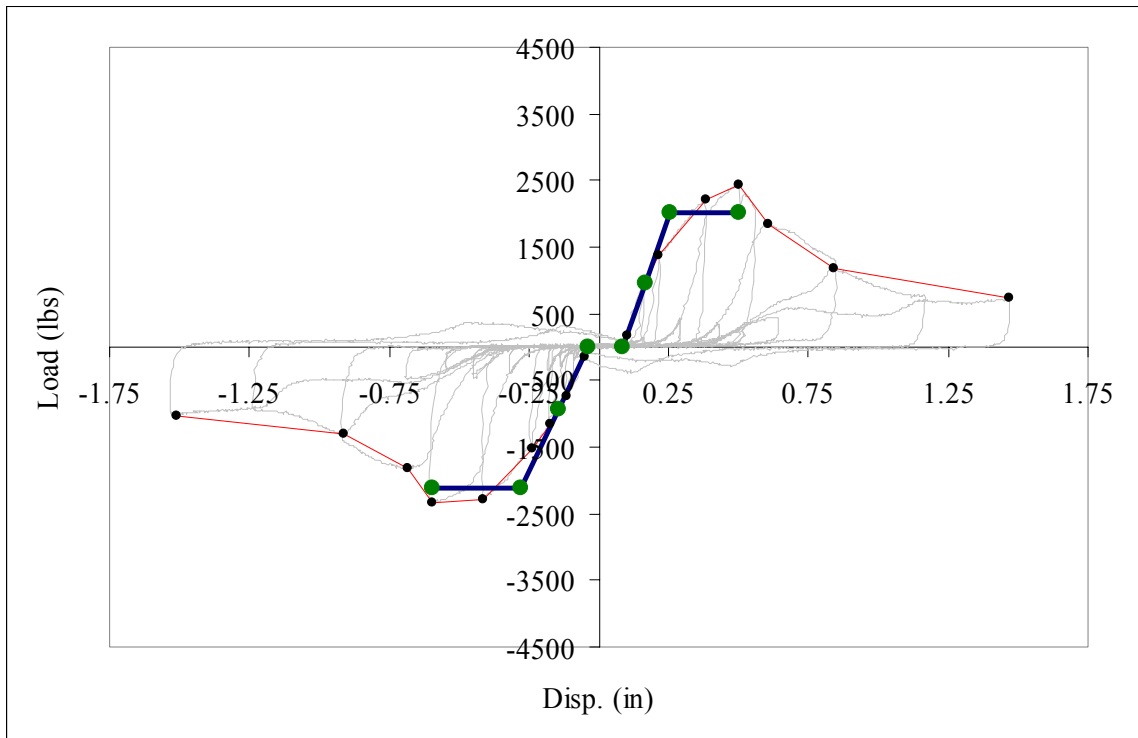


Figure B.11: Load (lbs) vs. Deflection (in.) plot. Test 2X1R1C10.

Table B.4: Connection properties, 2X1R3C Series.

Connection Properties 2X1R3C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	5412.84	5310.58	6024.12	6255.70	7230.15	5491.79	5793.29	5783.52	6623.38	5932.39	5985.78	590.51	0.10
@ Displacement (in)	0.30	0.27	0.31	0.30	0.38	0.24	0.26	0.34	0.27	0.31	0.30	0.04	0.14
Failure Load (lbs)	4330.27	4248.47	4819.30	5004.56	5784.12	4393.43	4634.63	4626.82	5298.70	4745.91	4788.62	472.41	0.10
@ Displacement (in)	0.30	0.27	0.31	0.30	0.38	0.24	0.26	0.34	0.27	0.31	0.30	0.04	0.14
40% Max (lbs)	2165.14	2124.23	2409.65	2502.28	2892.06	2196.71	2317.32	2313.41	2649.35	2372.96	2394.31	236.20	0.10
@ Displacement (in)	0.15	0.14	0.15	0.15	0.15	0.13	0.13	0.16	0.14	0.15	0.15	0.01	0.06
Yield (lbs)	4829.93	4720.26	5449.96	5537.60	6341.40	4433.21	4781.45	5109.83	6047.26	5010.72	5226.16	611.41	0.12
@ Displacement (in)	0.23	0.22	0.23	0.23	0.24	0.18	0.21	0.26	0.23	0.22	0.23	0.02	0.10
5% Offset (lbs)	4533.58	5086.52	5354.44	5654.59	5530.94	4793.69	5602.23	4900.53	6202.53	4871.01	5253.00	505.39	0.10
@ Displacement (in)	0.25	0.25	0.25	0.26	0.25	0.22	0.26	0.28	0.25	0.24	0.25	0.02	0.06
Elastic Stiff. (lb/in)	33425.32	32545.93	35671.08	36606.76	39018.84	46195.50	34020.08	28813.93	40633.71	38855.73	36578.69	4875.50	0.13
E.E.P. Energy (lb*in)	647.78	574.92	845.96	812.56	1389.12	472.48	612.10	874.08	692.43	756.44	767.79	252.61	0.33
Ductility Ratio	1.31	1.23	1.37	1.30	1.60	1.32	1.28	1.30	1.19	1.39	1.33	0.11	0.08
Yield Mode	II	II	II	II	II	II	II	II	II	II			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	B	A	B	B	B	B	B	A	A	B			

Table B.5: Member properties, 2X1R3C Series.

Member Properties 2X1R3C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard	
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	12.23	10.50	12.68	11.67	11.77	11.56	11.80	13.01	10.63	11.82	11.77	0.79	0.07
S.G.	0.60	0.53	0.56	0.60	0.62	0.64	0.64	0.51	0.75	0.47	0.59	0.08	0.13
D.E. 5% Yield (psi)	6058.76	5461.97	5067.68	6874.33	7140.36	7415.71	7001.74	4694.25	9223.59	5896.89	6483.53	1333.50	0.21
D.E. Capacity (psi)	6097.49	5542.84	5097.22	6951.10	7497.13	7415.71	7076.43	4752.34	9223.59	6219.97	6587.38	1328.70	0.20
Member B													
M.C. (%)	12.64	10.66	11.28	11.40	13.82	13.00	13.15	13.38	13.02	12.71	12.51	1.03	0.08
S.G.	0.57	0.93	0.57	0.58	0.54	0.55	0.61	0.57	0.65	0.58	0.62	0.11	0.19
D.E. 5% Yield (psi)	6588.82	6721.76	6217.35	6717.27	4976.10	5333.83	4733.12	6402.85	6955.40	6096.30	6074.28	785.68	0.13
D.E. Capacity (psi)	6615.62	6780.14	6287.12	6717.27	5040.85	5476.17	5024.19	6710.28	7295.72	6114.79	6206.21	781.91	0.13

Table B.6: Hysteretic properties, 2X1R3C Series.

Hysteretic Connection Properties 2X1R3C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	55.49	24.89	0.45	0.01	0.01	1.00	-38.95	23.20	0.60	-0.02	0.01	0.32
Primary2	60.15	26.82	0.45	0.02	0.01	0.62	-61.81	48.09	0.78	-0.03	0.01	0.43
Primary3	136.54	137.17	1.00	0.07	0.01	0.10	-596.55	349.93	0.59	-0.09	0.01	0.07
Primary4	801.81	572.98	0.71	0.11	0.01	0.06	-1886.94	500.96	0.27	-0.13	0.01	0.06
Primary5	2182.13	865.68	0.40	0.14	0.01	0.09	-3193.27	541.73	0.17	-0.17	0.01	0.08
Primary6	5027.42	1685.47	0.34	0.23	0.03	0.12	-5626.37	639.05	0.11	-0.27	0.03	0.10
Primary7	5881.11	1883.91	0.32	0.29	0.05	0.16	-5628.18	772.84	0.14	-0.38	0.04	0.10
Primary8	3390.26	1639.26	0.48	0.34	0.03	0.10	-4188.46	508.84	0.12	-0.43	0.04	0.10
Primary9	1395.50	614.54	0.44	0.57	0.04	0.08	-2336.42	695.27	0.30	-0.66	0.08	0.12
Primary10	872.66	420.08	0.48	0.78	0.29	0.37	-1703.60	655.74	0.38	-1.01	0.20	0.20
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	1.71	0.41	0.24	0.90	0.37	0.42	0.37	0.21	0.57	4708.77	6784.64	1.44
Primary2	2.82	0.58	0.20	1.79	0.95	0.53	0.31	0.16	0.50	2728.97	1704.79	0.62
Primary3	15.30	5.08	0.33	30.42	12.34	0.41	0.08	0.01	0.18	4766.48	1962.86	0.41
Primary4	60.83	11.64	0.19	160.74	24.57	0.15	0.06	0.01	0.16	11520.06	1752.64	0.15
Primary5	154.58	36.95	0.24	420.77	66.09	0.16	0.06	0.01	0.15	17352.67	2148.01	0.12
Primary6	744.50	221.86	0.30	1329.91	246.81	0.19	0.09	0.01	0.13	21563.06	2091.37	0.10
Primary7	1309.99	218.58	0.17	1914.31	331.63	0.17	0.11	0.01	0.12	17371.65	2167.24	0.12
Primary8	1717.80	212.99	0.12	1462.94	244.71	0.17	0.19	0.01	0.08	10025.25	2690.61	0.27
Primary9	1711.74	391.99	0.23	1168.15	327.15	0.28	0.24	0.04	0.15	3057.45	1019.30	0.33
Primary10	1926.86	574.08	0.30	1202.27	458.45	0.38	0.27	0.06	0.23	1478.33	559.21	0.38

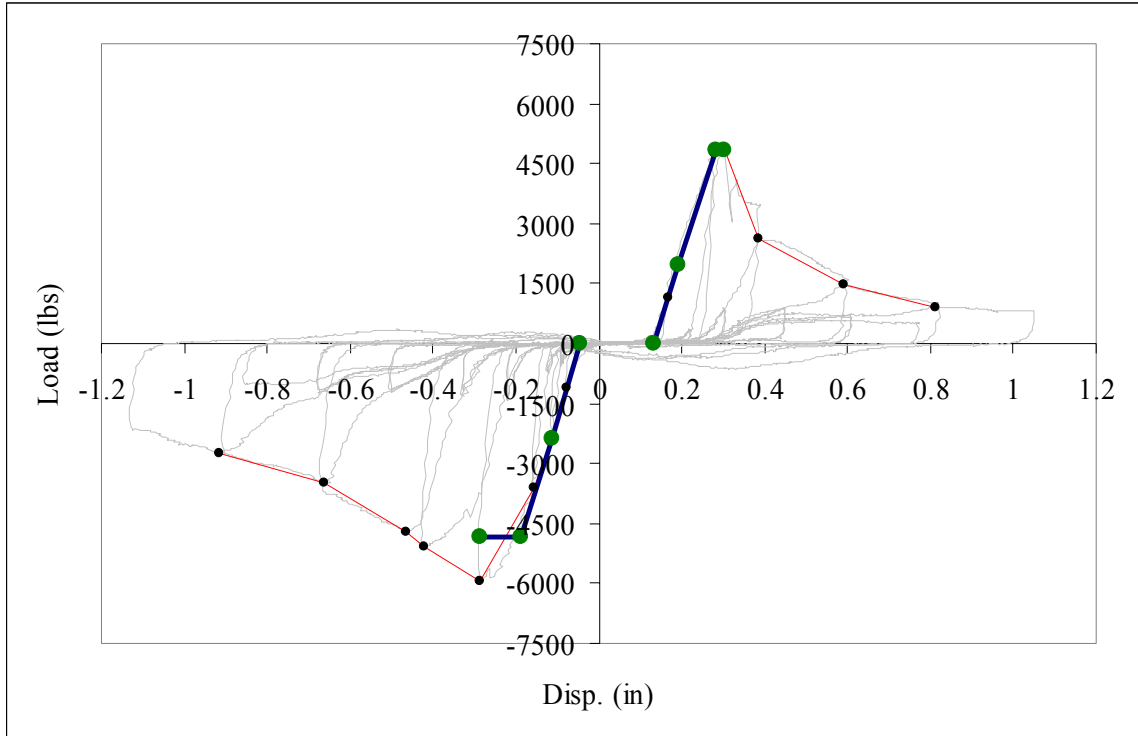


Figure B.12: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C01.

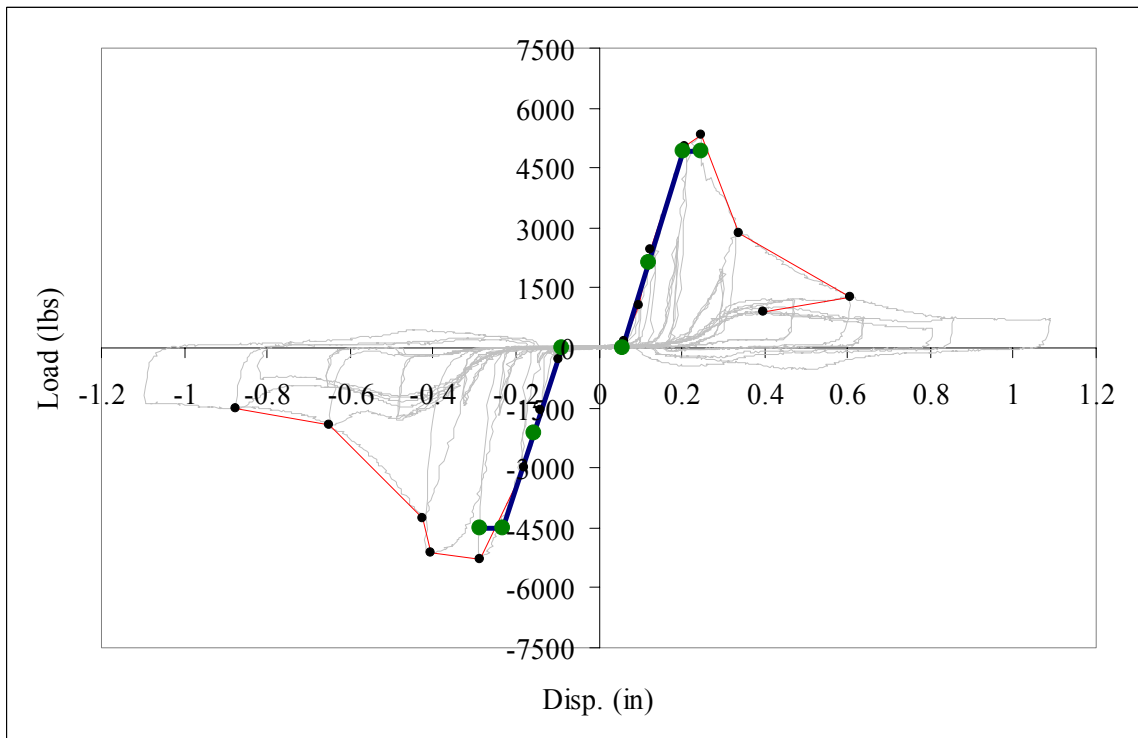


Figure B.13: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C02.

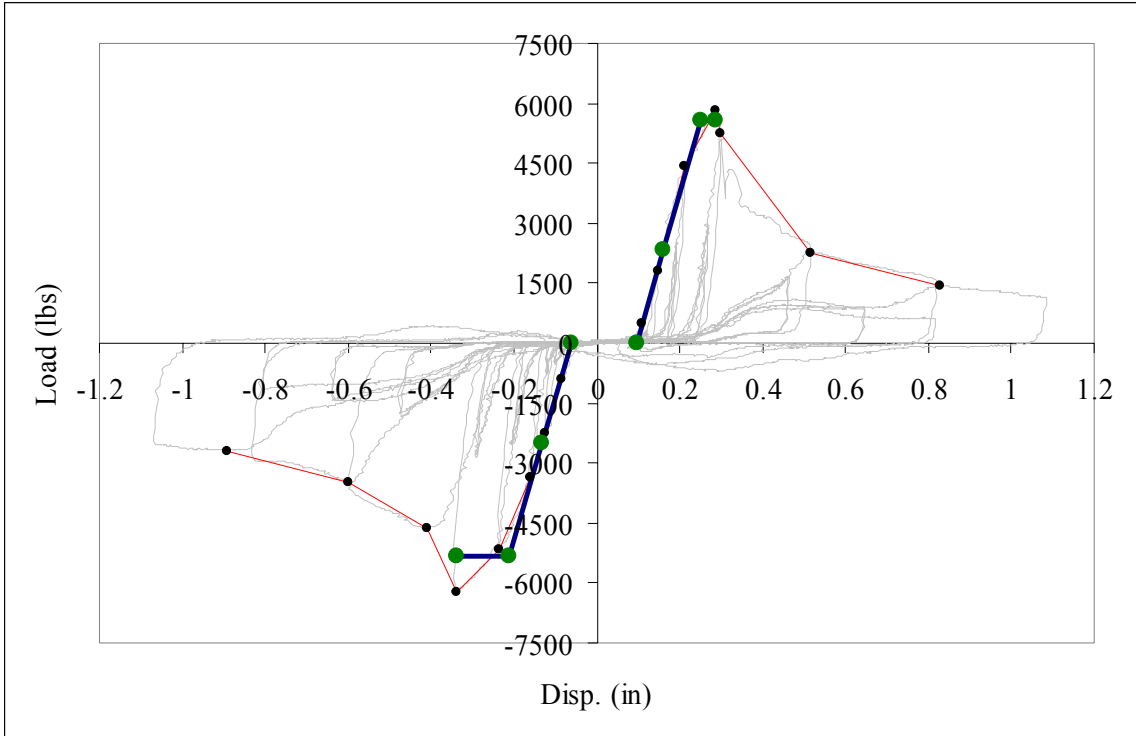


Figure B.14: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C03.

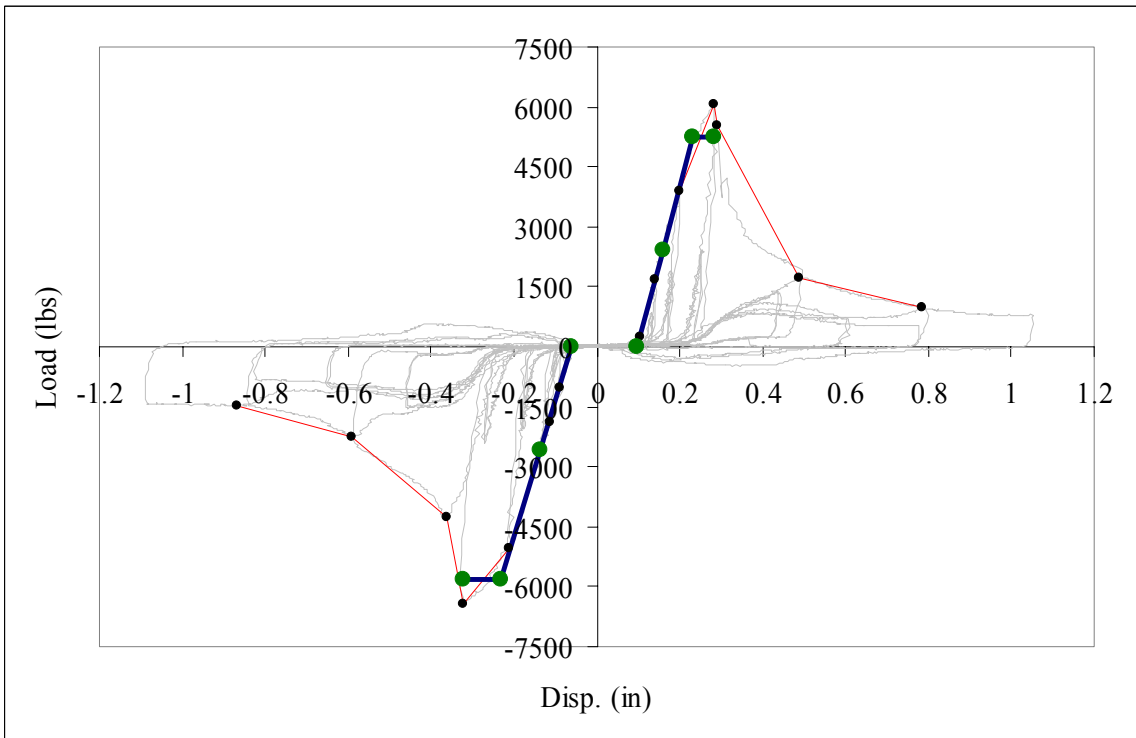


Figure B.15: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C04.

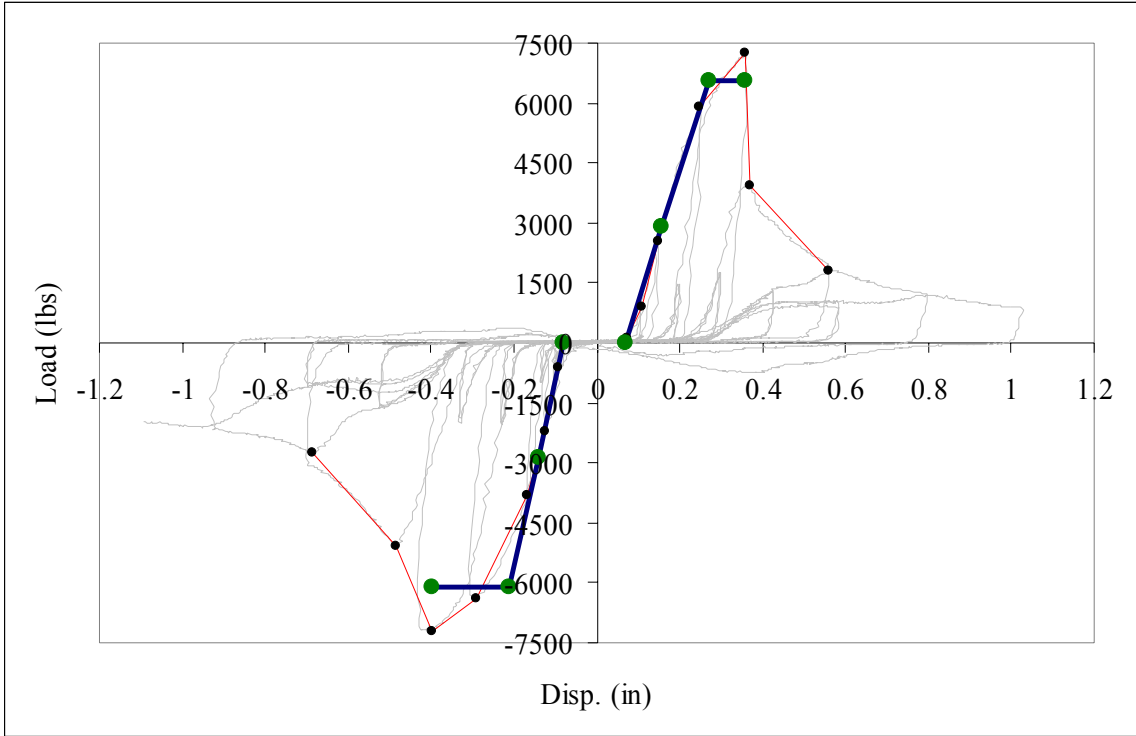


Figure B. 16: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C05.

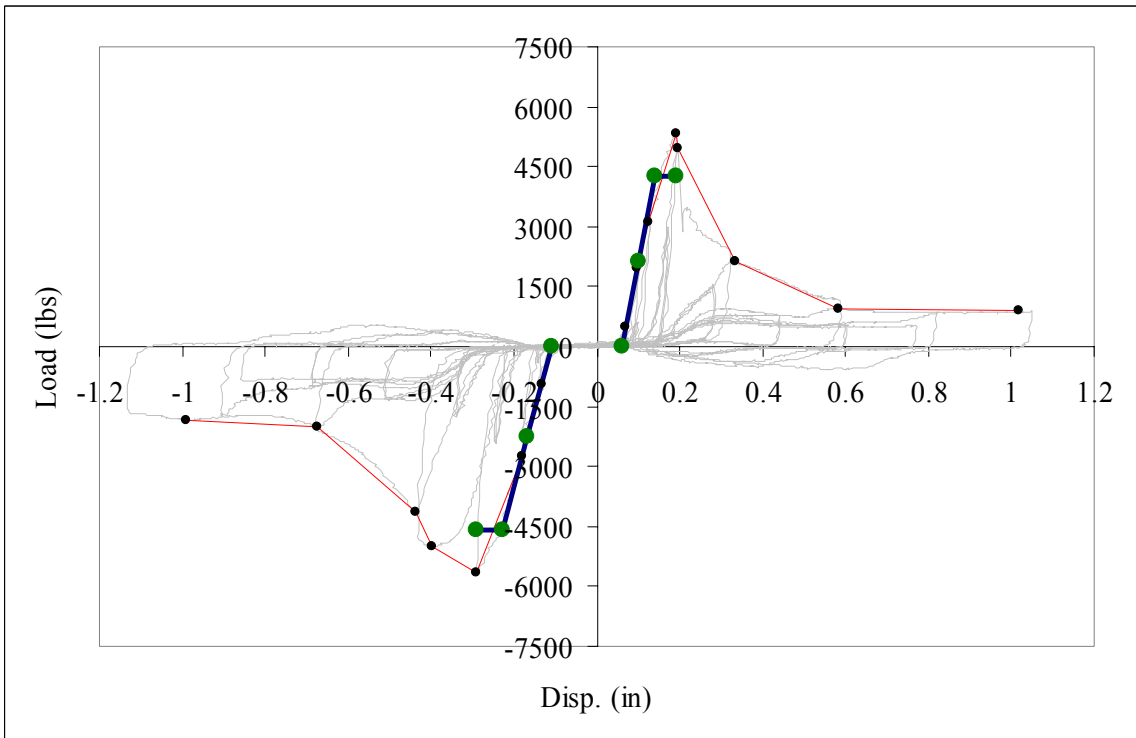


Figure B.17: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C06.

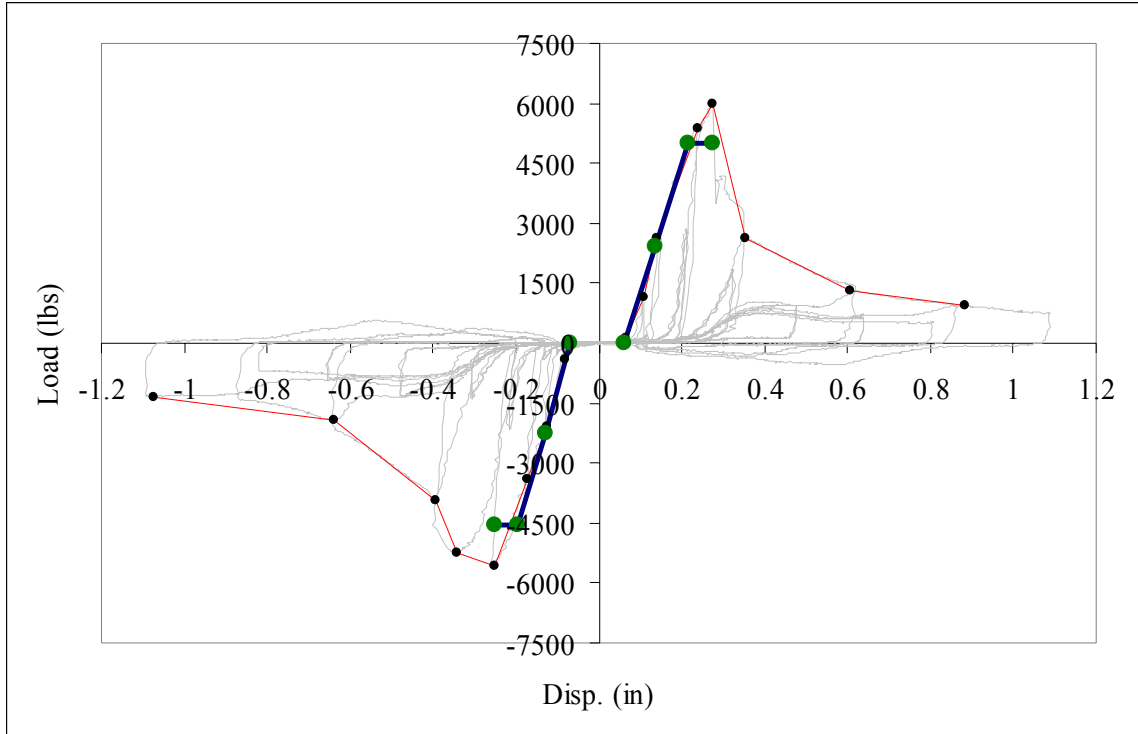


Figure B.18: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C07.

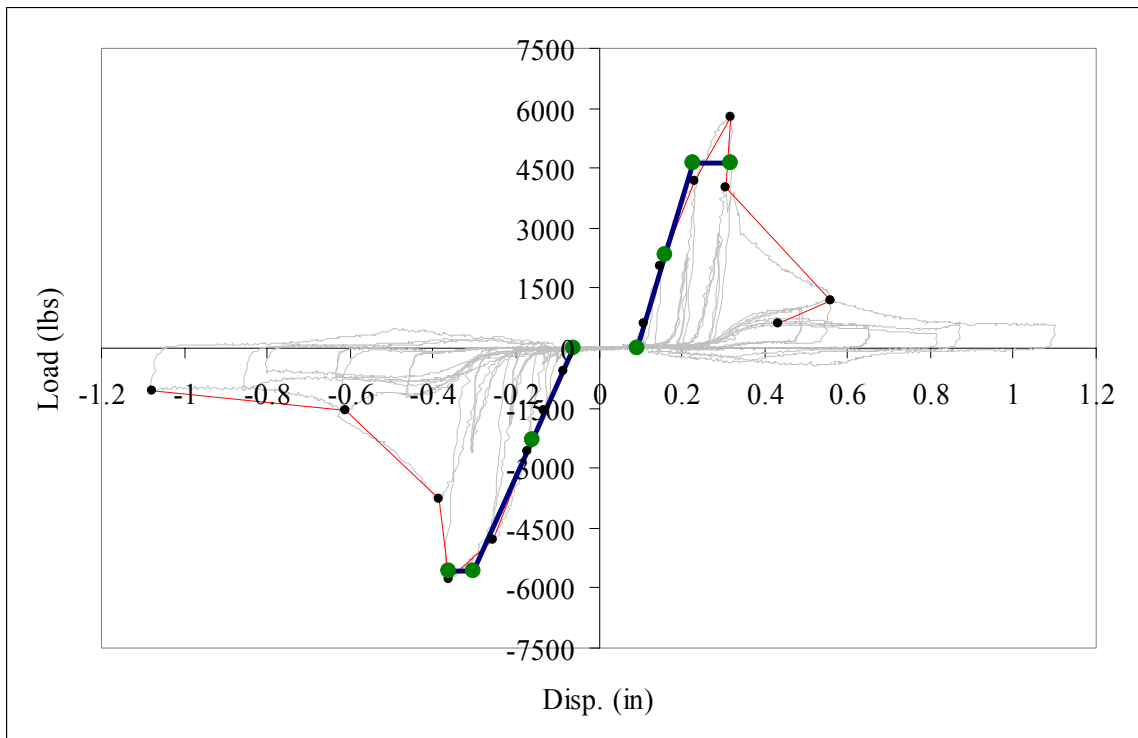


Figure B.19: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C08.

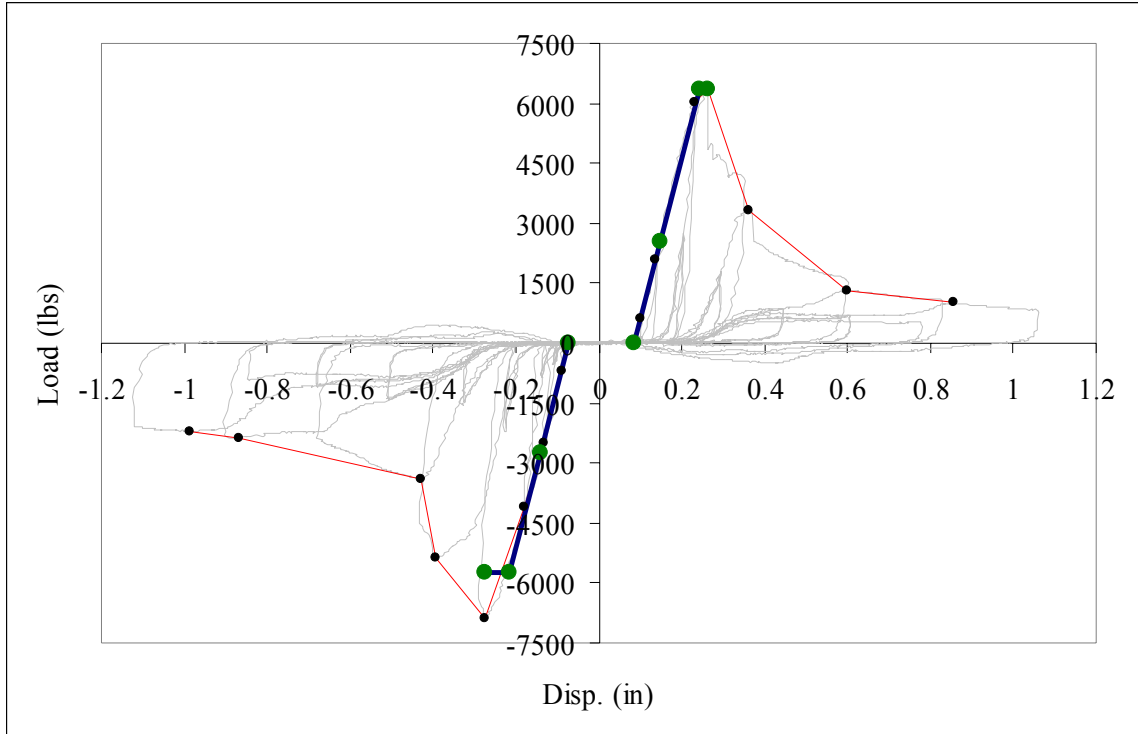


Figure B.20: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C09.

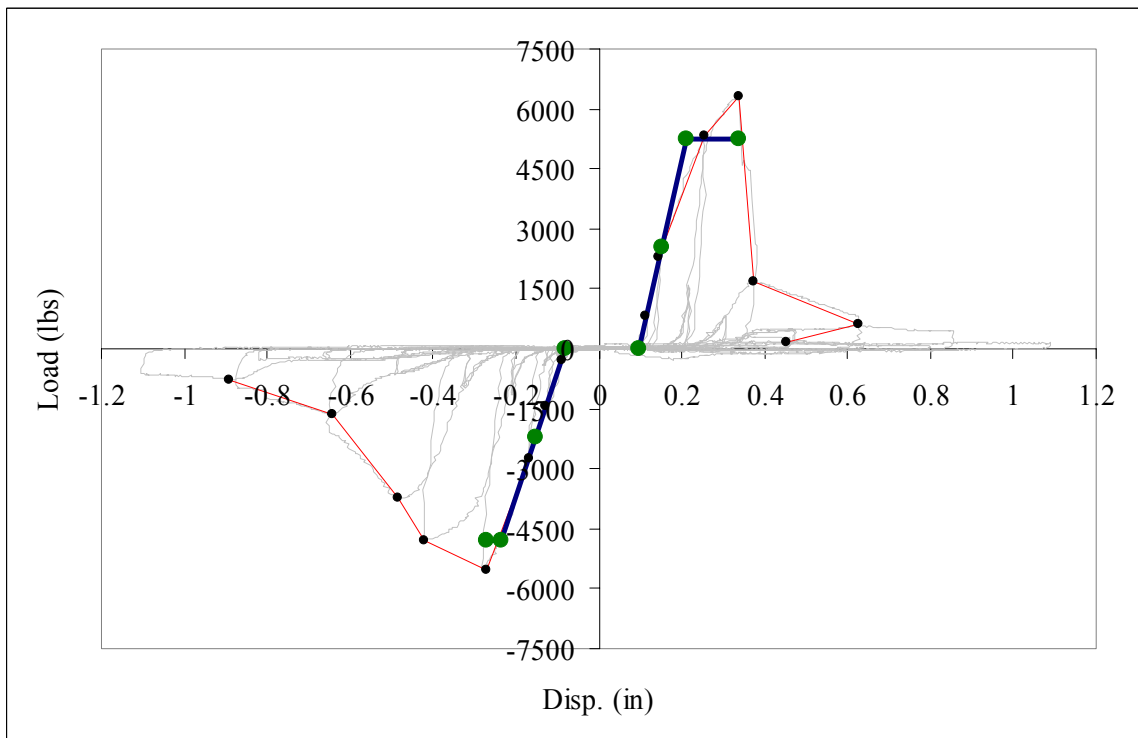


Figure B.21: Load (lbs) vs. Deflection (in.) plot. Test 2X1R3C010.

Table B.7: Connection properties, 2X1R5C Series.

Connection Properties 2X1R5C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
Max Load (lbs)	8310.61	8387.31	7521.13	7963.24	9572.28	9527.17	8315.12	9134.68	10209.13	7830.91	8677.16	881.39	0.10
@ Displacement (in)	0.30	0.32	0.29	0.32	0.27	0.29	0.33	0.30	0.31	0.29	0.30	0.02	0.06
Failure Load (lbs)	6648.49	6709.84	6016.90	6370.59	7657.82	7621.73	6652.10	7307.75	8167.30	6264.73	6941.73	705.11	0.10
@ Displacement (in)	0.31	0.32	0.29	0.32	0.27	0.31	0.33	0.29	0.31	0.29	0.30	0.02	0.06
40% Max (lbs)	3324.24	3354.92	3008.45	3185.30	3828.91	3810.87	3326.05	3653.87	4083.65	3132.36	3470.86	352.56	0.10
@ Displacement (in)	0.17	0.16	0.15	0.18	0.15	0.17	0.16	0.16	0.16	0.15	0.16	0.01	0.06
Yield (lbs)	7492.33	7629.11	6339.00	6760.99	8980.72	9797.91	7411.09	7558.57	8878.95	7082.79	7793.15	1085.83	0.14
@ Displacement (in)	0.25	0.27	0.23	0.25	0.23	0.25	0.26	0.21	0.25	0.23	0.24	0.02	0.08
5% Offset (lbs)	8078.24	8254.32	6457.67	7106.36	9324.70	9168.24	7362.05	8967.36	9735.43	7325.58	8178.00	1098.50	0.13
@ Displacement (in)	0.29	0.31	0.25	0.28	0.26	0.28	0.28	0.29	0.29	0.26	0.28	0.02	0.06
Elastic Stiff. (lb/in)	46760.86	40478.43	45987.21	51460.46	59383.66	47949.20	42516.98	50765.88	53852.40	47571.06	48672.62	5490.90	0.11
E.E.P. Energy (lb*in)	980.58	1083.93	856.74	967.97	936.68	1406.90	1195.22	914.14	1323.26	928.37	1059.38	188.09	0.18
Ductility Ratio	1.23	1.18	1.29	1.34	1.13	1.22	1.29	1.28	1.27	1.25	1.25	0.06	0.05
Yield Mode	II	II	II	II	II	II	II	II	II	II			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	A	A	B	B	B	B	B	B	A	A			

Table B.8: Member properties, 2X1R5C Series.

Member Properties 2X1R5C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Mean	Standard	COV
Member A	1	2	3	4	5	6	7	8	9	10		Deviation	
M.C. (%)	10.85	12.17	11.03	13.71	11.49	11.17	14.01	13.99	13.63	14.77	12.68	1.48	0.12
S.G.	0.51	0.54	0.59	0.46	0.65	0.56	0.59	0.54	0.60	0.67	0.57	0.06	0.11
D.E. 5% Yield (psi)	4986.49	5531.10	6785.81	4617.26	8089.05	6099.38	5439.02	5640.09	6352.70	6301.14	5984.21	989.24	0.17
D.E. Capacity (psi)	4986.49	5635.06	6928.56	4788.97	8158.43	6103.11	5512.69	5874.40	6388.69	6432.68	6080.91	982.33	0.16
Member B													
M.C. (%)	11.53	13.54	12.93	13.81	10.01	11.48	13.95	13.32	14.92	11.01	12.65	1.56	0.12
S.G.	0.51	0.56	0.51	0.50	0.52	0.63	0.52	0.62	0.61	0.54	0.55	0.05	0.09
D.E. 5% Yield (psi)	5213.52	5061.56	4283.04	4292.07	6365.07	7114.69	4720.28	6429.86	5969.92	6539.36	5598.94	1013.56	0.18
D.E. Capacity (psi)	5497.23	5205.80	4308.80	4365.13	6365.07	7228.59	4764.28	6527.37	6184.51	6583.90	5703.07	1019.68	0.18

Table B.9: Hysteretic properties, 2X1R5C Series.

Hysteretic Connection Properties 2X1R5C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard		Mean	Standard		Mean	Standard		Mean	Standard	
		Deviation	COV		Deviation	COV		Deviation	COV		Deviation	COV
Cycle I.D.												
Primary1	57.14	23.85	0.42	0.01	0.00	0.43	-33.23	22.29	0.67	-0.01	0.00	0.39
Primary2	61.96	26.70	0.43	0.01	0.01	0.44	-46.47	40.16	0.86	-0.02	0.01	0.25
Primary3	90.98	39.26	0.43	0.04	0.00	0.10	-136.09	220.35	1.62	-0.05	0.00	0.11
Primary4	212.48	120.31	0.57	0.07	0.00	0.06	-360.30	479.19	1.33	-0.08	0.00	0.05
Primary5	720.76	435.87	0.60	0.09	0.01	0.10	-895.80	668.99	0.75	-0.11	0.00	0.04
Primary6	3378.53	1418.60	0.42	0.15	0.01	0.08	-4064.10	505.83	0.12	-0.18	0.01	0.07
Primary7	5506.07	1912.96	0.35	0.20	0.02	0.12	-6057.66	530.99	0.09	-0.22	0.01	0.07
Primary8	8488.21	2786.89	0.33	0.27	0.02	0.07	-8319.79	703.47	0.08	-0.31	0.02	0.07
Primary9	7909.41	3251.44	0.41	0.30	0.03	0.11	-6622.17	825.62	0.12	-0.38	0.02	0.06
Primary10	2520.33	458.89	0.18	0.44	0.06	0.14	-3550.91	1567.74	0.44	-0.40	0.24	0.59

	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard		Mean	Standard		Mean	Standard		Mean	Standard	
		Deviation	COV		Deviation	COV		Deviation	COV		Deviation	COV
	Cycle I.D.											
Primary1	0.94	0.21	0.23	0.38	0.11	0.29	0.41	0.13	0.32	5331.38	1570.74	0.29
Primary2	1.53	0.49	0.32	0.91	0.44	0.48	0.32	0.21	0.65	3372.48	1143.63	0.34
Primary3	6.17	2.46	0.40	4.98	4.46	0.90	0.23	0.04	0.19	2701.36	2558.66	0.95
Primary4	13.85	7.87	0.57	21.42	15.82	0.74	0.11	0.02	0.17	3938.24	3042.06	0.77
Primary5	29.10	9.31	0.32	81.70	29.49	0.36	0.06	0.00	0.06	8253.84	2689.63	0.33
Primary6	243.46	45.41	0.19	613.96	99.74	0.16	0.06	0.01	0.12	22563.65	3250.15	0.14
Primary7	442.06	73.96	0.17	1214.76	140.39	0.12	0.06	0.01	0.10	27581.65	3501.92	0.13
Primary8	1209.55	171.08	0.14	2405.50	216.17	0.09	0.08	0.01	0.12	29357.71	3773.65	0.13
Primary9	2013.41	299.29	0.15	2479.71	396.87	0.16	0.13	0.01	0.11	21207.74	3972.32	0.19
Primary10	1470.12	322.55	0.22	1395.80	402.19	0.29	0.17	0.02	0.12	8127.24	3609.74	0.44

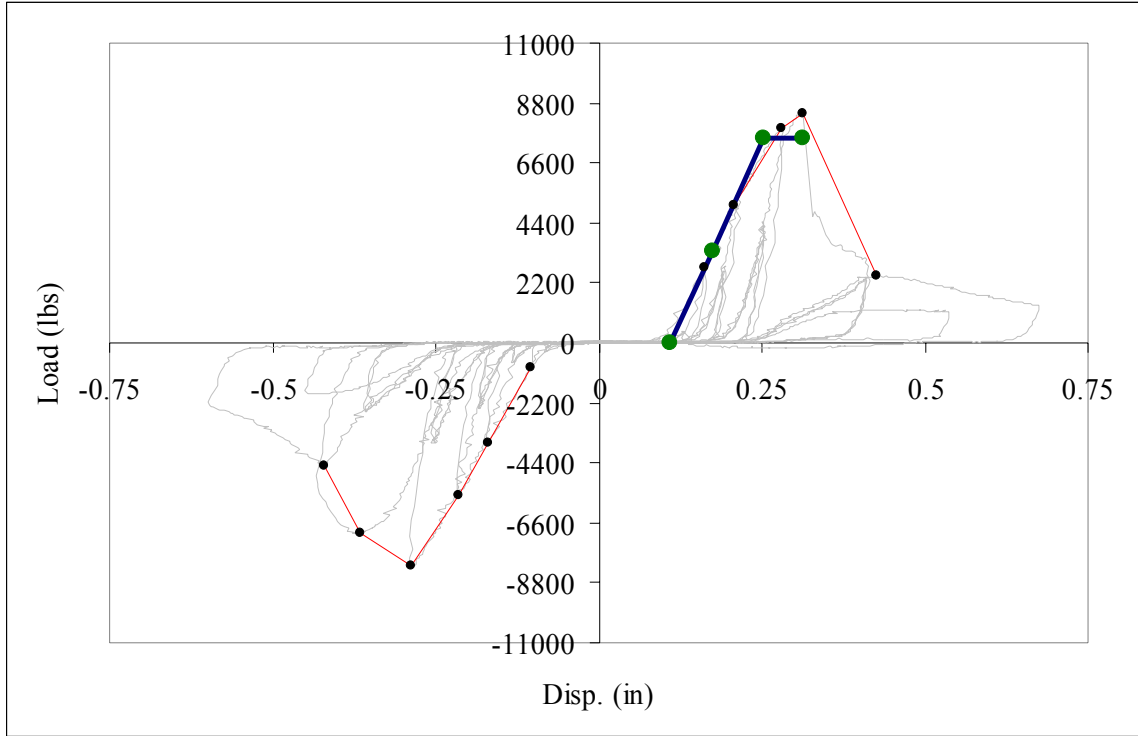


Figure B.22: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C01.

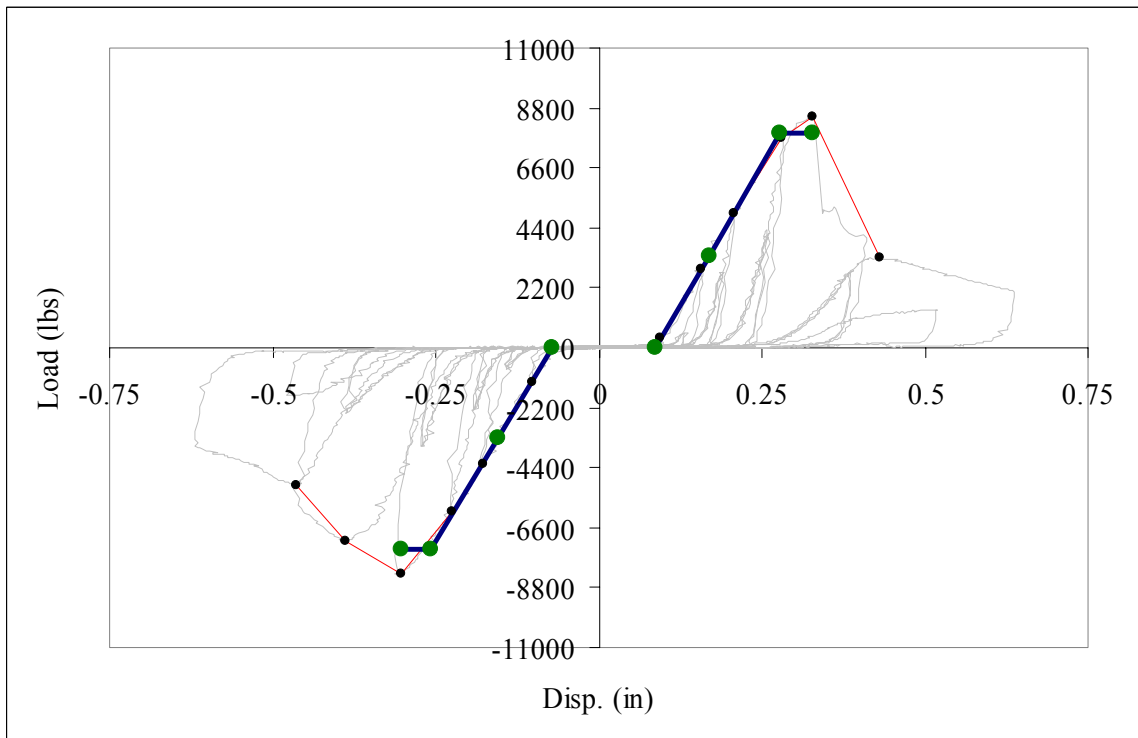


Figure B.23: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C02.

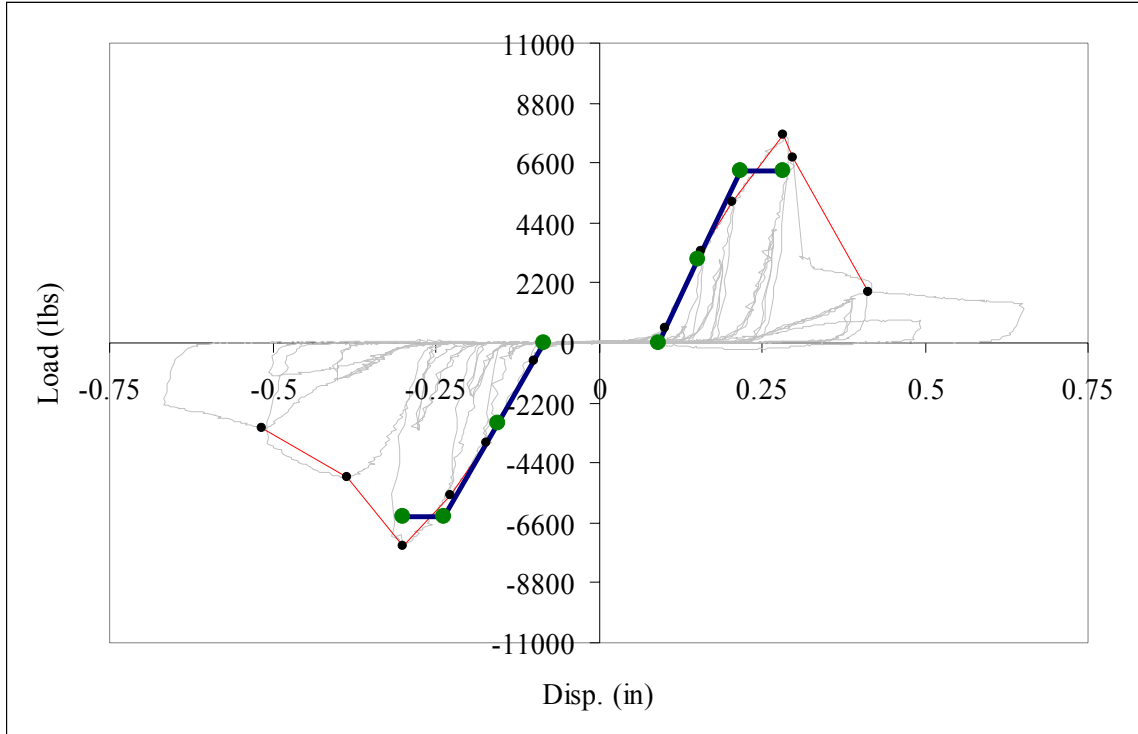


Figure B.24: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C03.

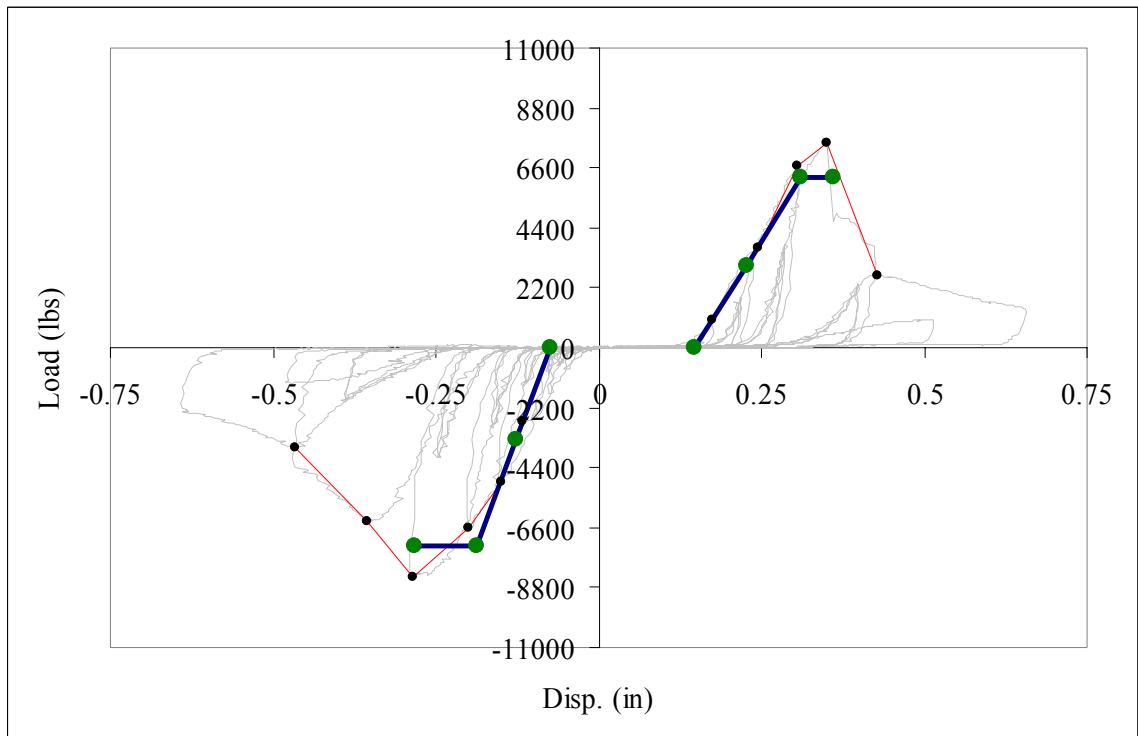


Figure B.25: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C04.

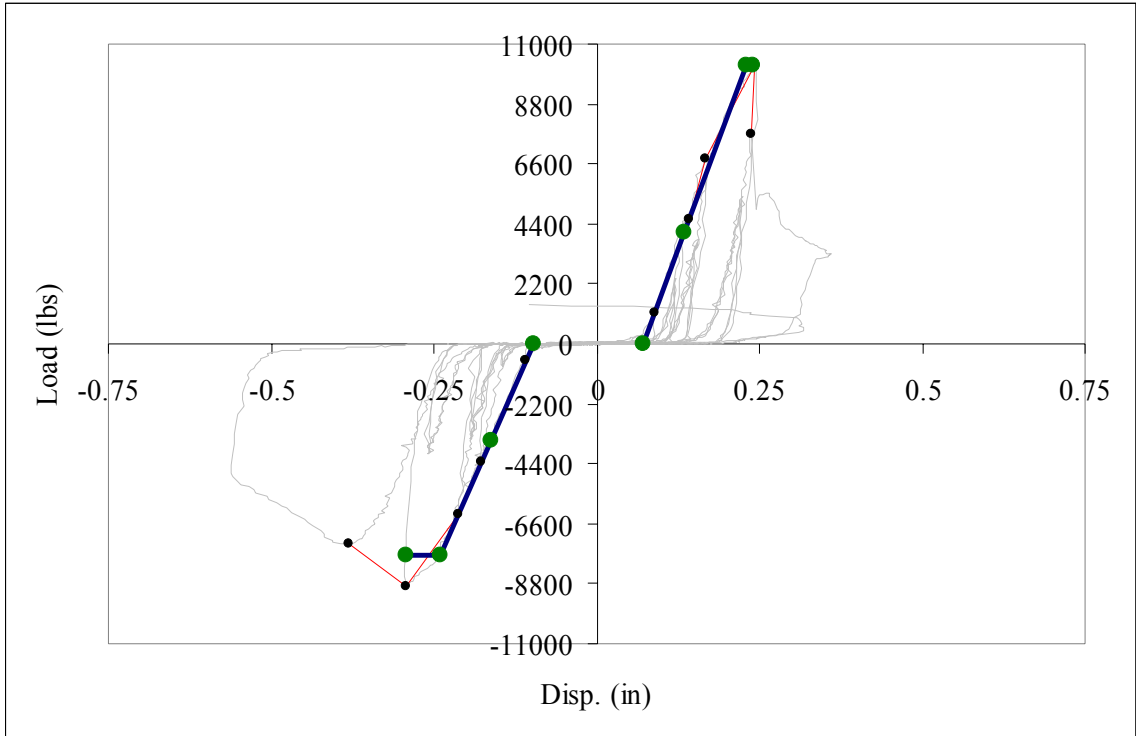


Figure B.26: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C05.

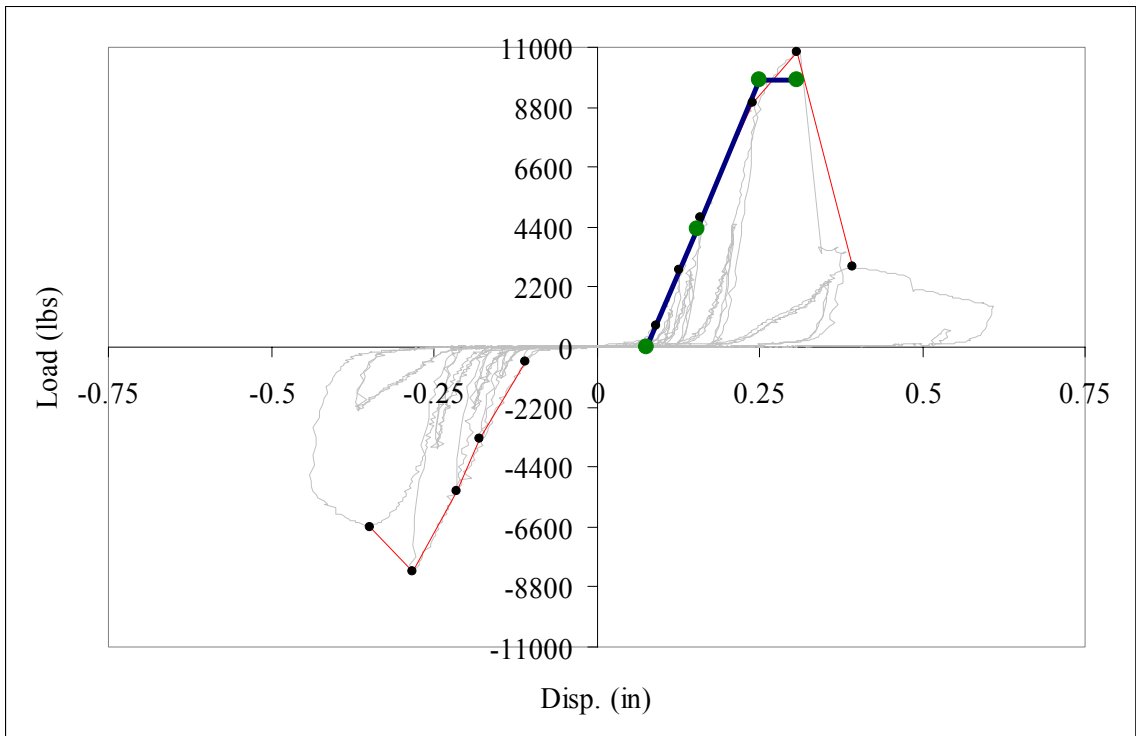


Figure B.27: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C06.

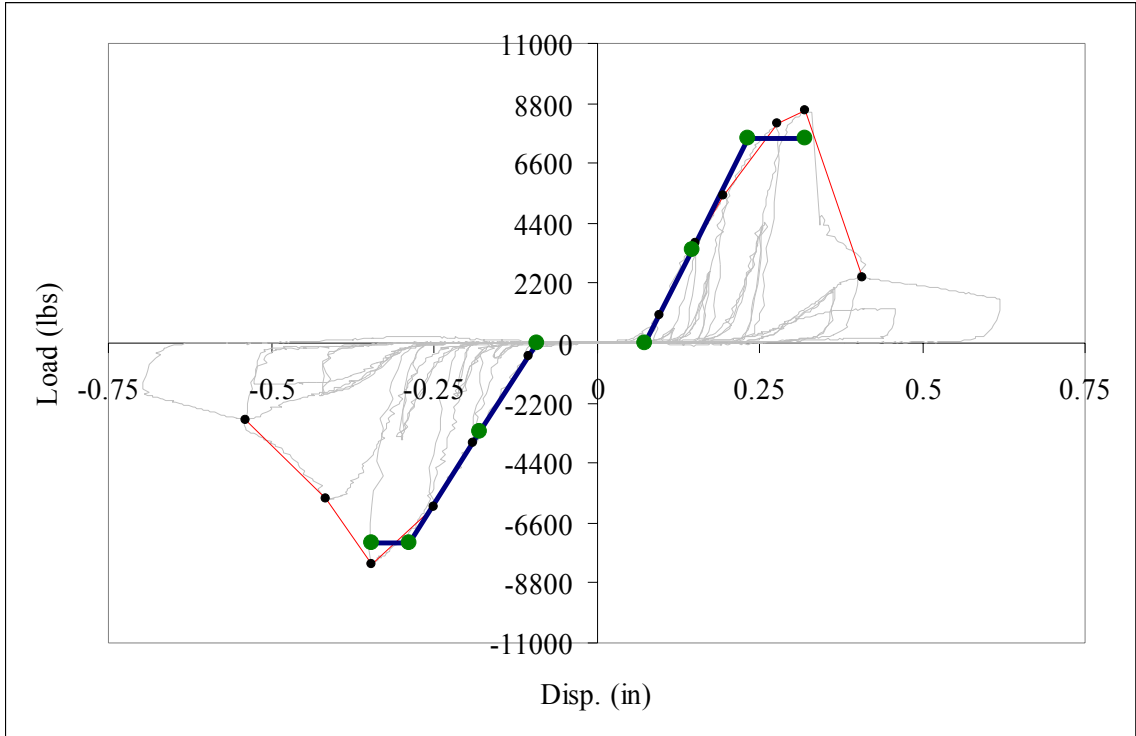


Figure B.28: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C07.

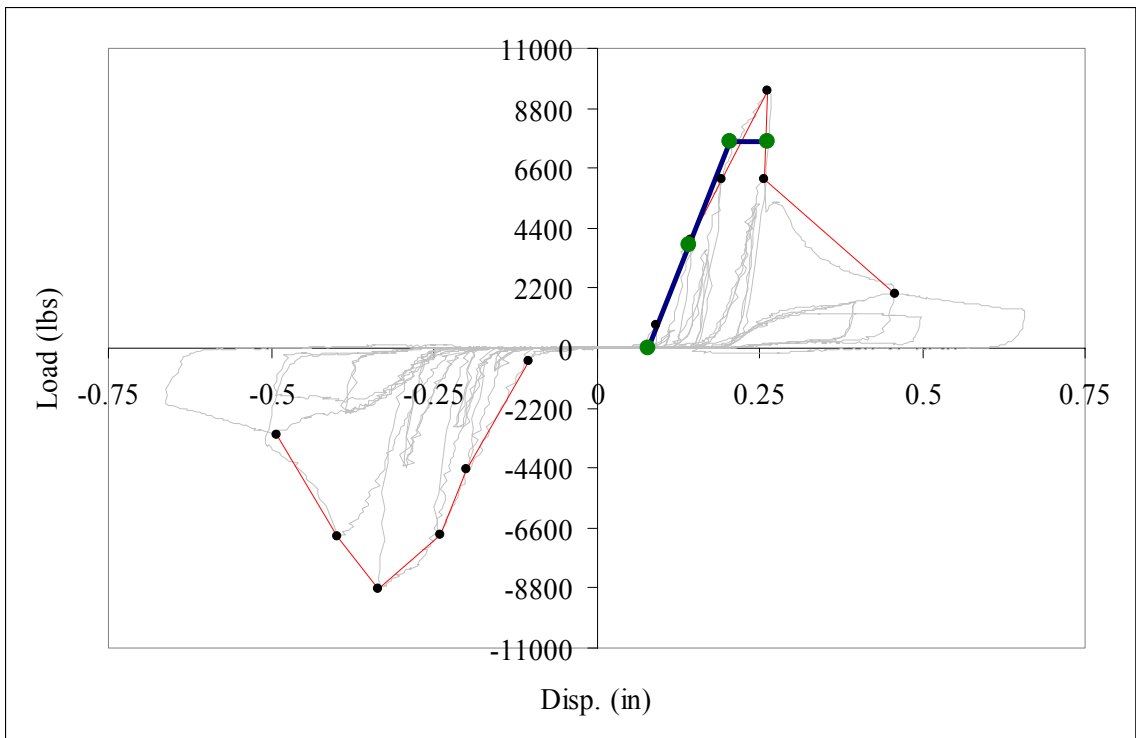


Figure B.29: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C08.

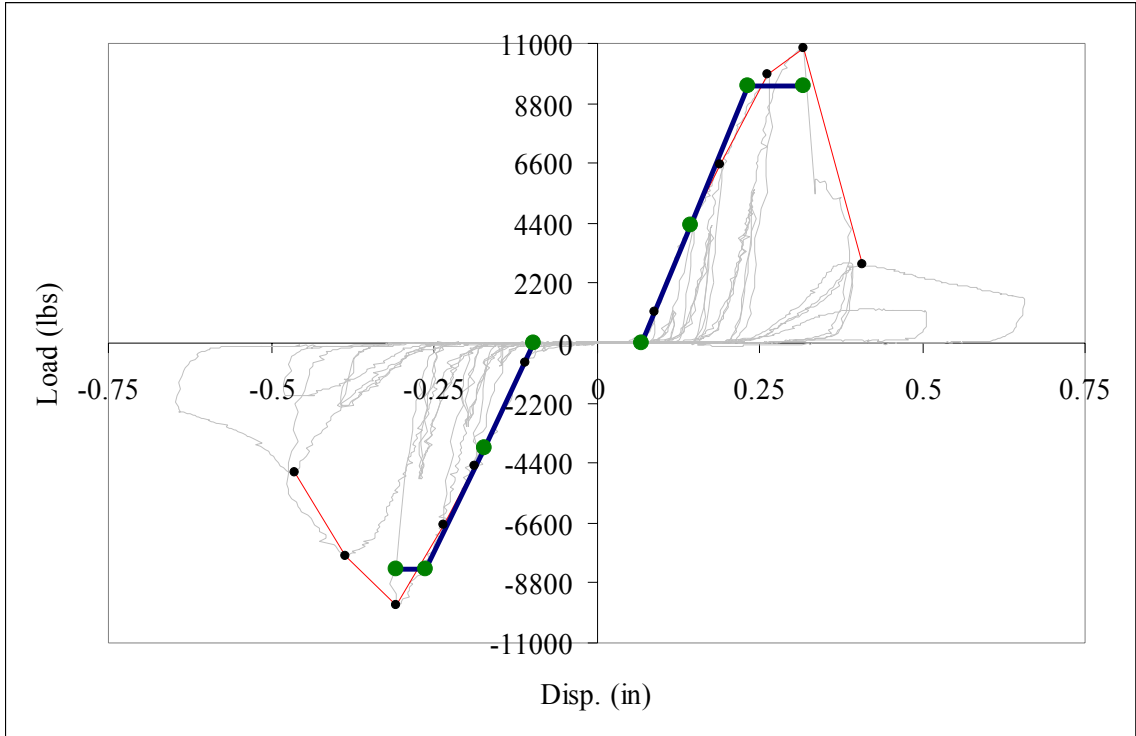


Figure B.30: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C09.

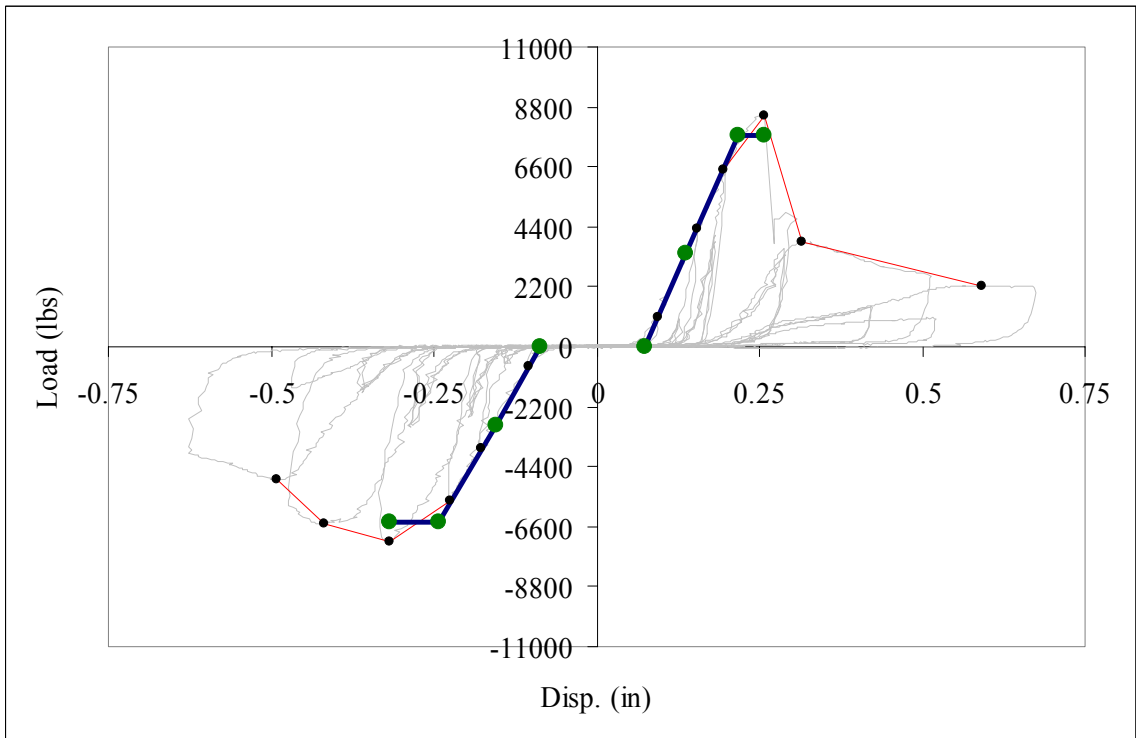


Figure B.31: Load (lbs) vs. Deflection (in.) plot. Test 2X1R5C10.

Table B.10: Connection properties, 2X2R3C Series.

Connection Properties 2X2R3C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
Max Load (lbs)	11172.30	11617.41	10121.16	11794.86	13583.60	12698.63	12182.83	14320.45	11708.39	9723.41	11892.30	1413.01	0.12
@ Displacement (in)	0.30	0.38	0.44	0.42	0.59	0.51	0.28	0.29	0.40	0.32	0.39	0.10	0.26
Failure Load (lbs)	8937.84	9293.93	8096.93	9435.89	10866.88	10158.90	9746.27	11456.36	9366.71	7778.73	9513.84	1130.41	0.12
@ Displacement (in)	0.37	0.38	0.44	0.42	0.59	0.51	0.28	0.32	0.40	0.32	0.40	0.09	0.23
40% Max (lbs)	4468.92	4646.97	4048.46	4717.94	5433.44	5079.45	4873.13	5728.18	4683.36	3889.36	4756.92	565.20	0.12
@ Displacement (in)	0.16	0.15	0.18	0.16	0.20	0.17	0.15	0.14	0.17	0.17	0.17	0.02	0.09
Yield (lbs)	10295.97	10783.64	9427.69	10818.88	11865.12	11290.44	10358.86	12922.09	10803.44	8913.34	10747.95	1142.28	0.11
@ Displacement (in)	0.25	0.24	0.30	0.28	0.34	0.29	0.23	0.23	0.30	0.29	0.27	0.04	0.13
5% Offset (lbs)	10775.46	10513.72	9418.02	10016.18	9550.29	11093.42	11853.36	14320.45	11472.52	9723.41	10873.68	1464.96	0.13
@ Displacement (in)	0.29	0.27	0.40	0.29	0.31	0.37	0.27	0.29	0.36	0.32	0.32	0.05	0.14
Elastic Stiff. (lb/in)	51934.45	65504.37	45568.51	53635.21	45772.14	52814.60	72276.43	81654.79	48690.66	44387.64	56223.88	12679.33	0.23
E.E.P. Energy (lb*in)	1587.84	2303.05	2304.55	2598.04	4558.49	3755.25	1288.18	2007.28	2308.26	1297.43	2400.84	1044.96	0.44
Ductility Ratio	1.27	1.52	1.46	1.50	1.75	1.77	1.24	1.40	1.35	1.18	1.44	0.20	0.14
Yield Mode	II	II	II	II	II	II	II	II	II	II			
Failure Mode	Splitting	Splitting	Blck Shr.	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	A	A	B	B	Both	B	Both	A	B	Both			

Table B.11: Member properties, 2X2R3C Series.

Member Properties 2X2R3C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard	
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	14.25	12.69	13.84	13.24	14.50	13.93	11.91	11.06	11.00	14.16	13.06	1.32	0.10
S.G.	0.53	0.52	0.58	0.57	0.59	0.52	0.59	0.72	0.56	0.54	0.57	0.06	0.10
D.E. 5% Yield (psi)	4434.39	5432.52	4564.96	6146.40	6194.40	4605.73	6844.63	7992.80	7452.72	4443.95	5811.25	1320.60	0.23
D.E. Capacity (psi)	4517.43	5464.76	4784.24	6449.28	6577.77	4641.25	6967.09	8300.36	7534.79	4474.05	5971.10	1384.32	0.23
Member B													
M.C. (%)	12.98	14.41	13.28	13.42	12.77	12.82	13.94	13.03	12.95	11.60	13.12	0.75	0.06
S.G.	0.53	0.62	0.46	0.48	0.53	0.55	0.70	0.65	0.46	0.62	0.56	0.08	0.15
D.E. 5% Yield (psi)	5169.24	5463.98	4433.56	4073.58	4576.67	4996.47	6192.07	7956.64	4258.05	4511.87	5163.21	1168.44	0.23
D.E. Capacity (psi)	5444.29	5653.47	4531.12	4180.16	4682.34	5037.73	6462.62	8107.49	4459.18	4511.87	5307.03	1201.97	0.23

Table B.12: Hysteretic properties, 2X2R3C Series.

Hysteretic Connection Properties 2X2R3C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Standard		COV	Standard		COV	Standard		COV	Standard		COV
	Mean	Deviation		Mean	Deviation		Mean	Deviation		Mean	Deviation	
Cycle I.D.												
Primary1	68.57	23.38	0.34	0.01	0.01	0.50	-40.60	17.44	0.43	-0.02	0.00	0.27
Primary2	77.14	27.22	0.35	0.03	0.00	0.09	-48.87	26.13	0.53	-0.02	0.00	0.15
Primary3	226.92	169.32	0.75	0.06	0.00	0.05	-199.10	155.53	0.78	-0.06	0.00	0.06
Primary4	1076.25	742.40	0.69	0.10	0.00	0.05	-985.87	514.47	0.52	-0.09	0.01	0.08
Primary5	2706.04	1363.36	0.50	0.13	0.00	0.03	-2520.18	751.79	0.30	-0.13	0.01	0.04
Primary6	7444.89	2743.51	0.37	0.21	0.01	0.05	-7895.27	1224.21	0.16	-0.22	0.01	0.04
Primary7	10393.94	3588.94	0.35	0.28	0.02	0.06	-10705.07	1184.92	0.11	-0.30	0.02	0.06
Primary8	11858.62	4019.45	0.34	0.35	0.06	0.16	-10707.03	1951.87	0.18	-0.42	0.05	0.12
Primary9	7205.19	4163.76	0.58	0.46	0.07	0.14	-7110.90	3622.76	0.51	-0.52	0.07	0.13
Primary10	3401.09	2179.52	0.64	0.60	0.10	0.17	-3864.55	2279.46	0.59	-0.64	0.10	0.15
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Standard		COV	Standard		COV	Standard		COV	Standard		COV
	Mean	Deviation		Mean	Deviation		Mean	Deviation		Mean	Deviation	
	Cycle I.D.											
Primary1	1.77	0.64	0.36	0.76	0.25	0.32	0.39	0.14	0.37	4019.09	1532.38	0.38
Primary2	2.55	0.76	0.30	1.62	0.57	0.35	0.26	0.06	0.23	2477.08	680.67	0.27
Primary3	10.45	2.89	0.28	13.25	5.35	0.40	0.13	0.03	0.25	3442.69	1556.18	0.45
Primary4	35.00	9.39	0.27	96.48	26.40	0.27	0.06	0.01	0.12	10787.64	2922.28	0.27
Primary5	103.60	18.67	0.18	330.38	76.57	0.23	0.05	0.01	0.13	20571.29	5089.44	0.25
Primary6	764.76	79.07	0.10	1642.47	221.13	0.13	0.07	0.00	0.06	35881.79	7391.89	0.21
Primary7	1442.30	122.24	0.08	3056.08	224.56	0.07	0.08	0.01	0.08	36520.33	6338.71	0.17
Primary8	3452.25	411.78	0.12	4356.84	878.70	0.20	0.13	0.03	0.20	29478.91	5022.93	0.17
Primary9	3117.92	1070.41	0.34	3630.28	2281.58	0.63	0.16	0.05	0.29	14484.35	6103.92	0.42
Primary10	2568.43	996.85	0.39	2303.22	1646.25	0.71	0.22	0.09	0.42	5796.17	4166.18	0.72

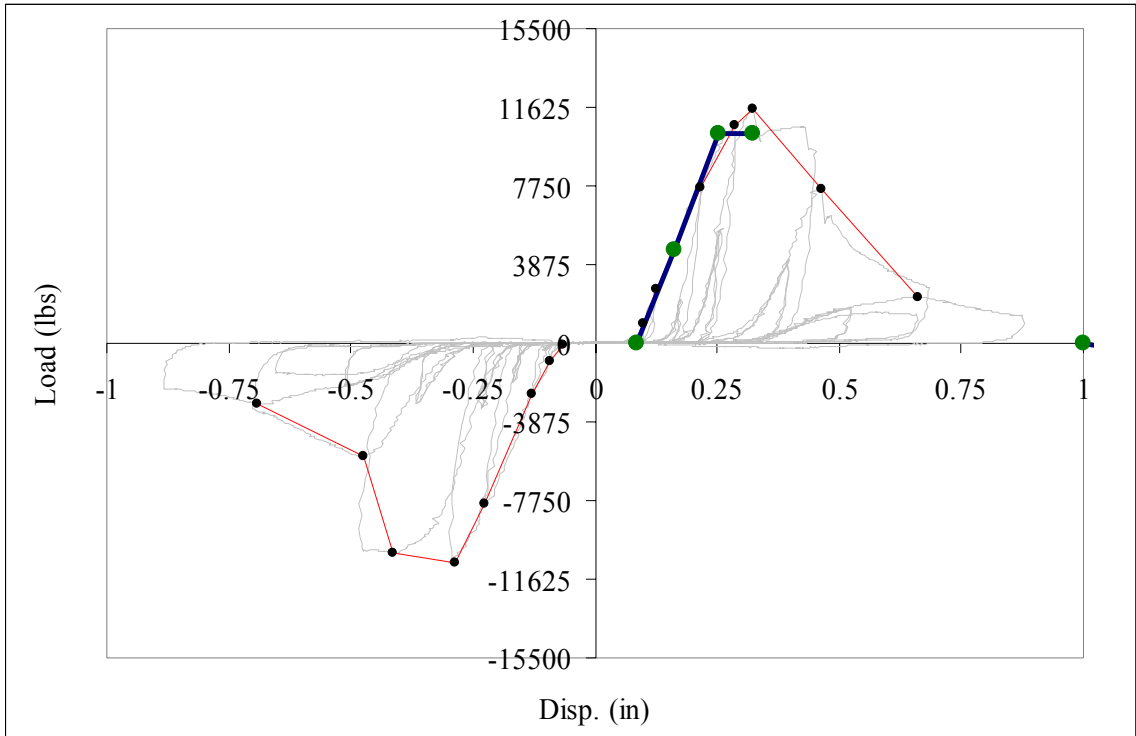


Figure B.32: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C01.

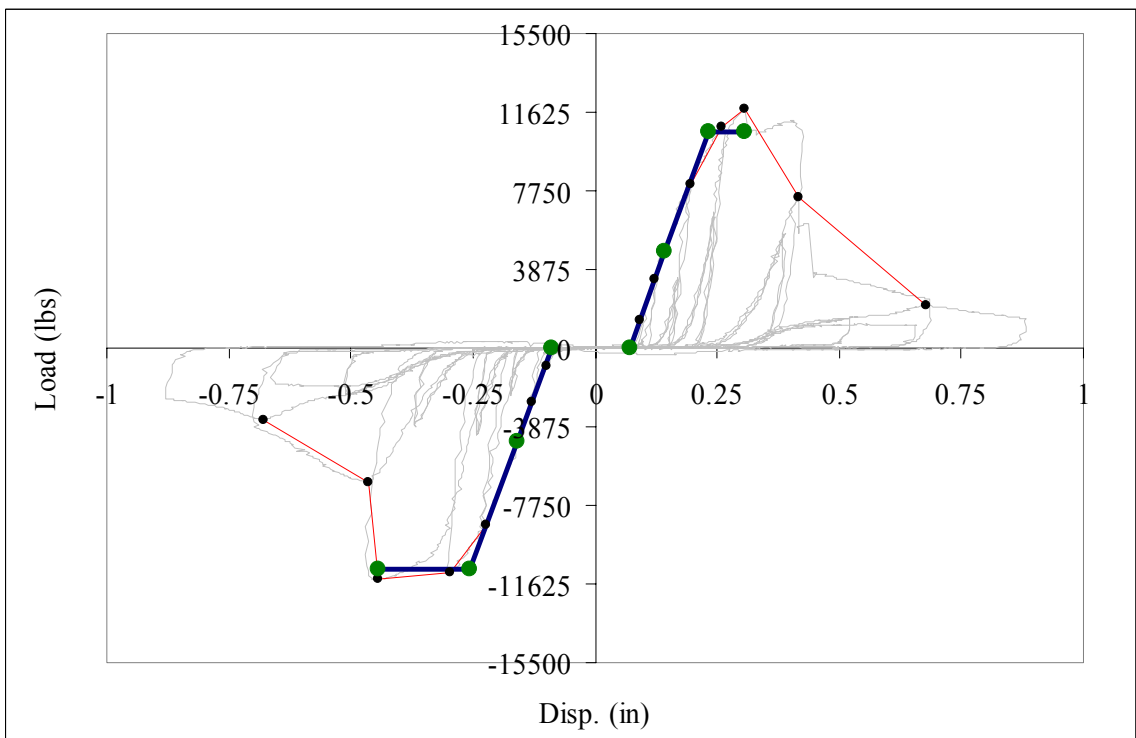


Figure B.33: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C02.

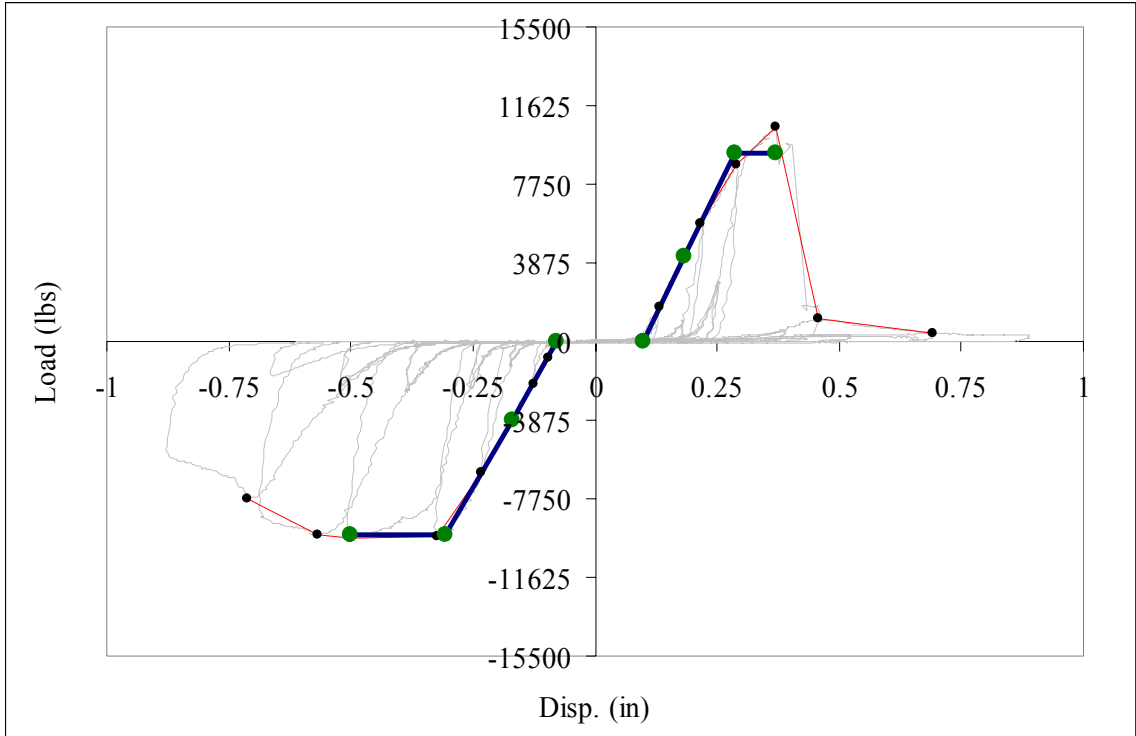


Figure B.34: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C03.

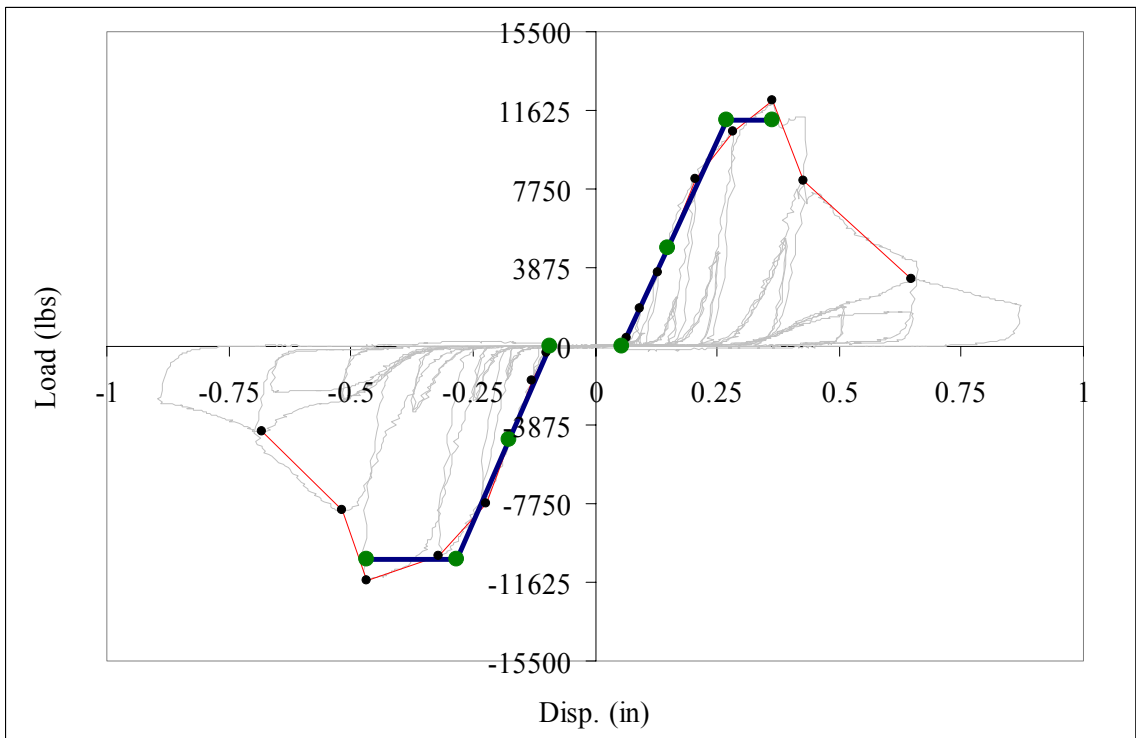


Figure B.35: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C04.

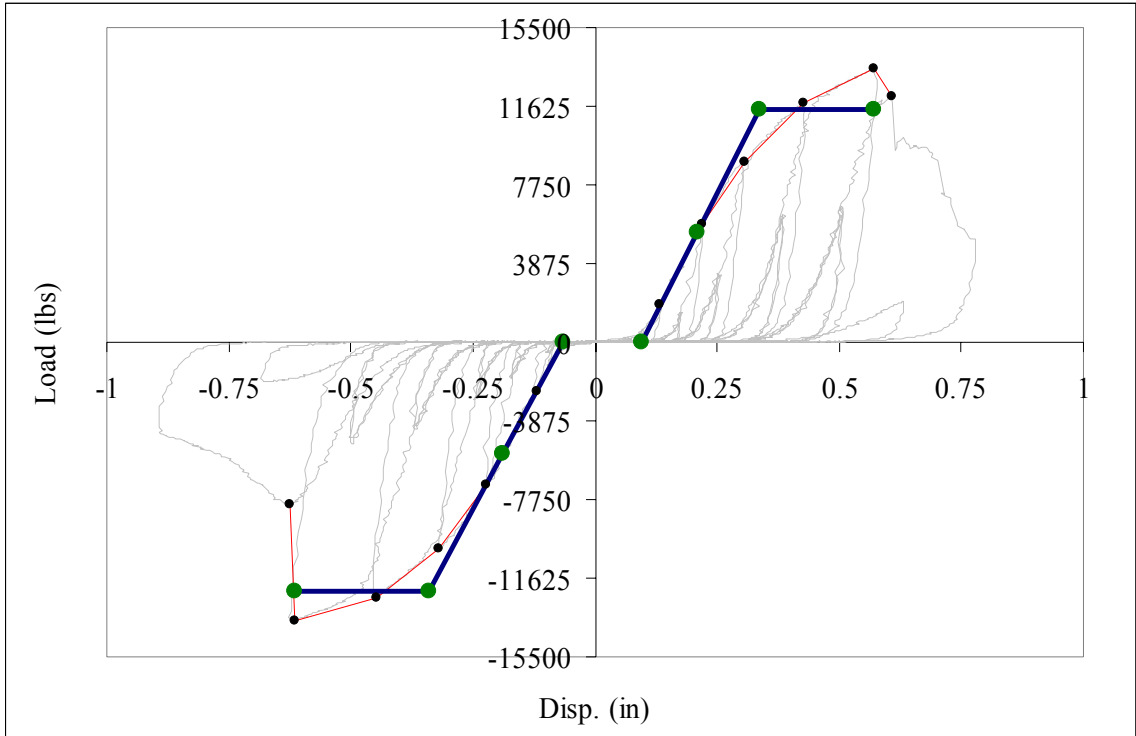


Figure B.36: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C05.

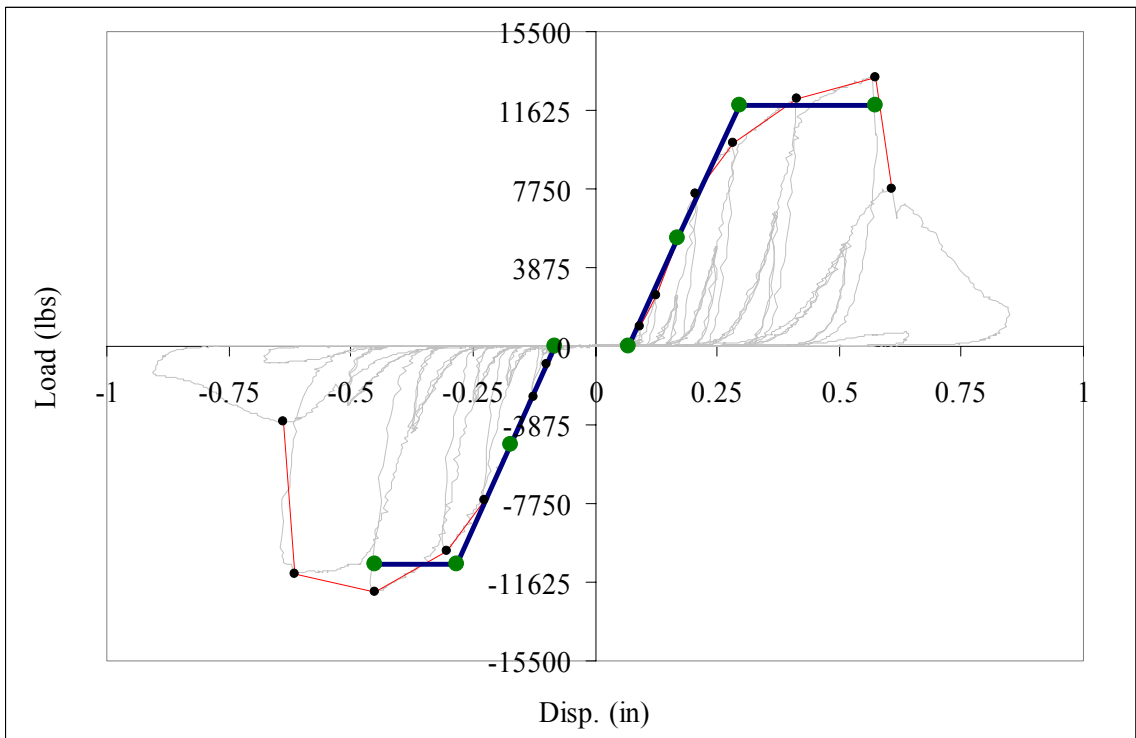


Figure B.37: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C06.

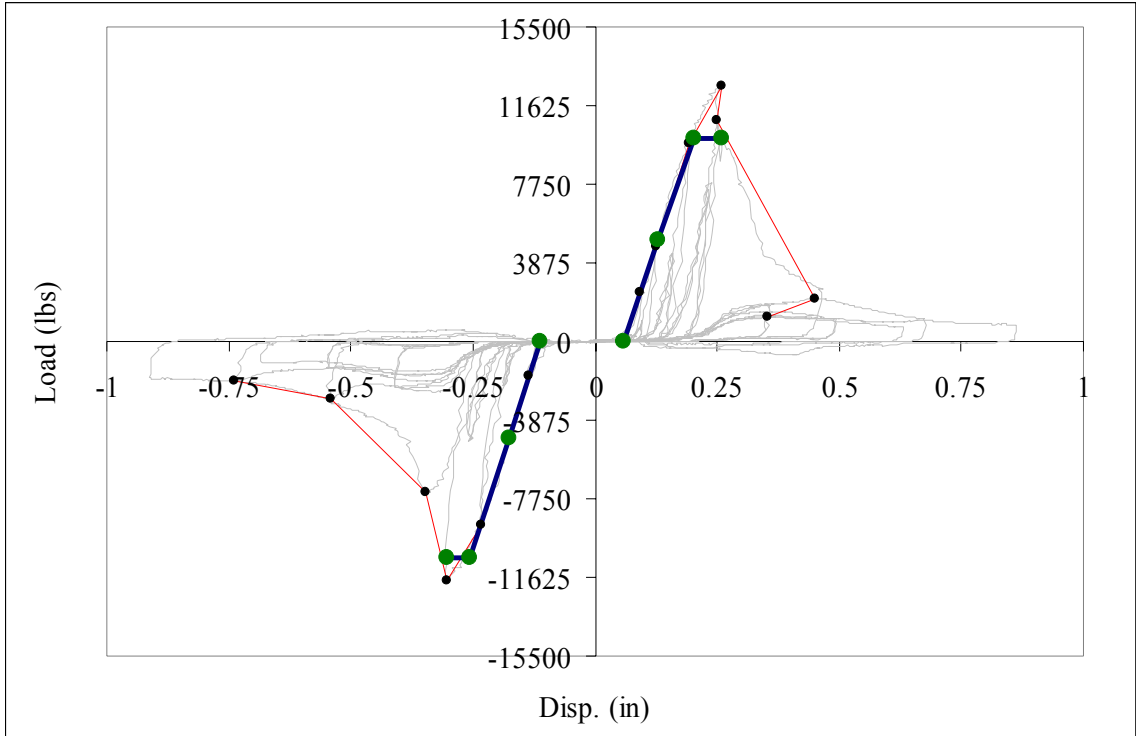


Figure B.38: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C07.

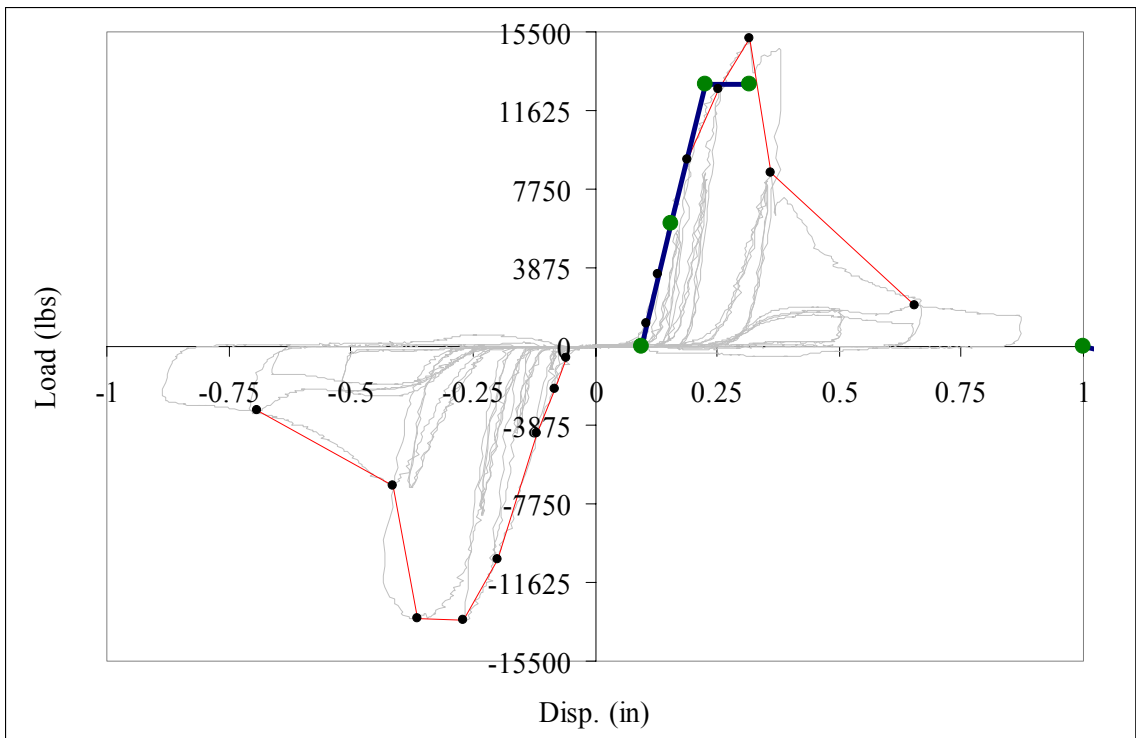


Figure B.39: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C08.

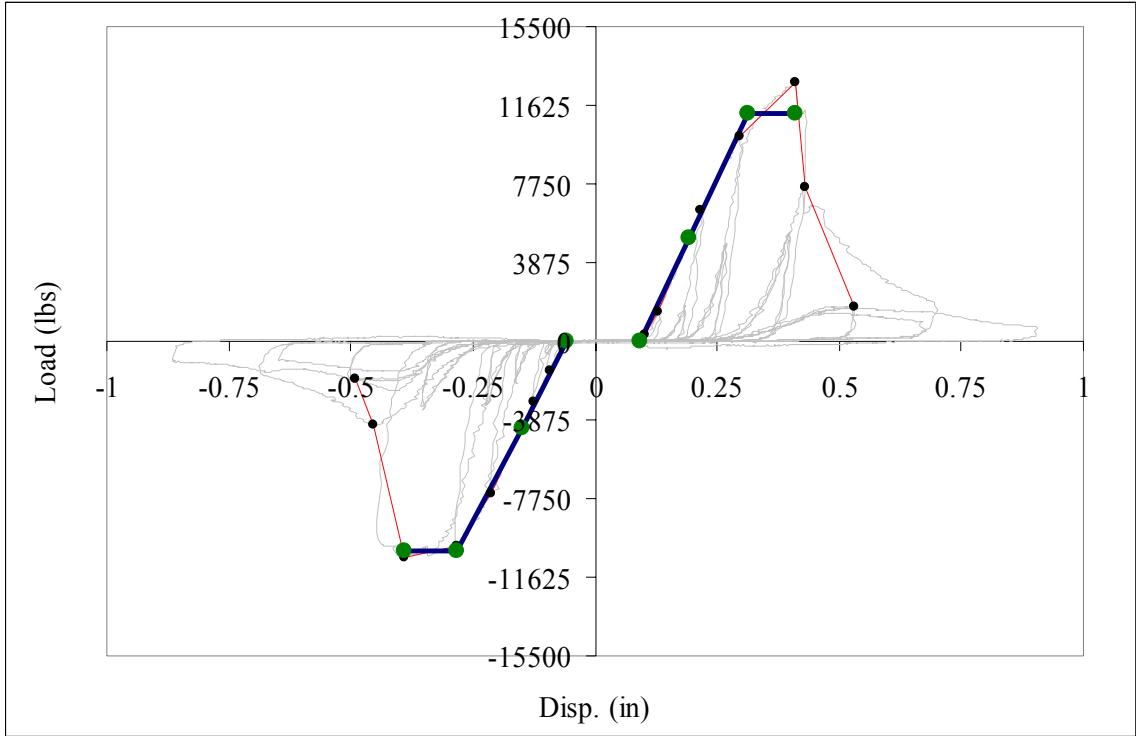


Figure B.40: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C09.

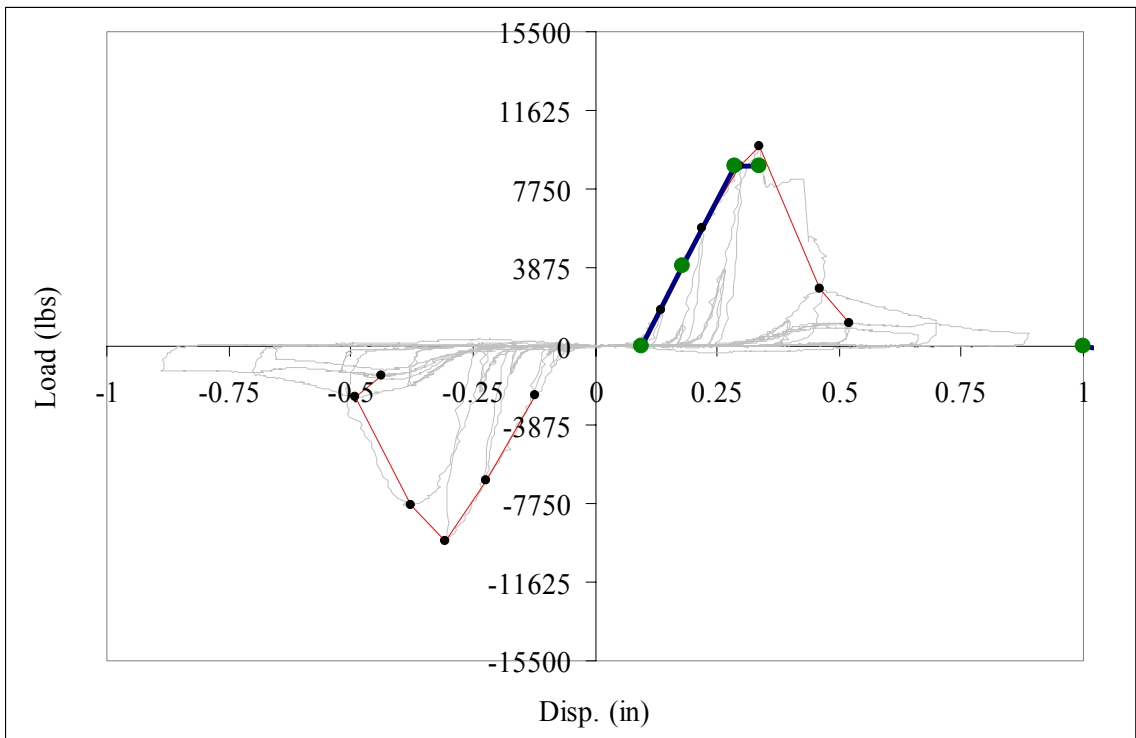


Figure B.41: Load (lbs) vs. Deflection (in.) plot. Test 2X2R3C10.

Table B.13: Connection properties, 2X2R5C Series.

Connection Properties 2X2R5C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	20929.54	13741.50	16350.55	15276.85	18064.10	18347.56	15393.39	16884.39	17751.31	13279.84	16601.90	2304.88	0.14
@ Displacement (in)	0.33	0.31	0.32	0.32	0.28	0.37	0.34	0.39	0.30	0.28	0.32	0.04	0.11
Failure Load (lbs)	16743.63	10993.20	13080.44	12221.48	14451.28	14678.05	12314.71	13507.51	14201.05	10623.87	13281.52	1843.90	0.14
@ Displacement (in)	0.33	0.31	0.35	0.32	0.28	0.37	0.34	0.39	0.31	0.28	0.33	0.04	0.11
40% Max (lbs)	8371.82	5496.60	6540.22	6110.74	7225.64	7339.02	6157.36	6753.75	7100.53	5311.93	6640.76	921.95	0.14
@ Displacement (in)	0.16	0.16	0.16	0.16	0.15	0.16	0.16	0.19	0.16	0.15	0.16	0.01	0.07
Yield (lbs)	19372.30	12497.31	16155.73	14304.72	16679.52	17528.78	13970.55	15713.56	17424.20	12875.63	15652.23	2214.09	0.14
@ Displacement (in)	0.28	0.27	0.28	0.24	0.25	0.27	0.26	0.33	0.26	0.25	0.27	0.03	0.10
5% Offset (lbs)	20929.54	13741.50	16350.55	13289.17	18064.10	17455.38	15393.39	15653.33	17751.31	12865.69	16149.40	2503.49	0.16
@ Displacement (in)	0.33	0.31	0.32	0.26	0.28	0.31	0.34	0.34	0.30	0.26	0.31	0.03	0.10
Elastic Stiff. (lb/in)	93957.54	65856.80	85710.88	78151.39	98543.34	100810.90	79310.56	62590.02	89028.15	77158.53	83111.81	12927.81	0.16
E.E.P. Energy (lb*in)	3119.15	1744.40	2777.84	2938.84	2054.14	3365.23	2435.83	2860.87	3233.86	1436.82	2596.70	656.69	0.25
Ductility Ratio	1.21	1.16	1.26	1.51	1.16	1.38	1.33	1.21	1.33	1.14	1.27	0.12	0.09
Yield Mode	II	II	II	II	II	II	II	II	II	II			
Failure Mode	Splitting	Bck Shr.	Bck Shr.	Bck Shr.	Bck Shr.	Splitting	Bck Shr.	Splitting	Ten. Rup.	Bck Shr.			
Governing Member	Both	A	B	A	A	B	A	Both	B	B			

Table B.14: Member properties, 2X2R5C Series.

Member Properties 2X2R5C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard	
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	11.51	12.82	10.52	14.60	11.19	12.83	14.15	13.20	12.71	11.04	12.46	1.36	0.11
S.G.	0.53	0.45	0.55	0.45	0.58	0.63	0.44	0.49	0.66	0.49	0.53	0.08	0.15
D.E. 5% Yield (psi)	5807.97	4390.96	5528.96	3636.61	5989.23	7272.14	3776.92	4121.08	5609.24	5005.06	5113.82	1145.70	0.22
D.E. Capacity (psi)	5867.90	4420.17	5618.46	3808.15	5989.23	7647.08	3847.72	4135.65	5836.92	5041.14	5221.24	1209.48	0.23
Member B													
M.C. (%)	11.70	12.74	11.87	10.91	13.65	12.36	13.76	14.26	11.35	14.29	12.69	1.24	0.10
S.G.	0.65	0.58	0.47	0.54	0.59	0.55	0.54	0.56	0.56	0.49	0.55	0.05	0.09
D.E. 5% Yield (psi)	5534.08	5245.95	4498.36	6198.50	5023.33	4583.34	5615.94	4728.87	5548.55	3766.42	5074.33	701.44	0.14
D.E. Capacity (psi)	5609.20	5535.77	4612.11	6295.71	5206.94	4583.34	5789.63	4754.99	5572.37	3851.86	5181.19	723.03	0.14

Table B.15: Hysteretic properties, 2X2R5C Series.

Hysteretic Connection Properties 2X2R5C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard		Mean	Standard		Mean	Standard		Mean	Standard	
		Deviation	COV		Deviation	COV		Deviation	COV		Deviation	COV
Cycle I.D.												
Primary1	104.14	43.41	0.42	0.01	0.00	0.34	-80.83	18.98	0.23	-0.01	0.00	0.18
Primary2	115.79	50.56	0.44	0.02	0.00	0.28	-90.23	16.35	0.18	-0.02	0.00	0.26
Primary3	209.21	128.60	0.61	0.04	0.00	0.07	-188.35	106.37	0.56	-0.04	0.01	0.13
Primary4	706.77	537.91	0.76	0.07	0.00	0.04	-489.10	404.87	0.83	-0.07	0.00	0.05
Primary5	1935.36	1251.26	0.65	0.10	0.01	0.05	-1444.00	878.19	0.61	-0.10	0.01	0.07
Primary6	7137.86	2849.25	0.40	0.16	0.01	0.08	-7276.58	1010.86	0.14	-0.17	0.01	0.08
Primary7	10621.54	3958.73	0.37	0.20	0.02	0.10	-10992.60	786.64	0.07	-0.22	0.01	0.05
Primary8	14888.69	5408.69	0.36	0.26	0.02	0.09	-15143.58	1272.50	0.08	-0.28	0.01	0.04
Primary9	14308.04	7026.36	0.49	0.33	0.04	0.12	-15649.79	2610.28	0.17	-0.35	0.04	0.11
Primary10	6074.82	6605.78	1.09	0.41	0.11	0.27	-12818.61	3612.72	0.28	-0.45	0.02	0.04

	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard		Mean	Standard		Mean	Standard		Mean	Standard	
		Deviation	COV		Deviation	COV		Deviation	COV		Deviation	COV
	Cycle I.D.											
Primary1	2.23	0.52	0.23	1.16	0.31	0.27	0.32	0.11	0.35	7598.96	1979.86	0.26
Primary2	3.64	0.98	0.27	1.79	0.41	0.23	0.32	0.05	0.14	6068.08	986.65	0.16
Primary3	12.23	2.10	0.17	8.68	2.71	0.31	0.24	0.05	0.23	4523.04	1170.32	0.26
Primary4	25.20	4.76	0.19	42.65	10.07	0.24	0.10	0.02	0.18	8374.73	2343.93	0.28
Primary5	57.27	9.32	0.16	162.91	17.68	0.11	0.06	0.01	0.13	17103.12	2366.09	0.14
Primary6	440.17	21.09	0.05	1189.41	127.49	0.11	0.06	0.01	0.12	43472.41	5718.50	0.13
Primary7	744.36	87.71	0.12	2234.79	80.27	0.04	0.05	0.01	0.14	52325.19	6683.51	0.13
Primary8	1737.32	212.65	0.12	4056.91	213.65	0.05	0.07	0.01	0.17	55720.64	8198.49	0.15
Primary9	3319.32	631.24	0.19	5065.44	994.67	0.20	0.11	0.03	0.26	44870.05	10854.44	0.24
Primary10	3112.46	1003.98	0.32	4018.49	1614.37	0.40	0.13	0.03	0.23	22801.92	11120.61	0.49

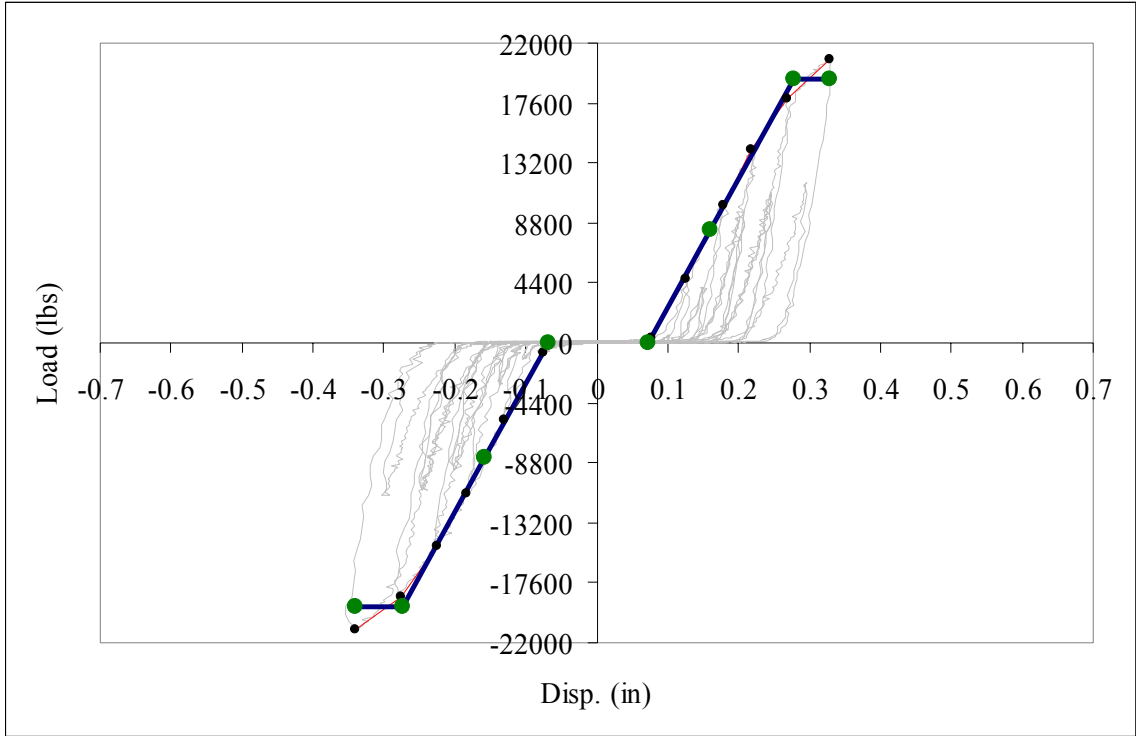


Figure B.42: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C01.

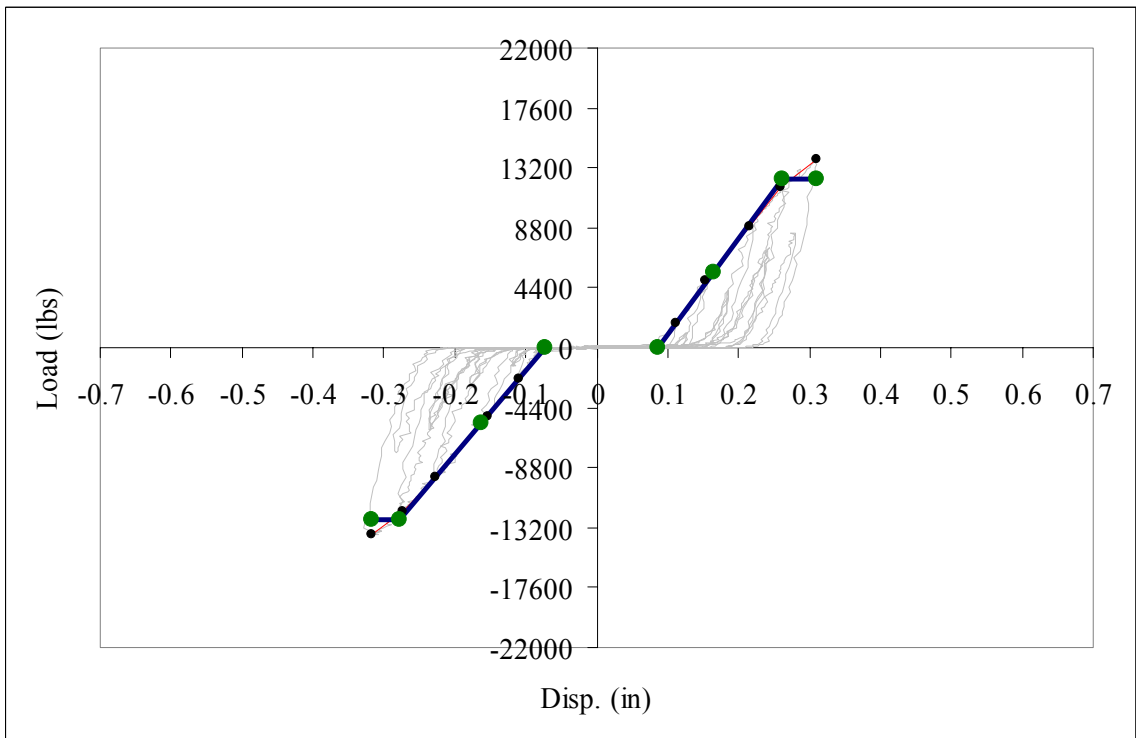


Figure B.43: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C02.

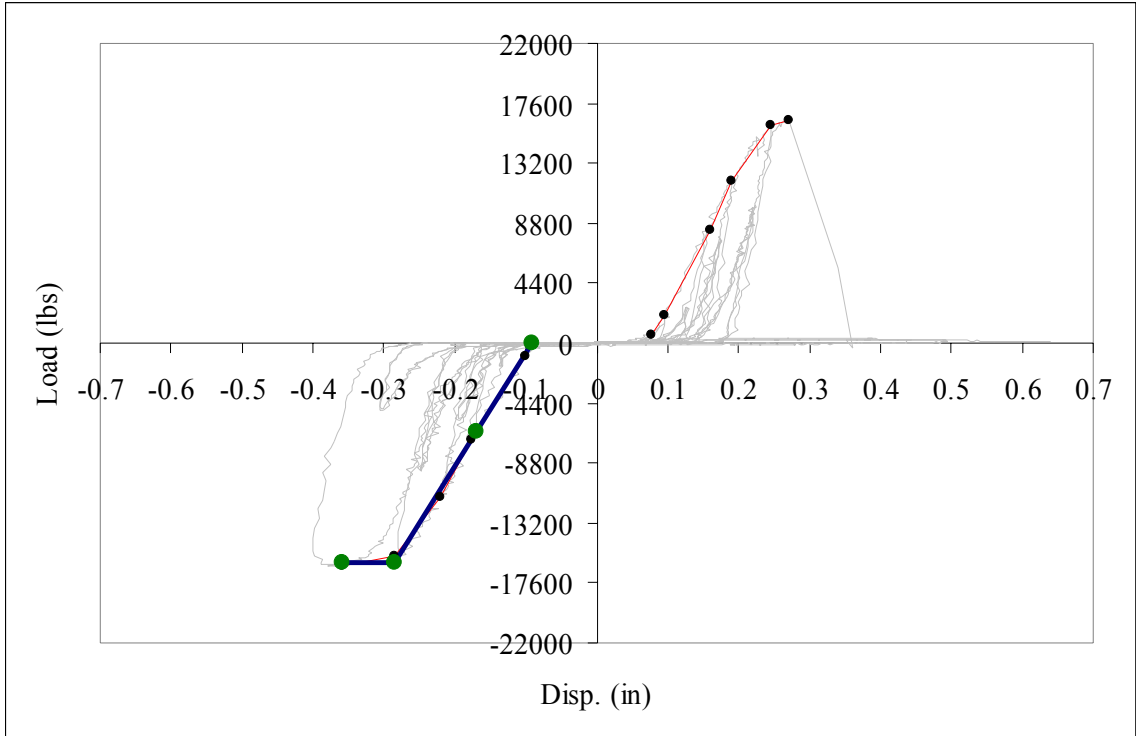


Figure B.44: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C03.

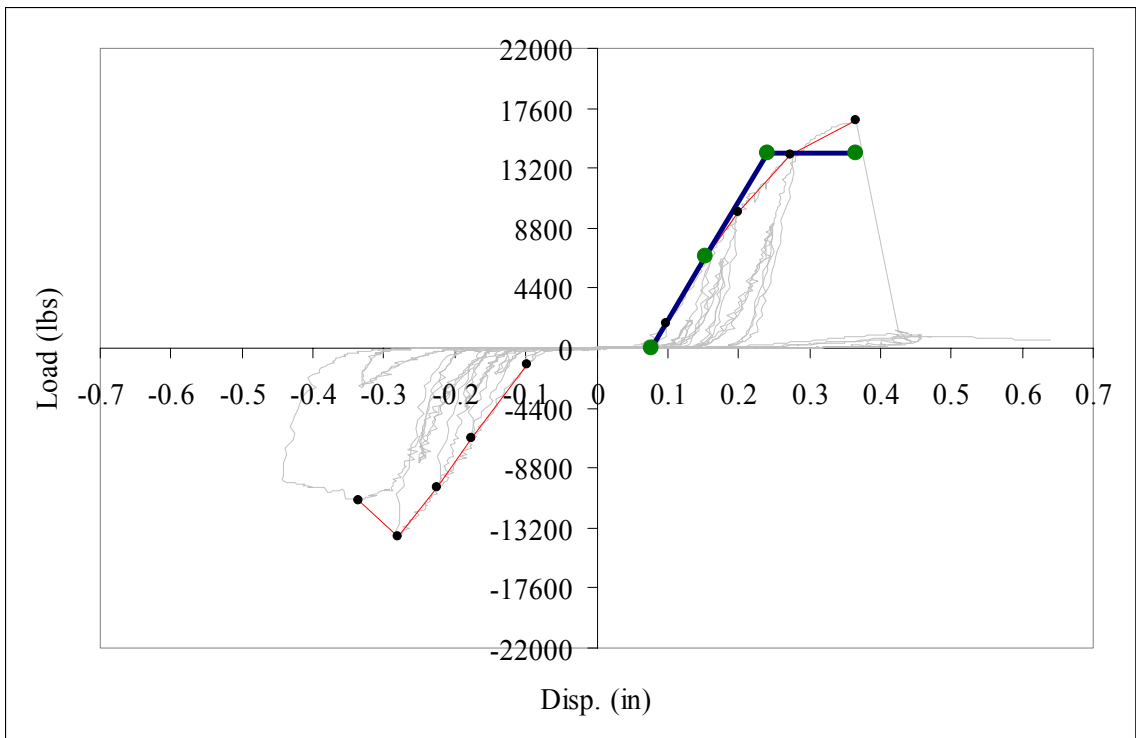


Figure B.45: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C04.

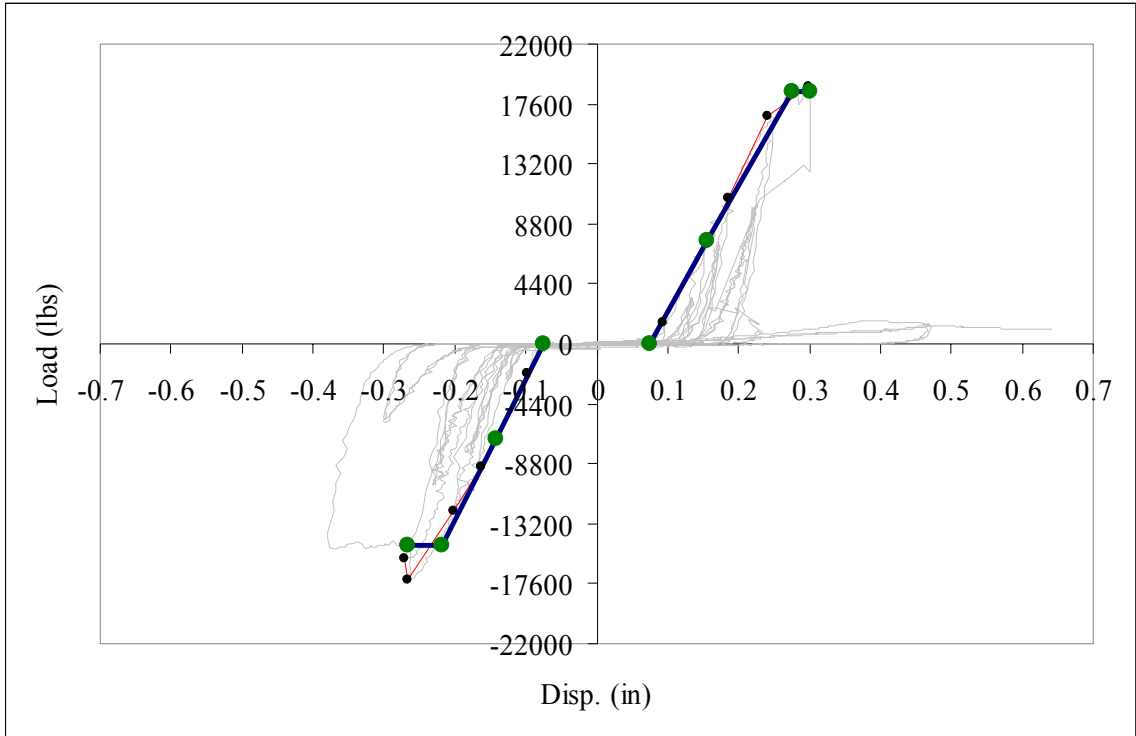


Figure B.46: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C05.

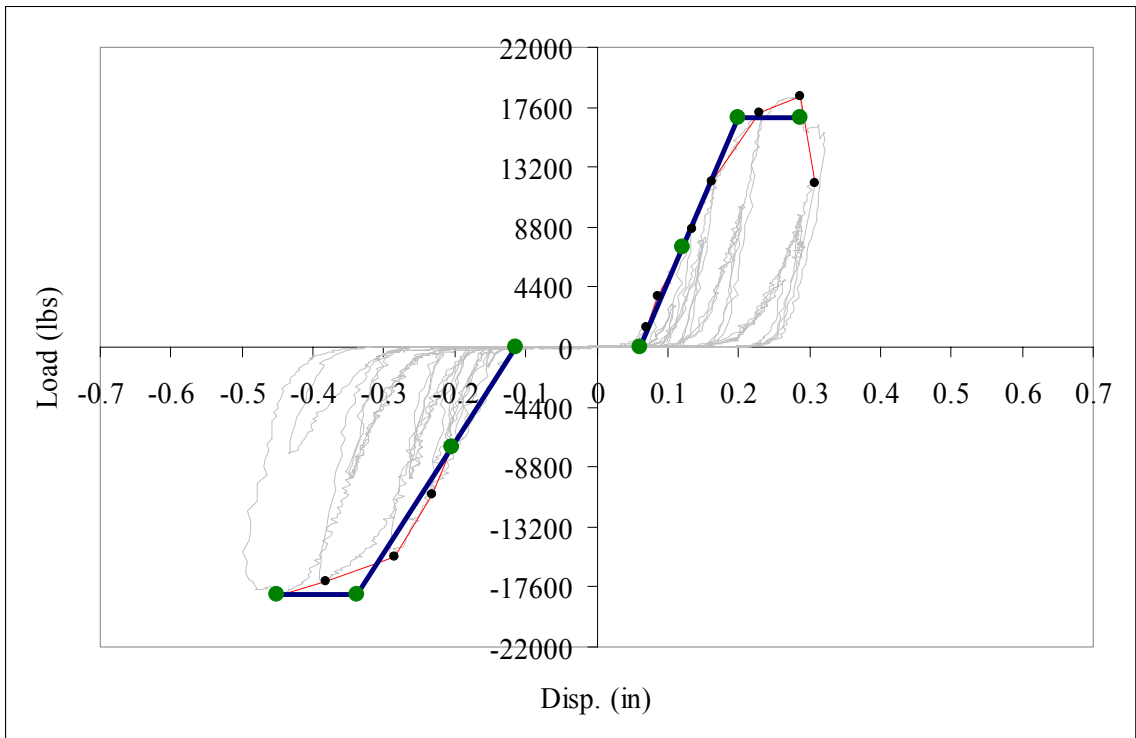


Figure B.47: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C06.

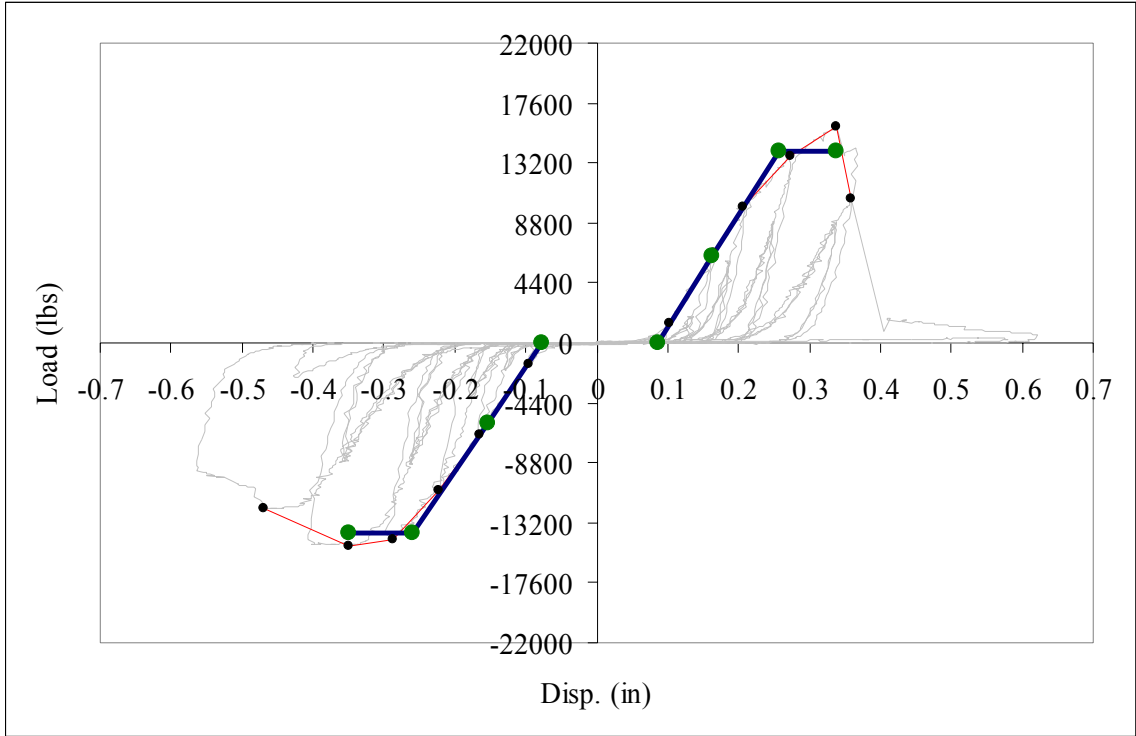


Figure B.48: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C07.

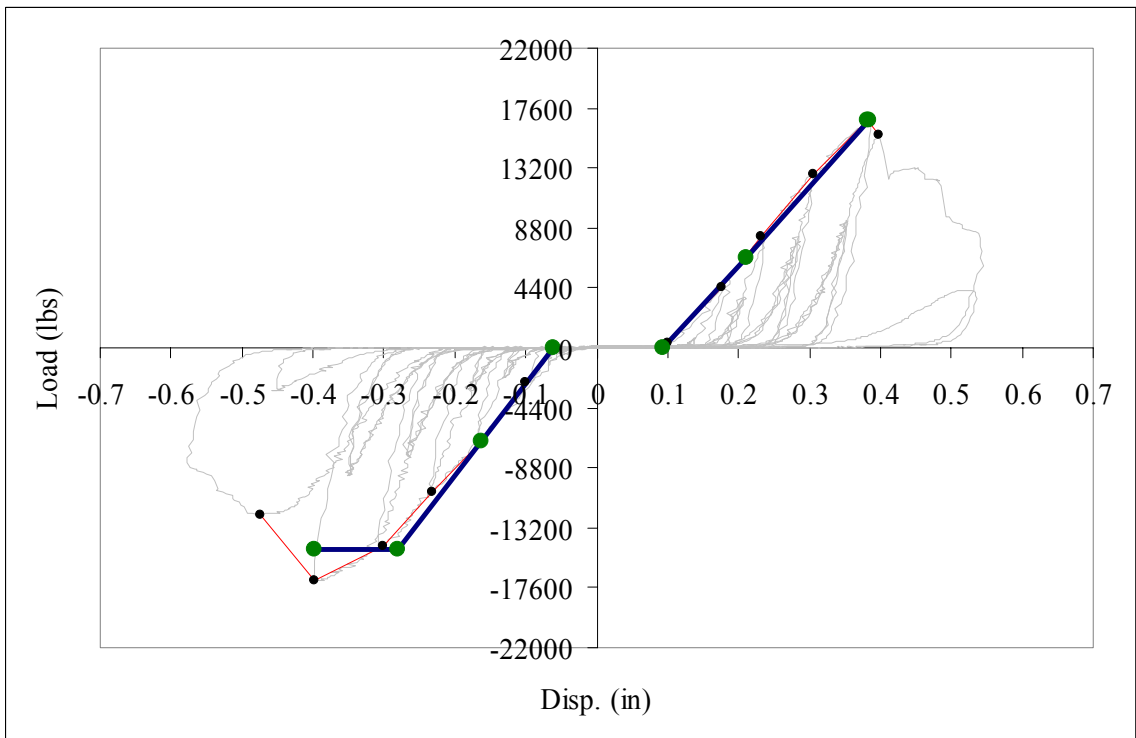


Figure B.49: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C08.

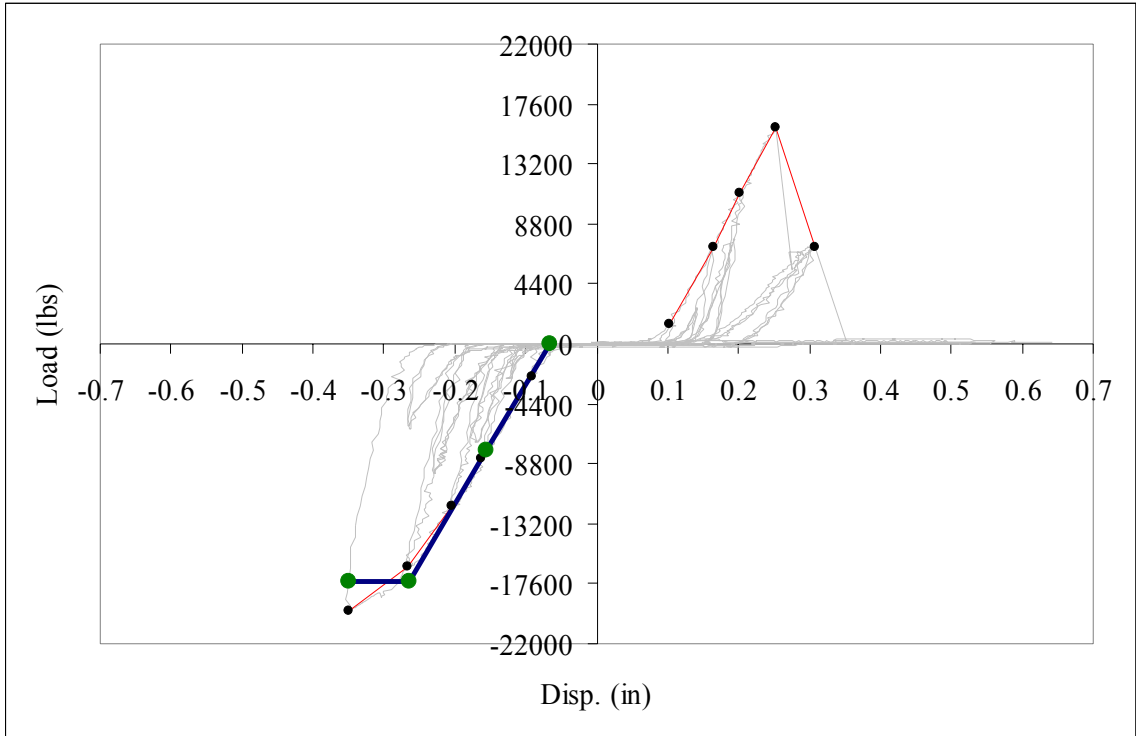


Figure B.50: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C09.

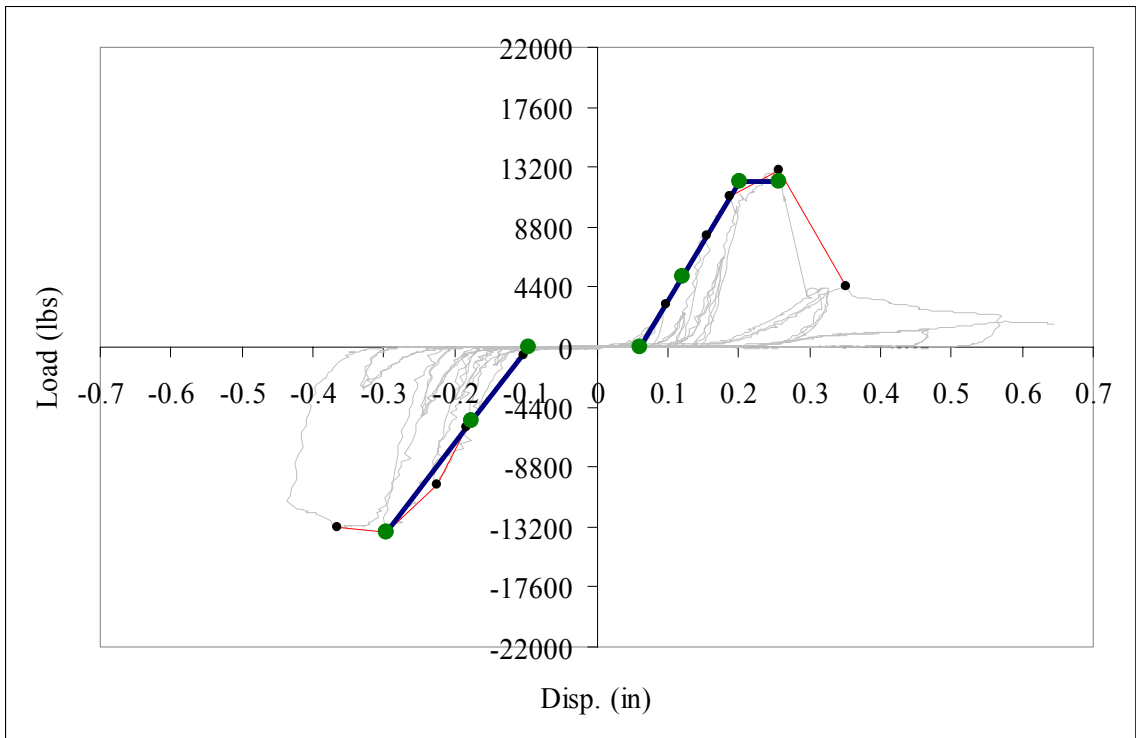


Figure B.51: Load (lbs) vs. Deflection (in.) plot. Test 2X2R5C10.

B.1.2 – ST Series Cyclic

Table B. 16: Connection and Material properties, ST1R1C Series.

Connection Properties ST1R1C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	3133.12	2907.55	2920.33	3277.48	3327.10	2778.98	2945.14	3218.83	2668.45	3140.63	3031.76	220.09	0.07
@ Displacement (in)	0.83	0.85	0.67	0.84	0.83	0.84	0.83	0.82	0.52	1.01	0.80	0.13	0.16
Failure Load (lbs)	2506.49	2326.04	2336.26	2621.98	2661.68	2223.18	2356.11	2575.06	2134.76	2512.51	2425.41	176.07	0.07
@ Displacement (in)	0.83	0.85	0.67	0.84	0.83	0.84	0.83	0.82	0.91	1.01	0.84	0.08	0.10
40% Max (lbs)	1253.25	1163.02	1168.13	1310.99	1330.84	1111.59	1178.06	1287.53	1067.38	1256.25	1212.70	88.04	0.07
@ Displacement (in)	0.09	0.07	0.07	0.09	0.09	0.09	0.09	0.09	0.10	0.11	0.09	0.01	0.11
Yield (lbs)	2936.53	2616.93	2607.54	2889.99	2921.11	2384.93	2591.90	2857.70	2505.84	2702.01	2701.45	191.45	0.07
@ Displacement (in)	0.17	0.13	0.13	0.18	0.16	0.16	0.18	0.19	0.18	0.20	0.17	0.02	0.14
5% Offset (lbs)	2187.57	1843.60	1727.11	2069.68	1898.11	2330.10	2305.67	1999.31	1831.22	1590.16	1978.25	245.74	0.12
@ Displacement (in)	0.16	0.12	0.11	0.15	0.13	0.57	0.42	0.15	0.16	0.15	0.21	0.15	0.72
Elastic Stiff. (lb/in)	20936.16	25892.01	25826.33	18035.32	22431.25	17941.79	16093.70	17283.81	17370.01	15894.53	19770.49	3792.20	0.19
E.E.P. Energy (lb*in)	2185.13	2001.82	1551.21	2158.69	2180.53	1772.37	1918.35	2071.83	2038.80	2424.38	2030.31	242.56	0.12
Ductility Ratio	5.02	6.62	5.77	4.61	5.30	5.10	4.63	4.42	5.19	5.12	5.18	0.64	0.12
Yield Mode	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV			
Failure Mode	Bolt Shr.	Bolt Shr.	Bolt Shr.	Bolt Shr.	Bolt Shr.	Bolt Shr.	Bolt Shr.	Bolt Shr.	Bolt Shr.	Bolt Shr.			
Governing Member	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.			
Member Properties ST1R1C Series													
Member A													
M.C. (%)	15.34	14.26	15.40	14.72	15.24	15.21	15.35	16.29	14.06	12.15	14.80	1.13	0.08
S.G.	0.48	0.45	0.51	0.50	0.51	0.44	0.52	0.55	0.46	0.46	0.49	0.04	0.07
D.E. 5% Yield (psi)	4391.88	3710.70	5085.66	4675.85	4157.39	4675.12	4944.77	5733.44	4037.03	4735.63	4614.75	578.70	0.13
D.E. Capacity (psi)	4764.07	4058.74	5473.40	5324.61	4542.62	5086.04	5471.92	5998.01	4251.02	5740.08	5071.05	646.76	0.13

Table B. 17: Hysteretic properties, ST1R1C Series.

Hysteretic Connection Properties ST1R1C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard		Mean	Standard		Mean	Standard		Mean	Standard	
		Deviation	COV		Deviation	COV		Deviation	COV		Deviation	COV
Cycle I.D.												
Primary1	337.15	298.31	0.88	0.04	0.00	0.09	-411.73	360.06	0.87	-0.04	0.00	0.07
Primary2	645.12	400.11	0.62	0.06	0.00	0.06	-675.35	444.43	0.66	-0.05	0.00	0.09
Primary3	1809.04	608.36	0.34	0.13	0.01	0.04	-1647.84	317.69	0.19	-0.12	0.00	0.03
Primary4	2272.20	752.59	0.33	0.19	0.00	0.01	-2161.68	255.79	0.12	-0.19	0.00	0.02
Primary5	2525.44	822.68	0.33	0.26	0.01	0.02	-2473.11	220.78	0.09	-0.26	0.00	0.02
Primary6	2786.95	901.96	0.32	0.45	0.03	0.06	-2766.95	216.40	0.08	-0.46	0.00	0.01
Primary7	2945.44	946.48	0.32	0.66	0.01	0.01	-2833.71	200.80	0.07	-0.68	0.01	0.01
Primary8	3296.84	1182.31	0.36	0.99	0.01	0.01	-2125.02	376.27	0.18	-0.80	0.10	0.12
Primary9	390.04	1106.26	2.84	0.07	0.75	10.65	-69.36	62.90	0.91	0.31	0.93	2.96
Primary10	9.02	66.35	7.35	0.59	0.60	1.02	-64.10	64.54	1.01	-0.44	1.03	2.35
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard		Mean	Standard		Mean	Standard		Mean	Standard	
		Deviation	COV		Deviation	COV		Deviation	COV		Deviation	COV
Cycle I.D.												
Primary1	17.11	4.10	0.24	14.89	3.55	0.24	0.19	0.04	0.22	9429.31	2793.15	0.30
Primary2	31.54	6.07	0.19	37.01	4.67	0.13	0.14	0.02	0.16	11626.80	2280.54	0.20
Primary3	182.18	25.01	0.14	212.85	23.59	0.11	0.14	0.01	0.07	14059.23	1382.63	0.10
Primary4	338.76	35.14	0.10	423.84	34.30	0.08	0.13	0.01	0.06	11601.11	986.24	0.09
Primary5	487.56	44.60	0.09	642.95	41.50	0.06	0.12	0.01	0.05	9714.88	651.74	0.07
Primary6	1448.46	106.31	0.07	1267.74	101.75	0.08	0.18	0.01	0.03	6082.30	399.33	0.07
Primary7	1948.09	133.49	0.07	1933.74	122.84	0.06	0.16	0.00	0.02	4317.48	302.81	0.07
Primary8	2491.20	313.01	0.13	2498.25	326.97	0.13	0.16	0.01	0.06	3026.96	271.49	0.09
Primary9	154.90	419.59	2.71	272.15	630.16	2.32	0.06	0.05	0.90	-7103.61	20062.75	2.82
Primary10	13.77	10.78	0.78	43.35	43.56	1.00	0.15	0.28	1.87	2.63	88.57	33.63

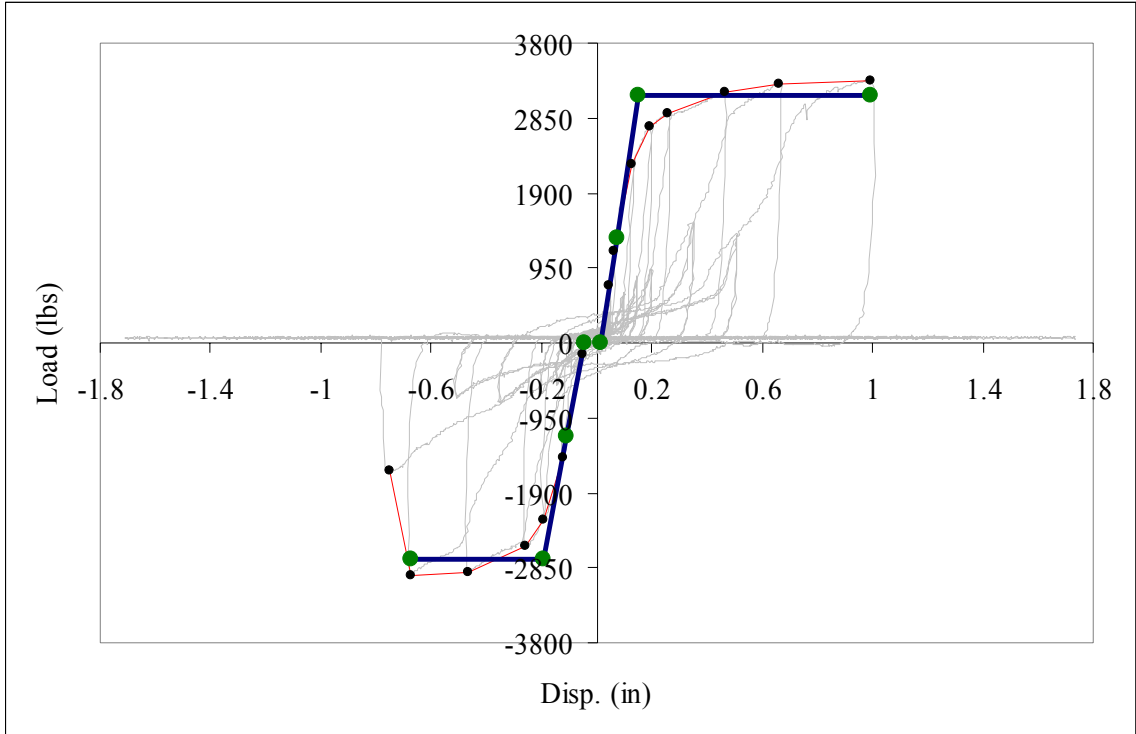


Figure B.52: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C01.

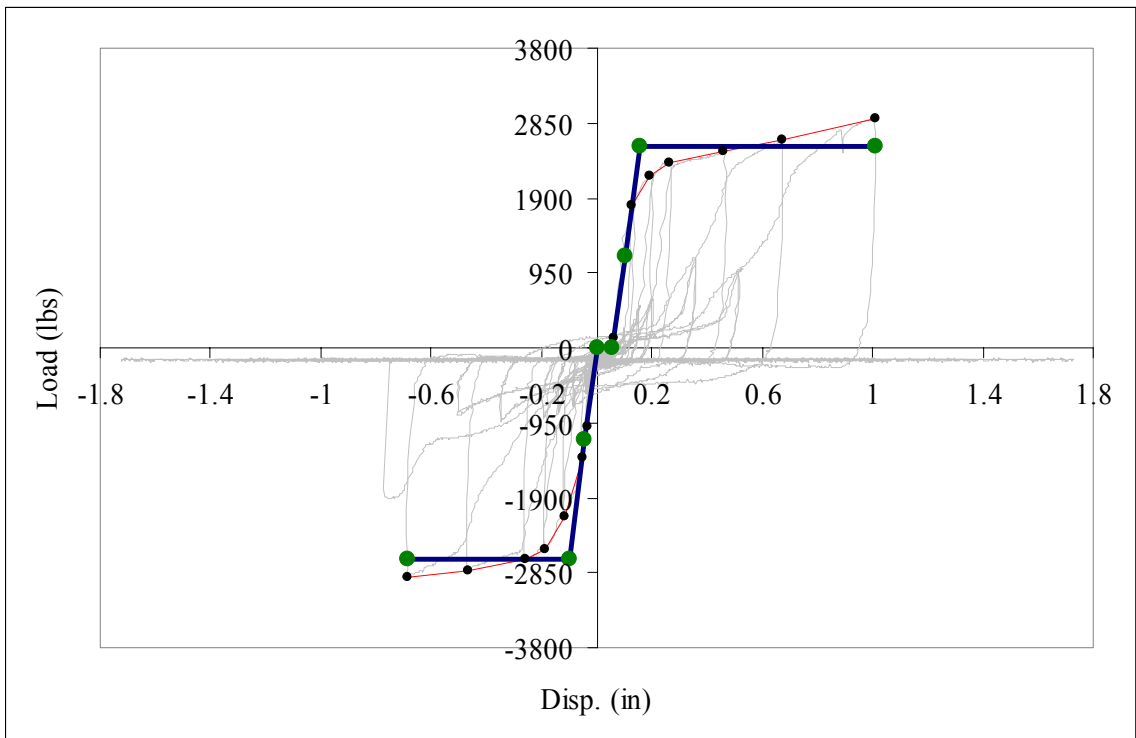


Figure B.53: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C02.

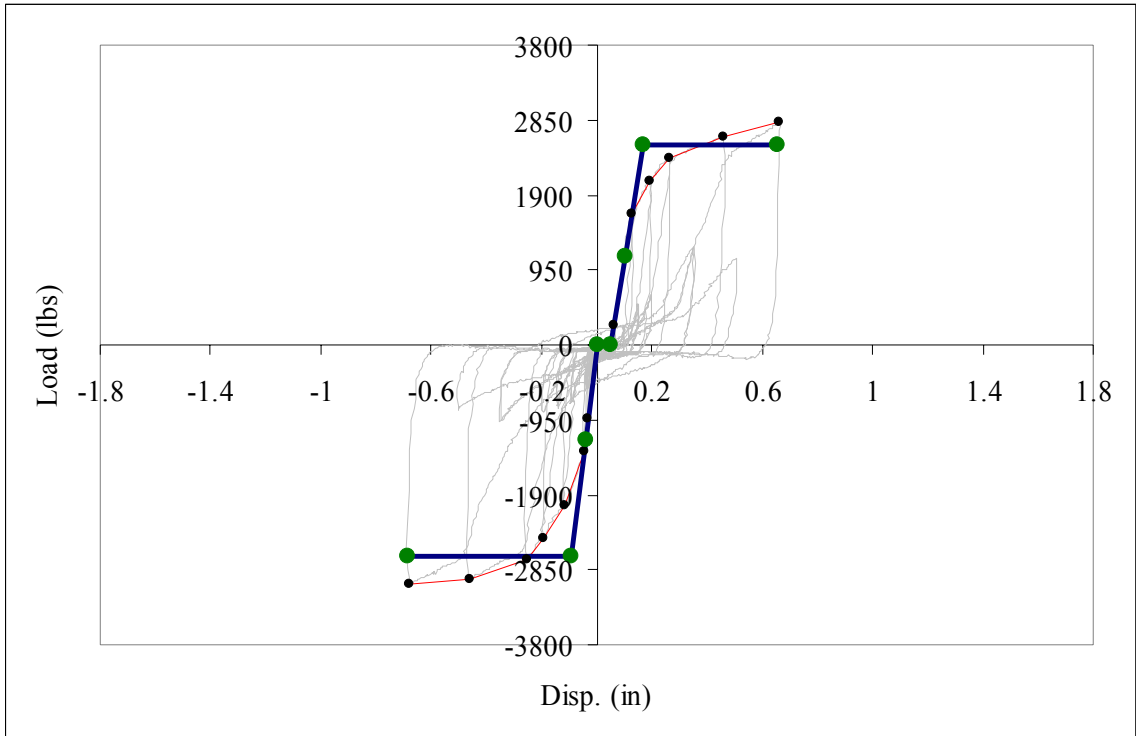


Figure B.54: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C03.

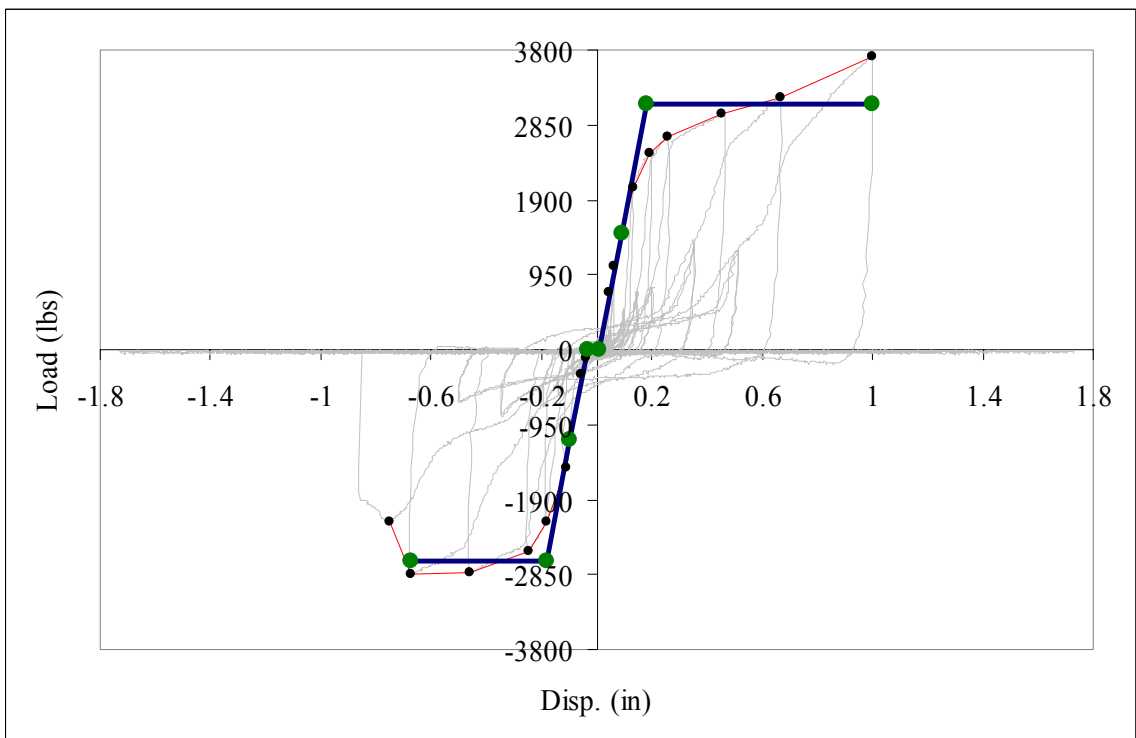


Figure B.55: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C04.

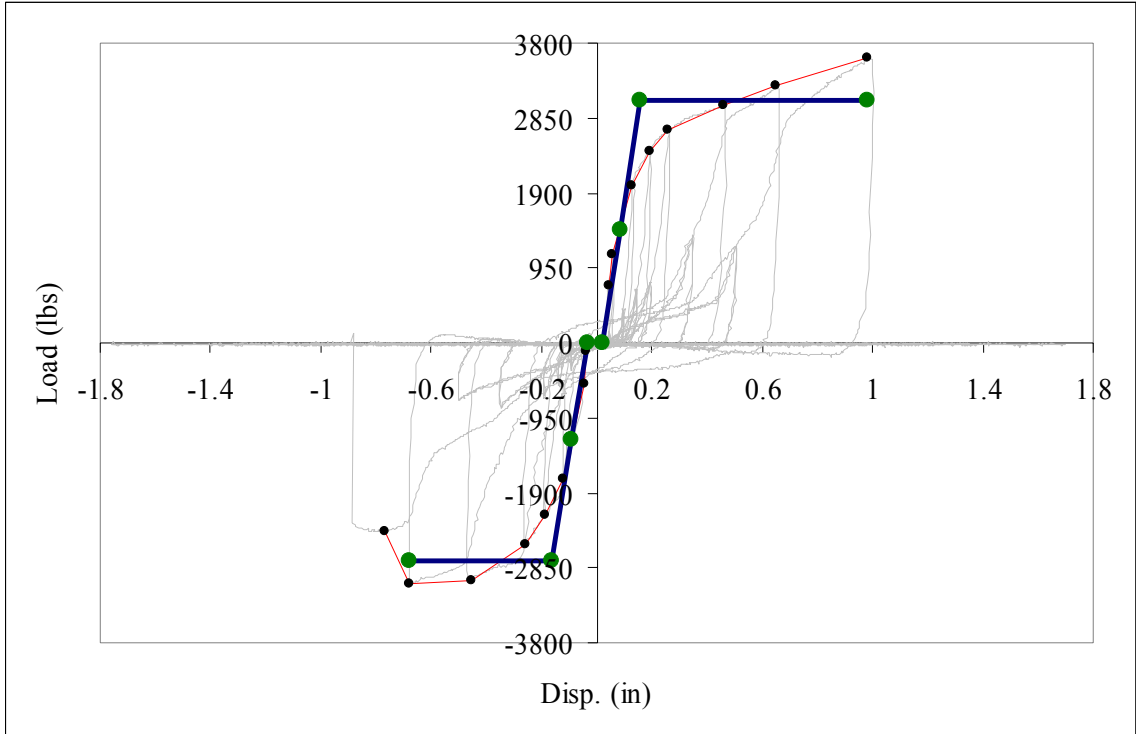


Figure B.56: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C05.

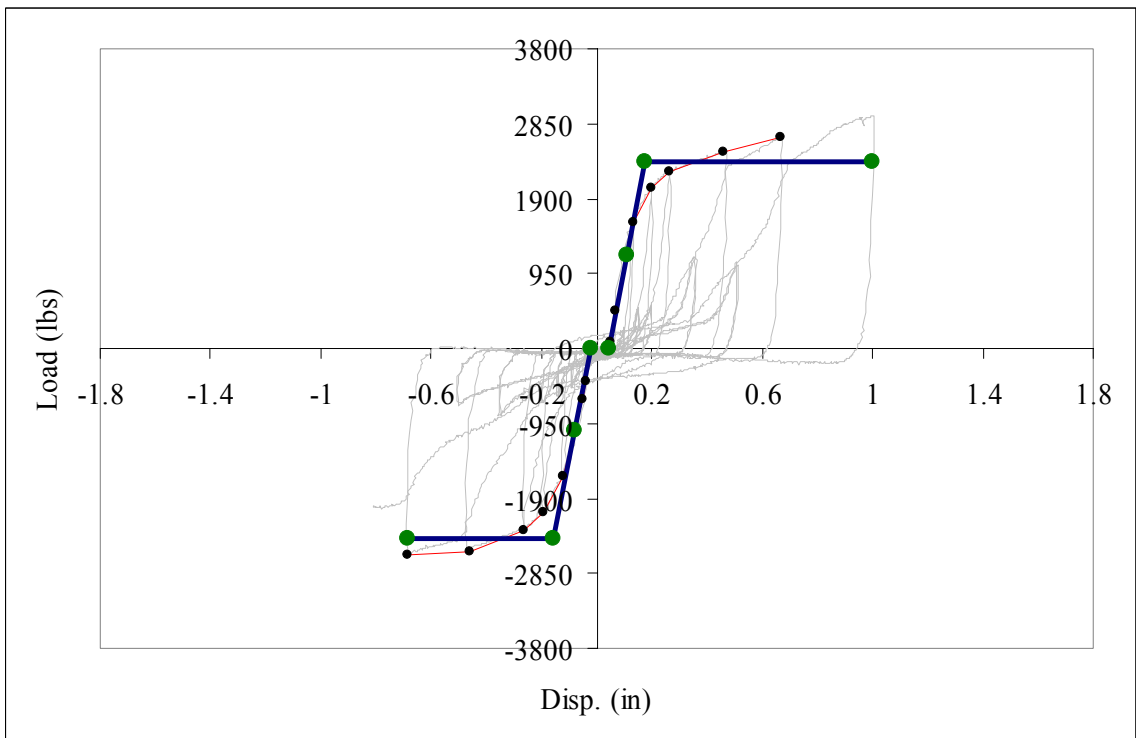


Figure B.57: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C06.

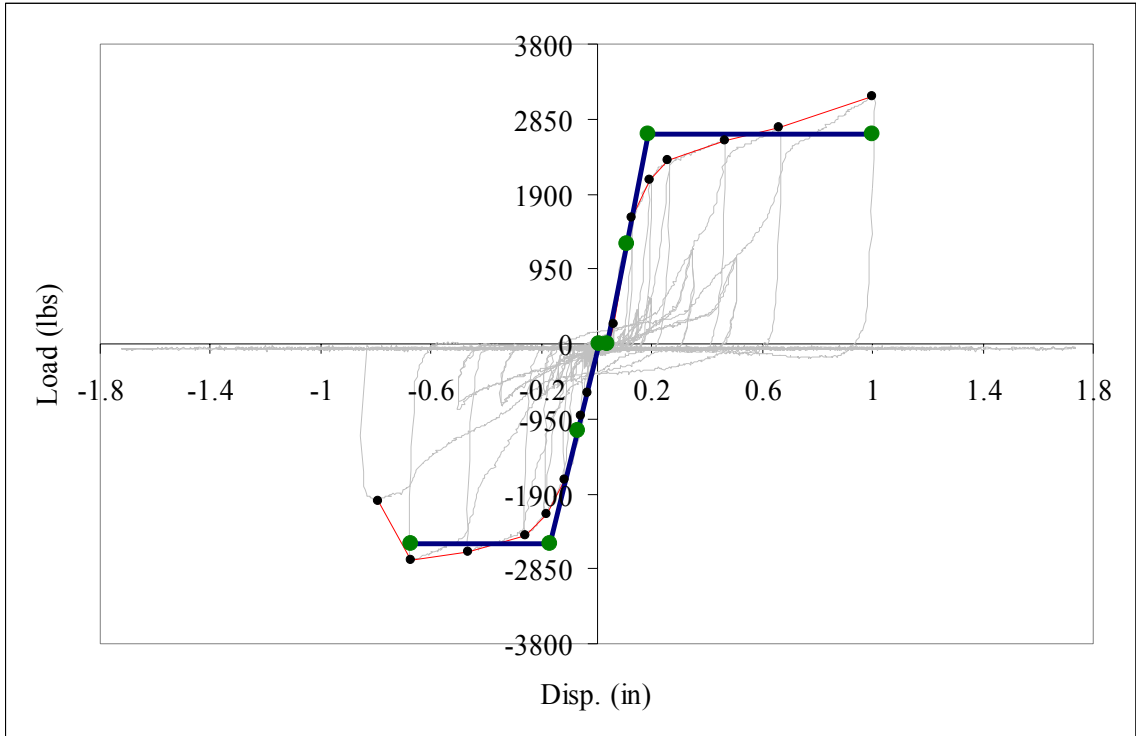


Figure B.58: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C07.

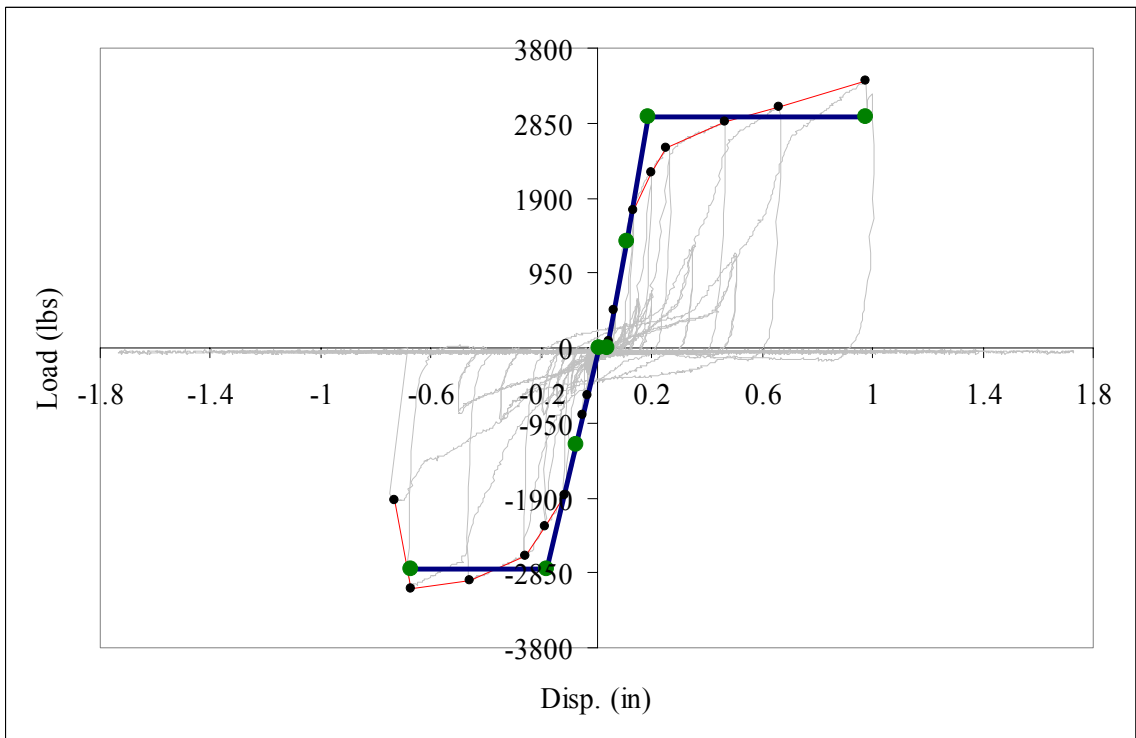


Figure B.59: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C08.

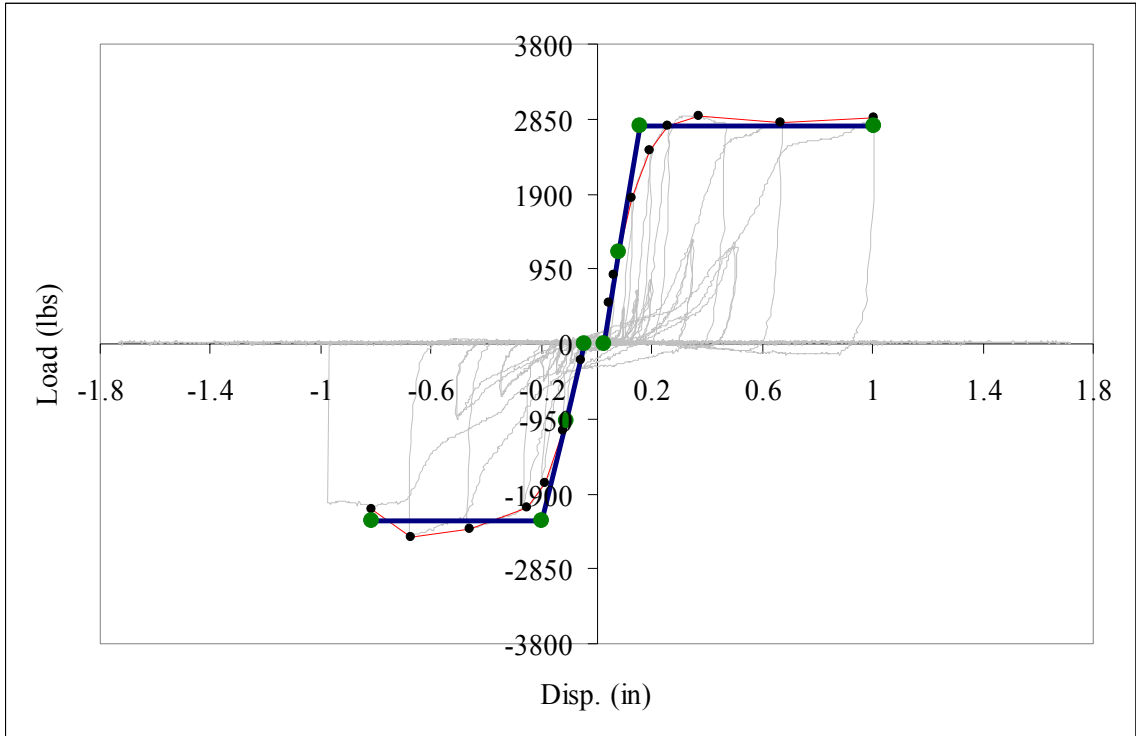


Figure B.60: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C09.

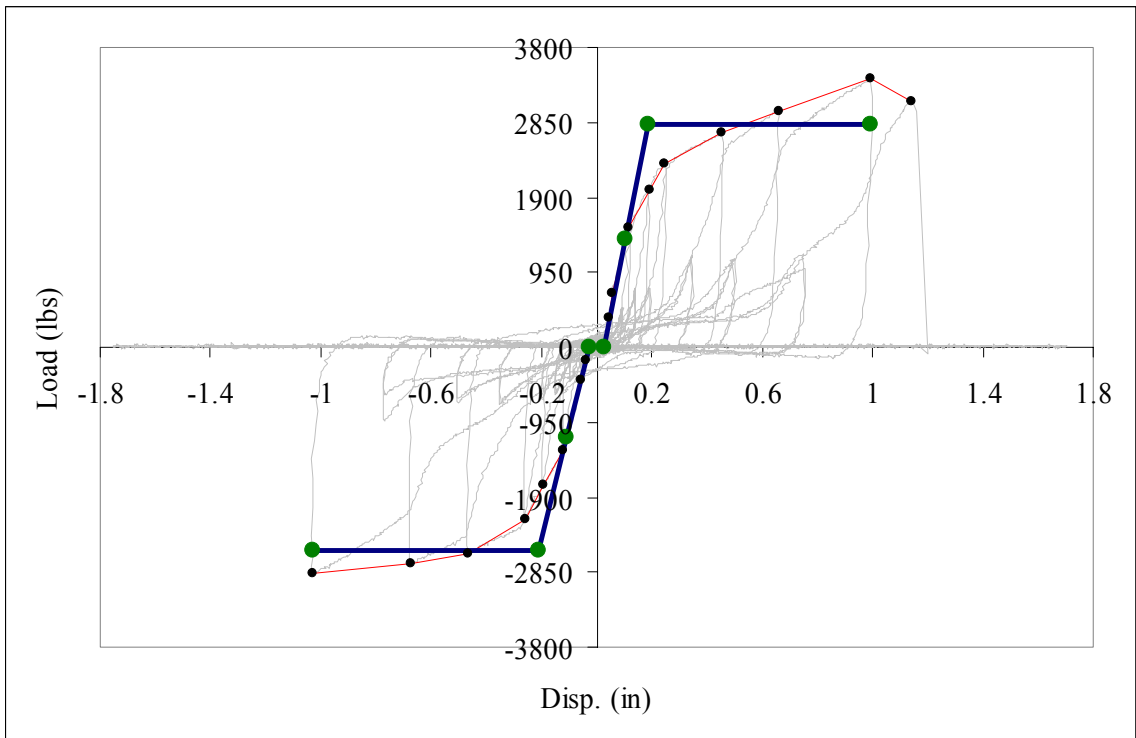


Figure B.61: Load (lbs) vs. Deflection (in.) plot. Test ST1R1C10.

Table B.18: Connection and Material properties, ST1R3C Series.

Connection Properties ST1R3C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	6291.04	7066.99	6751.20	5607.58	5415.09	6715.11	6352.70	6894.06	5736.15	6785.03	6361.49	586.69	0.09
@ Displacement (in)	0.27	0.36	0.25	0.21	0.30	0.37	0.33	0.23	0.15	0.28	0.27	0.07	0.25
Failure Load (lbs)	5032.83	5653.59	5400.96	4486.06	4332.08	5372.09	5082.16	5515.25	4588.92	5428.03	5089.20	469.35	0.09
@ Displacement (in)	0.27	0.36	0.25	0.21	0.65	0.37	0.53	0.64	0.15	0.41	0.38	0.18	0.46
40% Max (lbs)	2516.42	2826.80	2700.48	2243.03	2166.04	2686.04	2541.08	2757.62	2294.46	2714.01	2544.60	234.67	0.09
@ Displacement (in)	0.08	0.08	0.08	0.07	0.07	0.09	0.09	0.07	0.06	0.08	0.08	0.01	0.11
Yield (lbs)	5545.09	6221.12	5886.98	4837.99	5119.83	5862.52	5689.01	6103.20	4733.17	6148.70	5614.76	543.93	0.10
@ Displacement (in)	0.14	0.14	0.15	0.13	0.16	0.17	0.19	0.14	0.09	0.14	0.15	0.03	0.18
5% Offset (lbs)	5059.03	4807.96	6192.04	5607.58	4018.80	4352.71	5112.59	6367.18	4508.44	5262.53	5128.89	762.92	0.15
@ Displacement (in)	0.17	0.14	0.22	0.21	0.15	0.15	0.19	0.19	0.11	0.15	0.17	0.04	0.22
Elastic Stiff. (lb/in)	46862.88	65639.43	44650.86	46456.04	32454.39	40854.69	31613.15	48264.35	85322.95	65993.27	50811.20	16750.11	0.33
E.E.P. Energy (lb*in)	1017.39	1668.43	972.88	655.94	2918.48	1615.85	2447.60	3403.96	419.49	2019.27	1713.93	987.68	0.58
Ductility Ratio	1.96	3.03	1.64	1.65	4.09	2.24	2.75	4.51	1.69	3.98	2.76	1.10	0.40
Yield Mode	II-IV	II-IV	II-IV	II-IV	II-IV	IV	II-IV	II-IV	II-IV	II-IV			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.			
Member Properties ST1R3C Series													
Member A													
M.C. (%)	14.56	13.37	16.51	14.89	21.08	15.75	16.39	15.81	12.19	15.26	15.58	2.35	0.15
S.G.	0.49	0.43	0.50	0.49	0.52	0.44	0.50	0.57	0.49	0.47	0.49	0.04	0.08
D.E. 5% Yield (psi)	3304.49	3723.09	3987.03	4001.77	4580.30				3711.40	3746.91	3865.00	390.96	0.10
D.E. Capacity (psi)	3463.77	4131.80	4313.10	4222.20	5013.99				4138.17	4114.35	4199.62	453.45	0.11

Table B.19: Hysteretic properties, ST1R3C Series.

Hysteretic Connection Properties ST1R3C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	597.75	354.61	0.59	0.01	0.01	0.52	-214.74	96.27	0.45	-0.01	0.01	0.62
Primary2	877.45	518.81	0.59	0.02	0.00	0.21	-227.07	109.26	0.48	-0.01	0.01	0.44
Primary3	2023.33	971.98	0.48	0.04	0.01	0.14	-422.26	209.28	0.50	-0.04	0.01	0.14
Primary4	3087.55	1243.59	0.40	0.07	0.01	0.10	-1009.63	357.20	0.35	-0.07	0.01	0.08
Primary5	4012.52	1488.92	0.37	0.09	0.01	0.08	-2138.07	417.06	0.20	-0.09	0.00	0.05
Primary6	5666.37	1900.62	0.34	0.16	0.01	0.06	-4746.37	439.59	0.09	-0.16	0.00	0.03
Primary7	6179.91	2104.47	0.34	0.22	0.02	0.11	-5742.62	915.97	0.16	-0.23	0.02	0.08
Primary8	5976.30	2391.88	0.40	0.31	0.04	0.14	-5398.10	1457.54	0.27	-0.33	0.04	0.13
Primary9	4584.56	2256.54	0.49	0.43	0.05	0.12	-4459.44	1301.52	0.29	-0.44	0.06	0.14
Primary10	3523.80	1616.17	0.46	0.60	0.07	0.11	-3978.39	1332.95	0.34	-0.59	0.08	0.14
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	7.76	2.77	0.36	4.37	2.59	0.59	0.35	0.20	0.56	46866.07	28293.84	0.60
Primary2	12.97	4.46	0.34	10.57	6.07	0.57	0.23	0.09	0.38	34689.28	15559.77	0.45
Primary3	47.36	13.43	0.28	49.51	14.62	0.30	0.15	0.03	0.21	30784.79	8286.13	0.27
Primary4	93.83	16.42	0.18	134.10	19.94	0.15	0.11	0.02	0.19	30903.93	4044.25	0.13
Primary5	157.95	21.46	0.14	277.58	29.98	0.11	0.09	0.02	0.17	33952.03	5008.68	0.15
Primary6	650.41	68.54	0.11	842.25	61.40	0.07	0.12	0.01	0.07	32174.92	3871.39	0.12
Primary7	996.42	90.27	0.09	1354.28	257.11	0.19	0.12	0.02	0.20	26398.06	2710.74	0.10
Primary8	1851.06	388.61	0.21	1839.43	546.62	0.30	0.17	0.02	0.13	17849.12	3790.54	0.21
Primary9	1936.76	690.45	0.36	1982.27	705.77	0.36	0.16	0.01	0.09	10364.61	3513.39	0.34
Primary10	2004.49	752.01	0.38	2281.80	917.11	0.40	0.14	0.01	0.09	6188.97	1901.70	0.31

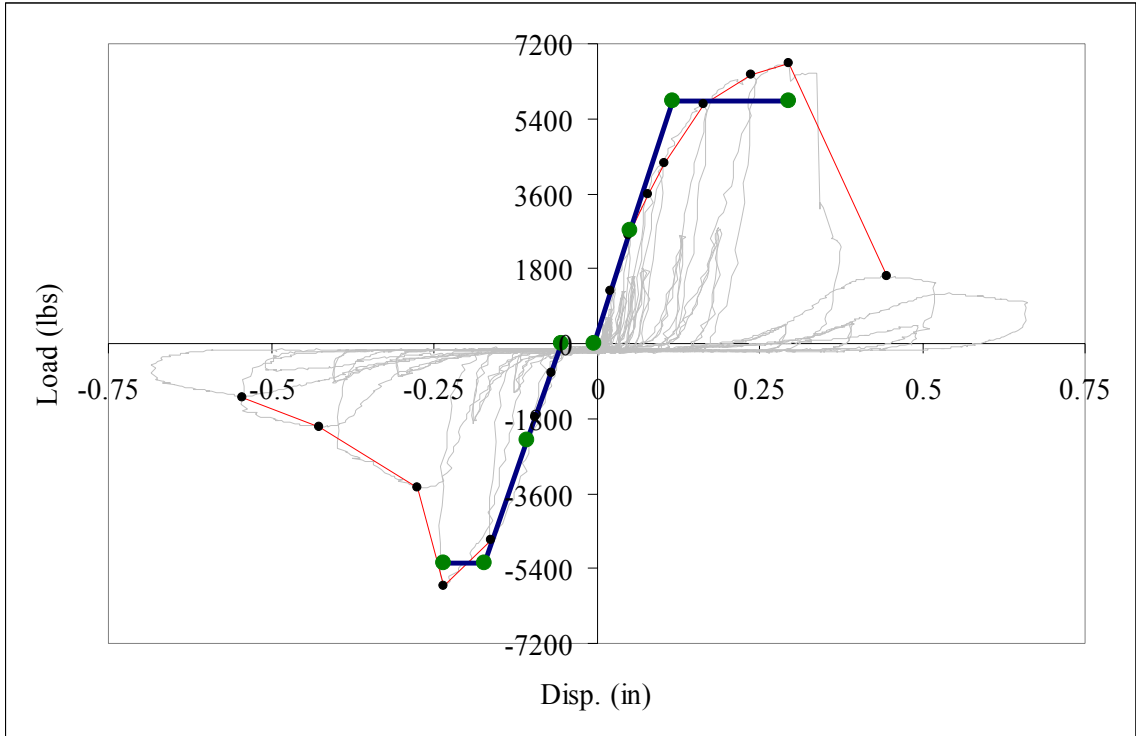


Figure B.62: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C01.

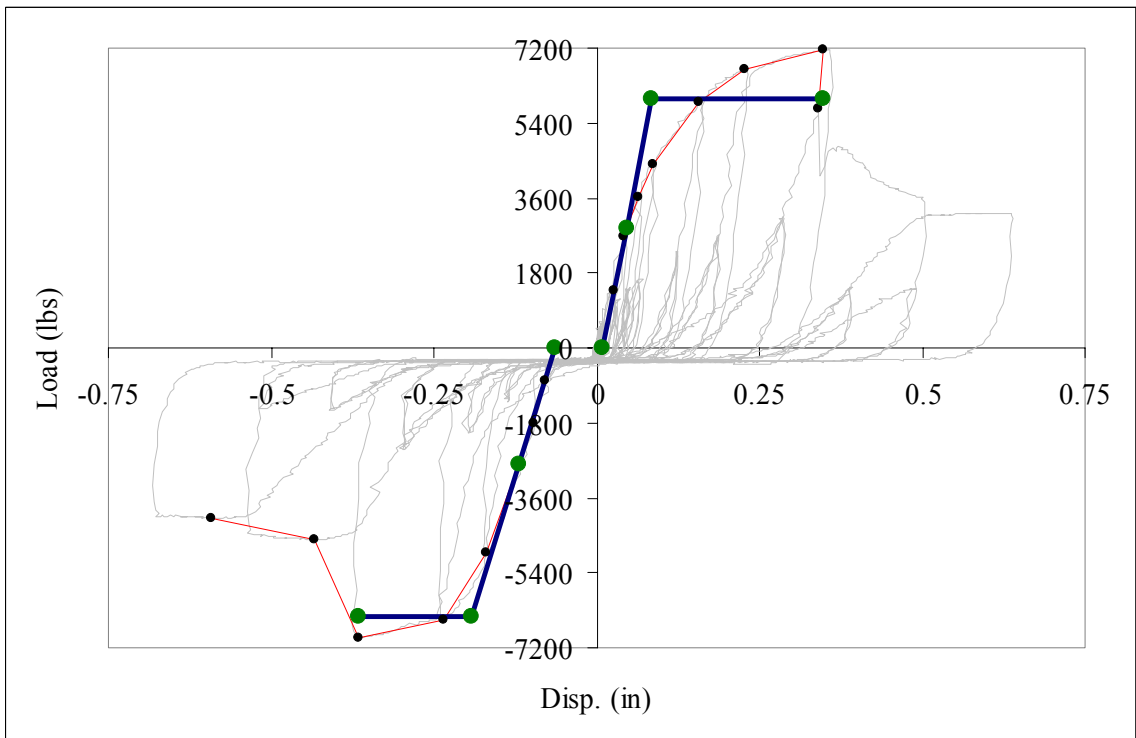


Figure B.63: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C02.

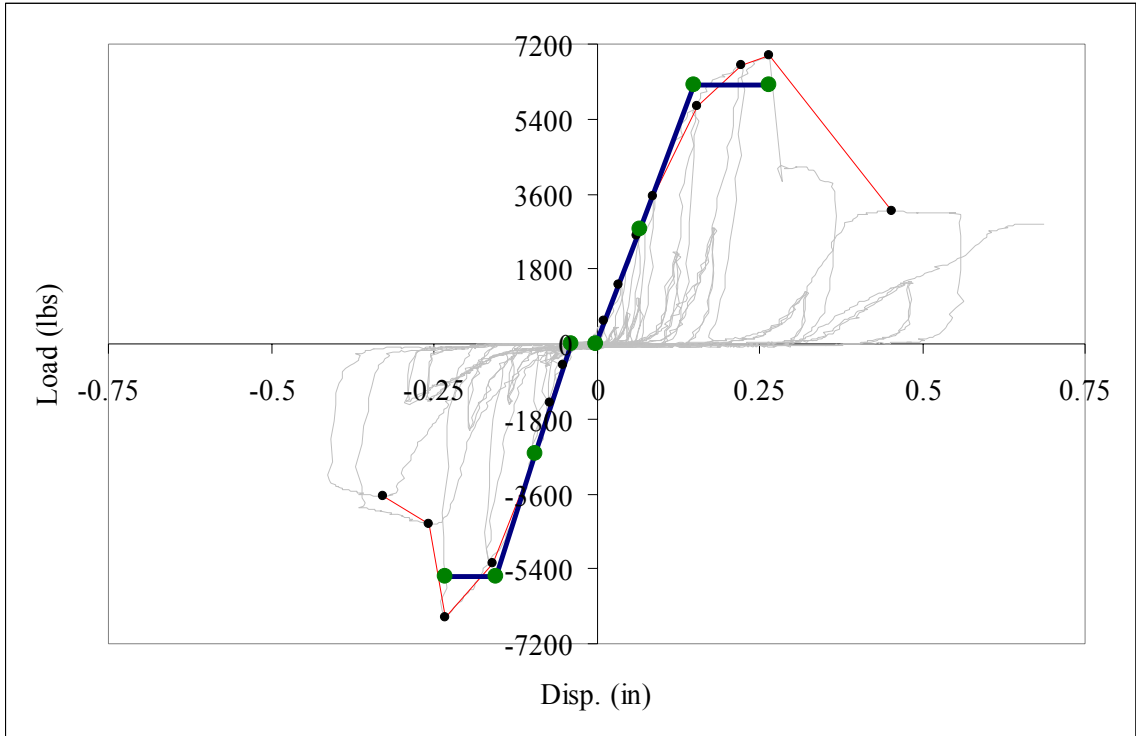


Figure B.64: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C03.

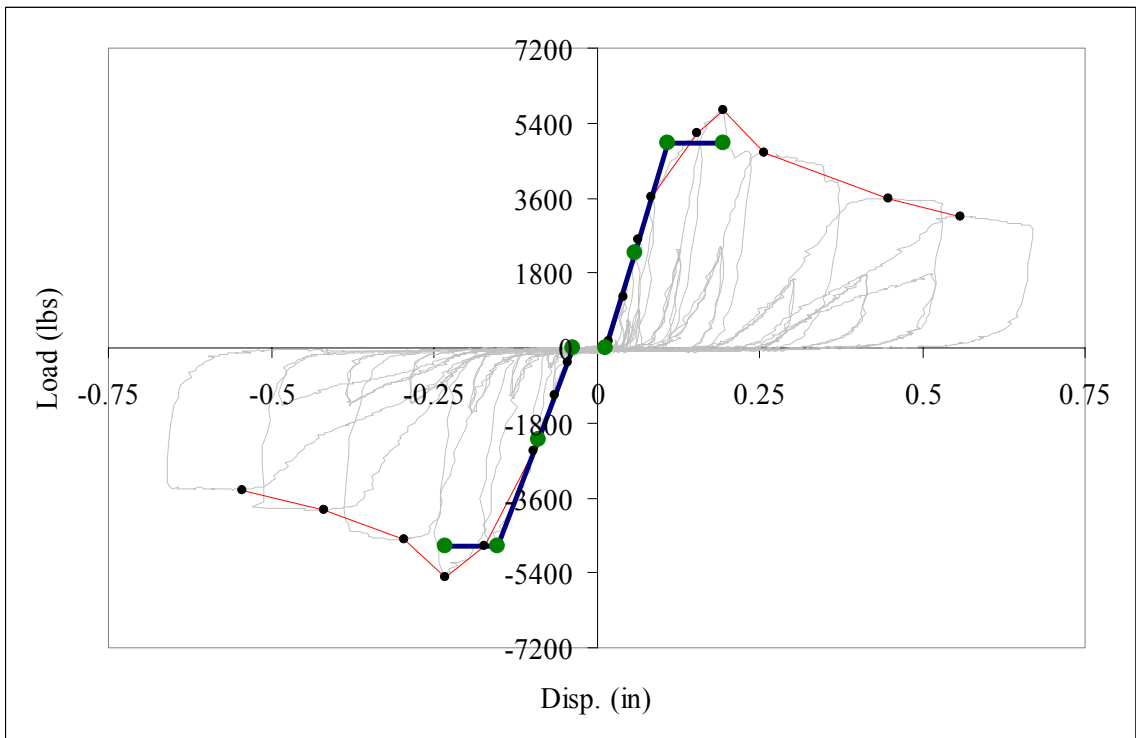


Figure B.65: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C04.

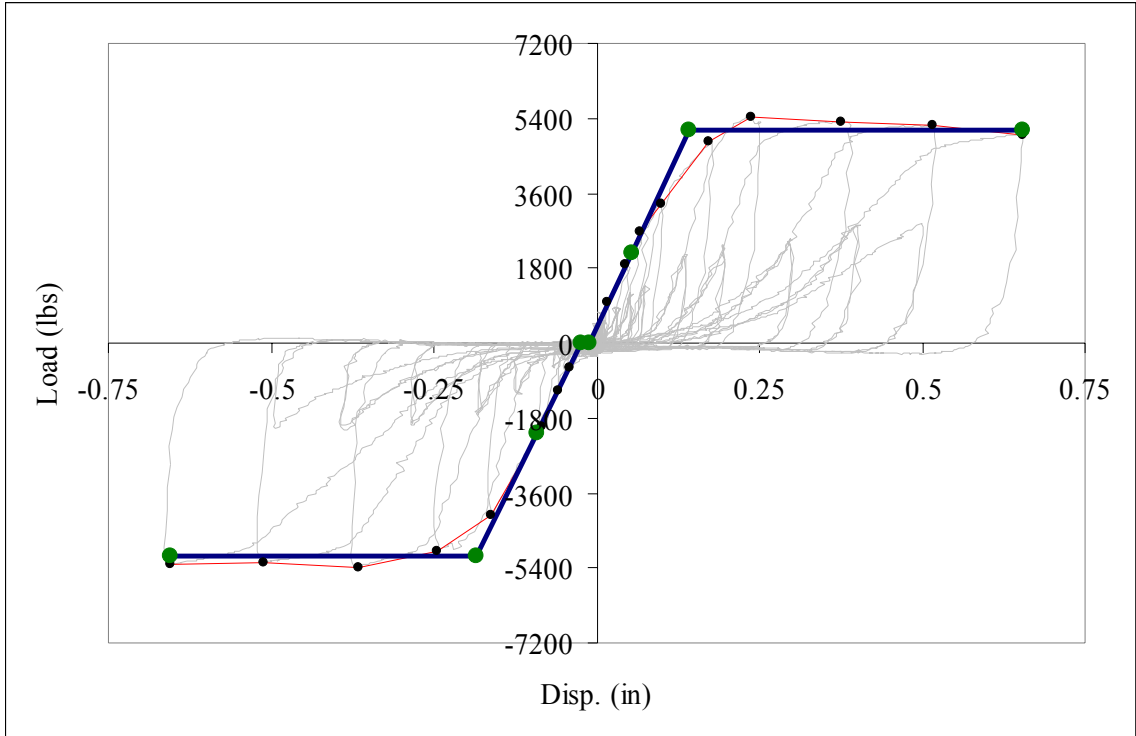


Figure B.66: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C05.

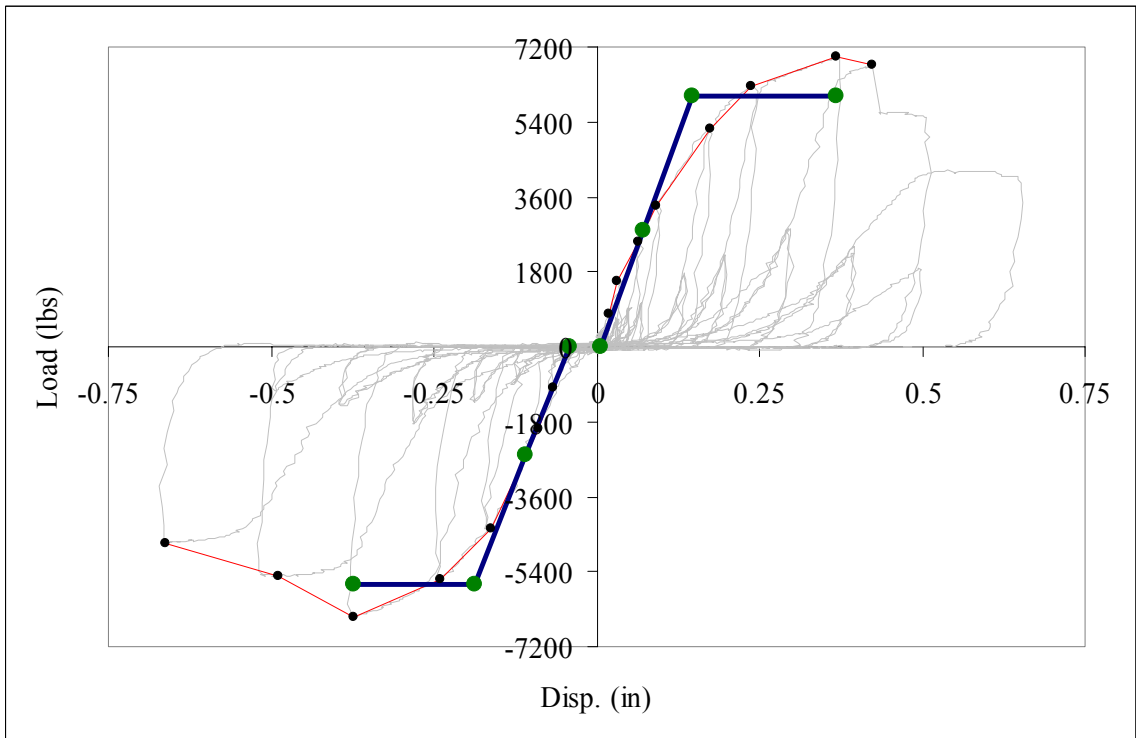


Figure B.67: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C06.

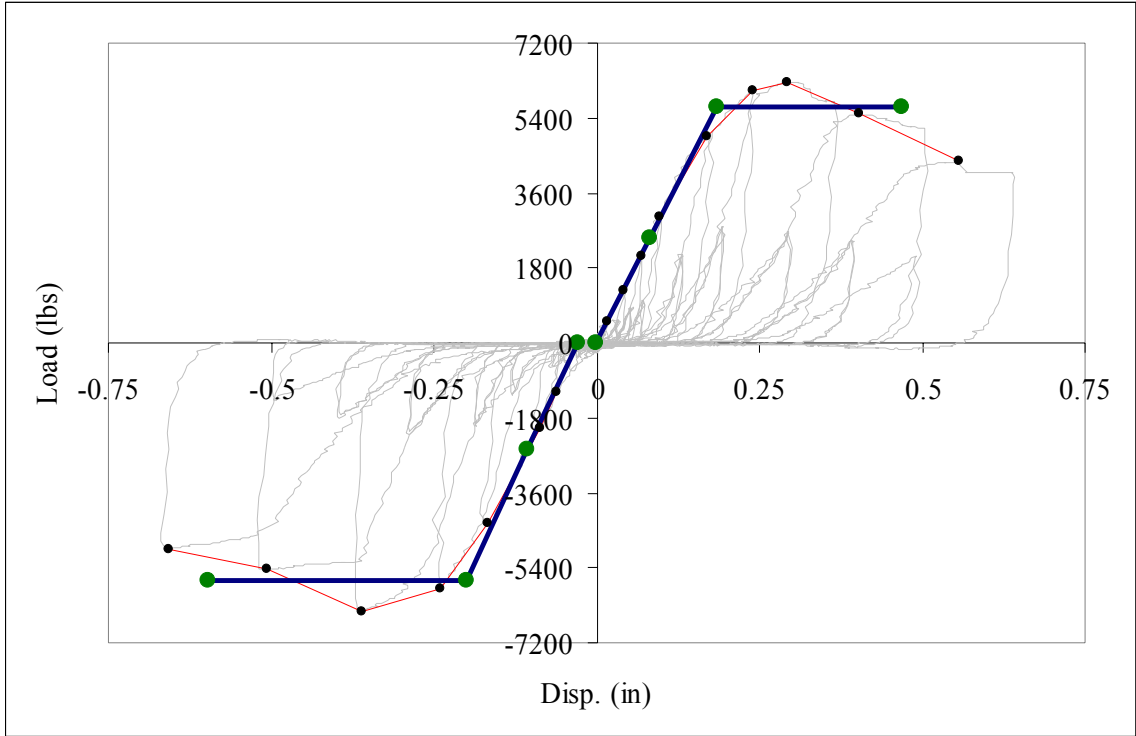


Figure B.68: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C07.

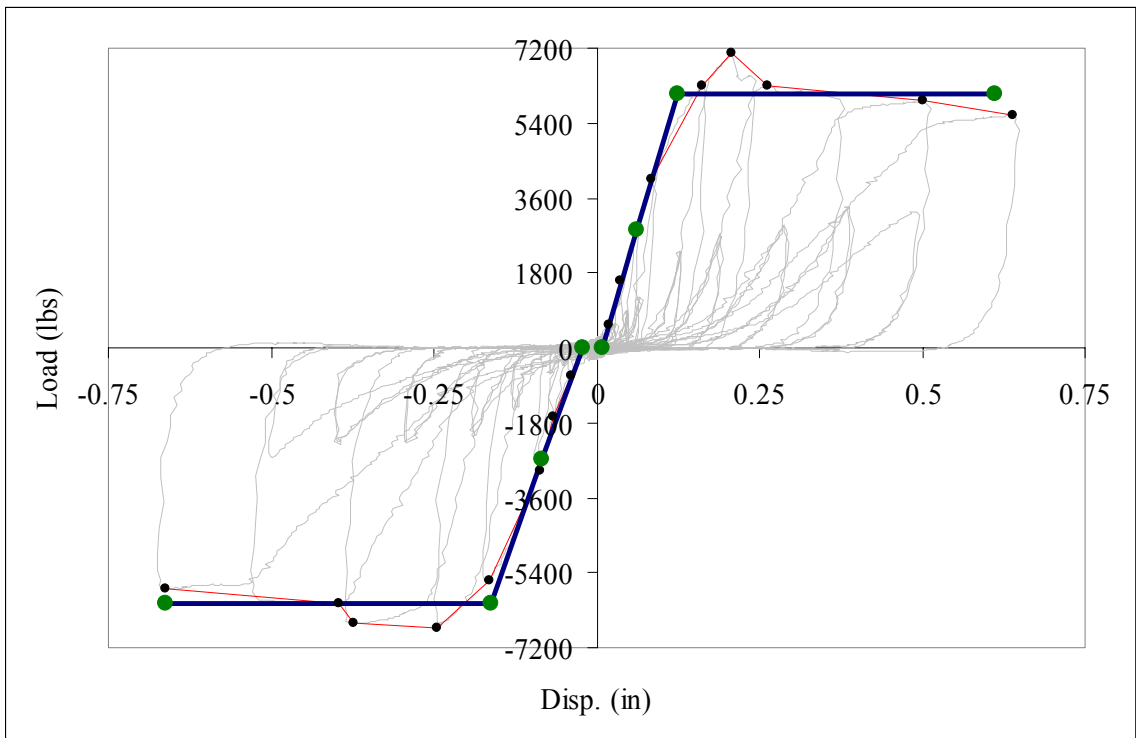


Figure B.69: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C08.

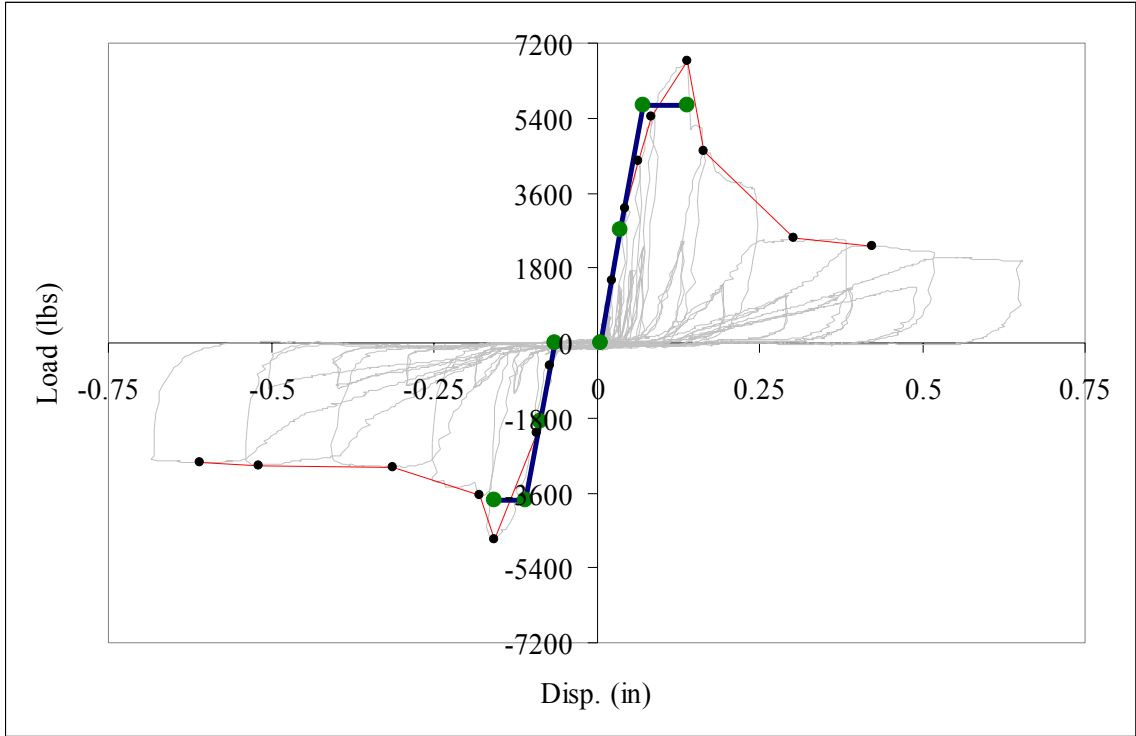


Figure B.70: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C09.

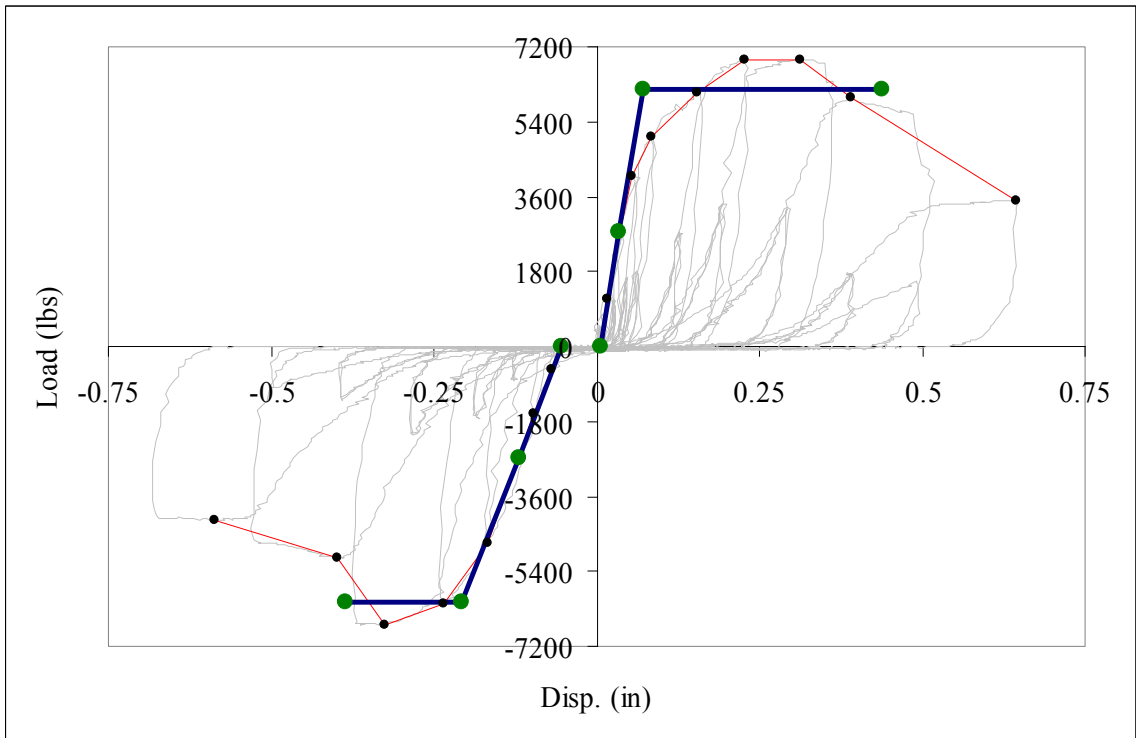


Figure B.71: Load (lbs) vs. Deflection (in.) plot. Test ST1R3C10.

Table B.20: Connection and Material properties, ST1R5C Series.

Connection Properties ST1R5C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	12482.84	9522.66	10177.55	8887.31	10038.45	9015.88	7044.43	12149.75	9942.96	10236.20	9949.80	1564.27	0.16
@ Displacement (in)	0.21	0.18	0.19	0.20	0.20	0.14	0.16	0.25	0.15	0.25	0.19	0.04	0.19
Failure Load (lbs)	9986.27	7618.12	8142.04	7109.85	8030.76	7212.71	5635.55	9719.80	7954.37	8188.96	7959.84	1251.42	0.16
@ Displacement (in)	0.22	0.18	0.20	0.20	0.20	0.14	0.17	0.25	0.16	0.26	0.20	0.04	0.19
40% Max (lbs)	4993.13	3809.06	4071.02	3554.92	4015.38	3606.35	2817.77	4859.90	3977.18	4094.48	3979.92	625.71	0.16
@ Displacement (in)	0.08	0.07	0.07	0.08	0.08	0.06	0.05	0.08	0.07	0.09	0.07	0.01	0.17
Yield (lbs)	12972.26	8153.93	10819.66	8358.03	9232.53	7848.97	5921.59	11200.86	8081.89	8939.87	9152.96	2014.67	0.22
@ Displacement (in)	0.17	0.13	0.17	0.17	0.14	0.10	0.12	0.18	0.12	0.20	0.15	0.03	0.21
5% Offset (lbs)	12482.84	8421.55	10177.55	8864.25	8936.96	8233.10	6598.96	12149.75	9942.96	10236.20	9604.41	1792.33	0.19
@ Displacement (in)	0.21	0.15	0.19	0.20	0.17	0.13	0.13	0.25	0.15	0.25	0.18	0.04	0.24
Elastic Stiff. (lb/in)	64210.80	76147.81	55902.44	54117.48	50965.82	86880.55	48451.72	61740.67	55707.87	47427.94	60155.31	12678.45	0.21
E.E.P. Energy (lb*in)	1125.97	877.97	1132.32	884.94	1425.55	649.69	647.86	1764.88	874.14	1392.67	1077.60	362.73	0.34
Ductility Ratio	1.51	1.41	1.09	1.16	1.60	1.36	1.43	1.36	1.36	1.30	1.36	0.15	0.11
Yield Mode	II-IV	II-IV	II-IV	II	II-IV	II-IV	II-IV	II-IV	II	II-IV			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.			
Member Properties ST1R5C Series													
Member A													
M.C. (%)	15.47	12.97	16.20	12.84	13.78	13.64	11.19	12.65	11.30	15.08	13.51	1.68	0.12
S.G.	0.65	0.60	0.70	0.54	0.48	0.59	0.56	0.48	0.45	0.43	0.55	0.09	0.16
D.E. 5% Yield (psi)	6371.83	6300.64	5435.38	4349.05	5389.23	4958.51	4984.81	4896.76	4158.04	4004.29	5084.86	815.09	0.16
D.E. Capacity (psi)	7183.25	6967.90	5651.20	4719.86	5873.22	5195.18	5041.40	5420.40	4208.99	4677.95	5493.93	966.69	0.18

Table B.21: Hysteretic properties, ST1R5C Series.

Hysteretic Connection Properties ST1R5C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	795.05	415.01	0.52	0.01	0.00	0.32	-738.96	145.57	0.20	-0.01	0.00	0.70
Primary2	1086.63	568.98	0.52	0.02	0.00	0.24	-945.57	171.95	0.18	-0.01	0.00	0.32
Primary3	2271.90	1071.33	0.47	0.04	0.00	0.08	-2024.53	375.28	0.19	-0.04	0.00	0.13
Primary4	3615.53	1433.88	0.40	0.07	0.01	0.12	-3428.46	637.14	0.19	-0.06	0.01	0.08
Primary5	4966.82	1799.11	0.36	0.09	0.01	0.11	-4831.78	805.18	0.17	-0.09	0.01	0.11
Primary6	8317.08	2820.33	0.34	0.15	0.02	0.11	-7850.91	1269.14	0.16	-0.14	0.02	0.13
Primary7	9862.51	3643.60	0.37	0.19	0.03	0.13	-9099.34	1578.03	0.17	-0.20	0.03	0.14
Primary8	8881.14	4192.08	0.47	0.26	0.05	0.18	-7424.29	1661.16	0.22	-0.28	0.04	0.14
Primary9	4673.13	1863.38	0.40	0.41	0.03	0.08	-5734.35	1293.95	0.23	-0.41	0.04	0.10
Primary10	3556.43	1370.22	0.39	0.55	0.03	0.05	-4956.44	1149.68	0.23	-0.55	0.04	0.08
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	12.19	5.09	0.42	7.13	2.84	0.40	0.29	0.09	0.33	82102.02	25533.07	0.31
Primary2	19.82	4.44	0.22	15.50	4.57	0.29	0.21	0.03	0.16	66331.63	20025.11	0.30
Primary3	85.53	15.10	0.18	83.92	18.86	0.22	0.17	0.02	0.13	54753.80	10360.13	0.19
Primary4	154.48	27.39	0.18	224.74	35.79	0.16	0.11	0.01	0.13	54956.27	9076.85	0.17
Primary5	225.71	41.90	0.19	423.25	60.26	0.14	0.08	0.01	0.12	56519.95	8667.96	0.15
Primary6	725.84	169.58	0.23	1144.17	186.17	0.16	0.10	0.02	0.15	57513.93	8227.42	0.14
Primary7	1294.44	246.44	0.19	1852.17	348.46	0.19	0.11	0.03	0.25	48759.29	10219.69	0.21
Primary8	2653.70	650.82	0.25	2197.40	663.40	0.30	0.20	0.03	0.13	30399.23	9075.78	0.30
Primary9	2331.35	458.99	0.20	2103.71	359.80	0.17	0.18	0.01	0.06	12914.40	3080.96	0.24
Primary10	2406.34	505.19	0.21	2337.89	487.42	0.21	0.17	0.02	0.10	7767.07	1719.58	0.22

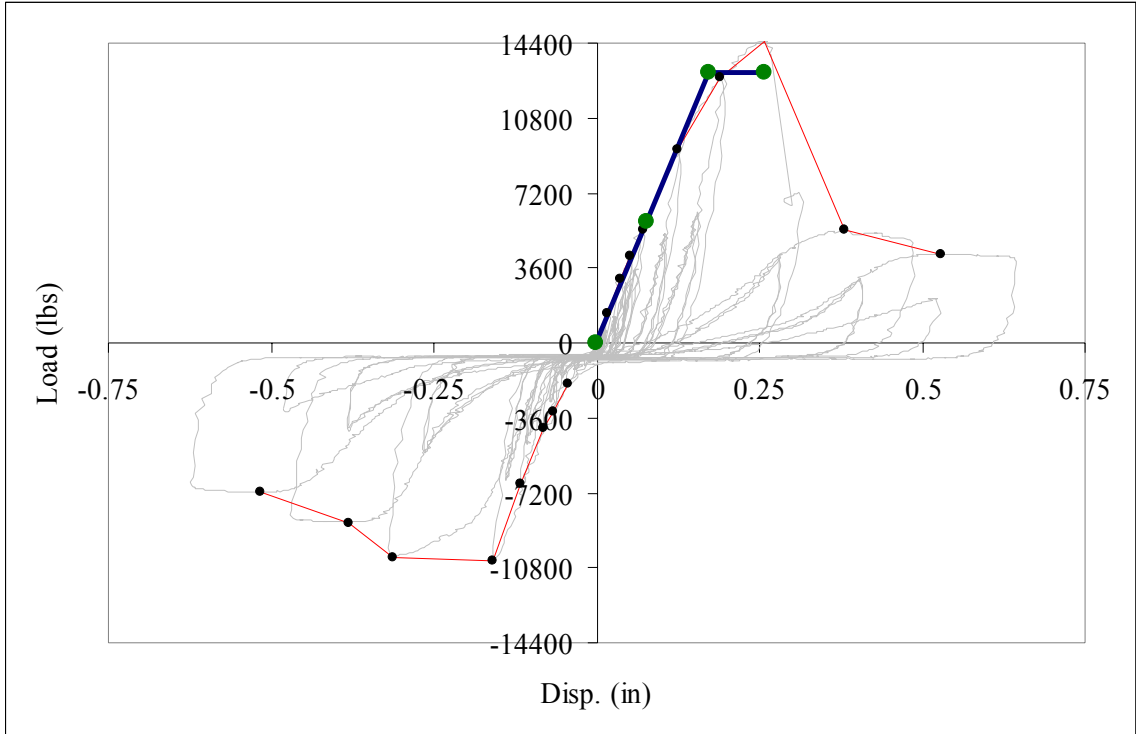


Figure B.72: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C01.

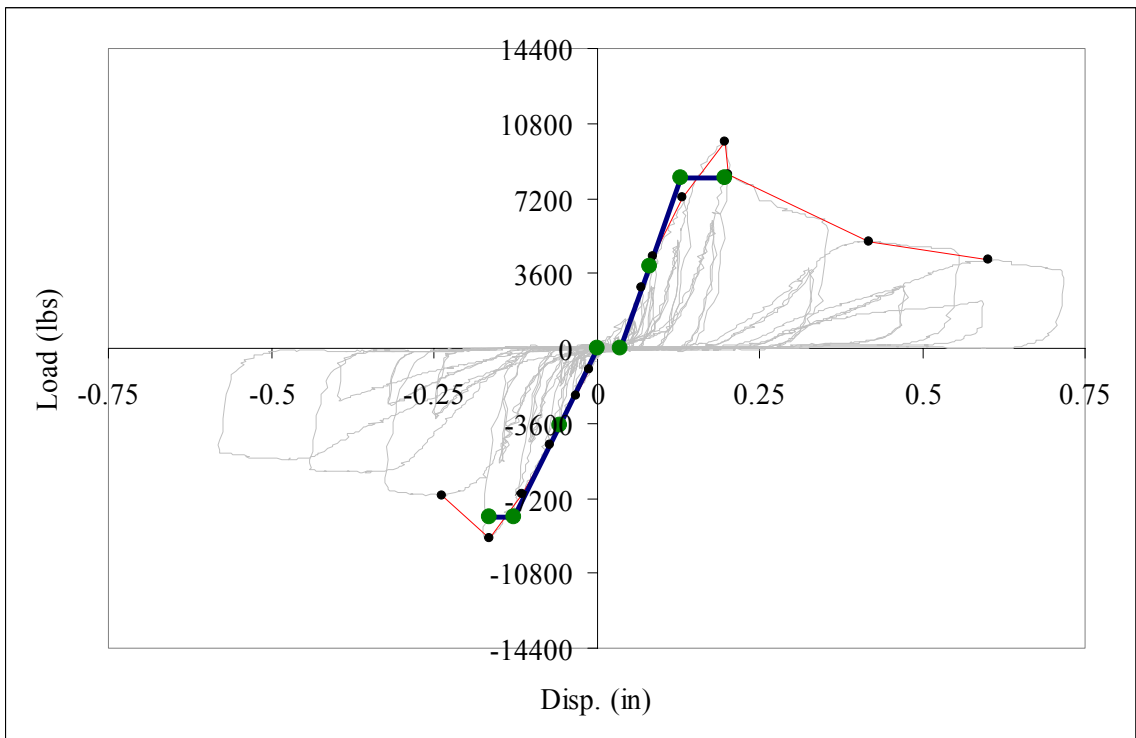


Figure B.73: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C02.

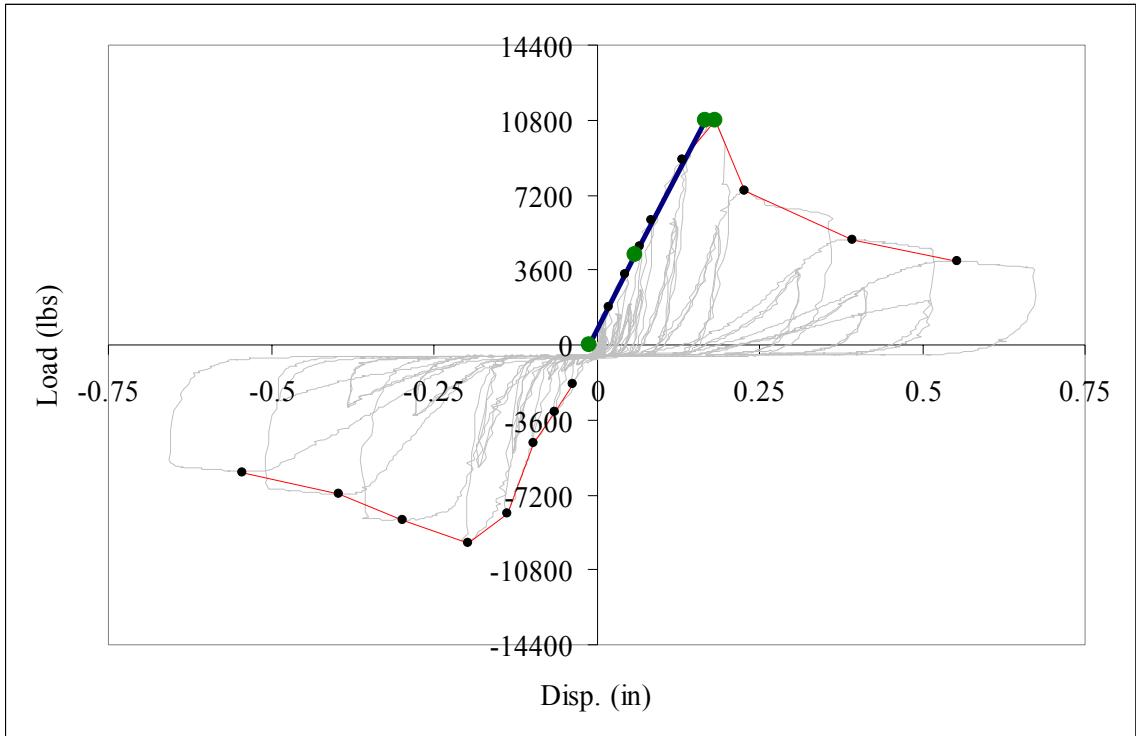


Figure B.74: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C03.

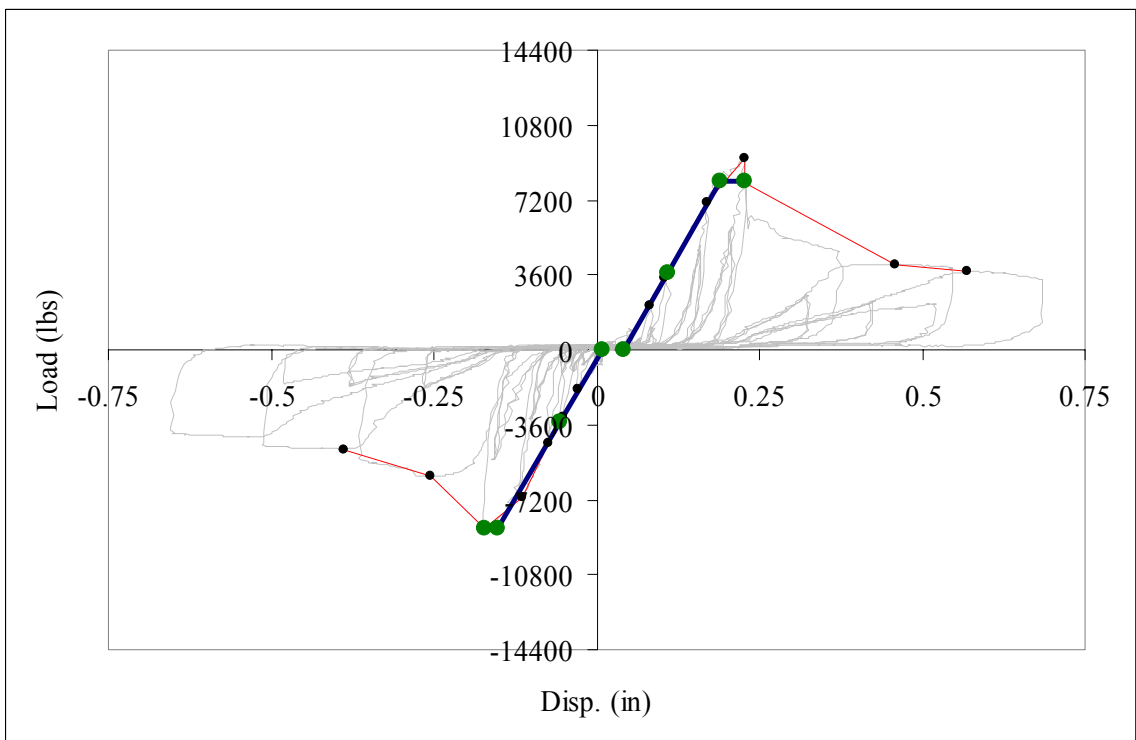


Figure B.75: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C04.

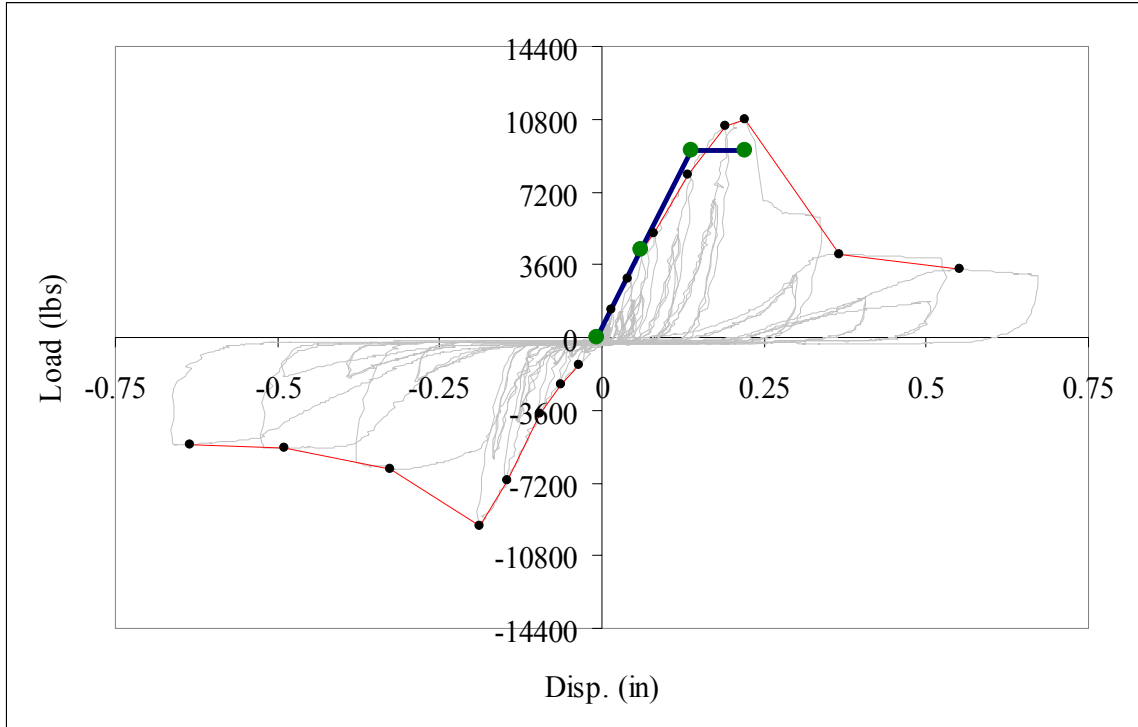


Figure B.76: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C05.

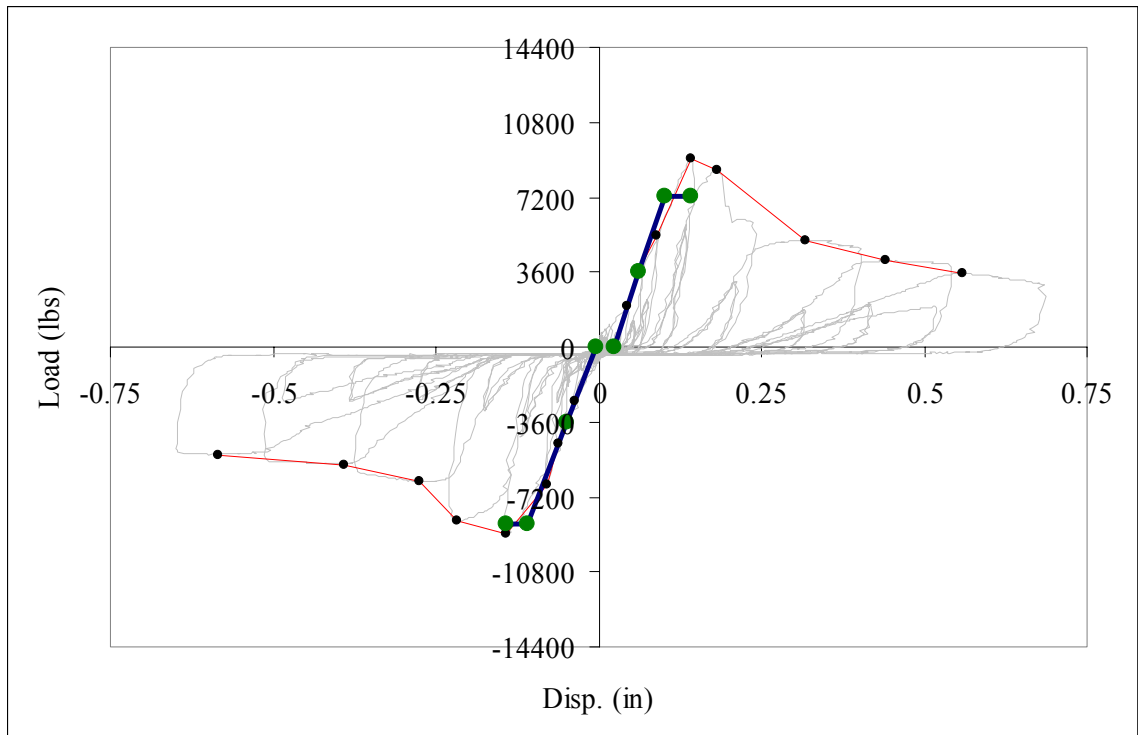


Figure B.77: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C06.

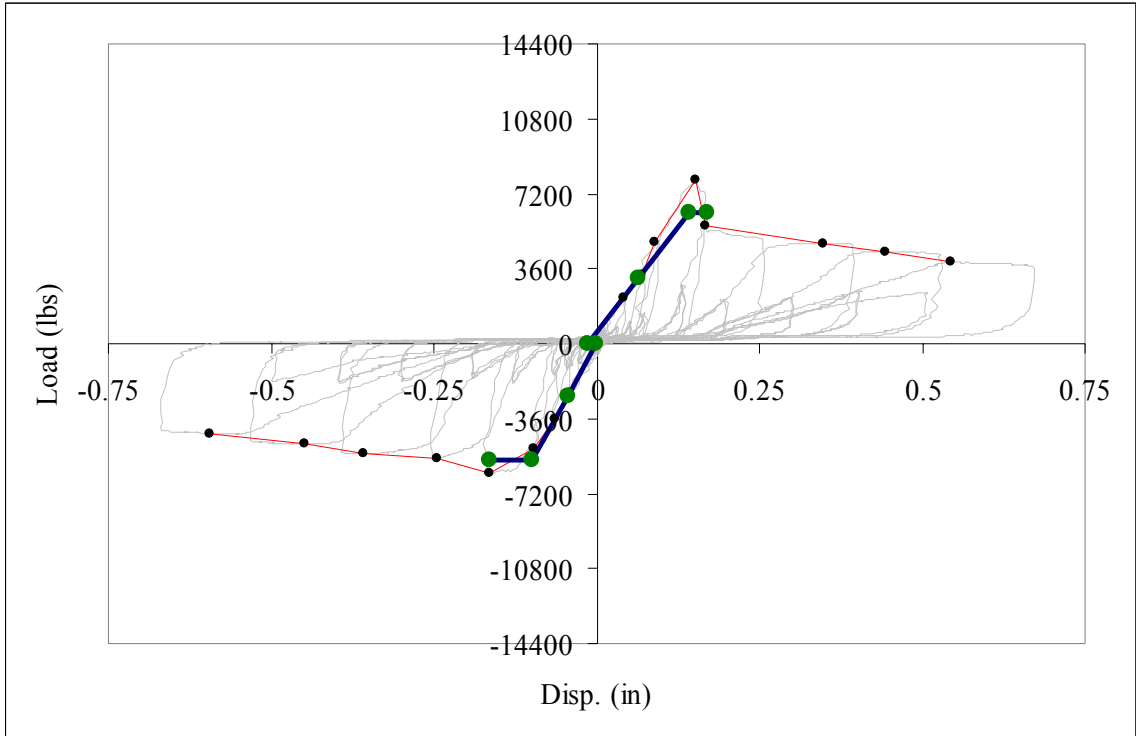


Figure B.78: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C07.

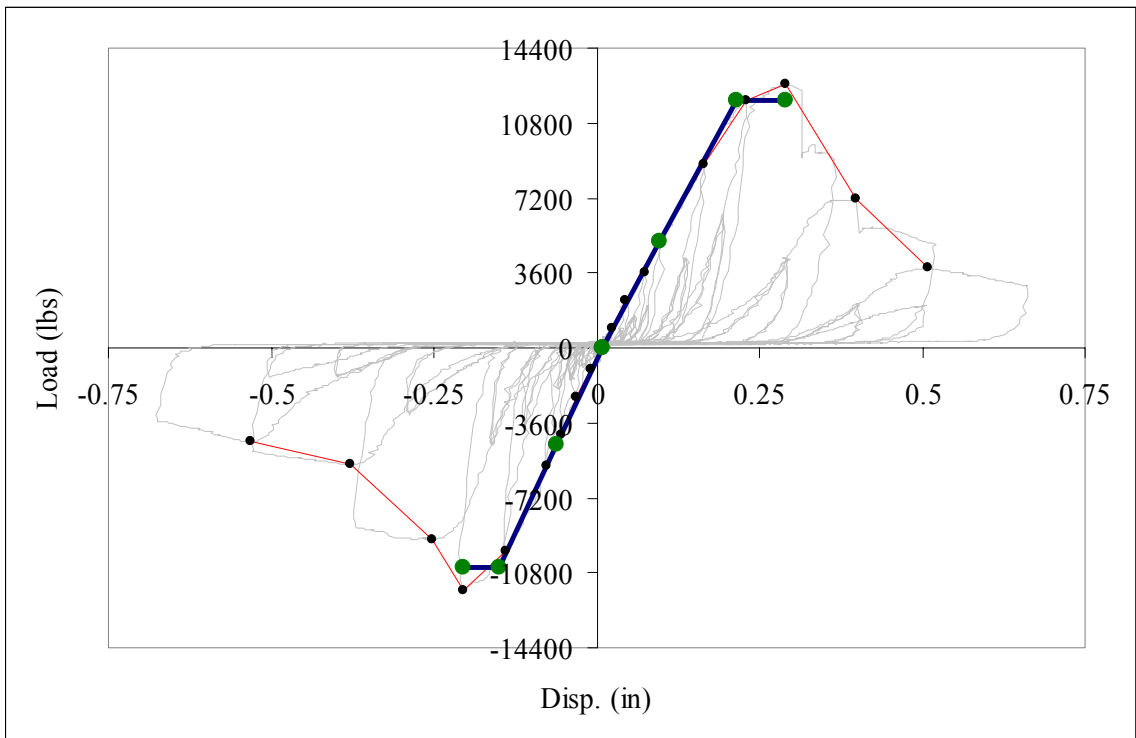


Figure B.79: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C08.

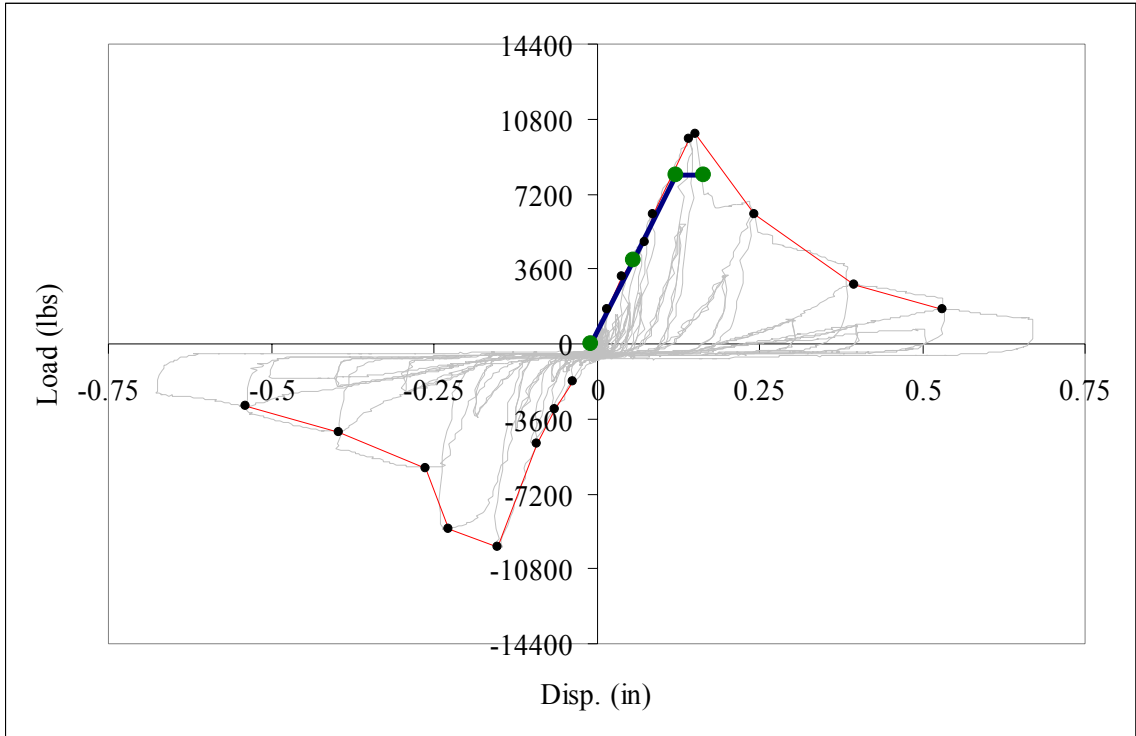


Figure B.80: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C09.

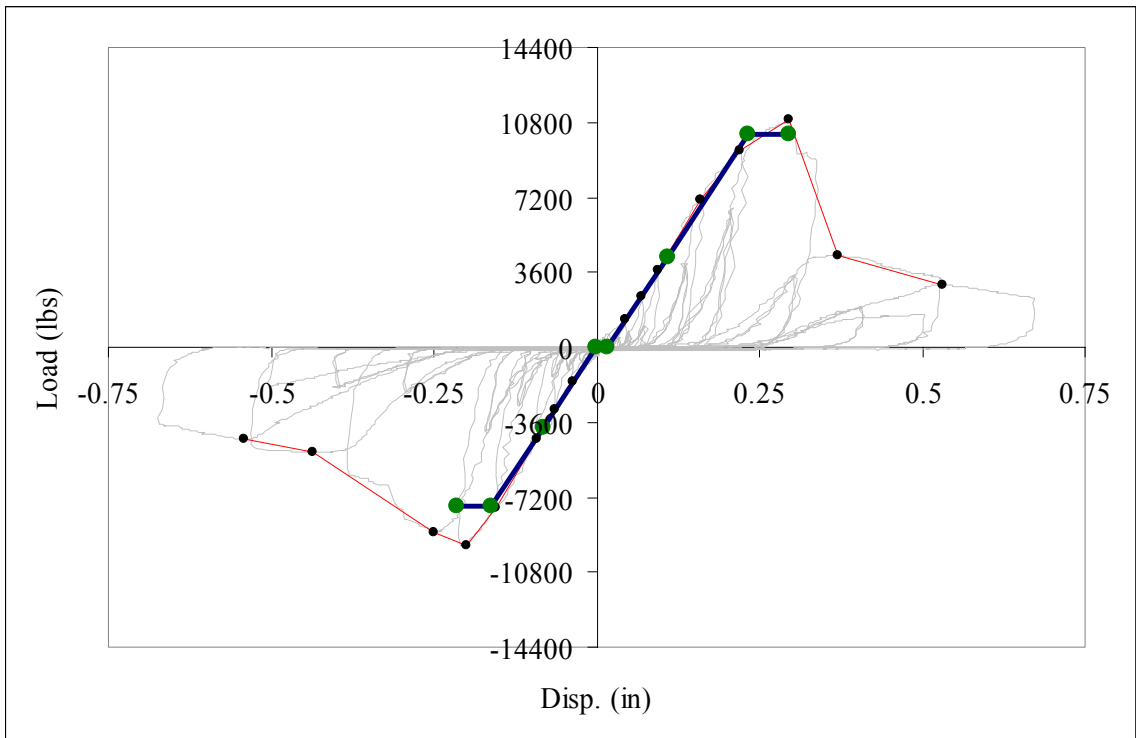


Figure B.81: Load (lbs) vs. Deflection (in.) plot. Test ST1R5C10.

Table B.22: Connection and Material properties, ST2R3C Series.

Connection Properties ST2R3C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	12993.37	14004.66	14983.61	13248.26	13472.32	11526.44	11200.12	11350.49	13224.20	14371.58	13037.50	1302.91	0.10
@ Displacement (in)	0.39	0.22	0.38	0.41	0.77	0.34	0.53	0.26	0.38	0.37	0.40	0.15	0.38
Failure Load (lbs)	10394.69	11203.73	11986.89	10598.61	10777.86	9221.15	8960.09	9080.39	10579.36	11497.26	10430.00	1042.33	0.10
@ Displacement (in)	0.53	0.65	0.78	0.41	0.77	0.69	0.78	0.45	0.63	0.81	0.65	0.14	0.22
40% Max (lbs)	5197.35	5601.86	5993.45	5299.30	5388.93	4610.57	4480.05	4540.20	5289.68	5748.63	5215.00	521.16	0.10
@ Displacement (in)	0.12	0.08	0.09	0.10	0.10	0.09	0.08	0.10	0.10	0.10	0.10	0.01	0.12
Yield (lbs)	11780.10	12832.28	14244.37	12407.60	12734.09	10593.49	10168.76	10295.18	12160.78	12978.25	12019.49	1320.79	0.11
@ Displacement (in)	0.25	0.16	0.20	0.21	0.21	0.18	0.17	0.20	0.21	0.20	0.20	0.03	0.13
5% Offset (lbs)	12131.15	13292.66	14382.24	12019.81	11521.00	10714.10	9416.55	9925.22	12097.20	12369.30	11786.92	1487.63	0.13
@ Displacement (in)	0.32	0.18	0.31	0.30	0.47	0.21	0.31	0.21	0.27	0.26	0.29	0.08	0.29
Elastic Stiff. (lb/in)	51681.52	96577.64	77686.60	66312.45	66071.19	65791.97	64644.53	61672.23	63956.28	70674.50	68506.89	11834.43	0.17
E.E.P. Energy (lb*in)	4639.12	7151.76	9619.42	3620.27	8345.67	6192.93	7011.64	3515.42	6195.72	9043.27	6533.52	2137.79	0.33
Ductility Ratio	2.13	4.10	3.99	1.95	3.68	3.73	4.68	2.33	2.99	4.00	3.36	0.94	0.28
Yield Mode	II, IV	IV	IV	IV	IV	IV	IV	II, IV	IV	IV			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.			
Member Properties ST2R3C Series													
Member A													
M.C. (%)	15.84	13.00	15.06	13.30	15.86	13.43		17.19	15.34	15.45	14.94	1.41	0.09
S.G.	0.43	0.72	0.56	0.40	0.51	0.49	0.60	0.44	0.46	0.50	0.51	0.09	0.19
D.E. 5% Yield (psi)	3693.16	7215.93	5498.49	3620.23	4124.81	4988.80	4947.09	4130.55	4021.72	4220.03	4646.08	1085.67	0.23
D.E. Capacity (psi)	3915.67	7619.08	5921.31	4276.41	4597.29	5388.91	5293.73	4213.78	4304.16	4906.24	5043.66	1100.48	0.22

Table B.23: Hysteretic properties, ST2R3C Series.

Hysteretic Connection Properties ST2R3C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	696.25	336.16	0.48	0.02	0.01	0.28	-376.39	213.62	0.57	-0.02	0.01	0.35
Primary2	1039.11	471.89	0.45	0.03	0.00	0.10	-537.00	301.09	0.56	-0.02	0.00	0.16
Primary3	2970.71	1004.17	0.34	0.06	0.00	0.04	-1894.91	960.14	0.51	-0.05	0.00	0.07
Primary4	5115.24	1653.30	0.32	0.09	0.00	0.03	-4024.10	1205.33	0.30	-0.09	0.01	0.08
Primary5	6768.19	2203.27	0.33	0.11	0.01	0.07	-5985.17	1061.88	0.18	-0.11	0.01	0.10
Primary6	10265.67	3393.87	0.33	0.18	0.02	0.10	-9691.98	1148.63	0.12	-0.17	0.02	0.11
Primary7	12610.81	4240.38	0.34	0.25	0.03	0.10	-11690.05	1242.68	0.11	-0.25	0.02	0.07
Primary8	13147.81	4383.34	0.33	0.37	0.04	0.10	-12363.74	1534.87	0.12	-0.41	0.03	0.06
Primary9	11791.85	4024.03	0.34	0.54	0.05	0.10	-11397.56	1860.09	0.16	-0.56	0.05	0.09
Primary10	10174.69	3739.51	0.37	0.73	0.06	0.08	-10024.31	2322.15	0.23	-0.76	0.07	0.09
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	12.01	4.42	0.37	9.38	3.68	0.39	0.21	0.06	0.28	32203.75	13608.27	0.42
Primary2	19.09	7.33	0.38	20.52	7.96	0.39	0.15	0.04	0.24	31249.25	7742.70	0.25
Primary3	105.59	23.30	0.22	139.52	23.49	0.17	0.12	0.01	0.12	42817.25	8389.85	0.20
Primary4	217.94	33.38	0.15	403.90	55.74	0.14	0.09	0.01	0.10	51823.80	9304.95	0.18
Primary5	323.39	51.27	0.16	713.94	48.87	0.07	0.07	0.01	0.12	57122.82	10128.77	0.18
Primary6	1073.28	175.14	0.16	1742.78	151.70	0.09	0.10	0.01	0.12	57759.01	11747.67	0.20
Primary7	2076.30	341.12	0.16	3049.91	173.69	0.06	0.11	0.02	0.16	48677.99	8876.44	0.18
Primary8	5107.00	555.77	0.11	4936.64	553.75	0.11	0.17	0.02	0.13	33034.33	4766.44	0.14
Primary9	6654.22	960.77	0.14	6424.41	1348.64	0.21	0.17	0.02	0.11	21055.16	2780.19	0.13
Primary10	7331.75	1608.73	0.22	7583.22	2145.74	0.28	0.16	0.01	0.09	13494.49	2618.52	0.19

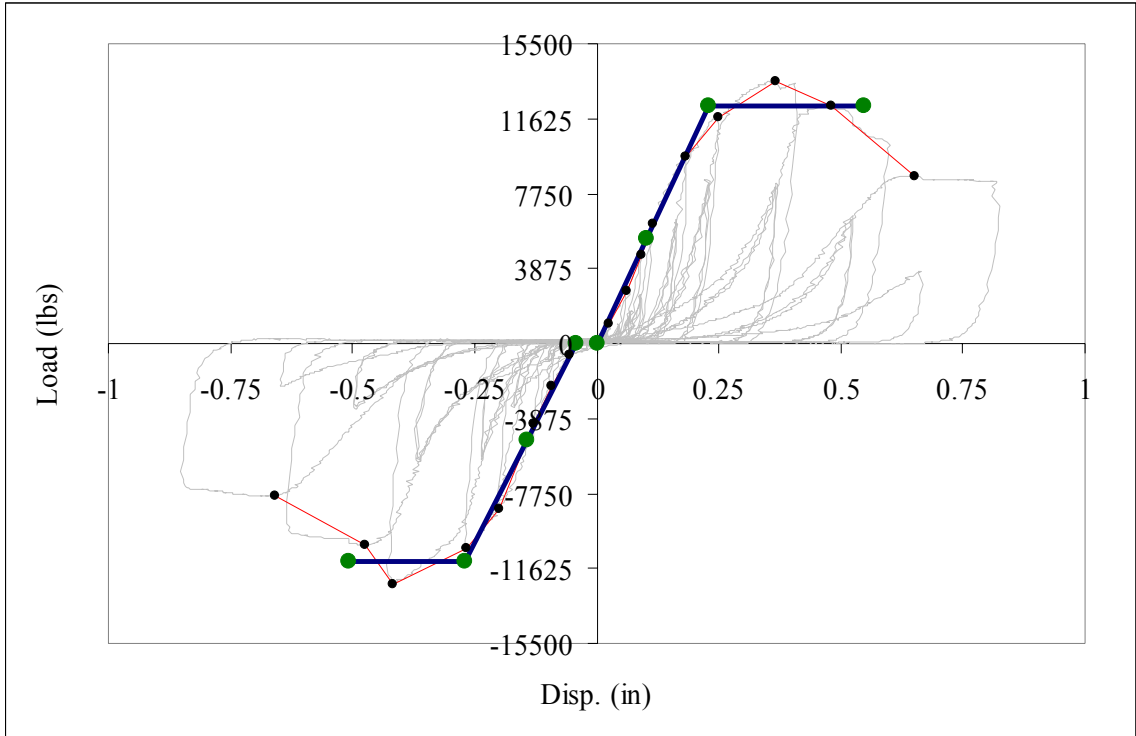


Figure B.82: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C01.

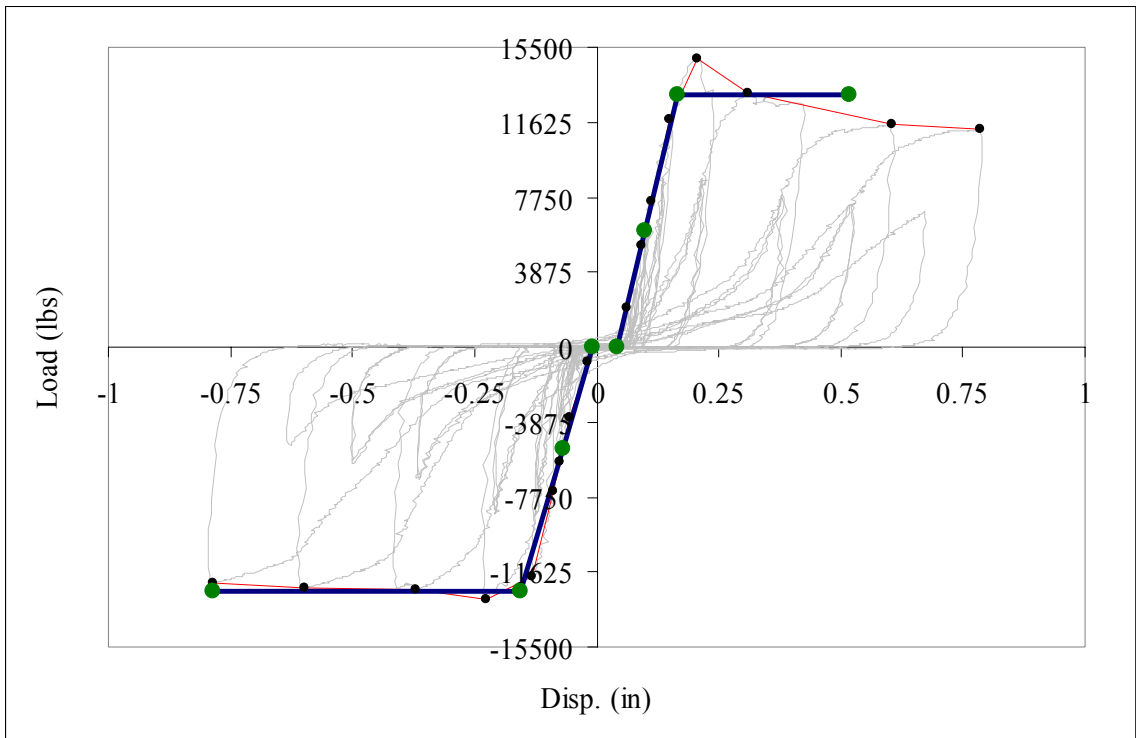


Figure B.83: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C02.

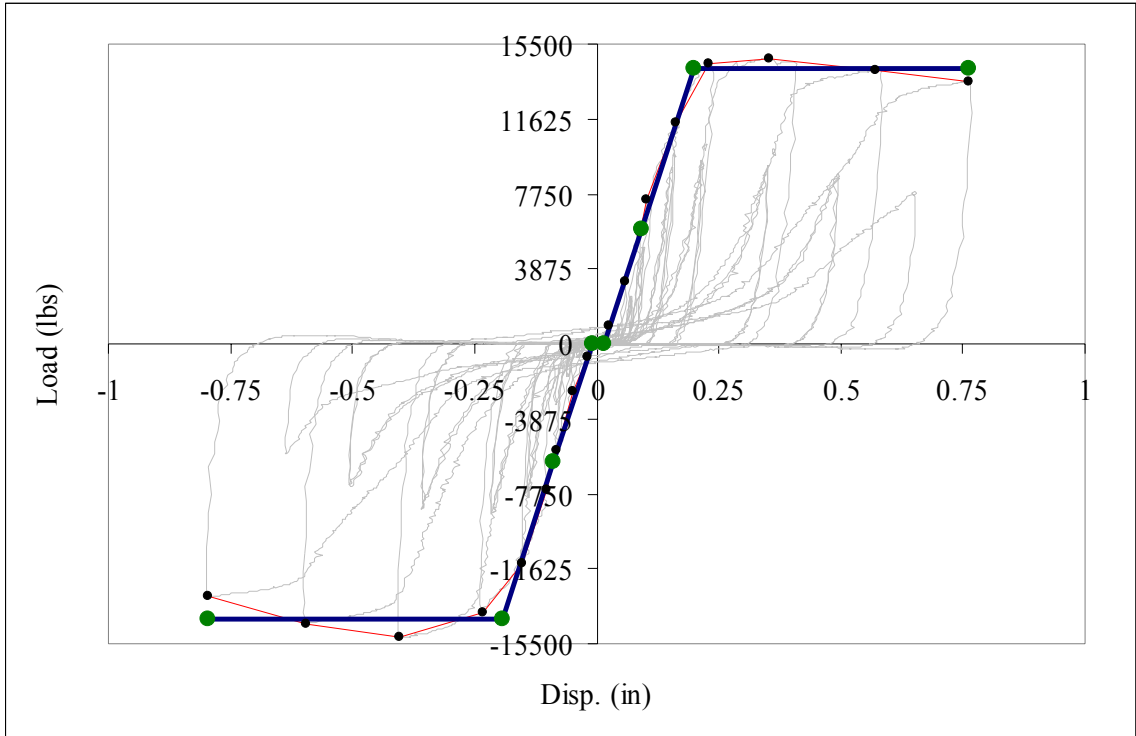


Figure B.84: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C03.

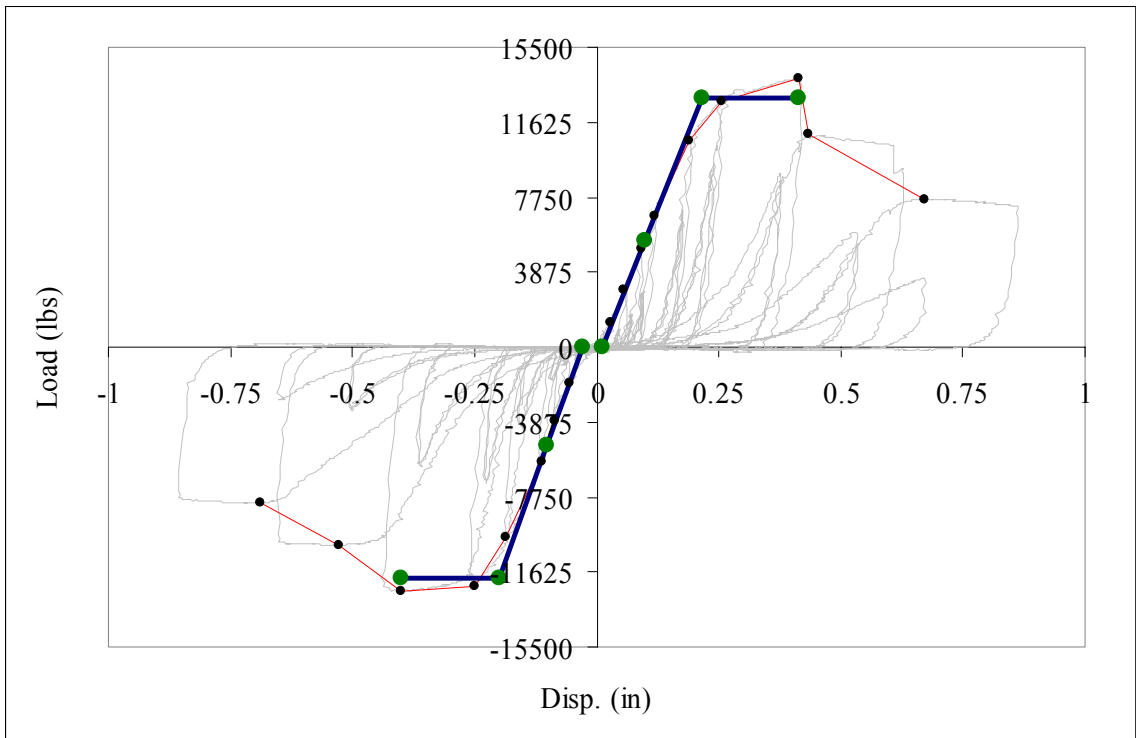


Figure B.85: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C04.

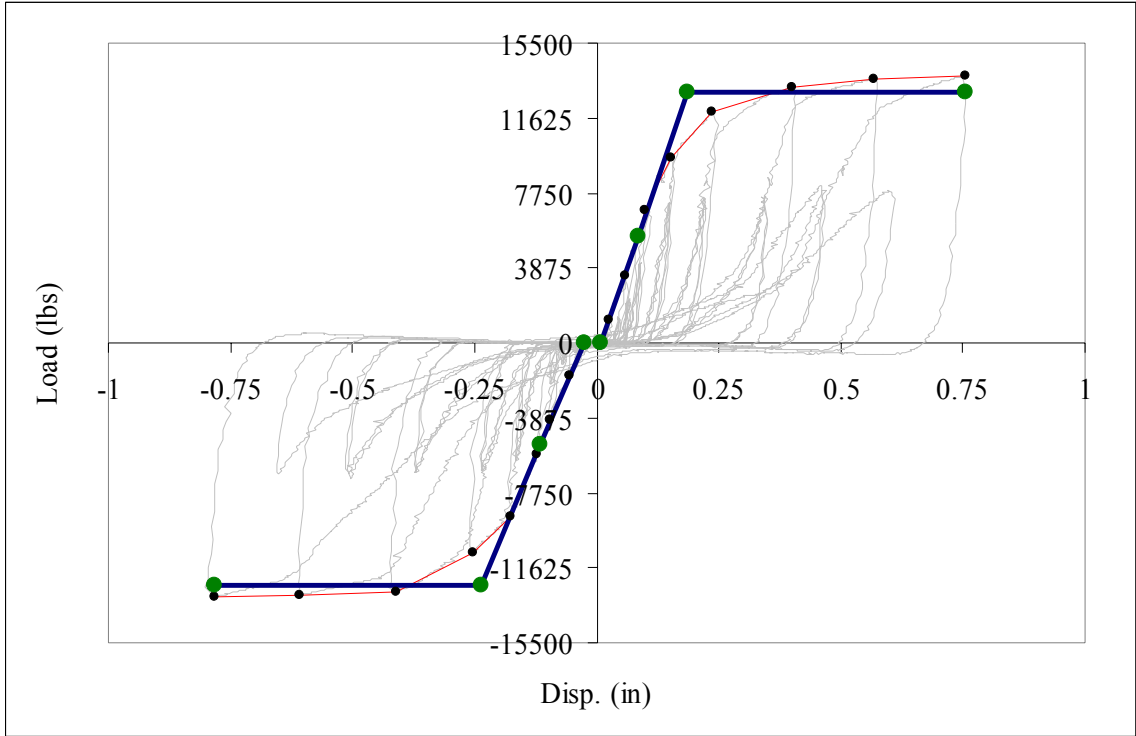


Figure B.86: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C05.

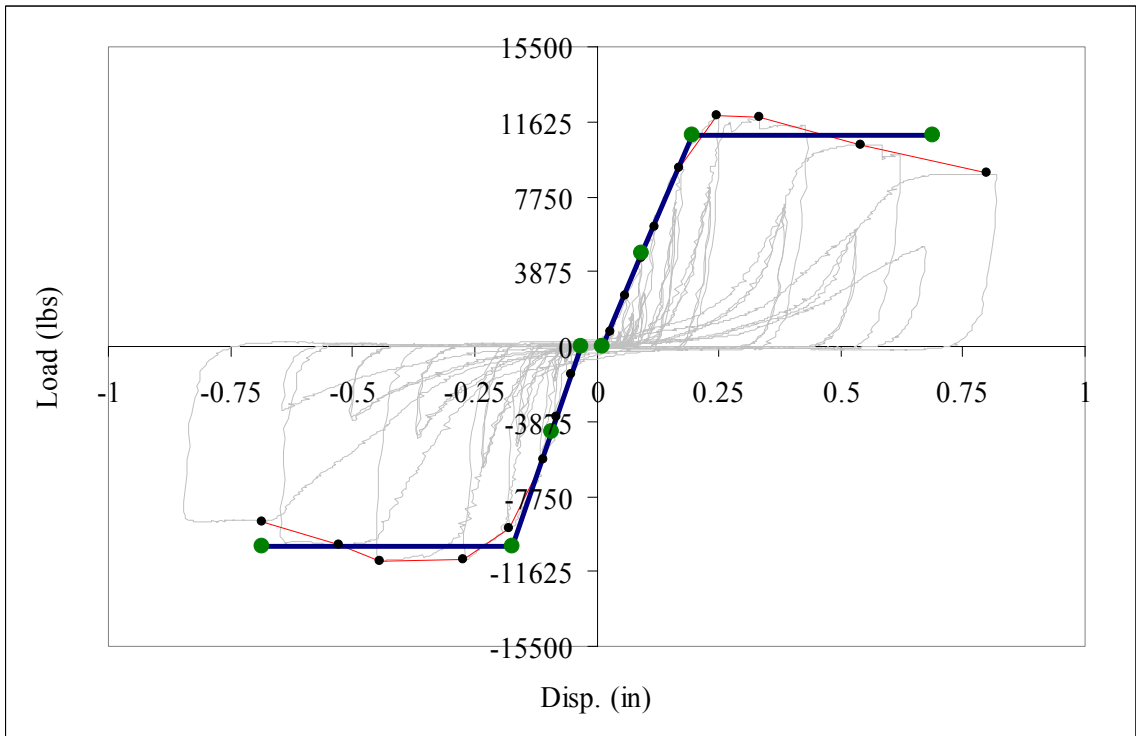


Figure B.87: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C06.

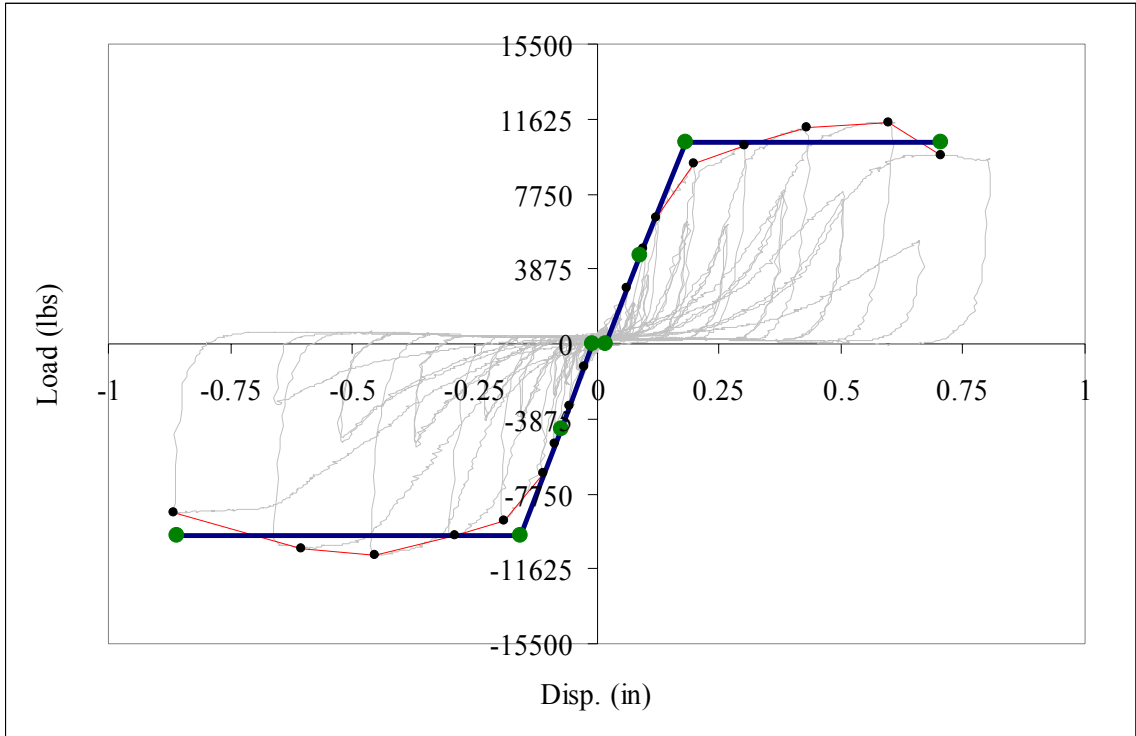


Figure B.88: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C07.

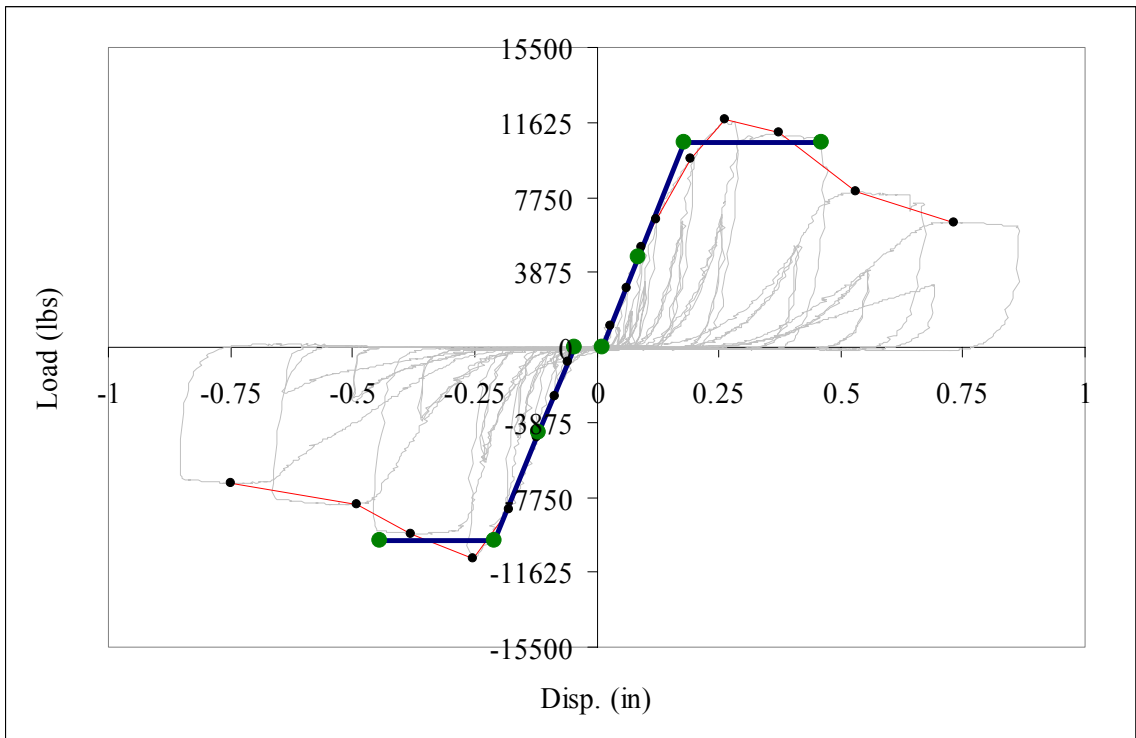


Figure B.89: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C08.

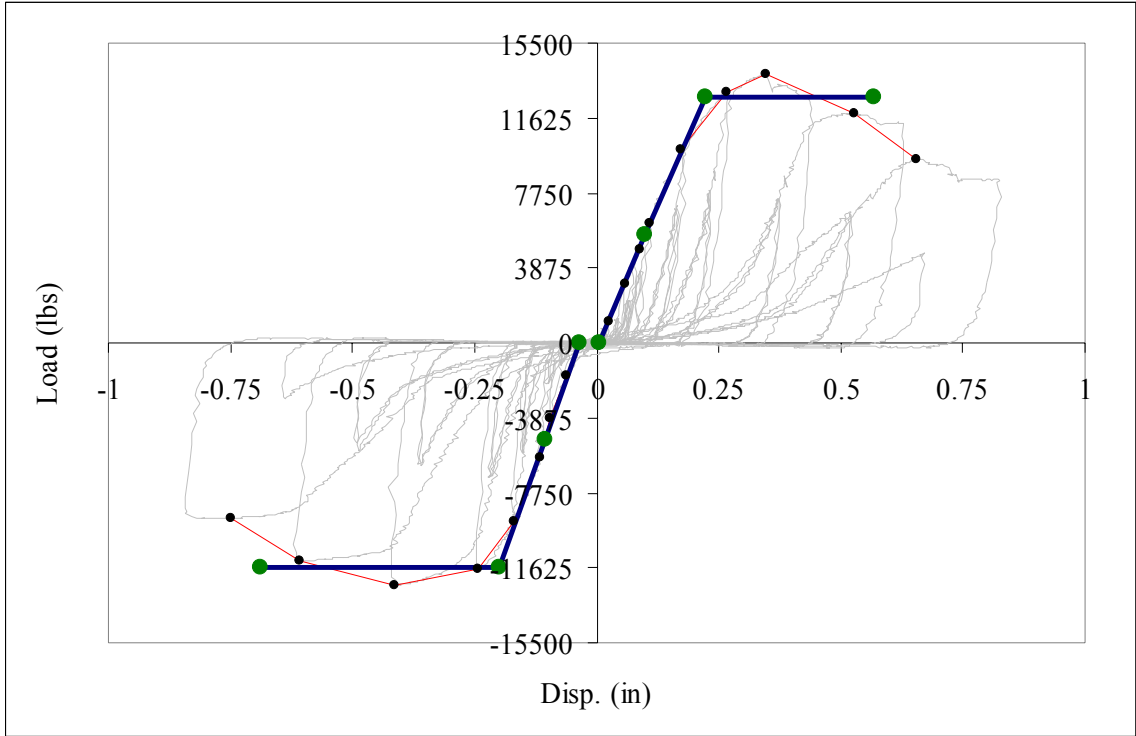


Figure B.90: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C09.

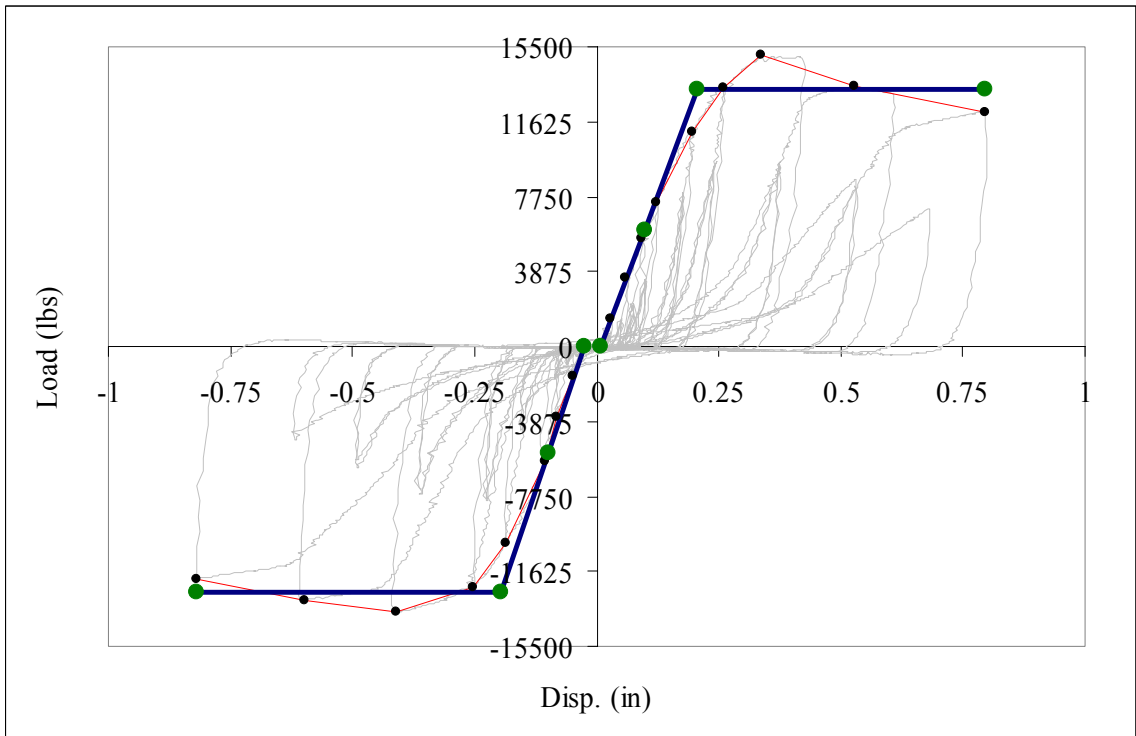


Figure B.91: Load (lbs) vs. Deflection (in.) plot. Test ST2R3C10.

Table B.24: Connection and Material properties, ST2R5C Series.

Connection Properties ST2R5C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	18768.62	20401.72	21306.24	18500.19	21349.85	20329.53	18886.66	16286.64	20046.83	19724.26	19560.05	1517.87	0.08
@ Displacement (in)	0.20	0.30	0.24	0.21	0.34	0.30	0.34	0.39	0.21	0.28	0.28	0.06	0.23
Failure Load (lbs)	15014.89	16321.37	17044.99	14800.15	17079.88	16263.63	15109.33	13029.31	16037.46	15779.41	15648.04	1214.29	0.08
@ Displacement (in)	0.20	0.30	0.24	0.21	0.34	0.30	0.60	0.40	0.22	0.28	0.31	0.12	0.39
40% Max (lbs)	7507.45	8160.69	8522.49	7400.08	8539.94	8131.81	7554.66	6514.65	8018.73	7889.71	7824.02	607.15	0.08
@ Displacement (in)	0.07	0.12	0.10	0.10	0.11	0.08	0.10	0.11	0.09	0.10	0.10	0.01	0.15
Yield (lbs)	17789.15	18643.24	19739.12	17651.81	20898.69	18601.51	16804.88	14228.80	18321.56	17042.45	17972.12	1796.02	0.10
@ Displacement (in)	0.15	0.24	0.20	0.16	0.24	0.16	0.19	0.22	0.20	0.21	0.20	0.03	0.18
5% Offset (lbs)	18664.47	17981.21	21169.34	18500.19	20576.50	18586.32	15830.84	16038.28	20046.83	19724.26	18711.82	1775.39	0.09
@ Displacement (in)	0.20	0.26	0.24	0.21	0.29	0.19	0.26	0.31	0.21	0.28	0.25	0.04	0.17
Elastic Stiff. (lb/in)	137483.75	86748.20	112890.24	95627.82	92263.12	104194.99	114530.64	72045.44	109673.61	83271.95	100872.97	18861.35	0.19
E.E.P. Energy (lb*in)	2168.29	3119.25	2592.10	1892.57	4389.43	5380.73	8177.62	3977.77	1930.55	2974.71	3660.30	1950.65	0.53
Ductility Ratio	1.38	1.24	1.23	1.19	1.39	2.38	3.17	1.83	1.14	1.36	1.63	0.66	0.40
Yield Mode	II-IV	II-IV	II-IV	II-IV	II-IV	II-IV	II-IV	II-IV	II-IV	II-IV			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Blck Shr.	Splitting	Splitting		
Governing Member	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		
Member Properties ST2R5C Series													
Member A													
M.C. (%)	14.80	11.21	14.86	13.80	14.34	15.70	15.26	14.70	14.77	15.30	14.47	1.26	0.09
S.G.	0.64	0.47	0.56	0.50	0.68	0.59	0.47	0.45	0.49	0.50	0.54	0.08	0.15
D.E. 5% Yield (psi)	5335.51	4771.72	4227.94	4914.70	3757.07	5108.94	3387.62	3619.86	4132.89	4236.54	4349.28	660.78	0.15
D.E. Capacity (psi)	5477.13	4877.92	4266.85	5104.61	4602.91	5387.56	3620.96	3962.92	4335.15	4861.26	4649.73	606.50	0.13

Table B.25: Hysteretic properties, ST2R5C Series.

Hysteretic Connection Properties ST2R5C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	1213.21	967.78	0.80	0.02	0.00	0.19	-1015.88	524.30	0.52	-0.02	0.00	0.21
Primary2	1607.54	1246.82	0.78	0.03	0.00	0.16	-1338.36	685.88	0.51	-0.02	0.00	0.17
Primary3	3479.07	2005.83	0.58	0.05	0.01	0.17	-2973.97	757.56	0.25	-0.05	0.01	0.31
Primary4	5547.26	2419.01	0.44	0.08	0.01	0.19	-4868.56	1170.26	0.24	-0.07	0.02	0.29
Primary5	7442.18	3041.88	0.41	0.09	0.02	0.19	-6390.38	1462.99	0.23	-0.08	0.02	0.27
Primary6	13449.43	4835.67	0.36	0.15	0.02	0.14	-12431.37	1640.84	0.13	-0.14	0.02	0.14
Primary7	18415.40	6366.88	0.35	0.21	0.02	0.10	-17939.37	1666.54	0.09	-0.21	0.02	0.09
Primary8	19866.04	7017.13	0.35	0.30	0.06	0.22	-17638.45	2079.12	0.12	-0.35	0.04	0.12
Primary9	14380.60	5399.94	0.38	0.45	0.02	0.04	-14844.33	2088.97	0.14	-0.51	0.07	0.13
Primary10	10908.20	4485.54	0.41	0.65	0.05	0.07	-12574.94	2349.08	0.19	-0.68	0.06	0.09
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	16.62	6.96	0.42	17.51	7.81	0.45	0.16	0.04	0.26	70384.19	48341.22	0.69
Primary2	24.74	10.42	0.42	34.14	14.10	0.41	0.12	0.04	0.36	61282.43	33038.64	0.54
Primary3	108.59	25.79	0.24	156.94	43.84	0.28	0.11	0.02	0.18	64971.20	23825.70	0.37
Primary4	173.36	27.73	0.16	376.82	103.90	0.28	0.08	0.01	0.15	71990.90	18807.82	0.26
Primary5	218.29	30.03	0.14	611.70	135.49	0.22	0.06	0.01	0.19	78576.65	20070.79	0.26
Primary6	858.01	107.39	0.13	1827.47	129.68	0.07	0.08	0.01	0.15	91803.74	16441.02	0.18
Primary7	2238.71	436.58	0.20	3799.24	179.62	0.05	0.09	0.02	0.19	87068.87	10846.09	0.12
Primary8	6883.38	424.78	0.06	5993.07	909.71	0.15	0.19	0.04	0.21	58800.36	7898.76	0.13
Primary9	7754.13	966.71	0.12	7035.69	1387.90	0.20	0.18	0.02	0.10	30516.16	5687.62	0.19
Primary10	7723.00	1198.61	0.16	7865.98	1741.13	0.22	0.16	0.02	0.12	17687.80	3940.67	0.22

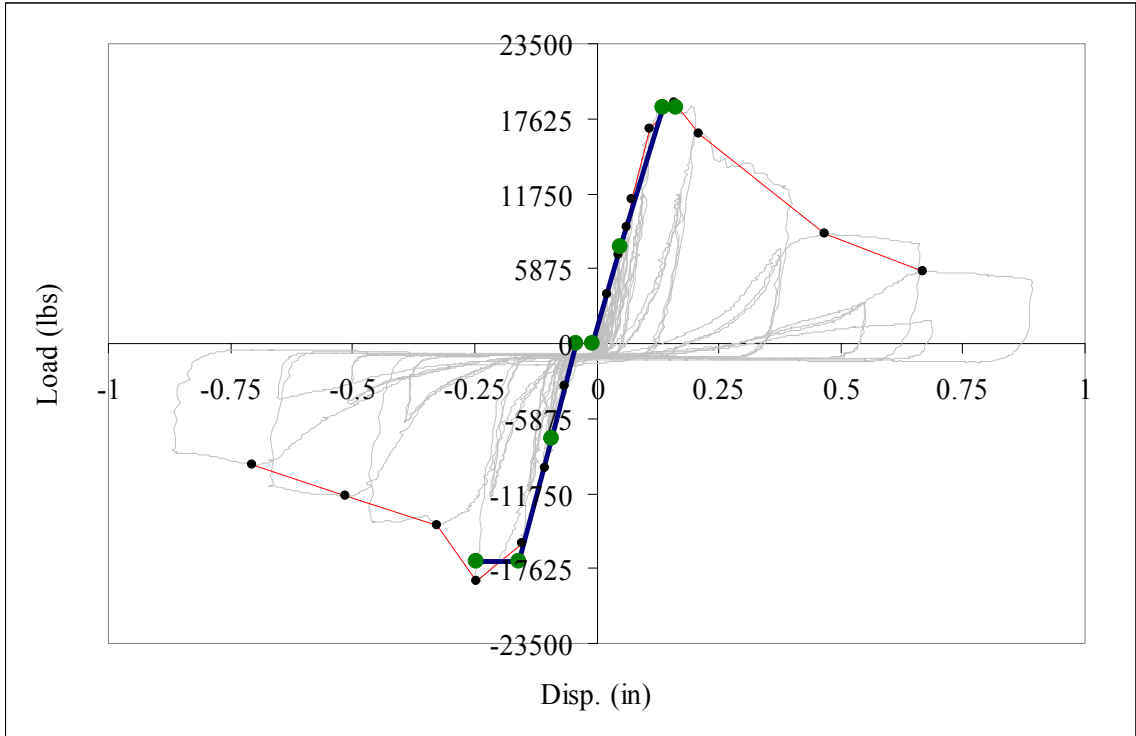


Figure B.92: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C01.

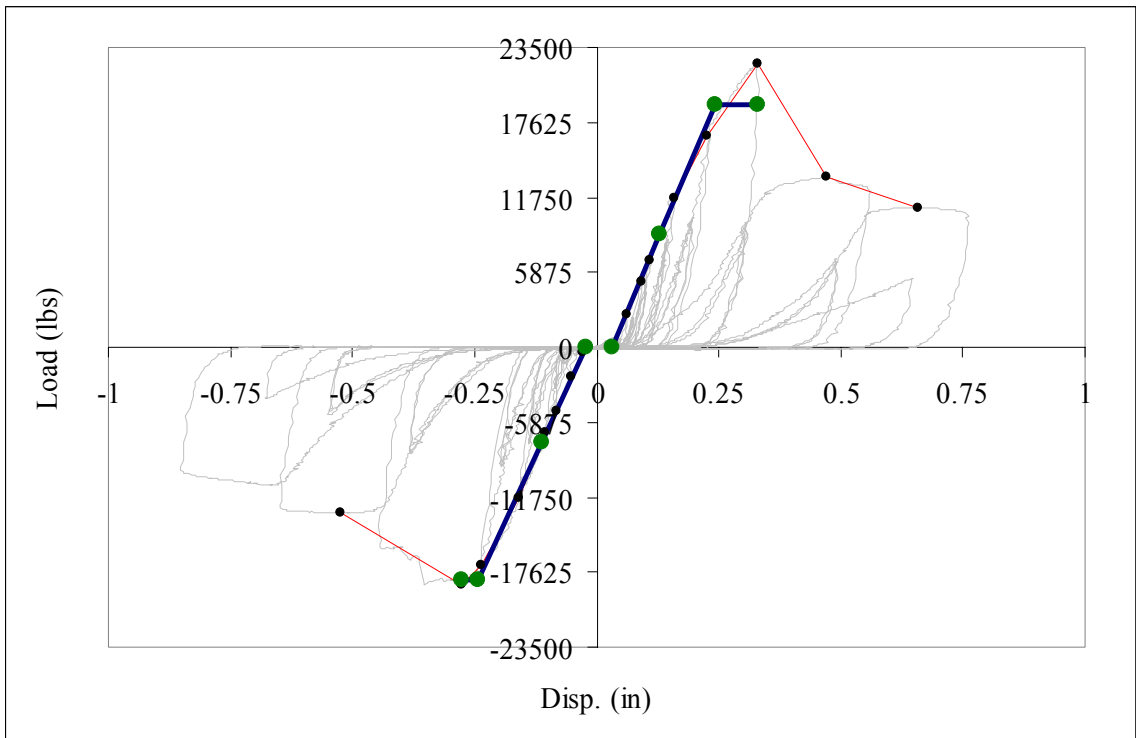


Figure B.93: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C02.

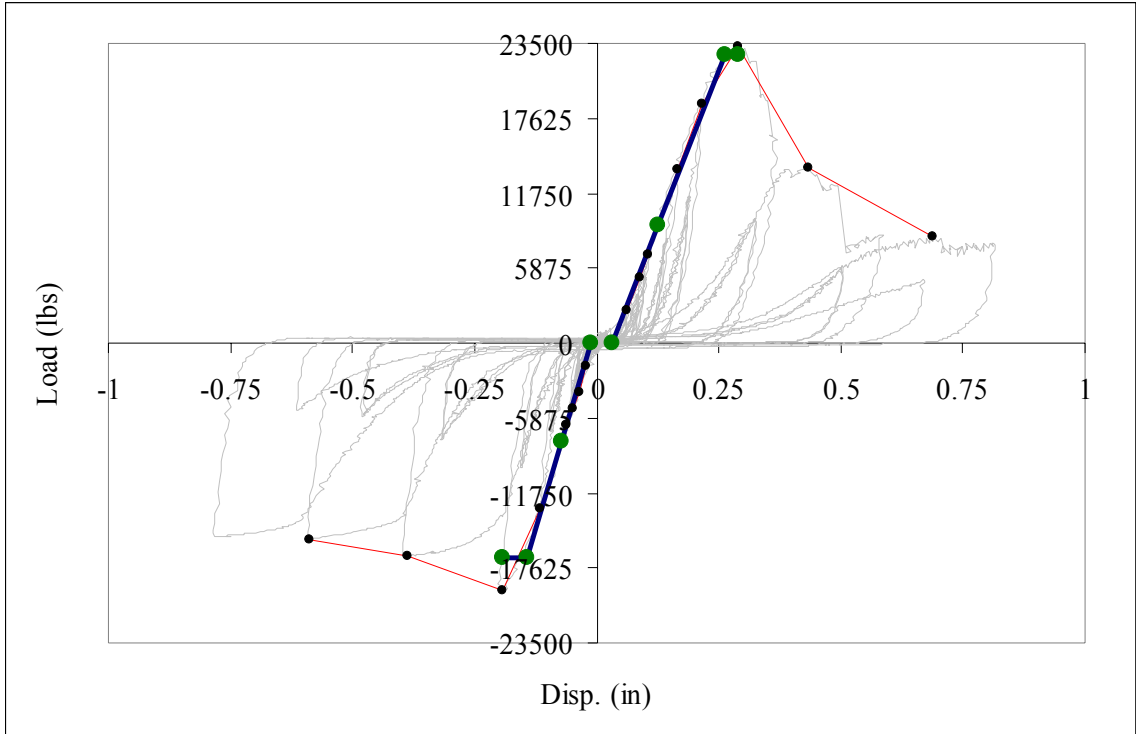


Figure B.94: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C03.

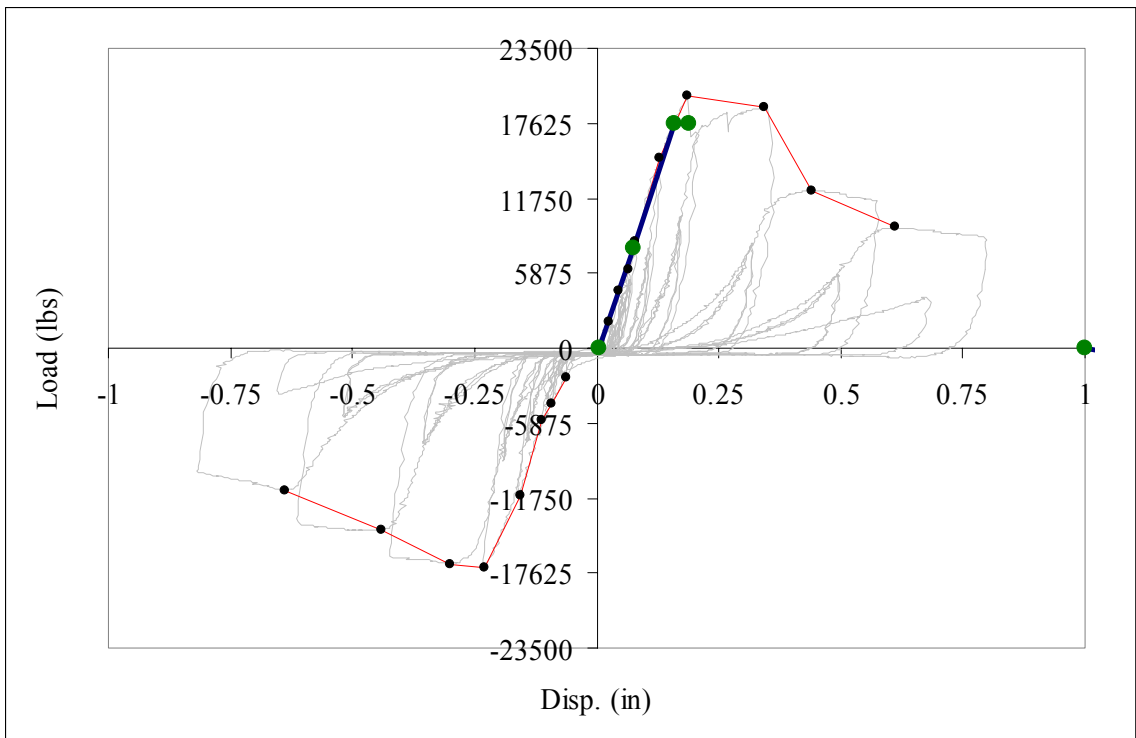


Figure B.95: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C04.

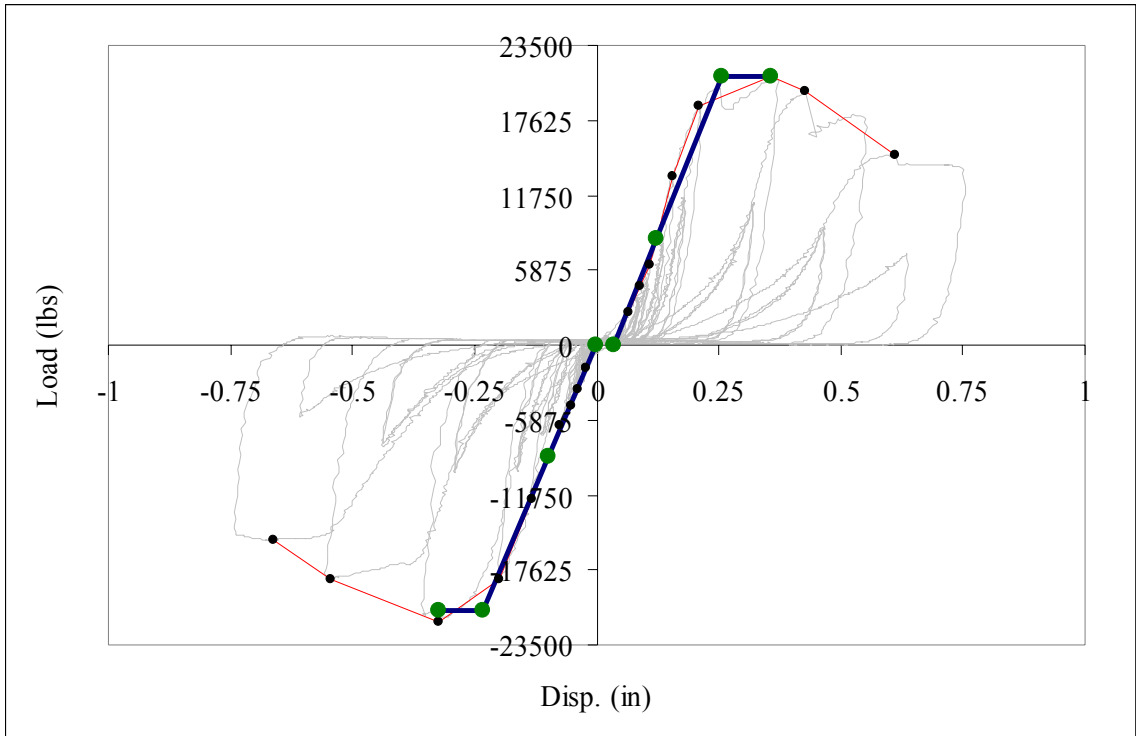


Figure B.96: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C05.

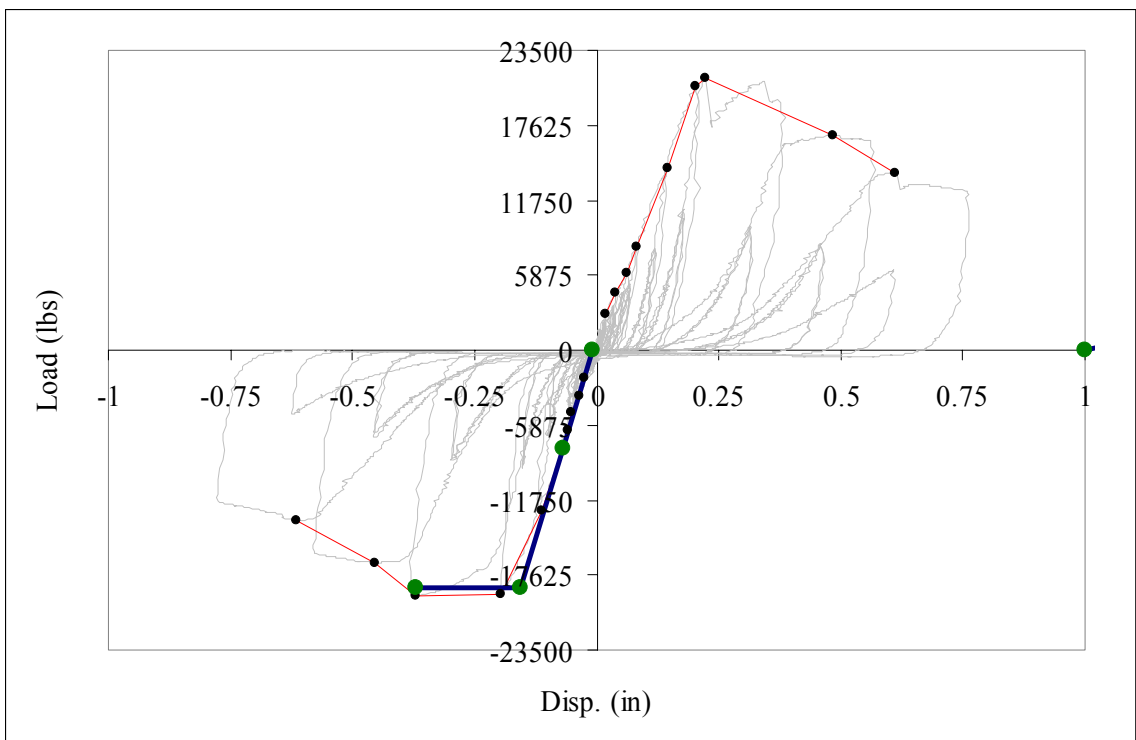


Figure B.97: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C06.

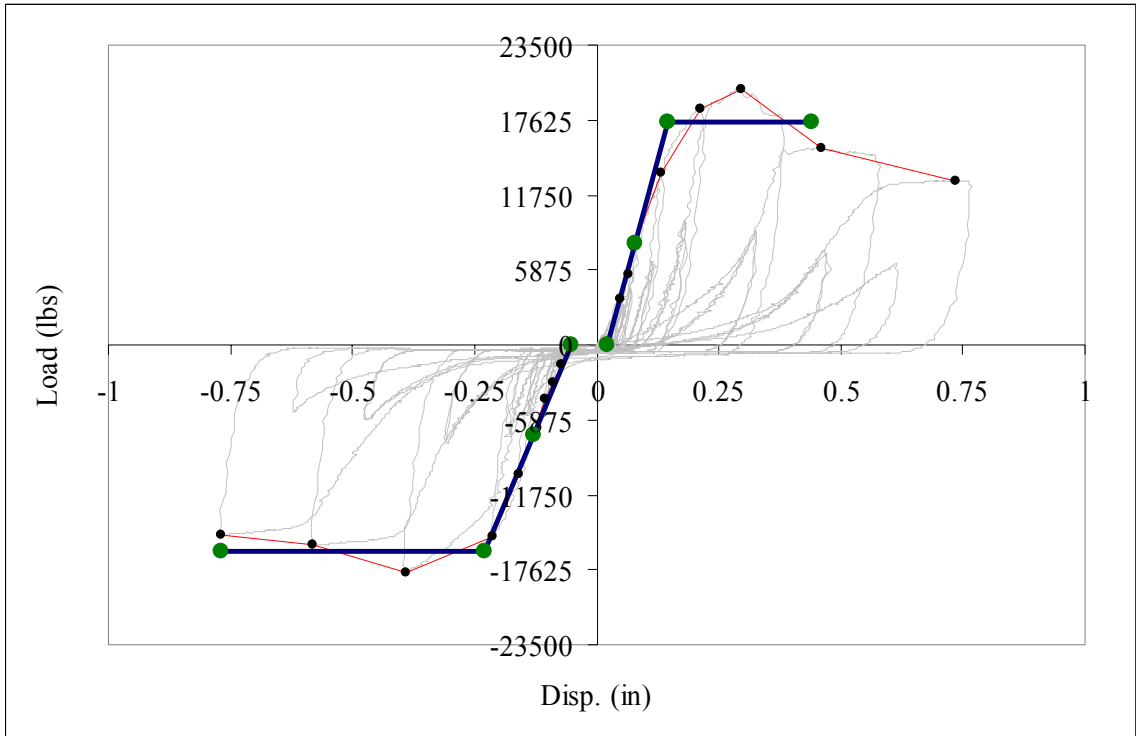


Figure B.98: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C07.

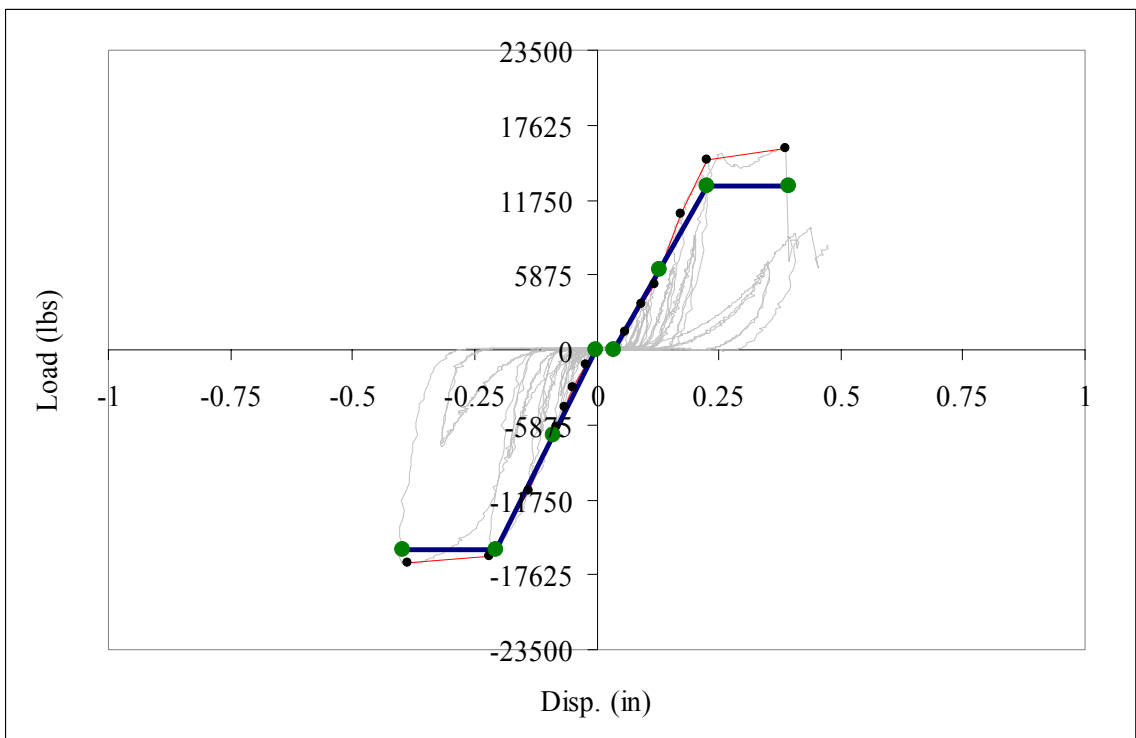


Figure B.99: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C08.

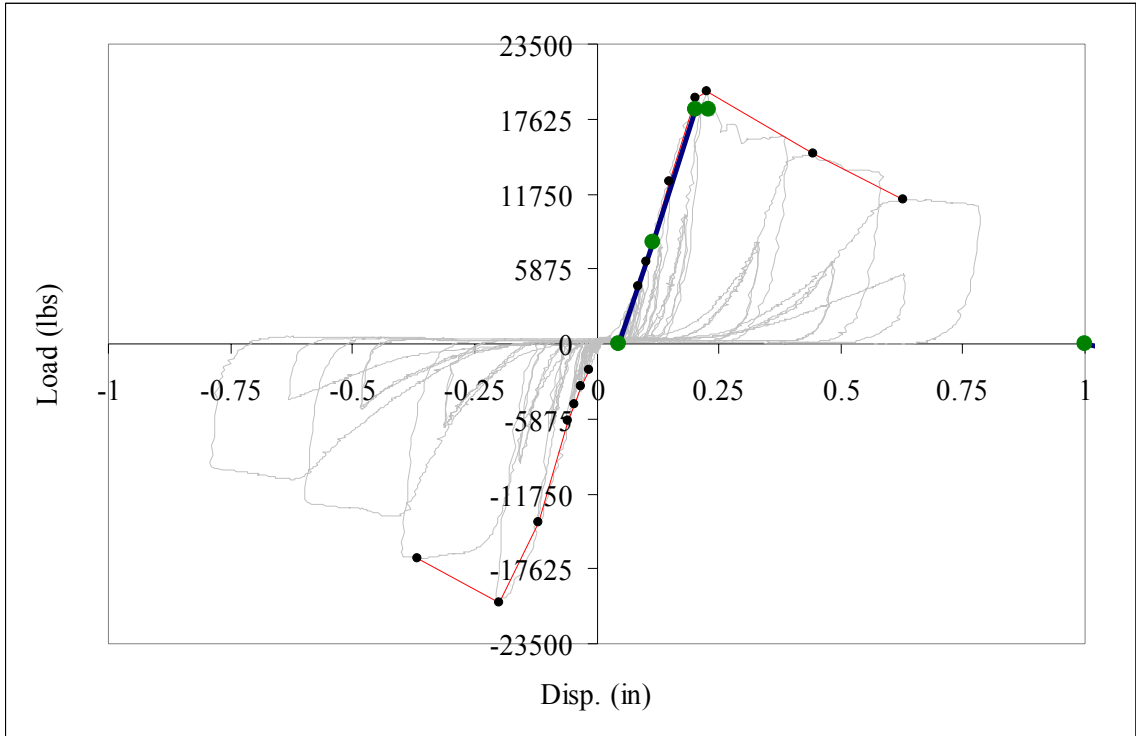


Figure B.100: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C09.

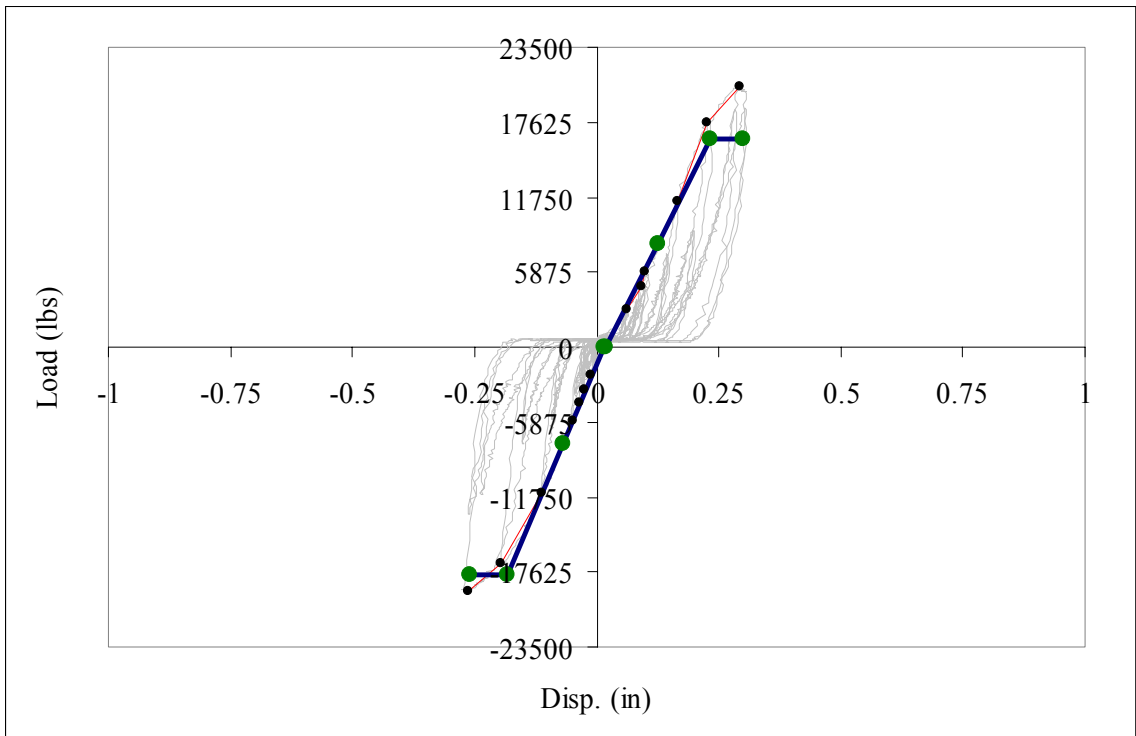


Figure B.101: Load (lbs) vs. Deflection (in.) plot. Test ST2R5C10.

B.1.3 – 46 Series Cyclic

Table B.26: Connection properties, 461R1C Series.

Connection Properties 461R1C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	2914.32	2494.01	3093.27	3178.23	2724.84	2381.98	2996.27	2136.11	2140.62	2978.98	2703.86	390.13	0.14
@ Displacement (in)	1.98	1.97	1.98	1.96	1.98	1.98	1.95	1.58	1.95	1.94	1.93	0.12	0.06
Failure Load (lbs)	2331.45	1995.21	2474.61	2542.58	2179.87	1905.58	2397.02	1708.89	1712.50	2383.18	2163.09	312.10	0.14
@ Displacement (in)	1.98	1.97	1.98	1.96	1.98	1.98	1.95	1.58	1.95	1.94	1.93	0.12	0.06
40% Max (lbs)	1165.73	997.60	1237.31	1271.29	1089.94	952.79	1198.51	854.44	856.25	1191.59	1081.55	156.05	0.14
@ Displacement (in)	0.25	0.15	0.16	0.18	0.15	0.16	0.16	0.13	0.16	0.17	0.17	0.03	0.19
Yield (lbs)	2331.45	2098.04	2474.61	2542.58	2179.87	1936.48	2449.33	1940.88	1818.53	2443.51	2221.53	262.42	0.12
@ Displacement (in)	0.43	0.26	0.26	0.33	0.26	0.26	0.27	0.24	0.27	0.31	0.29	0.05	0.19
5% Offset (lbs)	1286.87	1512.84	1533.52	1498.75	1390.68	1260.37	1489.40	1432.35	1178.92	1594.99	1417.87	135.58	0.10
@ Displacement (in)	0.28	0.22	0.20	0.22	0.20	0.21	0.21	0.21	0.21	0.24	0.22	0.02	0.11
Elastic Stiff. (lb/in)	6474.89	10335.34	11718.56	8848.90	10031.84	9330.53	11741.90	9799.03	8420.66	9249.43	9595.11	1554.90	0.16
E.E.P. Energy (lb*in)	4044.95	3804.79	4514.47	4507.57	3982.56	3525.56	4375.44	2778.60	3246.85	4299.49	3908.03	576.67	0.15
Ductility Ratio	4.63	7.73	7.58	6.19	7.54	7.68	7.28	6.56	7.20	6.30	6.87	0.97	0.14
Yield Mode	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV			
Failure Mode	Crush	Crush	Crush	Crush	Crush	Crush	Crush	Crush	Crush	Crush			
Governing Member	N.A.	B	N.A.	A	B	B	A	A	A	B			

Table B.27: Material properties, 461R1C Series.

Member Properties 461R1C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard	
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	15.36	16.17	15.50	14.82	16.92	14.15	16.21	14.92	14.33	13.22	15.16	1.11	0.07
S.G.	0.46	0.41	0.45	0.51	0.48	0.58	0.79	0.41	0.40	0.51	0.50	0.12	0.23
D.E. 5% Yield (psi)	5081.41	4745.76	4549.43	5093.50	4904.46	4477.00	7238.45	3727.25	3522.98	6185.59	4952.58	1093.46	0.22
D.E. Capacity (psi)	5280.96	4987.46	4696.29	5796.72	5508.87	5485.12	7869.73	3953.29	3769.66	7003.04	5435.11	1258.92	0.23
Member B													
M.C. (%)	14.53	17.21	16.84	17.16	16.40	15.11	14.88	16.92	17.55	15.15	16.18	1.13	0.07
S.G.	0.45	0.41	0.49	0.48	0.45	0.48	0.78	0.59	0.55	0.42	0.51	0.11	0.22
D.E. 5% Yield (psi)	4172.77	3478.71	4827.04	4470.05	4451.99	3868.28	5887.13	6302.91	4378.99	3893.99	4573.19	892.08	0.20
D.E. Capacity (psi)	4570.20	4043.12	5312.87	4826.88	4594.76	4183.86	6523.92	6676.94	4946.83	4211.54	4989.09	931.92	0.19

Table B.28: Hysteretic properties, 461R1C Series.

Hysteretic Connection Properties 461R1C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	124.36	91.17	0.73	0.04	0.02	0.47	-118.95	80.39	0.68	-0.01	0.04	2.79
Primary2	221.21	171.97	0.78	0.06	0.03	0.49	-177.30	142.53	0.80	-0.05	0.05	1.01
Primary3	1000.61	379.98	0.38	0.14	0.00	0.02	-887.08	256.94	0.29	-0.15	0.01	0.04
Primary4	1455.80	487.45	0.33	0.22	0.01	0.04	-1421.52	228.02	0.16	-0.22	0.01	0.04
Primary5	1634.30	538.31	0.33	0.30	0.01	0.03	-1622.87	174.35	0.11	-0.30	0.01	0.03
Primary6	1864.68	621.54	0.33	0.53	0.01	0.03	-1829.79	165.78	0.09	-0.53	0.01	0.02
Primary7	2029.65	681.76	0.34	0.76	0.01	0.02	-1942.13	185.85	0.10	-0.78	0.01	0.02
Primary8	2375.66	819.36	0.34	1.16	0.01	0.01	-2138.52	249.65	0.12	-1.19	0.01	0.01
Primary9	2631.16	917.04	0.35	1.56	0.02	0.01	-2364.84	296.01	0.13	-1.59	0.02	0.01
Primary10	2820.03	1016.74	0.36	1.93	0.06	0.03	-2555.06	385.64	0.15	-1.98	0.02	0.01
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	14.28	9.30	0.65	5.17	2.67	0.52	0.49	0.28	0.57	5868.33	12125.16	2.07
Primary2	21.41	12.22	0.57	13.11	5.30	0.40	0.29	0.19	0.65	6188.33	6997.53	1.13
Primary3	99.42	25.07	0.25	136.49	20.98	0.15	0.12	0.02	0.20	6508.97	1011.83	0.16
Primary4	233.04	42.21	0.18	316.24	37.71	0.12	0.12	0.01	0.10	6541.04	817.91	0.13
Primary5	380.74	65.72	0.17	487.03	42.54	0.09	0.12	0.01	0.12	5445.44	510.06	0.09
Primary6	1206.68	151.52	0.13	978.99	96.70	0.10	0.20	0.01	0.06	3485.28	284.71	0.08
Primary7	1764.15	214.91	0.12	1530.83	137.53	0.09	0.18	0.01	0.07	2575.89	255.93	0.10
Primary8	3073.27	340.33	0.11	2644.07	301.83	0.11	0.19	0.01	0.06	1925.41	238.71	0.12
Primary9	4042.94	438.04	0.11	3933.69	500.62	0.13	0.16	0.01	0.05	1585.43	204.43	0.13
Primary10	4772.51	621.59	0.13	5259.95	852.67	0.16	0.15	0.01	0.05	1372.15	207.30	0.15

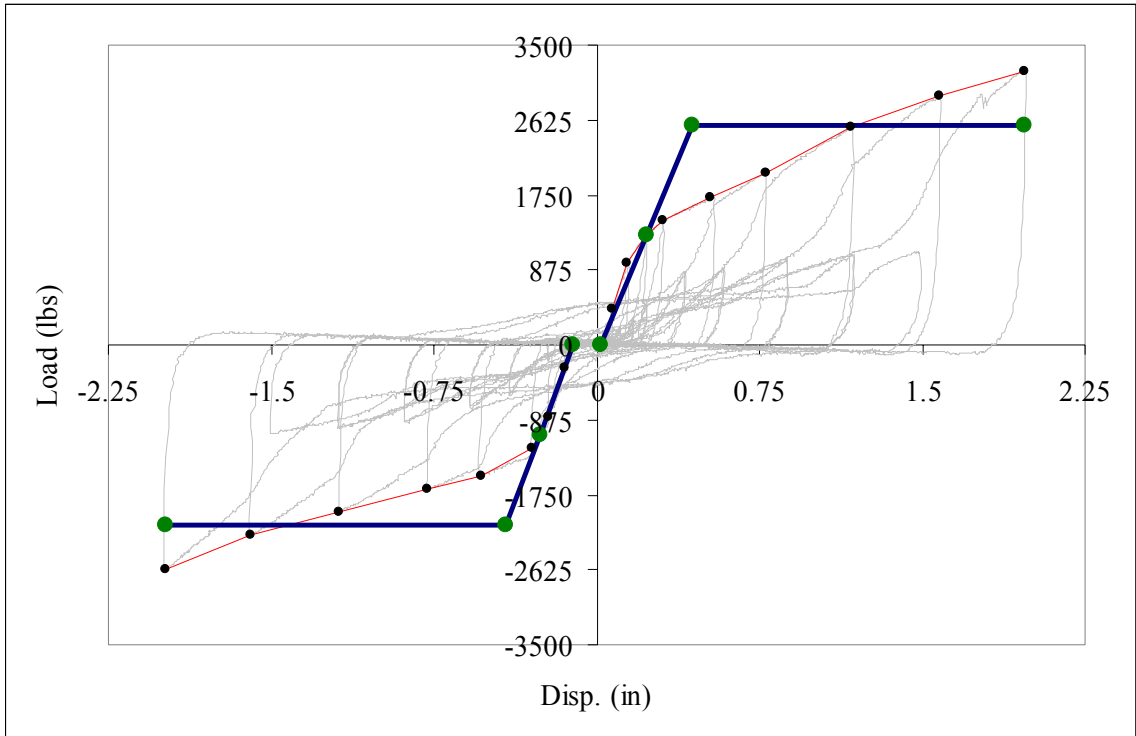


Figure B.102: Load (lbs) vs. Deflection (in.) plot. Test 461R1C01.

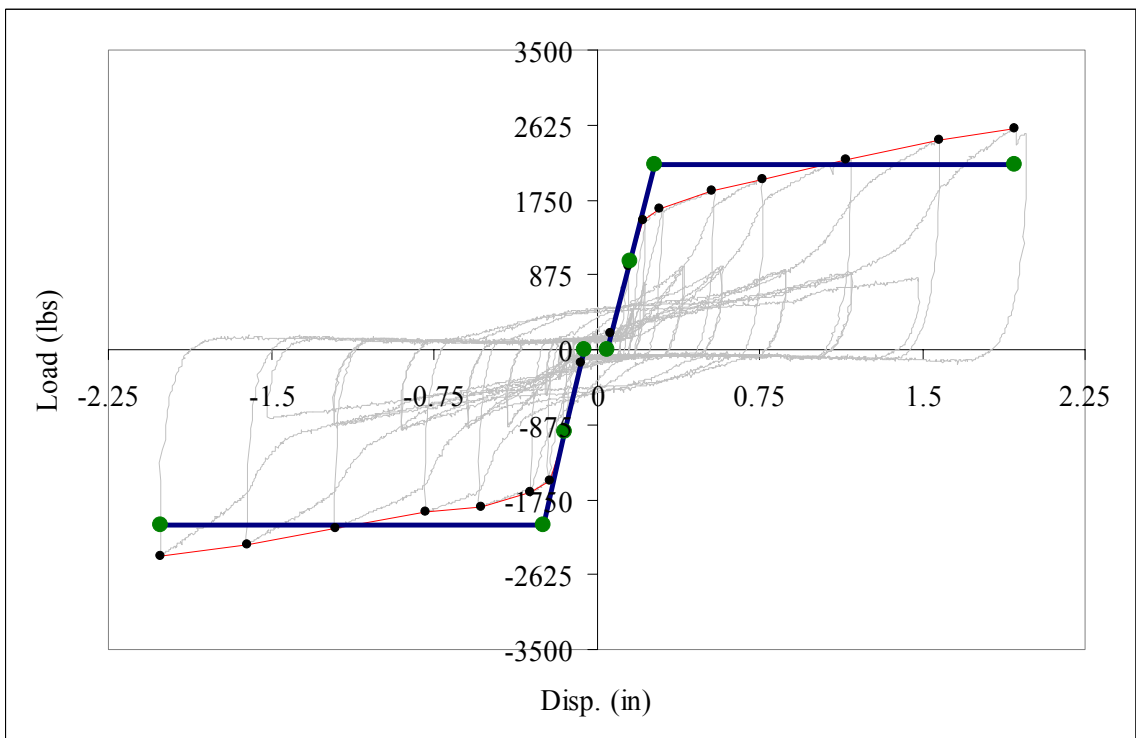


Figure B.103: Load (lbs) vs. Deflection (in.) plot. Test 461R1C02.

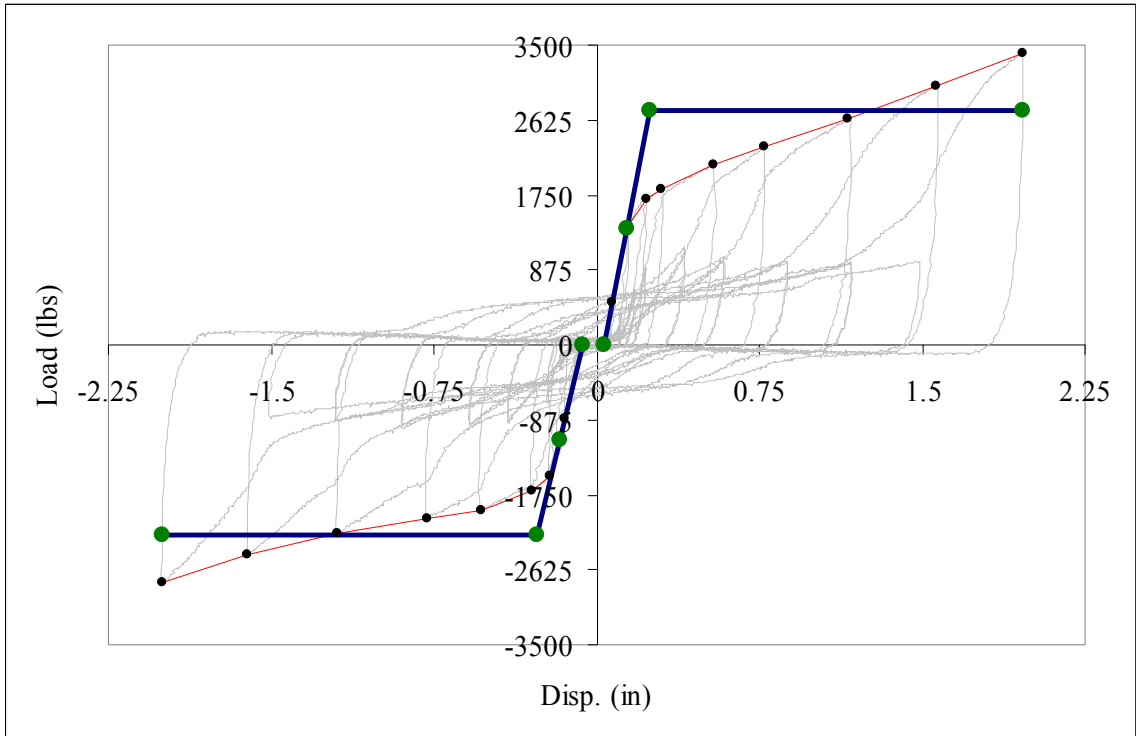


Figure B.104: Load (lbs) vs. Deflection (in.) plot. Test 461R1C03.

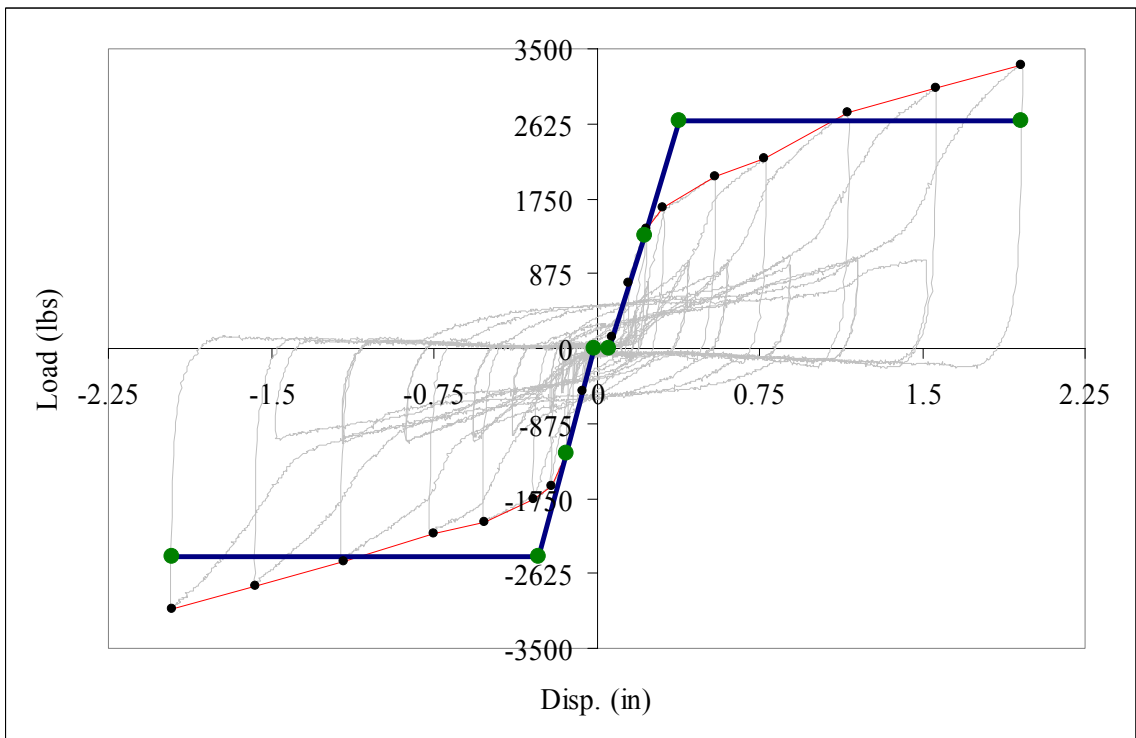


Figure B.105: Load (lbs) vs. Deflection (in.) plot. Test 461R1C04.

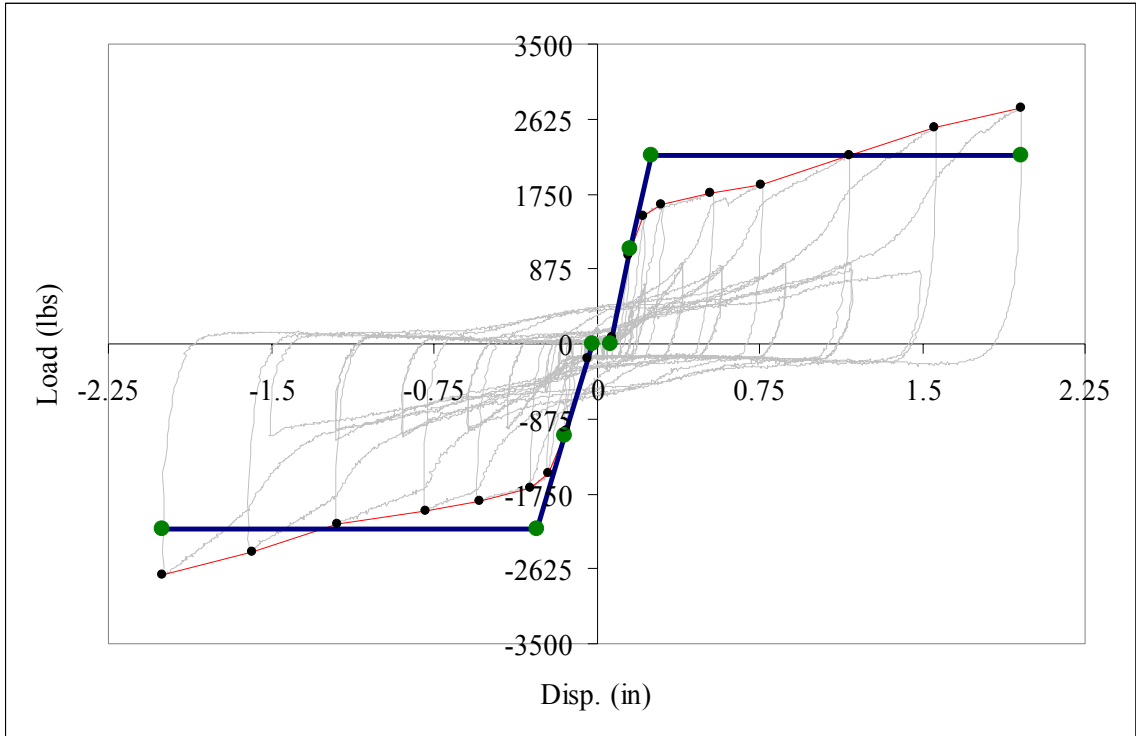


Figure B.106: Load (lbs) vs. Deflection (in.) plot. Test 461R1C05.

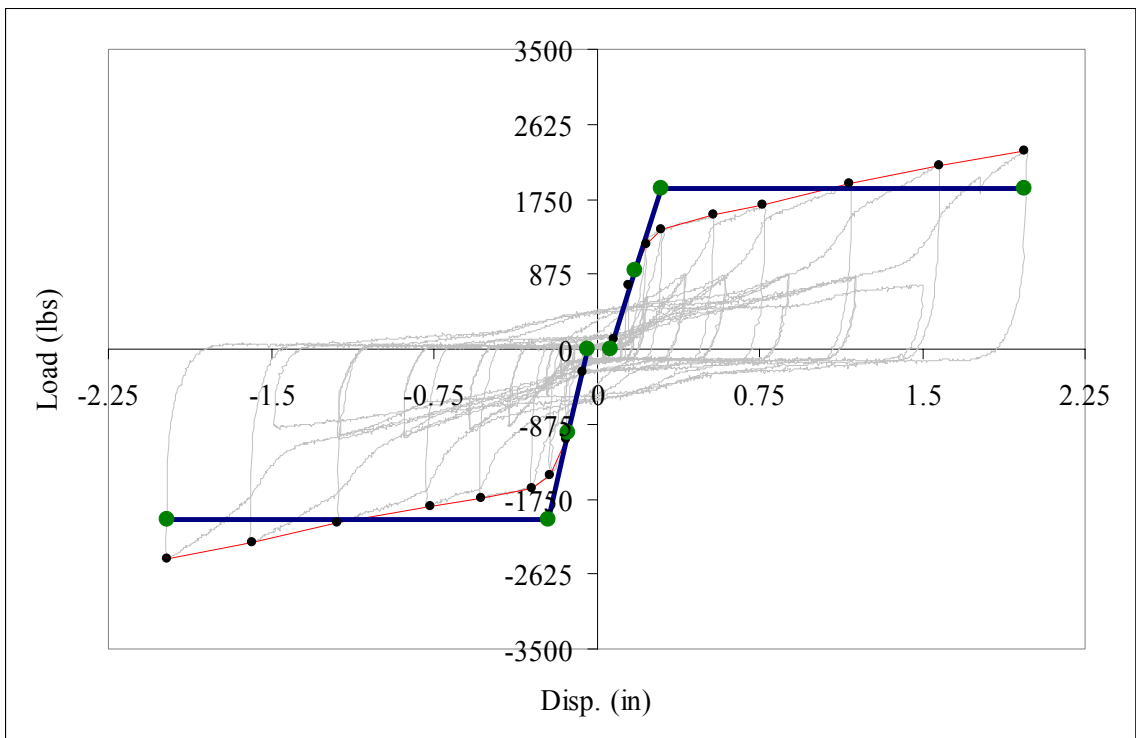


Figure B.107: Load (lbs) vs. Deflection (in.) plot. Test 461R1C06.

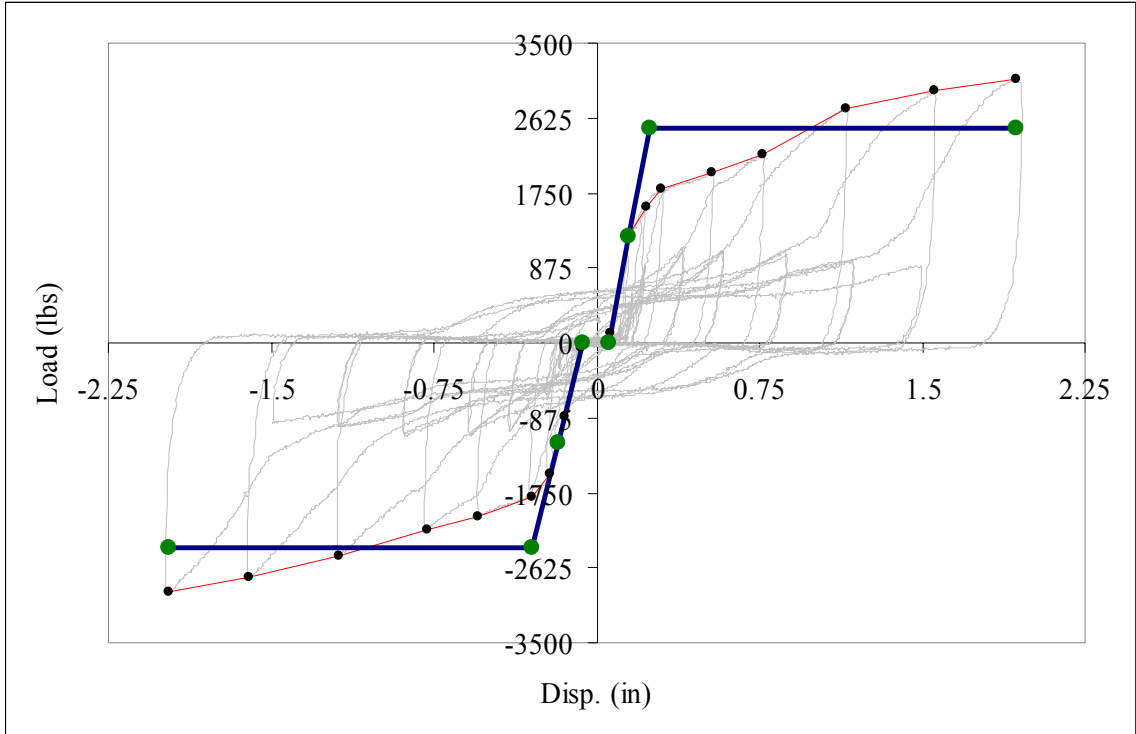


Figure B.108: Load (lbs) vs. Deflection (in.) plot. Test 461R1C07.

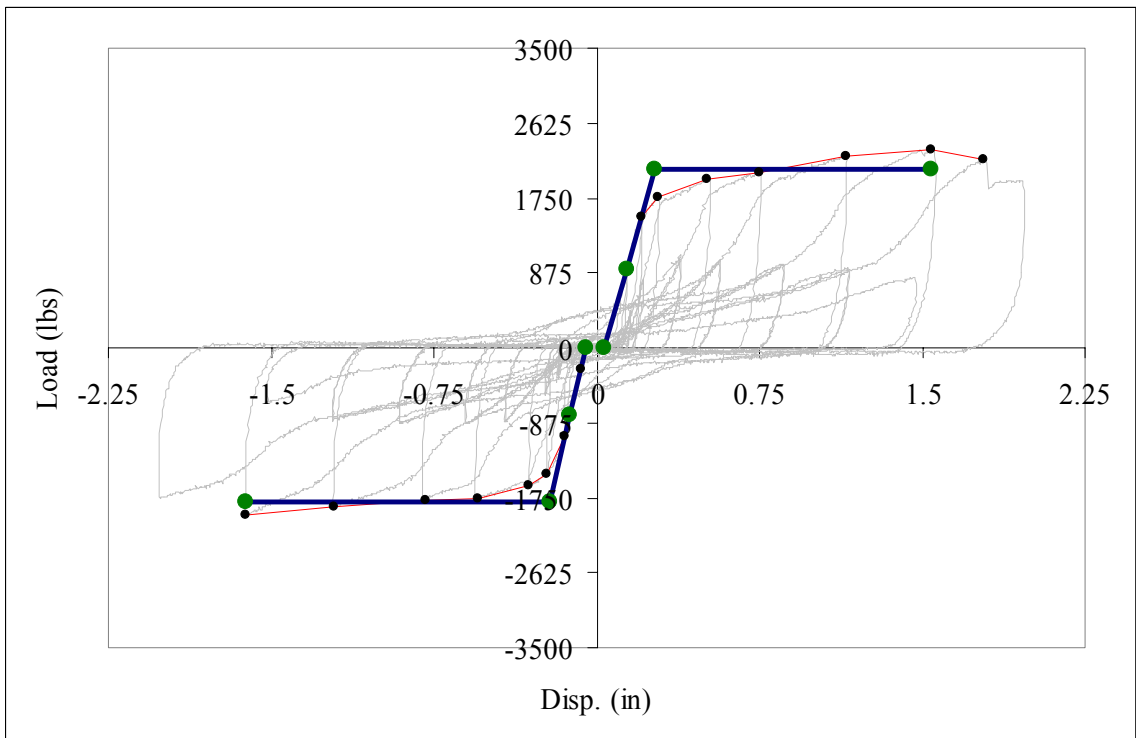


Figure B.109: Load (lbs) vs. Deflection (in.) plot. Test 461R1C08.

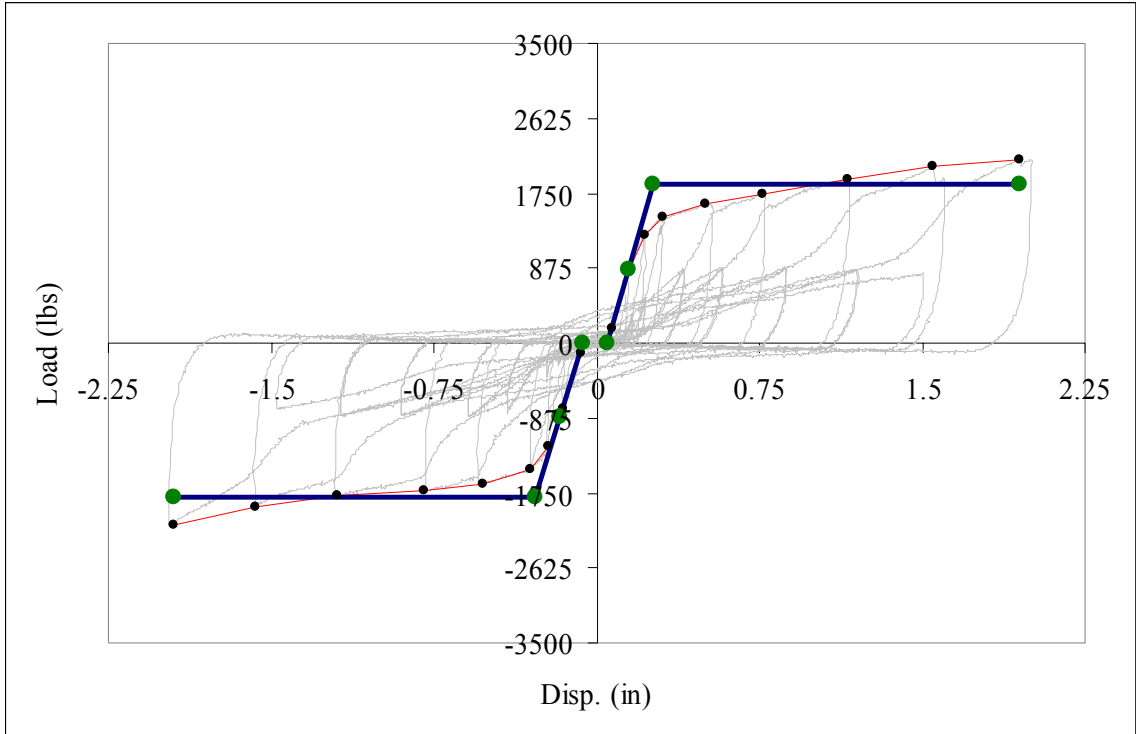


Figure B.110: Load (lbs) vs. Deflection (in.) plot. Test 461R1C09.

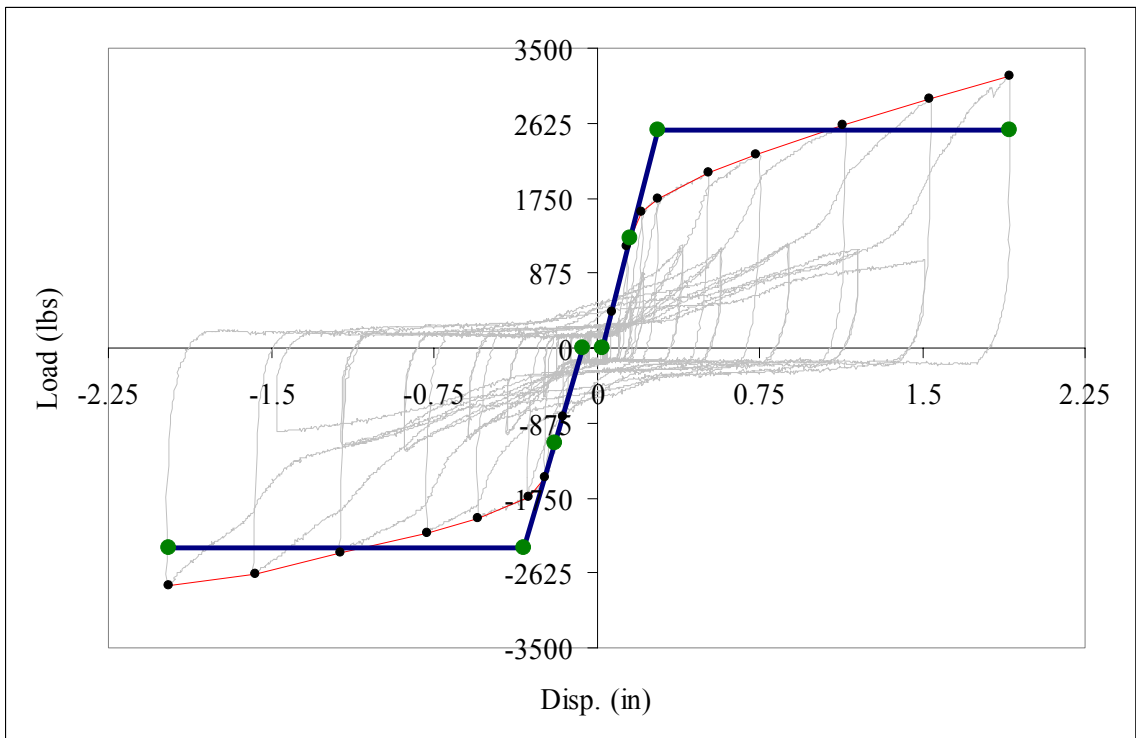


Figure B.111: Load (lbs) vs. Deflection (in.) plot. Test 461R1C10.

Table B.29: Connection properties, 461R3C Series.

Connection Properties 461R3C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
Max Load (lbs)	5044.41	4818.85	5471.49	4497.04	4367.71	5185.77	5811.34	5128.62	4562.45	4547.42	4943.51	469.46	0.09
@ Displacement (in)	0.45	0.43	0.28	0.57	0.54	0.36	0.59	0.98	0.48	0.39	0.50	0.19	0.38
Failure Load (lbs)	4035.53	3855.08	4377.19	3597.63	3494.17	4148.61	4649.07	4102.90	3649.96	3637.93	3954.81	375.57	0.09
@ Displacement (in)	0.71	0.43	1.08	0.57	1.06	0.36	0.96	1.24	0.63	0.93	0.80	0.30	0.38
40% Max (lbs)	2017.77	1927.54	2188.59	1798.82	1747.09	2074.31	2324.54	2051.45	1824.98	1818.97	1977.40	187.78	0.09
@ Displacement (in)	0.13	0.14	0.11	0.14	0.13	0.13	0.14	0.14	0.13	0.13	0.13	0.01	0.07
Yield (lbs)	4692.40	4275.77	5009.60	4131.28	4047.61	4684.42	5362.80	4919.81	4334.16	4117.94	4557.58	445.05	0.10
@ Displacement (in)	0.21	0.22	0.19	0.26	0.24	0.23	0.24	0.28	0.26	0.23	0.24	0.03	0.11
5% Offset (lbs)	4234.66	3259.54	4528.78	3965.43	3334.99	5185.77	5031.26	2189.75	4508.60	4094.91	4033.37	902.43	0.22
@ Displacement (in)	0.33	0.20	0.19	0.37	0.22	0.36	0.37	0.15	0.41	0.27	0.29	0.09	0.31
Elastic Stiff. (lb/in)	31006.43	29080.55	37433.91	20348.90	22537.68	25781.53	29579.31	20063.80	19218.33	22831.42	25788.18	5896.24	0.23
E.E.P. Energy (lb*in)	2694.07	1199.31	4800.90	1695.55	3711.18	1026.14	4347.95	5357.30	2072.97	3239.19	3014.46	1526.48	0.51
Ductility Ratio	3.40	1.95	6.05	2.18	4.87	1.59	4.23	4.49	2.39	3.99	3.51	1.46	0.42
Yield Mode	IV	III, IV	IV	IV	IV	III, IV	IV	IV	III	IV			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	B	B	B	A	B	B	B	A	A	B			

Table B.30: Material properties, 461R3C Series.

Member Properties 461R3C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	14.60	16.16	16.18	13.13	17.37	16.13	15.39	15.21	16.09	15.06	15.53	1.15	0.07
S.G.	0.46	0.44	0.60	0.48	0.43	0.53	0.60	0.55	0.44	0.52	0.51	0.06	0.13
D.E. 5% Yield (psi)	4367.22	4133.88	5163.22	4745.18	3492.25	4306.26	5719.28	4272.41	4094.91	4528.82	4482.34	615.09	0.14
D.E. Capacity (psi)	4669.57	4425.77	5609.27	4859.73	4121.65	4573.97	6031.23	4623.61	4857.22	4970.36	4874.24	562.83	0.12
Member B													
M.C. (%)	16.18	12.72	18.80	13.33	14.21	12.32	16.96	20.43	17.09	15.81	15.79	2.66	0.17
S.G.	0.66	0.45	0.60	0.40	0.46	0.50	0.46	0.53	0.51	0.45	0.50	0.08	0.16
D.E. 5% Yield (psi)	4876.48	4095.59	5004.65	4078.70	3911.58	5281.56	4068.05	4248.19	4711.00	4507.82	4478.36	469.57	0.10
D.E. Capacity (psi)	5211.11	4188.52	5577.87	4358.74	4030.81	5379.16	4289.11	4838.06	5100.38	4825.83	4779.96	539.45	0.11

Table B.31: Hysteretic properties, 461R3C Series.

Hysteretic Connection Properties 461R3C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	154.59	117.05	0.76	0.02	0.01	0.62	-262.41	240.24	0.92	-0.02	0.01	0.41
Primary2	221.36	207.93	0.94	0.03	0.01	0.45	-386.02	335.75	0.87	-0.02	0.03	1.11
Primary3	730.53	697.74	0.96	0.09	0.01	0.14	-1244.98	800.90	0.64	-0.09	0.01	0.11
Primary4	1809.64	888.97	0.49	0.14	0.01	0.07	-2507.09	699.73	0.28	-0.13	0.02	0.12
Primary5	2897.47	1057.48	0.36	0.18	0.01	0.08	-3513.87	630.42	0.18	-0.18	0.02	0.12
Primary6	4493.58	1507.49	0.34	0.30	0.01	0.04	-4763.66	513.70	0.11	-0.31	0.03	0.08
Primary7	4821.70	1583.55	0.33	0.43	0.04	0.10	-4877.19	441.62	0.09	-0.45	0.05	0.12
Primary8	4686.67	1573.35	0.34	0.59	0.10	0.17	-4232.22	1004.59	0.24	-0.69	0.11	0.16
Primary9	3546.05	1632.62	0.46	0.83	0.11	0.13	-3765.30	1173.51	0.31	-0.98	0.09	0.09
Primary10	3106.95	1490.82	0.48	1.19	0.03	0.02	-3582.14	1209.25	0.34	-1.25	0.07	0.05
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	9.41	5.85	0.62	4.65	1.78	0.38	0.33	0.15	0.45	12968.15	11084.19	0.85
Primary2	14.15	8.34	0.59	11.16	4.26	0.38	0.21	0.09	0.41	17091.04	17038.11	1.00
Primary3	60.61	15.30	0.25	84.68	14.49	0.17	0.12	0.03	0.24	11367.12	2680.42	0.24
Primary4	145.89	25.74	0.18	287.22	46.72	0.16	0.08	0.01	0.09	15820.46	2920.61	0.18
Primary5	267.82	38.81	0.14	574.79	73.64	0.13	0.07	0.01	0.09	17725.53	2833.89	0.16
Primary6	1103.23	197.16	0.18	1410.25	151.09	0.11	0.12	0.01	0.09	15232.14	2025.68	0.13
Primary7	2074.93	298.67	0.14	2137.60	230.56	0.11	0.15	0.02	0.13	11089.25	1589.25	0.14
Primary8	3629.99	811.45	0.22	2883.38	770.13	0.27	0.20	0.03	0.14	6976.88	781.47	0.11
Primary9	4026.06	1277.44	0.32	3332.90	1171.87	0.35	0.20	0.02	0.12	4048.20	1248.81	0.31
Primary10	4362.17	1398.57	0.32	4100.82	1436.87	0.35	0.17	0.02	0.11	2735.94	933.58	0.34

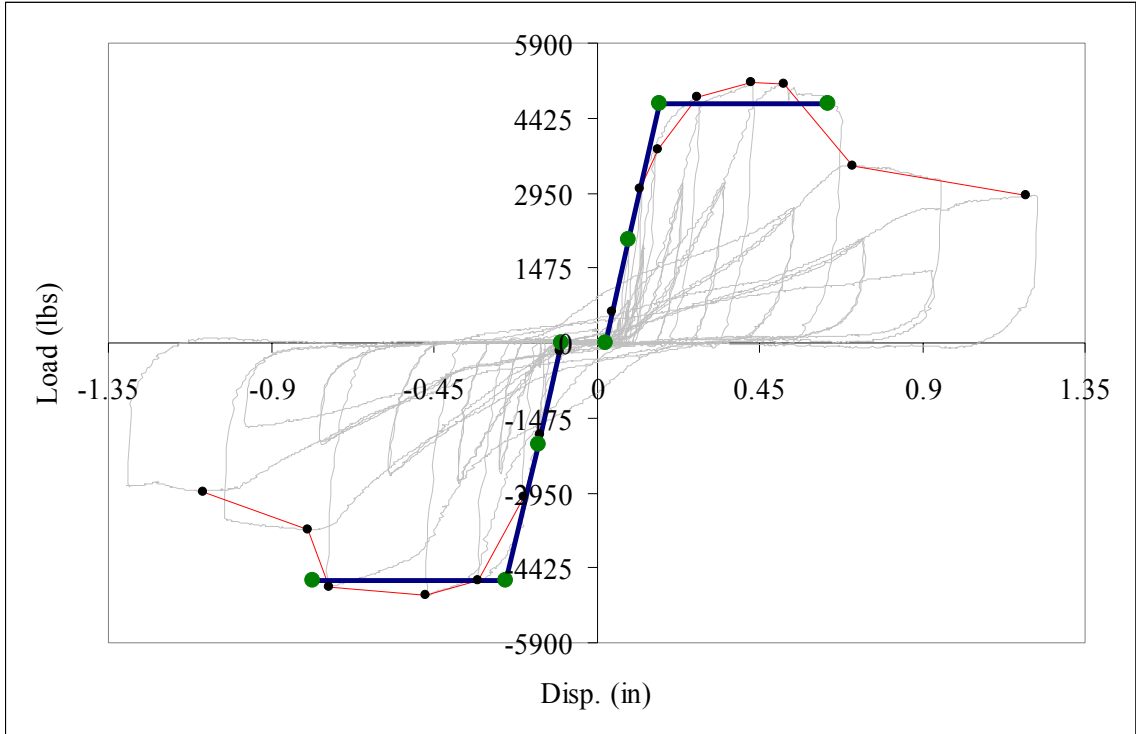


Figure B.112: Load (lbs) vs. Deflection (in.) plot. Test 461R3C01.

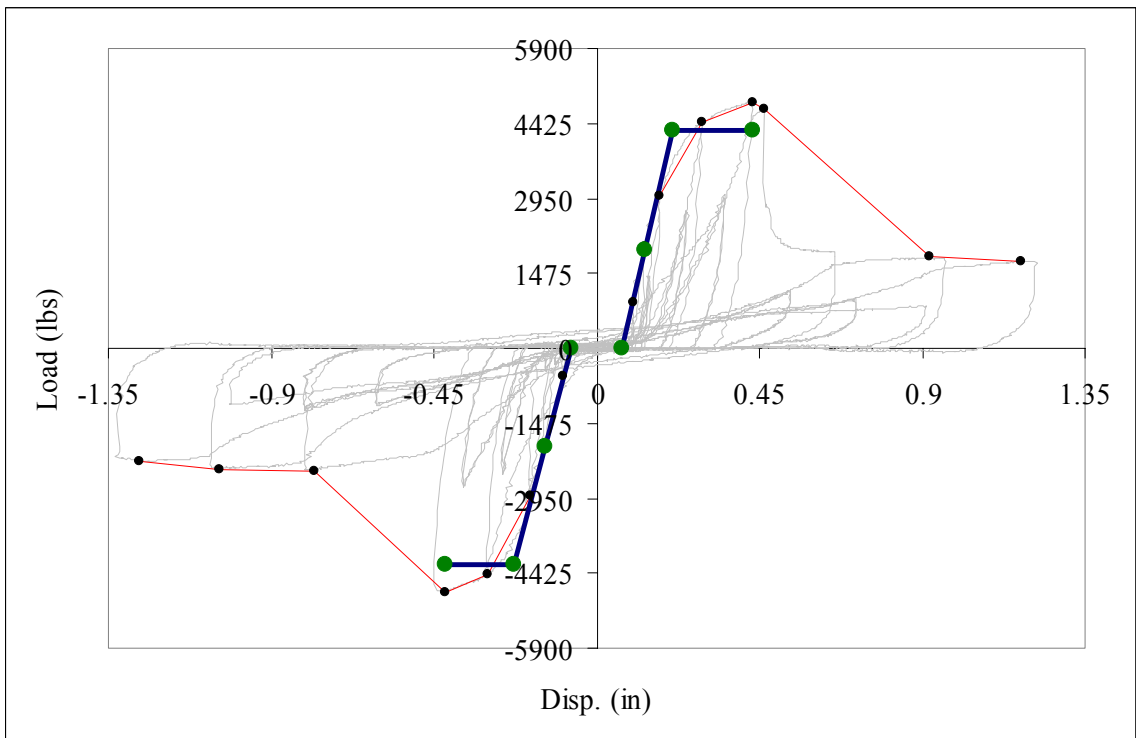


Figure B.113: Load (lbs) vs. Deflection (in.) plot. Test 461R3C02.

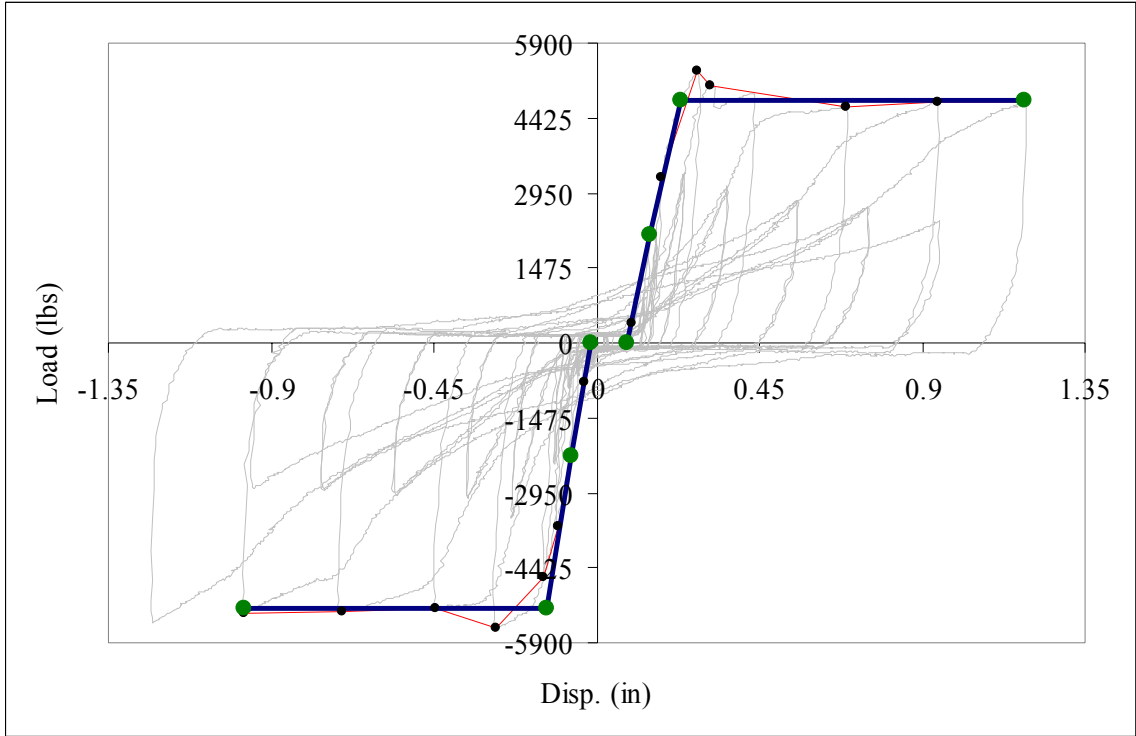


Figure B.114: Load (lbs) vs. Deflection (in.) plot. Test 461R3C03.

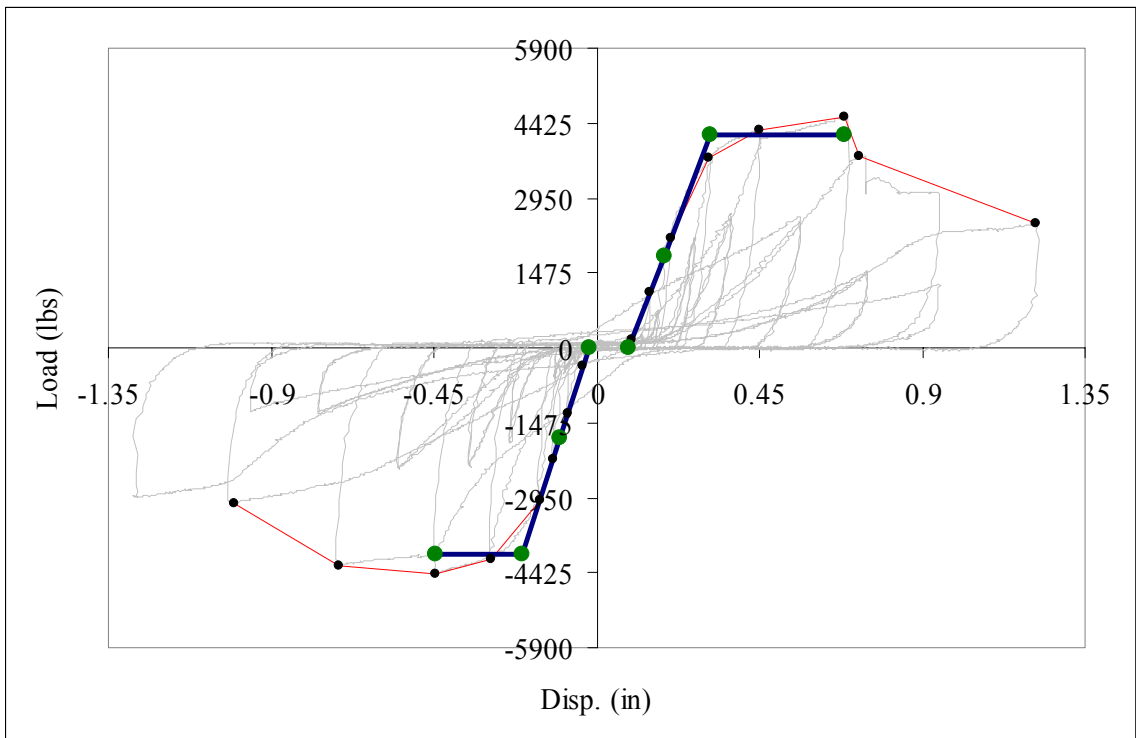


Figure B.115: Load (lbs) vs. Deflection (in.) plot. Test 461R3C04.

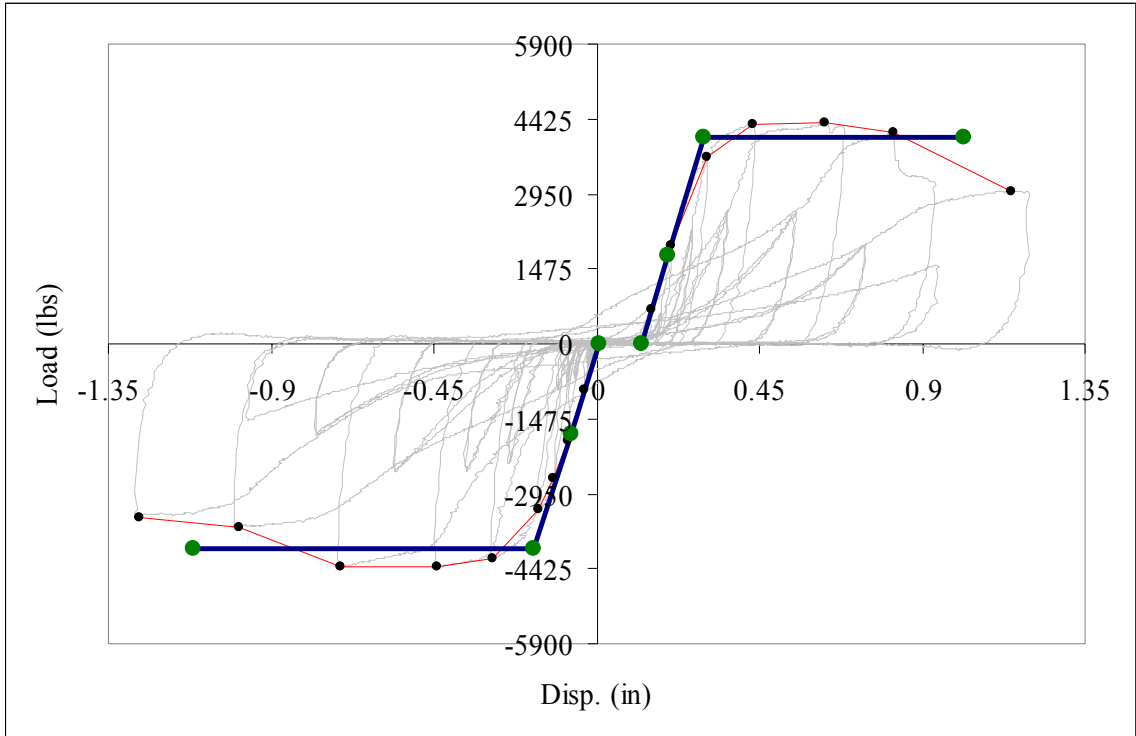


Figure B.116: Load (lbs) vs. Deflection (in.) plot. Test 461R3C05.

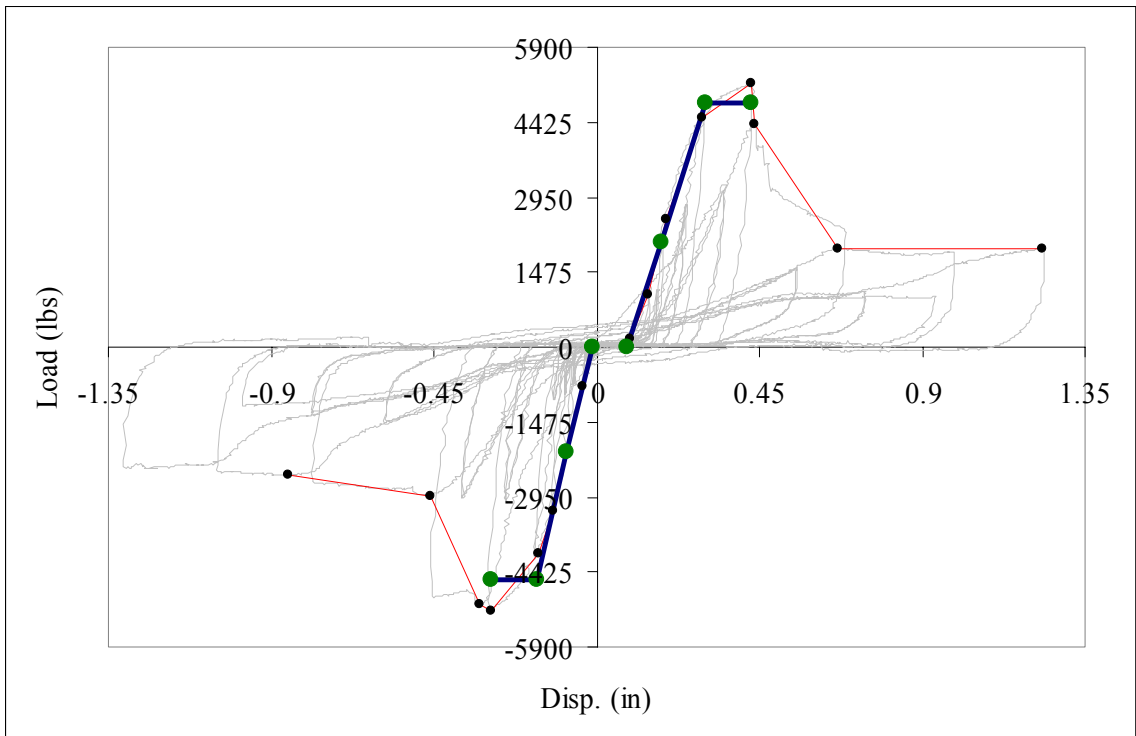


Figure B.117: Load (lbs) vs. Deflection (in.) plot. Test 461R3C06.

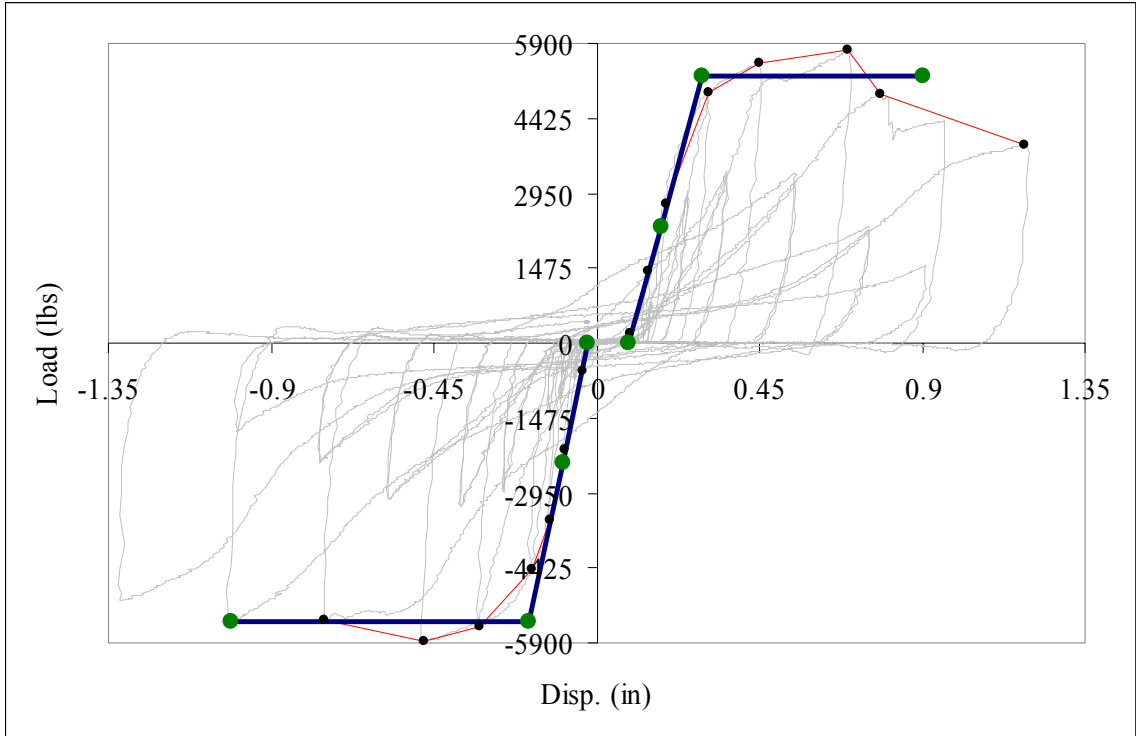


Figure B.118: Load (lbs) vs. Deflection (in.) plot. Test 461R3C07.

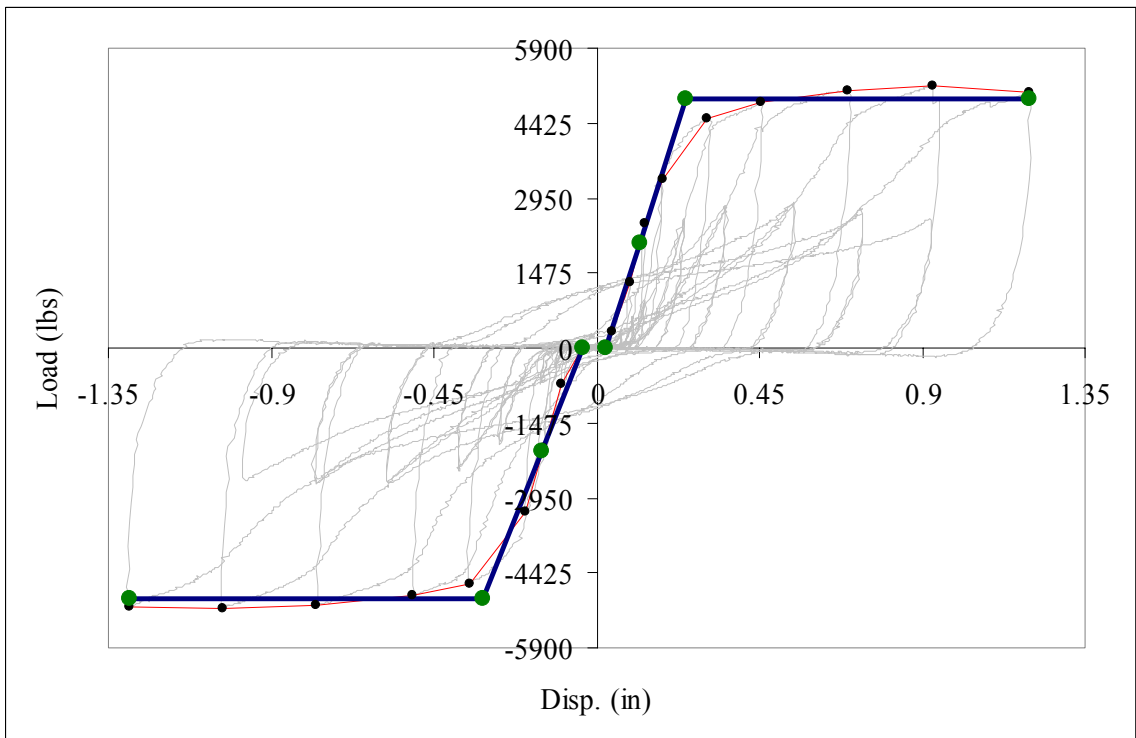


Figure B.119: Load (lbs) vs. Deflection (in.) plot. Test 461R3C08.

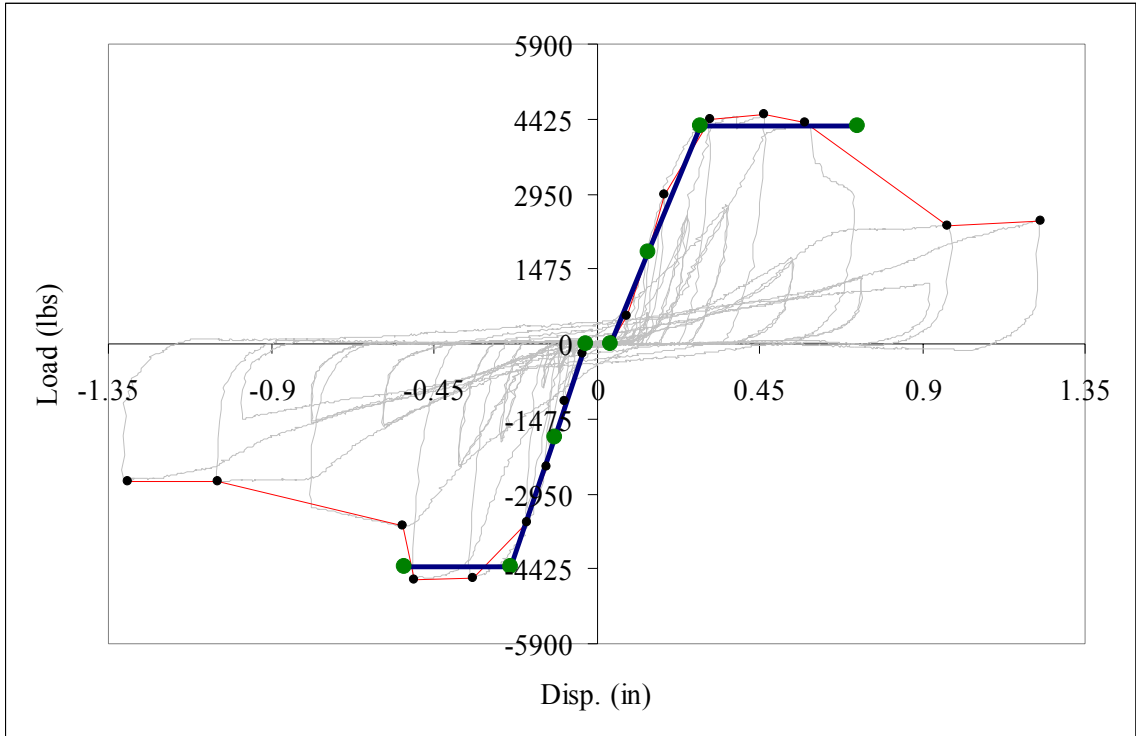


Figure B.120: Load (lbs) vs. Deflection (in.) plot. Test 461R3C09.

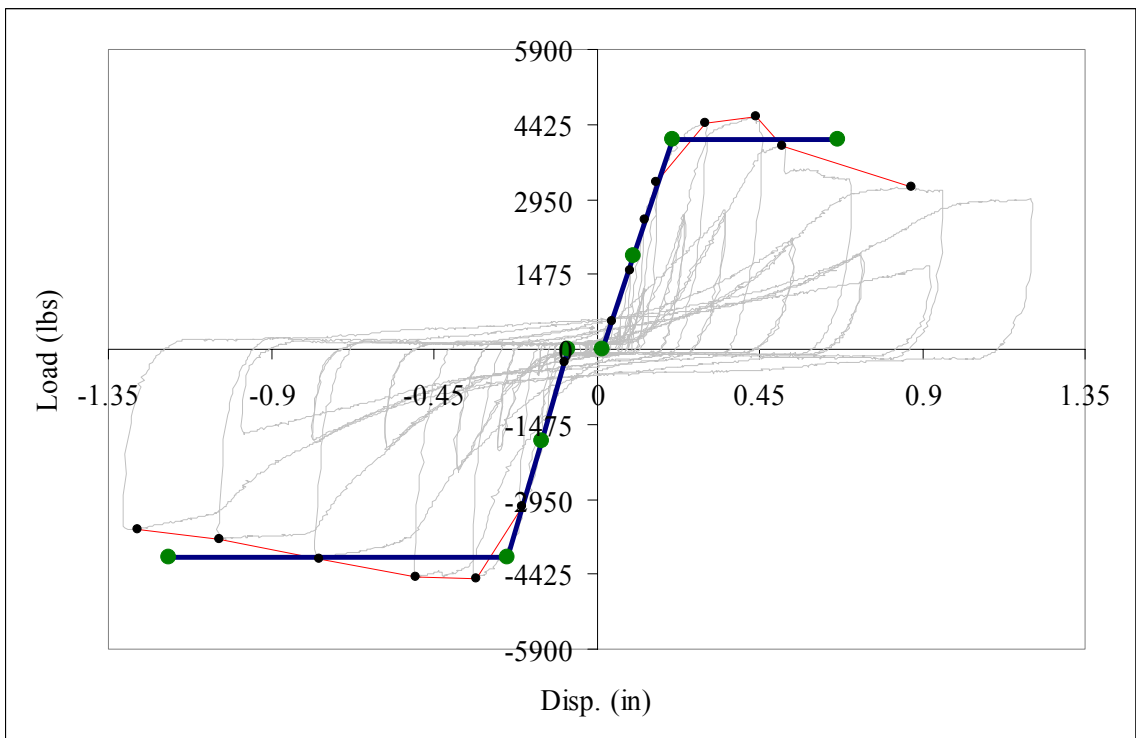


Figure B.121: Load (lbs) vs. Deflection (in.) plot. Test 461R3C10.

Table B.32: Connection properties, 461R5C Series.

Connection Properties 461R5C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	8489.56	8551.97	8168.51	7409.85	8476.03	9021.90	7978.28	7585.04	8322.64	7724.14	8172.79	499.58	0.06
@ Displacement (in)	0.38	0.27	0.27	0.27	0.39	0.28	0.28	0.28	0.31	0.39	0.31	0.05	0.17
Failure Load (lbs)	6791.65	6841.57	6534.80	5927.88	6780.82	7217.52	6382.62	6068.03	6658.11	6179.31	6538.23	399.66	0.06
@ Displacement (in)	0.38	0.27	0.28	0.27	0.39	0.28	0.28	0.29	0.31	0.39	0.31	0.05	0.17
40% Max (lbs)	3395.82	3420.79	3267.40	2963.94	3390.41	3608.76	3191.31	3034.02	3329.06	3089.66	3269.12	199.83	0.06
@ Displacement (in)	0.12	0.11	0.12	0.11	0.13	0.12	0.12	0.14	0.12	0.15	0.13	0.01	0.11
Yield (lbs)	8063.10	7302.84	7621.28	6806.72	7562.34	8234.97	6823.83	6437.07	7474.68	7114.63	7344.15	566.53	0.08
@ Displacement (in)	0.26	0.19	0.23	0.18	0.22	0.22	0.20	0.24	0.22	0.28	0.22	0.03	0.14
5% Offset (lbs)	7820.25	7189.25	7958.24	7409.85	7129.28	9021.90	6468.54	7036.96	6933.65	7724.14	7469.21	707.95	0.09
@ Displacement (in)	0.31	0.21	0.25	0.27	0.30	0.28	0.21	0.26	0.22	0.39	0.27	0.05	0.20
Elastic Stiff. (lb/in)	34357.64	55543.92	38782.18	38996.02	47613.28	41531.22	50431.17	34790.34	51876.96	32638.38	42656.11	8143.87	0.19
E.E.P. Energy (lb*in)	1944.54	1097.00	1089.34	1230.82	1908.77	1361.34	1039.85	918.92	1341.69	1576.28	1350.85	356.72	0.26
Ductility Ratio	1.51	1.60	1.20	1.58	1.80	1.36	1.39	1.21	1.53	1.40	1.46	0.19	0.13
Yield Mode	III, IV	III, IV	III, IV	III, IV	III, IV	III, IV	III, IV	III, IV	III, IV	III, IV	III, IV		
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting		
Governing Member	B	A	B	A	B	A	A	B	B	A			

Table B.33: Material properties, 461R5C Series.

Member Properties 461R5C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Mean	Standard	COV
Member A	1	2	3	4	5	6	7	8	9	10		Deviation	
M.C. (%)	16.25	16.79	17.28	15.34	15.75	15.85	15.22	15.21	16.98	16.27	16.09	0.75	0.05
S.G.	0.53	0.61	0.69	0.56	0.47	0.59	0.57	0.60	0.67	0.51	0.58	0.07	0.12
D.E. 5% Yield (psi)	5349.48	4591.92	5178.11	6226.22	4522.15	5255.26	5646.94	6491.90	5423.48	3696.85	5238.23	821.37	0.16
D.E. Capacity (psi)	5785.37	5047.19	5581.29	7015.33	4994.57	5644.64	5972.37	7149.59	5744.02	4257.69	5719.21	877.64	0.15
Member B													
M.C. (%)	15.01	15.93	14.03	16.32	17.69	15.20	15.89	12.52	14.87	13.51	15.10	1.49	0.10
S.G.	0.50	0.51	0.45	0.59	0.61	0.62	0.56	0.38	0.44	0.62	0.53	0.09	0.16
D.E. 5% Yield (psi)	4774.09	4906.13	3964.44	5053.16	5211.78	5983.94	4818.43	4987.95	4565.32	6610.82	5087.61	736.97	0.14
D.E. Capacity (psi)	4997.61	5235.26	4307.59	5505.29	5393.79	6470.37	4994.92	5177.12	4845.06	7247.31	5417.43	847.90	0.16

Table B.34: Hysteretic properties, 461R5C Series.

Hysteretic Connection Properties 461R5C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	437.15	499.85	1.14	0.02	0.01	0.62	-244.36	209.86	0.86	-0.02	0.01	0.33
Primary2	611.28	694.81	1.14	0.04	0.00	0.09	-349.78	289.18	0.83	-0.03	0.01	0.38
Primary3	1808.89	1295.78	0.72	0.08	0.00	0.05	-1216.40	680.91	0.56	-0.08	0.01	0.08
Primary4	3308.91	1618.06	0.49	0.12	0.01	0.06	-2784.24	1007.48	0.36	-0.12	0.01	0.06
Primary5	4824.26	1854.10	0.38	0.15	0.01	0.06	-4846.97	978.00	0.20	-0.17	0.01	0.08
Primary6	7491.96	2436.17	0.33	0.25	0.01	0.06	-7981.14	691.85	0.09	-0.28	0.02	0.07
Primary7	8074.37	2591.58	0.32	0.32	0.04	0.14	-6733.45	1728.78	0.26	-0.38	0.05	0.12
Primary8	5128.93	2372.85	0.46	0.45	0.09	0.19	-4732.68	949.34	0.20	-0.52	0.12	0.23
Primary9	3085.30	1133.39	0.37	0.74	0.10	0.13	-4012.37	1003.79	0.25	-0.85	0.11	0.13
Primary10	2681.40	1301.78	0.49	1.04	0.11	0.11	-3802.27	1307.20	0.34	-1.14	0.17	0.15
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	11.25	6.98	0.62	8.08	6.27	0.78	0.31	0.19	0.62	16829.33	12208.09	0.73
Primary2	18.14	10.92	0.60	16.66	11.93	0.72	0.20	0.08	0.39	15756.32	14366.24	0.91
Primary3	77.65	29.53	0.38	118.03	32.05	0.27	0.10	0.02	0.17	19235.73	7047.34	0.37
Primary4	178.96	43.94	0.25	358.04	60.52	0.17	0.08	0.01	0.10	25617.52	4667.05	0.18
Primary5	328.43	81.51	0.25	771.38	104.73	0.14	0.07	0.01	0.13	30152.93	4502.69	0.15
Primary6	1272.91	237.16	0.19	2025.19	171.68	0.08	0.10	0.01	0.12	29654.68	2869.23	0.10
Primary7	2482.02	426.14	0.17	2599.21	545.83	0.21	0.16	0.03	0.20	21022.73	3289.19	0.16
Primary8	3518.65	910.14	0.26	2347.47	578.56	0.25	0.24	0.04	0.17	10649.01	3964.43	0.37
Primary9	3852.56	891.72	0.23	2889.36	983.54	0.34	0.22	0.05	0.23	4442.02	932.13	0.21
Primary10	4698.61	1270.34	0.27	3512.37	1340.97	0.38	0.23	0.05	0.24	3029.78	1153.40	0.38

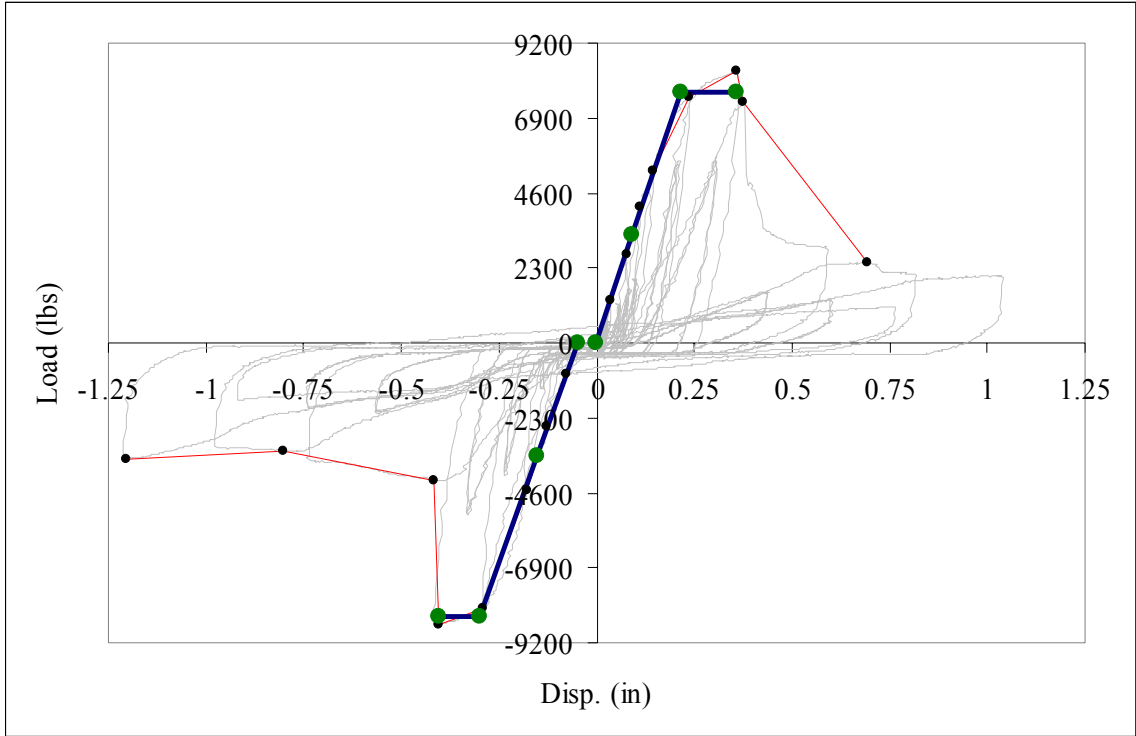


Figure B.122: Load (lbs) vs. Deflection (in.) plot. Test 461R5C01.

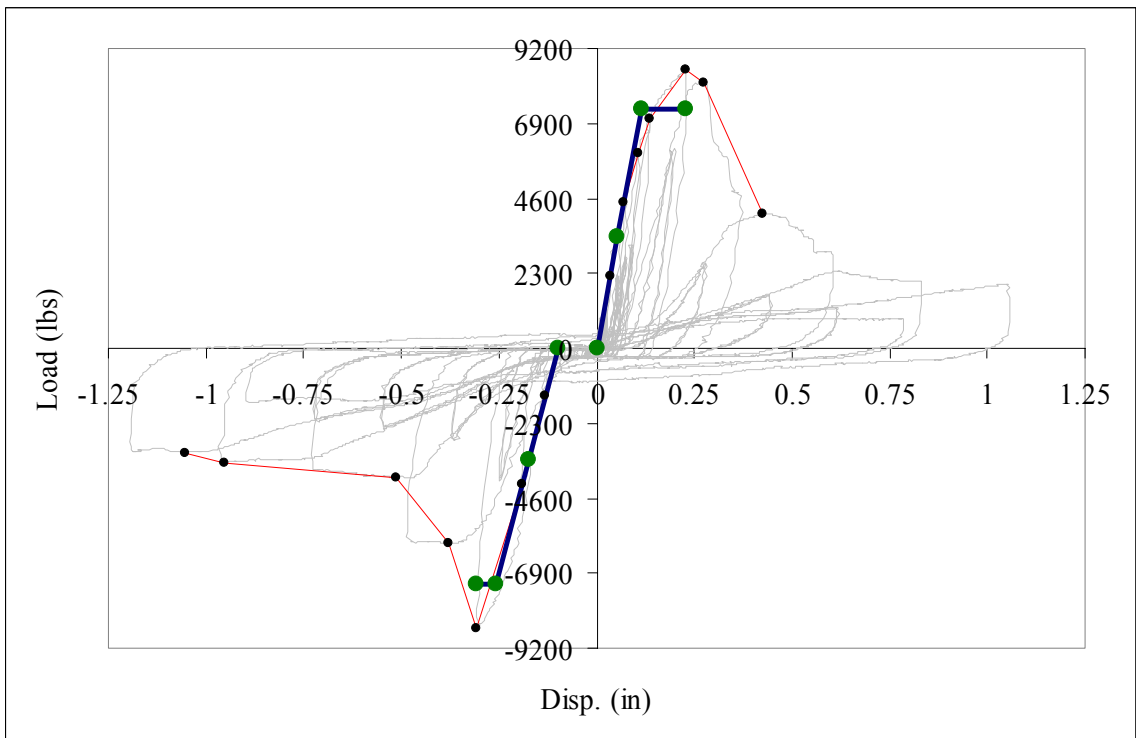


Figure B.123: Load (lbs) vs. Deflection (in.) plot. Test 461R5C02.

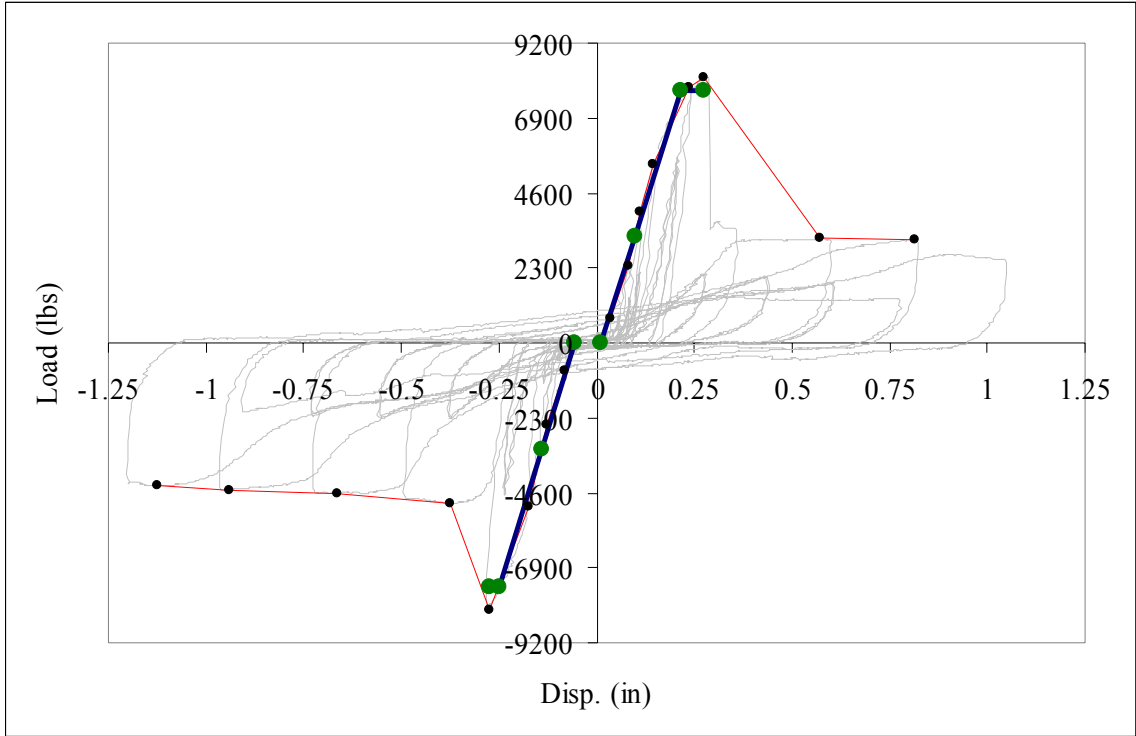


Figure B.124: Load (lbs) vs. Deflection (in.) plot. Test 461R5C03.

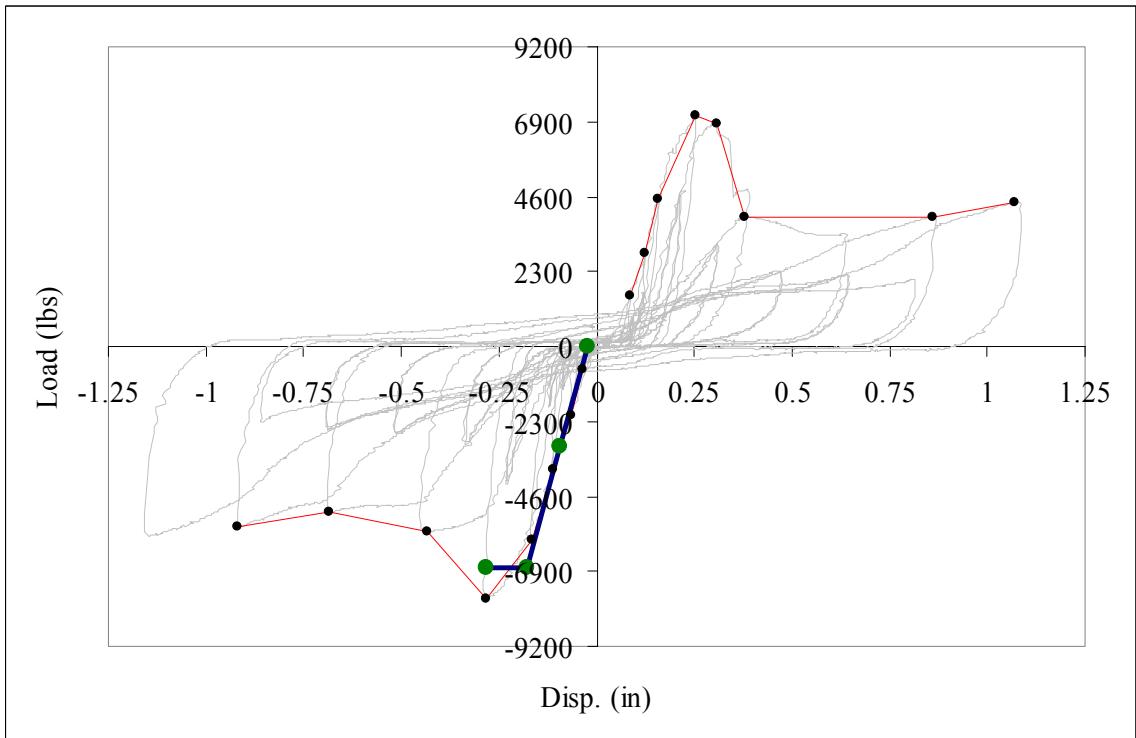


Figure B.125: Load (lbs) vs. Deflection (in.) plot. Test 461R5C04.

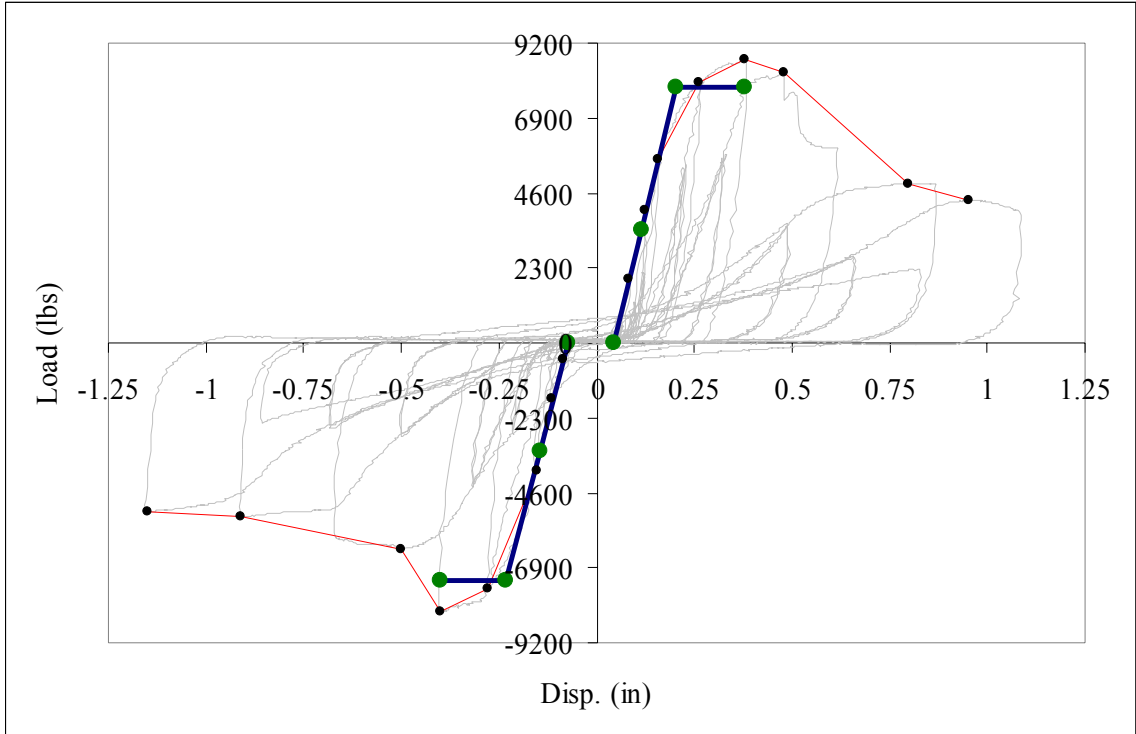


Figure B.126: Load (lbs) vs. Deflection (in.) plot. Test 461R5C05.

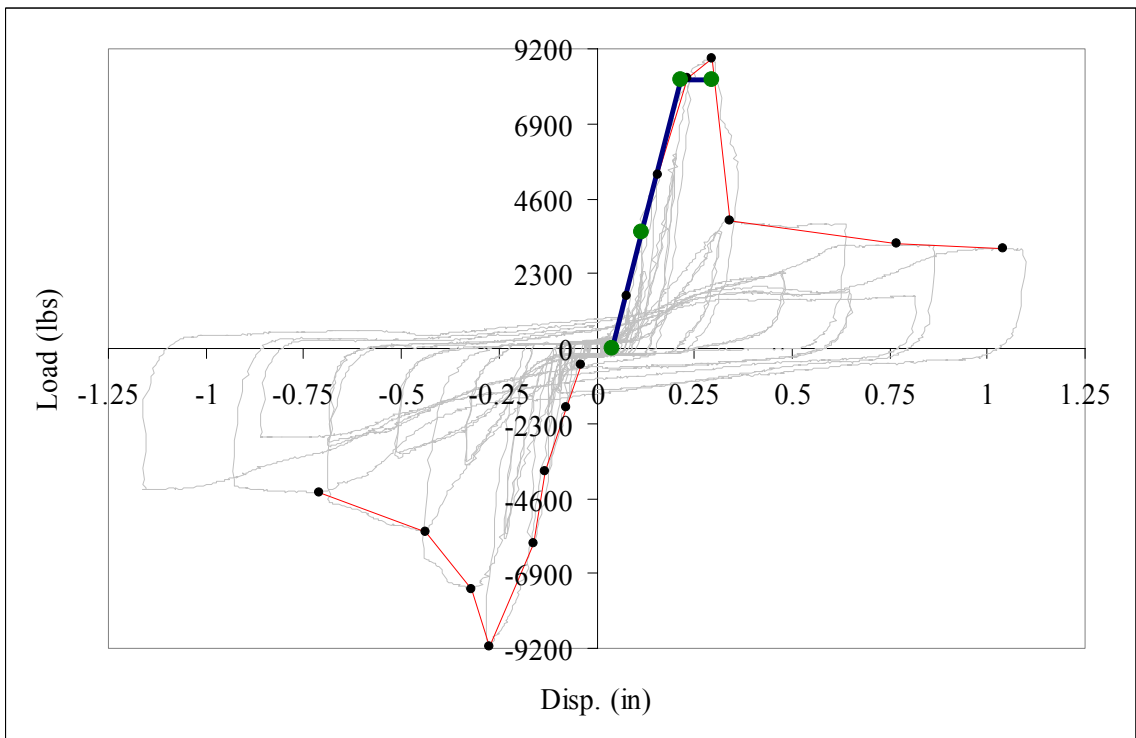


Figure B.127: Load (lbs) vs. Deflection (in.) plot. Test 461R5C06.

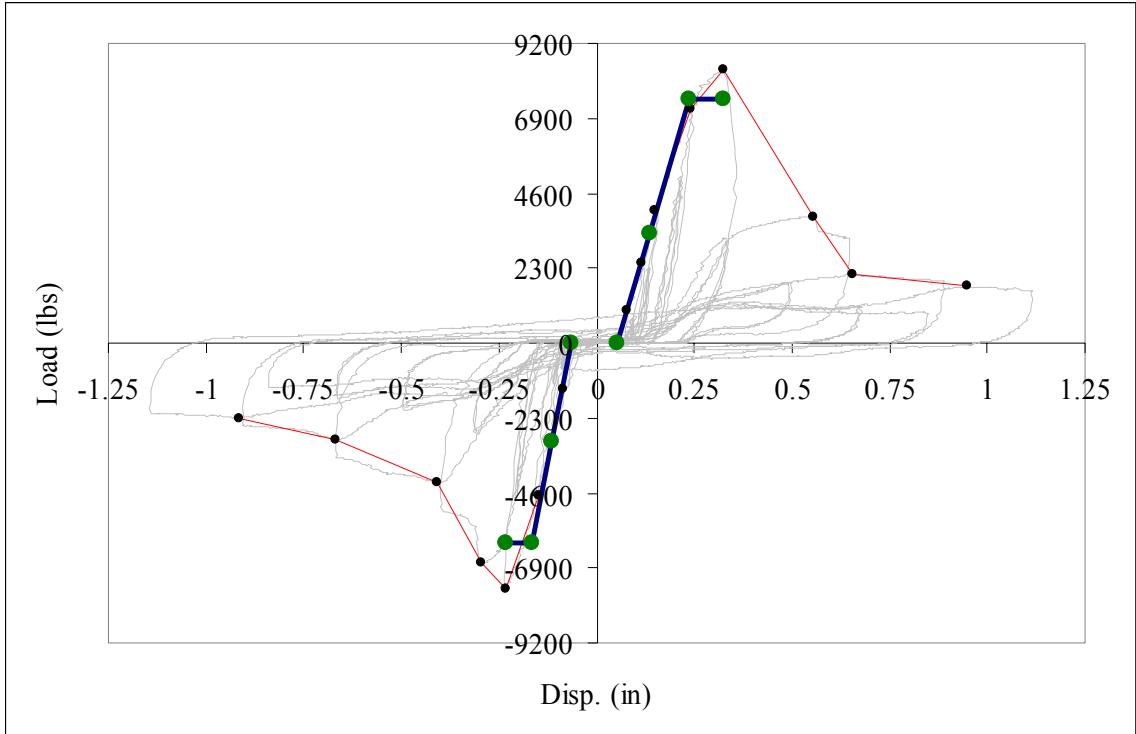


Figure B.128: Load (lbs) vs. Deflection (in.) plot. Test 461R5C07.

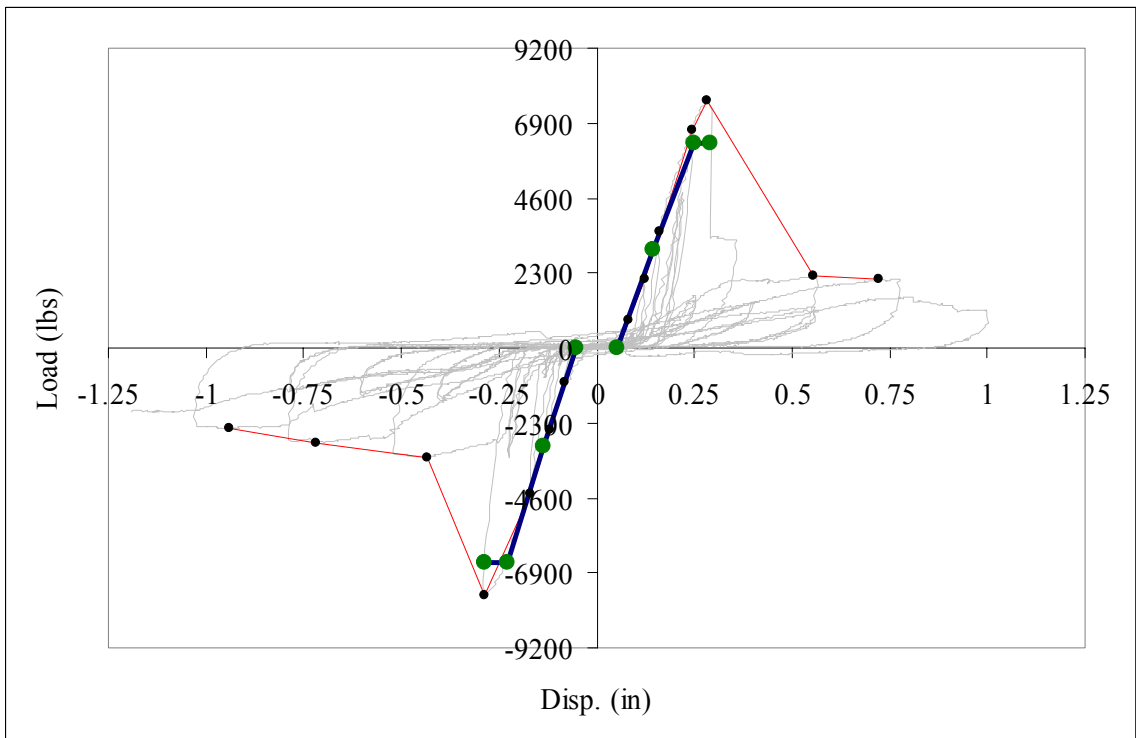


Figure B.129: Load (lbs) vs. Deflection (in.) plot. Test 461R5C08.

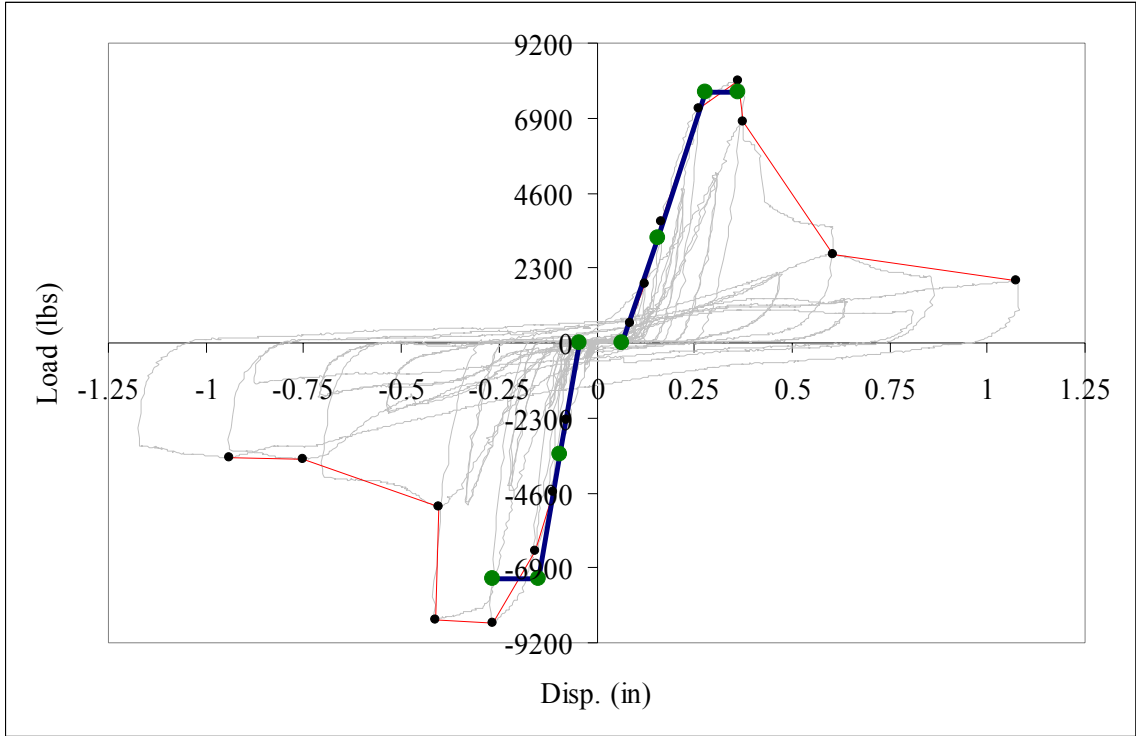


Figure B.130: Load (lbs) vs. Deflection (in.) plot. Test 461R5C09.

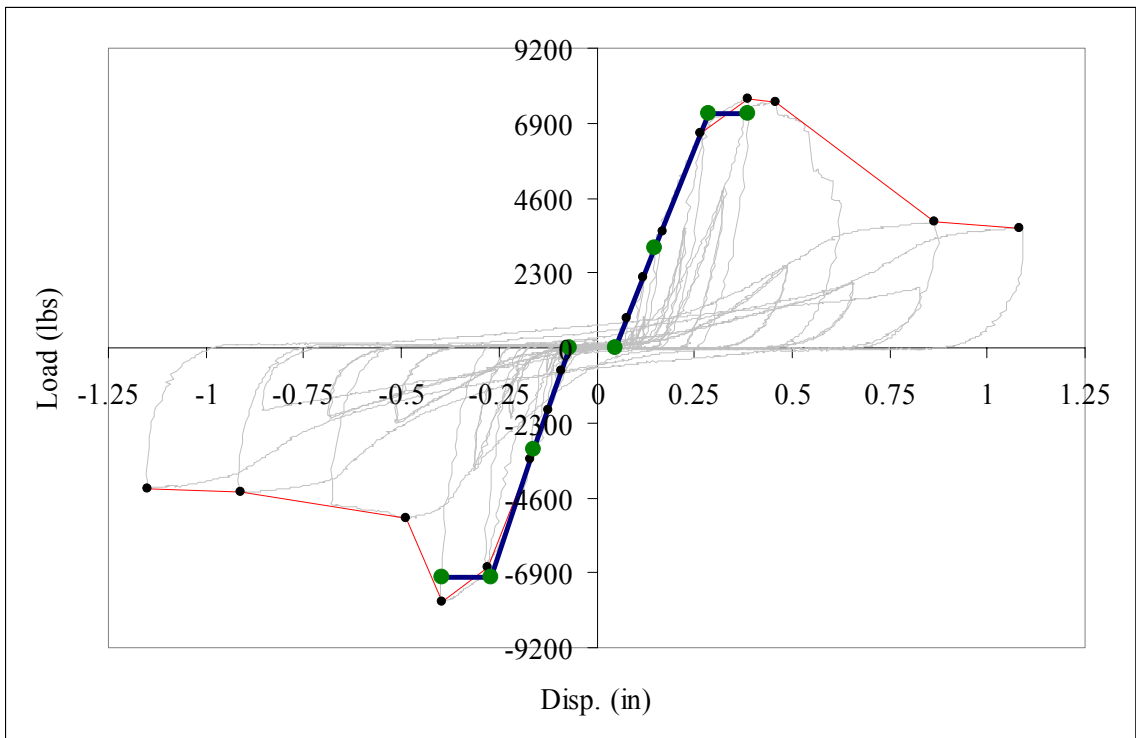


Figure B.131: Load (lbs) vs. Deflection (in.) plot. Test 461R5C10.

Table B.35: Connection properties, 462R3C Series.

Connection Properties 462R3C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
Max Load (lbs)	9287.31	9946.72	10648.23	10353.49	11998.62	9182.05	9920.40	9739.95	10573.79	11215.15	10286.57	867.82	0.08
@ Displacement (in)	0.36	0.60	0.58	0.57	1.05	0.79	0.70	0.67	0.44	0.96	0.67	0.22	0.32
Failure Load (lbs)	7429.85	7957.38	8518.58	8282.79	9598.90	7345.64	7936.32	7791.96	8459.04	8972.12	8229.26	694.26	0.08
@ Displacement (in)	0.36	0.60	0.96	1.08	1.05	1.10	1.09	1.08	0.44	1.07	0.88	0.30	0.34
40% Max (lbs)	3714.93	3978.69	4259.29	4141.40	4799.45	3672.82	3968.16	3895.98	4229.52	4486.06	4114.63	347.13	0.08
@ Displacement (in)	0.14	0.15	0.15	0.13	0.17	0.16	0.16	0.15	0.14	0.16	0.15	0.01	0.08
Yield (lbs)	8386.20	9093.61	9643.89	9563.84	10830.19	8867.45	9404.86	9257.47	9138.07	10549.94	9473.55	737.43	0.08
@ Displacement (in)	0.25	0.28	0.31	0.23	0.34	0.31	0.30	0.29	0.23	0.32	0.29	0.04	0.13
5% Offset (lbs)	7684.80	7203.07	8152.77	7289.92	8261.44	7952.28	8629.84	7506.08	8313.73	7764.80	7875.87	468.21	0.06
@ Displacement (in)	0.25	0.25	0.29	0.21	0.29	0.30	0.41	0.27	0.26	0.27	0.28	0.05	0.19
Elastic Stiff. (lb/in)	42305.88	40406.89	34087.80	58290.68	37189.64	33829.45	39442.81	37524.33	54688.13	36565.11	41433.07	8395.78	0.20
E.E.P. Energy (lb*in)	1753.37	3930.26	7608.03	8986.30	9277.10	8148.80	8610.38	8463.20	2752.07	9409.93	6893.94	2910.61	0.42
Ductility Ratio	1.47	2.15	3.08	5.04	3.11	3.59	3.72	3.69	1.97	3.33	3.12	1.03	0.33
Yield Mode	III, IV	IV	IV	IV	IV	IV	IV	IV	IV	IV			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	B	B	B	B	B	B	B	A	A	A			

Table B.36: Material properties, 462R3C Series.

Member Properties 462R3C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	13.11	16.95	17.84	18.25	15.75	13.61	15.61	15.73	14.92	16.39	15.82	1.66	0.10
S.G.	0.50	0.45	0.57	0.68	0.44	0.49	0.51	0.50	0.50	0.50	0.51	0.07	0.13
D.E. 5% Yield (psi)	5330.28	4036.11	4575.77	6506.56	4260.00	5496.04	4240.17	5209.78	5047.19	4102.60	4880.45	786.52	0.16
D.E. Capacity (psi)	5676.33	4588.60	4898.68	7068.32	4496.08	5731.37	4705.11	5728.35	5246.24	4715.66	5285.47	792.16	0.15
Member B													
M.C. (%)	15.47	20.70	15.47	13.61	17.52	14.06	18.33	13.25	16.54	16.37	16.13	2.30	0.14
S.G.	0.43	0.60	0.50	0.52	0.47	0.45	0.47	0.51	0.58	0.49	0.50	0.05	0.11
D.E. 5% Yield (psi)	4100.92	4552.49	5428.30	6091.79	4317.89	4468.16	4477.74	6161.91	5888.82	4901.11	5038.91	784.55	0.16
D.E. Capacity (psi)	4261.21	5034.85	5680.62	6419.66	4574.32	4777.81	4868.18	6282.61	6399.13	5193.61	5349.20	795.43	0.15

Table B.37: Hysteretic properties, 462R3C Series.

Hysteretic Connection Properties 462R3C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	506.47	358.67	0.71	0.03	0.00	0.15	-336.85	197.93	0.59	-0.03	0.01	0.30
Primary2	712.19	452.78	0.64	0.04	0.01	0.20	-448.73	267.83	0.60	-0.04	0.01	0.33
Primary3	1703.93	755.53	0.44	0.07	0.02	0.25	-1324.37	462.01	0.35	-0.09	0.02	0.25
Primary4	2611.00	975.75	0.37	0.10	0.02	0.22	-2343.18	595.24	0.25	-0.12	0.03	0.22
Primary5	3531.47	1277.60	0.36	0.12	0.03	0.21	-3182.29	712.59	0.22	-0.14	0.02	0.17
Primary6	6633.15	2285.66	0.34	0.20	0.02	0.09	-6506.98	722.82	0.11	-0.22	0.02	0.08
Primary7	9122.05	2943.91	0.32	0.32	0.02	0.05	-9293.33	389.79	0.04	-0.35	0.02	0.05
Primary8	10001.46	3273.07	0.33	0.52	0.05	0.10	-9988.22	721.78	0.07	-0.60	0.03	0.05
Primary9	9662.06	3176.53	0.33	0.74	0.09	0.12	-9525.21	1389.86	0.15	-0.86	0.04	0.05
Primary10	8484.30	3126.73	0.37	1.01	0.09	0.09	-8739.19	2154.29	0.25	-1.14	0.04	0.04
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	19.81	10.35	0.52	10.86	5.22	0.48	0.29	0.08	0.27	17671.56	13060.52	0.74
Primary2	30.52	14.78	0.48	20.90	7.63	0.36	0.23	0.09	0.37	17430.39	12025.43	0.69
Primary3	93.63	29.87	0.32	120.62	25.77	0.21	0.13	0.04	0.28	18148.41	4018.16	0.22
Primary4	145.82	37.62	0.26	270.58	61.21	0.23	0.09	0.02	0.23	22346.45	2961.75	0.13
Primary5	195.52	48.98	0.25	435.72	95.67	0.22	0.07	0.02	0.26	25584.87	3384.62	0.13
Primary6	771.79	121.19	0.16	1400.19	164.96	0.12	0.09	0.01	0.12	30781.49	2615.40	0.08
Primary7	2224.20	256.47	0.12	3095.48	171.03	0.06	0.11	0.01	0.09	27421.68	1599.16	0.06
Primary8	6575.46	469.48	0.07	5630.65	634.98	0.11	0.19	0.02	0.09	17786.70	1053.05	0.06
Primary9	9150.34	945.94	0.10	7696.69	1401.90	0.18	0.19	0.02	0.13	11980.91	1237.61	0.10
Primary10	10170.38	1815.72	0.18	9222.14	2230.10	0.24	0.18	0.02	0.09	8055.27	2073.07	0.26

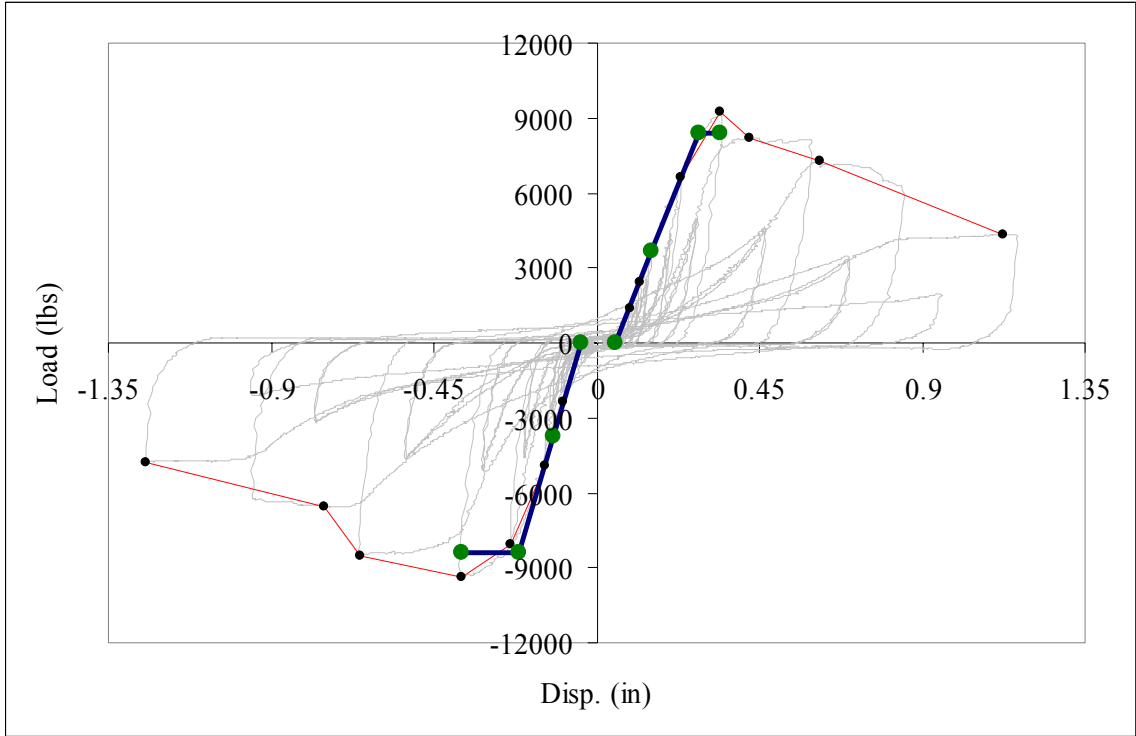


Figure B.132: Load (lbs) vs. Deflection (in.) plot. Test 462R3C01.

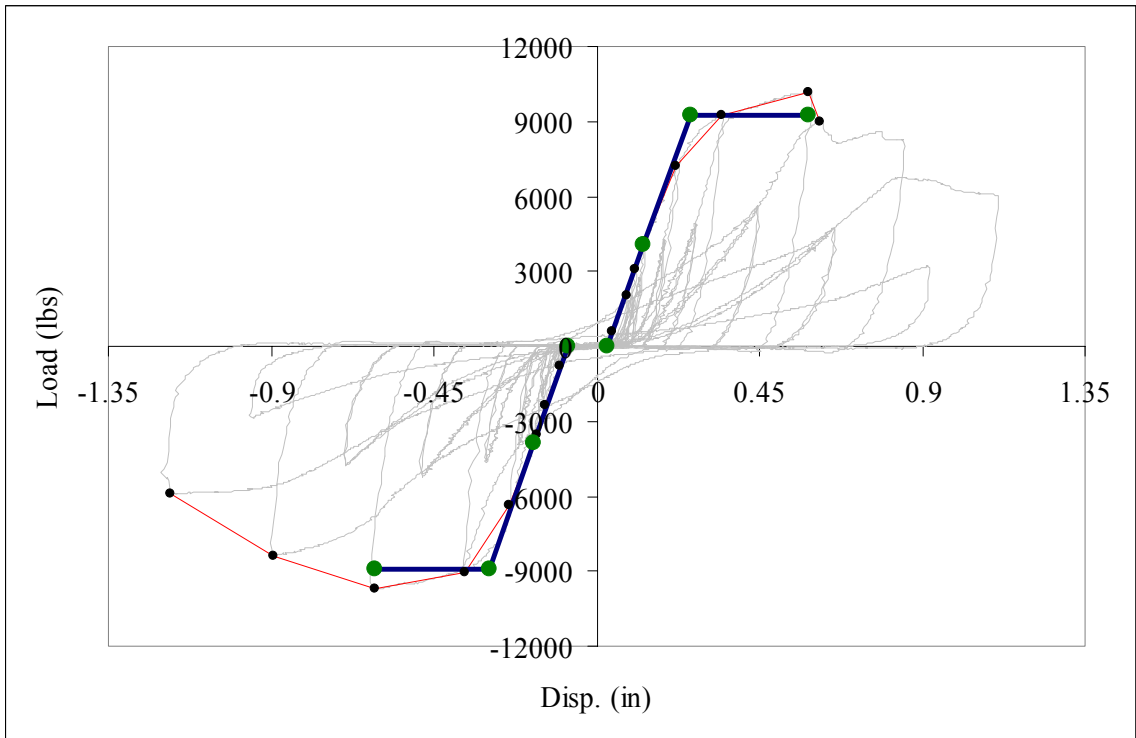


Figure B.133: Load (lbs) vs. Deflection (in.) plot. Test 462R3C02.

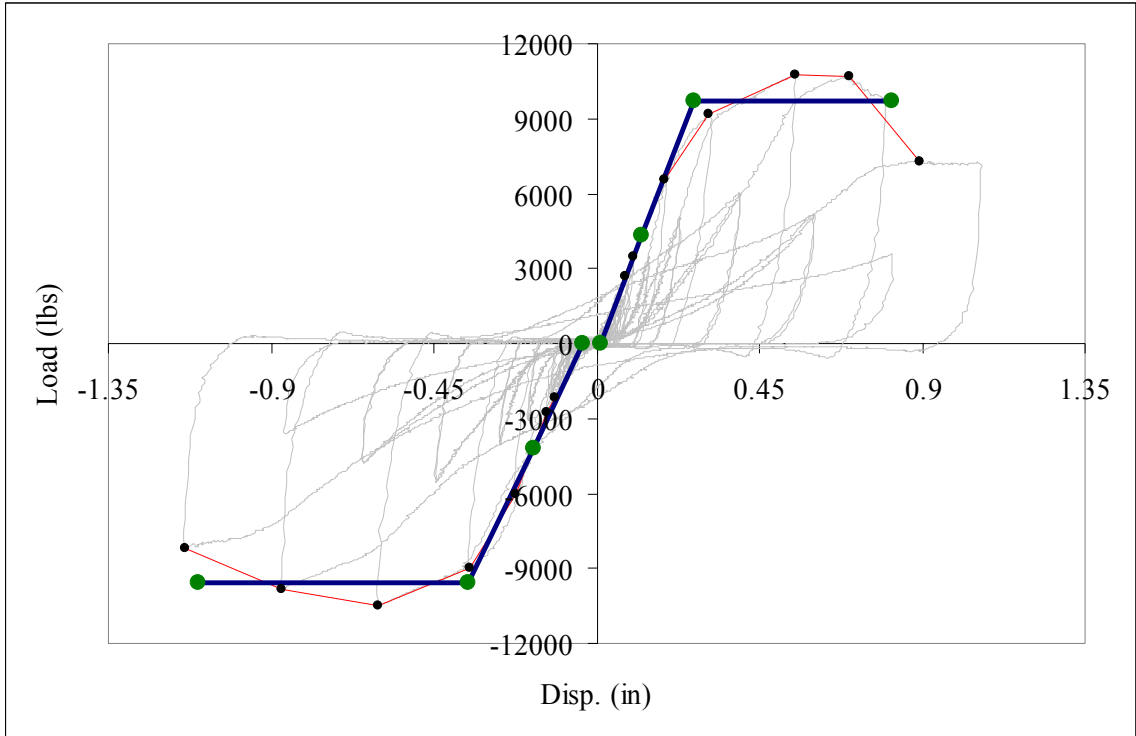


Figure B.134: Load (lbs) vs. Deflection (in.) plot. Test 462R3C03.

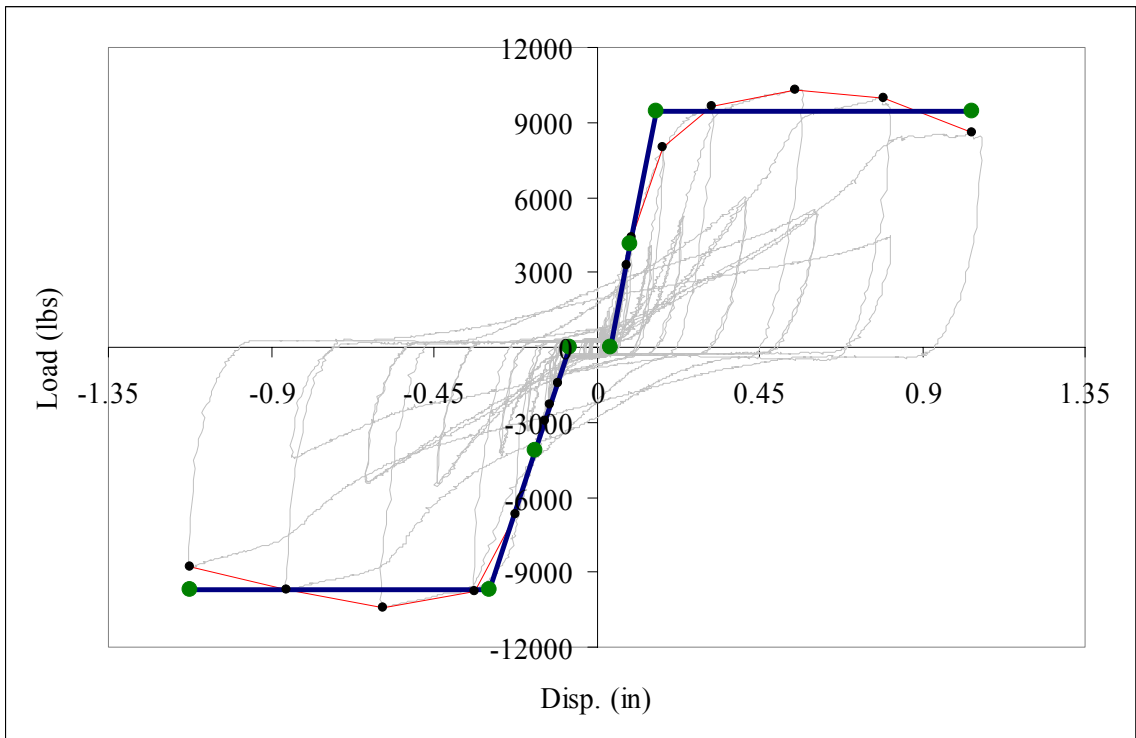


Figure B.135: Load (lbs) vs. Deflection (in.) plot. Test 462R3C04.

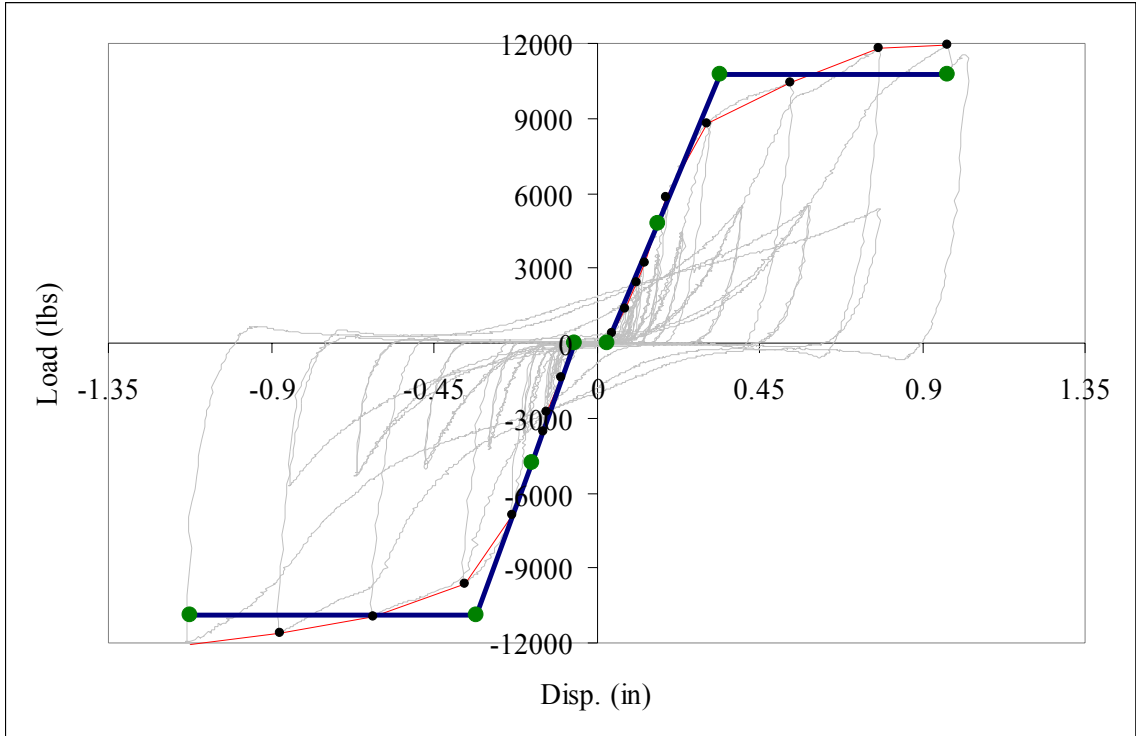


Figure B.136: Load (lbs) vs. Deflection (in.) plot. Test 462R3C05.

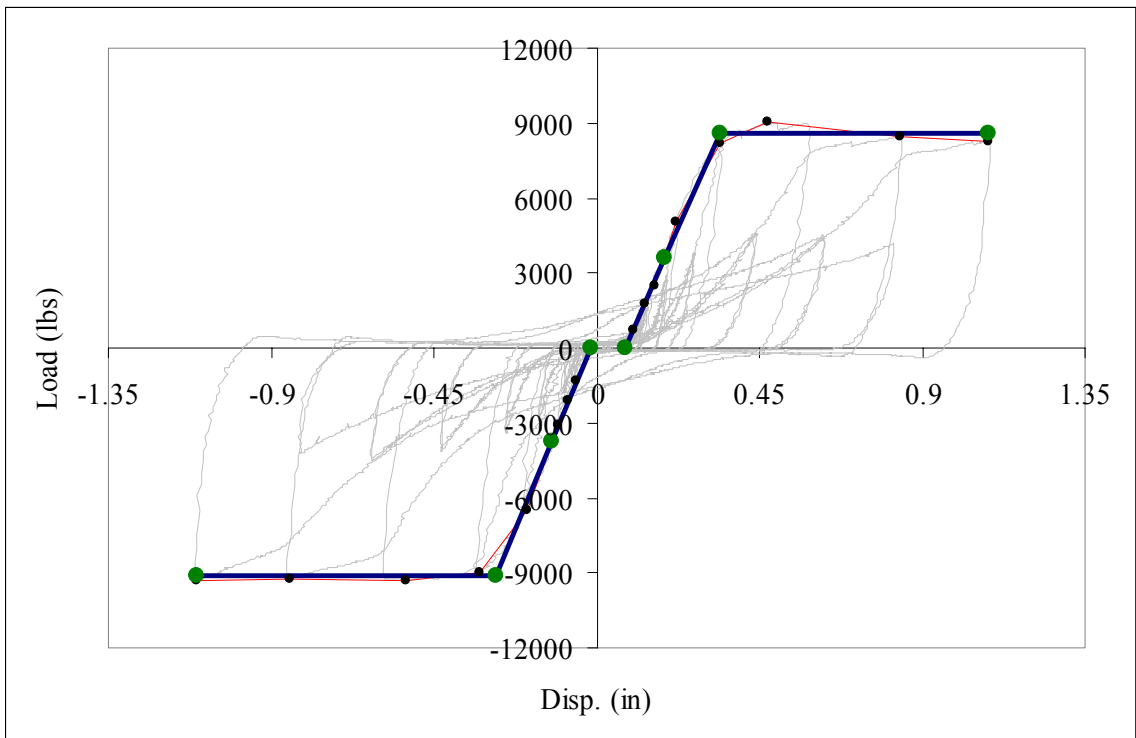


Figure B.137: Load (lbs) vs. Deflection (in.) plot. Test 462R3C06.

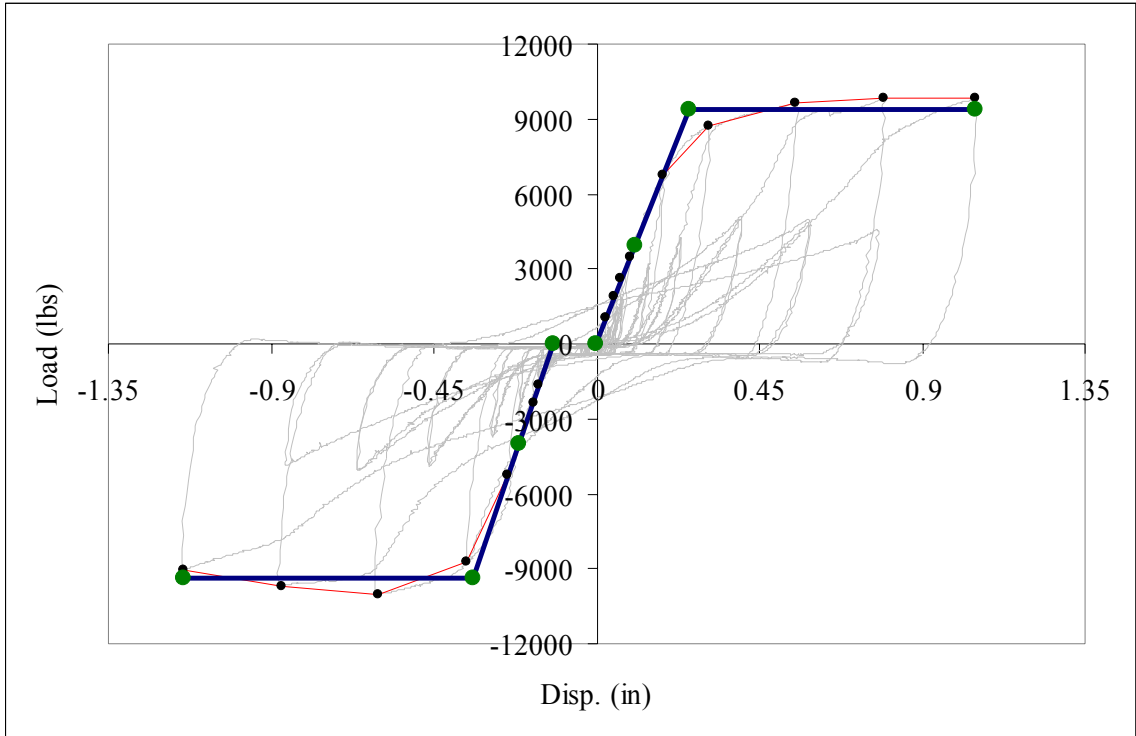


Figure B.138: Load (lbs) vs. Deflection (in.) plot. Test 462R3C07.

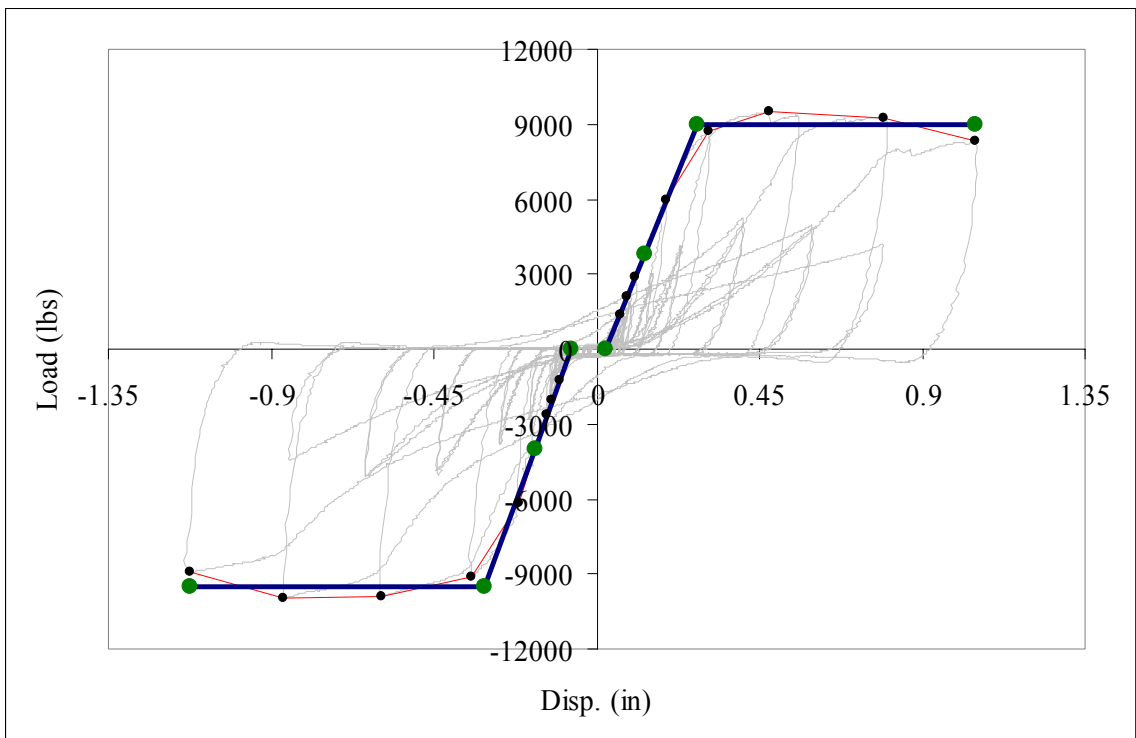


Figure B.139: Load (lbs) vs. Deflection (in.) plot. Test 462R3C08.

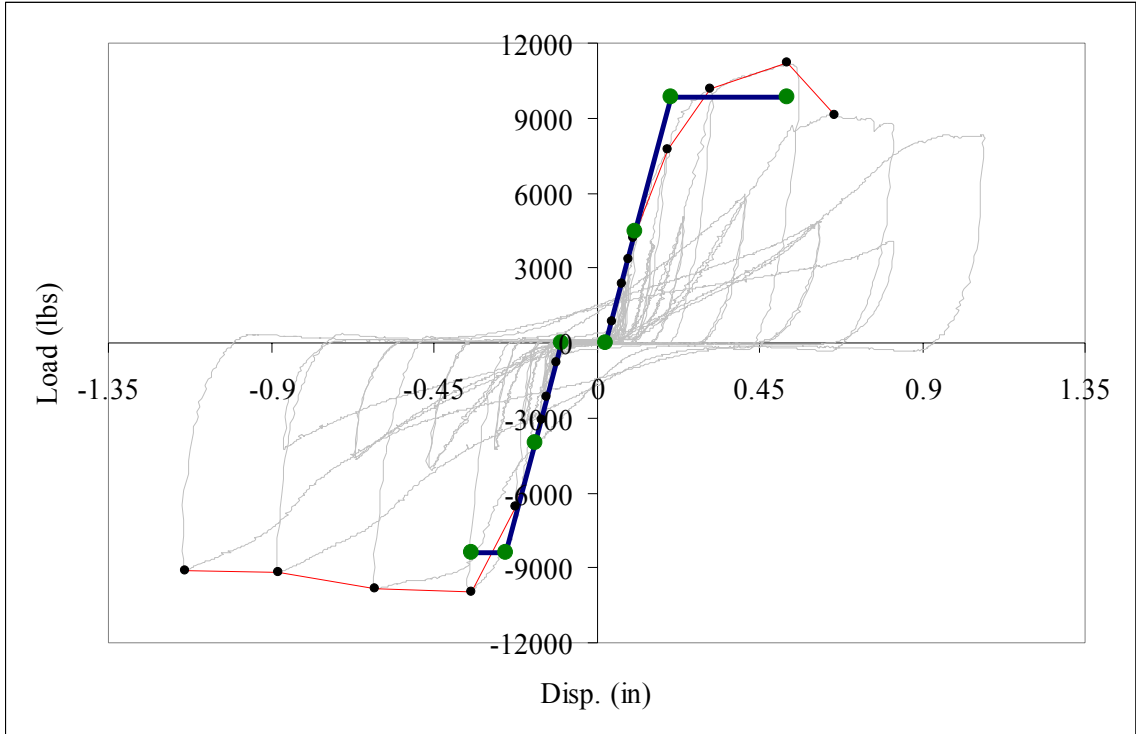


Figure B.140: Load (lbs) vs. Deflection (in.) plot. Test 462R3C09.

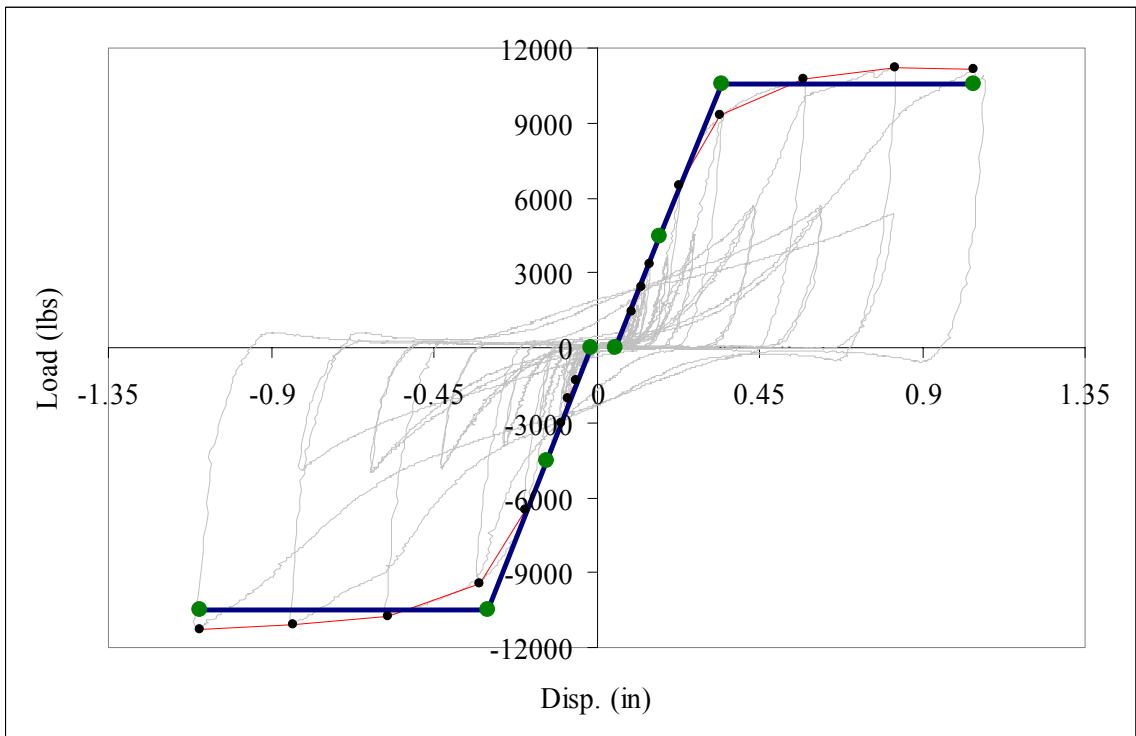


Figure B.141: Load (lbs) vs. Deflection (in.) plot. Test 462R3C010.

Table B.38: Connection properties, 462R5C Series.

Connection Properties 462R5C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
Max Load (lbs)	13905.41	17121.23	17209.20	16820.48	15936.26	14418.95	16083.63	14018.94	14978.35	12967.80	15346.02	1497.27	0.10
@ Displacement (in)	0.44	0.47	0.29	0.32	0.35	0.33	0.52	0.34	0.33	0.34	0.37	0.08	0.20
Failure Load (lbs)	11124.33	13696.98	13767.36	13456.38	12749.00	11535.16	12866.90	11215.15	11982.68	10374.24	12276.82	1197.82	0.10
@ Displacement (in)	0.44	0.81	0.45	0.32	0.35	0.33	0.52	0.34	0.33	0.34	0.42	0.15	0.36
40% Max (lbs)	5562.16	6848.49	6883.68	6728.19	6374.50	5767.58	6433.45	5607.58	5991.34	5187.12	6138.41	598.91	0.10
@ Displacement (in)	0.16	0.15	0.12	0.12	0.15	0.13	0.15	0.14	0.15	0.15	0.14	0.01	0.09
Yield (lbs)	12150.05	15471.78	17091.21	15256.38	14229.78	13109.46	15235.06	12940.74	13865.85	11960.14	14131.05	1640.56	0.12
@ Displacement (in)	0.30	0.30	0.26	0.26	0.27	0.24	0.31	0.27	0.29	0.23	0.27	0.03	0.10
5% Offset (lbs)	13905.41	16543.01	17209.20	16180.79	13582.86	12525.88	15087.09	12700.80	14978.35	12967.80	14568.12	1684.65	0.12
@ Displacement (in)	0.44	0.42	0.29	0.28	0.28	0.25	0.42	0.29	0.33	0.34	0.33	0.07	0.21
Elastic Stiff. (lb/in)	46340.92	56838.43	57790.41	63722.66	69042.89	62717.53	52878.78	55964.02	54380.06	42699.21	56237.49	7893.76	0.14
E.E.P. Energy (lb*in)	3330.79	9962.17	5643.32	2956.38	2741.55	2532.45	5283.98	2412.06	2321.21	2419.90	3960.38	2426.52	0.61
Ductility Ratio	1.50	2.69	1.74	1.31	1.34	1.40	1.65	1.26	1.14	1.38	1.54	0.44	0.29
Yield Mode	IV	IV	IV	IV	IV	IV	IV	III, IV	III, IV	III, IV			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	Both	B	B	B	Both	B	Both	Both	Both	B			

Table B.39: Material properties, 462R5C Series.

Member Properties 462R5C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard	
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	20.54	16.69	13.53	17.24	16.31	12.97	15.36	16.28	15.60	13.73	15.83	2.20	0.14
S.G.	0.50	0.67	0.73	0.62	0.50	0.70	0.51	0.46	0.54	0.46	0.57	0.10	0.18
D.E. 5% Yield (psi)	4091.87	5497.82	7239.77	5057.85	4055.11	7540.97	3995.61	4146.88	4839.87	3982.10	5044.78	1342.47	0.27
D.E. Capacity (psi)	4374.35	6158.55	7501.51	5618.86	4358.15	7737.80	4262.39	4777.54	5210.69	4255.33	5425.52	1319.24	0.24
Member B													
M.C. (%)	15.03	15.90	15.96	13.14	12.18	15.83	15.14	15.10	14.83	17.00	15.01	1.41	0.09
S.G.	0.51	0.75	0.56	0.78	0.60	0.45	0.53	0.54	0.45	0.50	0.57	0.11	0.20
D.E. 5% Yield (psi)	3916.41	6123.74	5374.45	7192.73	5393.96	4808.39	4377.45	4593.32	3682.09	3428.09	4889.06	1164.99	0.24
D.E. Capacity (psi)	4289.31	6529.29	5790.00	7718.95	5907.37	5190.98	4724.58	5005.15	4079.36	4018.01	5325.30	1180.86	0.22

Table B.40: Hysteretic properties, 462R5C Series.

Hysteretic Connection Properties 462R5C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	1006.63	649.87	0.65	0.02	0.00	0.10	-386.02	239.34	0.62	-0.02	0.00	0.08
Primary2	1372.04	826.35	0.60	0.03	0.00	0.15	-530.53	356.51	0.67	-0.04	0.00	0.12
Primary3	3332.06	1606.89	0.48	0.08	0.01	0.07	-1712.50	964.31	0.56	-0.08	0.01	0.09
Primary4	5685.02	2318.96	0.41	0.12	0.01	0.06	-3883.80	1447.46	0.37	-0.12	0.01	0.07
Primary5	7766.25	2796.57	0.36	0.15	0.01	0.07	-6590.90	1571.08	0.24	-0.16	0.01	0.08
Primary6	12044.34	4066.98	0.34	0.23	0.03	0.13	-11799.97	1316.86	0.11	-0.26	0.03	0.11
Primary7	15259.86	5066.38	0.33	0.32	0.05	0.14	-14766.17	1217.84	0.08	-0.35	0.04	0.11
Primary8	15258.80	4988.16	0.33	0.41	0.07	0.17	-12045.69	2720.19	0.23	-0.46	0.08	0.17
Primary9	8731.37	4316.36	0.49	0.59	0.06	0.09	-8342.79	2766.37	0.33	-0.71	0.09	0.13
Primary10	6233.00	3394.79	0.54	1.00	0.09	0.09	-6594.50	1945.59	0.30	-1.04	0.10	0.10
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	15.00	4.19	0.28	16.35	6.46	0.40	0.16	0.08	0.50	30032.11	13228.56	0.44
Primary2	24.69	6.58	0.27	31.97	10.46	0.33	0.13	0.06	0.44	27943.66	11813.29	0.42
Primary3	117.02	20.45	0.17	191.04	36.52	0.19	0.10	0.02	0.15	33310.15	9288.91	0.28
Primary4	257.33	41.10	0.16	563.06	104.38	0.19	0.07	0.01	0.10	40290.46	8166.22	0.20
Primary5	433.46	47.72	0.11	1119.51	143.36	0.13	0.06	0.00	0.08	45736.18	8247.57	0.18
Primary6	1363.61	400.61	0.29	2880.36	296.30	0.10	0.07	0.01	0.19	49723.00	8905.09	0.18
Primary7	2857.74	848.13	0.30	4991.25	507.63	0.10	0.09	0.02	0.20	45598.42	7722.96	0.17
Primary8	8154.57	1313.65	0.16	5909.65	1458.38	0.25	0.23	0.04	0.17	31869.52	3865.09	0.12
Primary9	8507.39	2476.13	0.29	5643.58	2372.27	0.42	0.25	0.04	0.17	12996.25	4338.31	0.33
Primary10	8447.37	2336.41	0.28	6523.41	2446.67	0.38	0.21	0.04	0.18	6354.60	2501.17	0.39

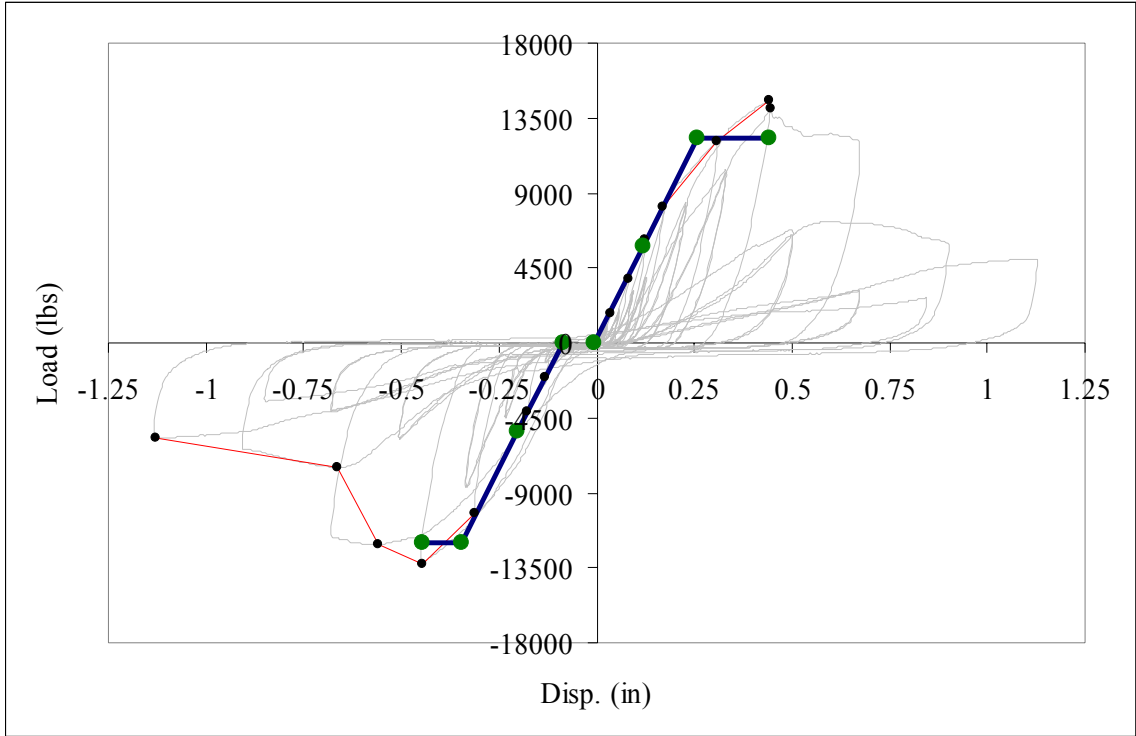


Figure B.142: Load (lbs) vs. Deflection (in.) plot. Test 462R5C01.

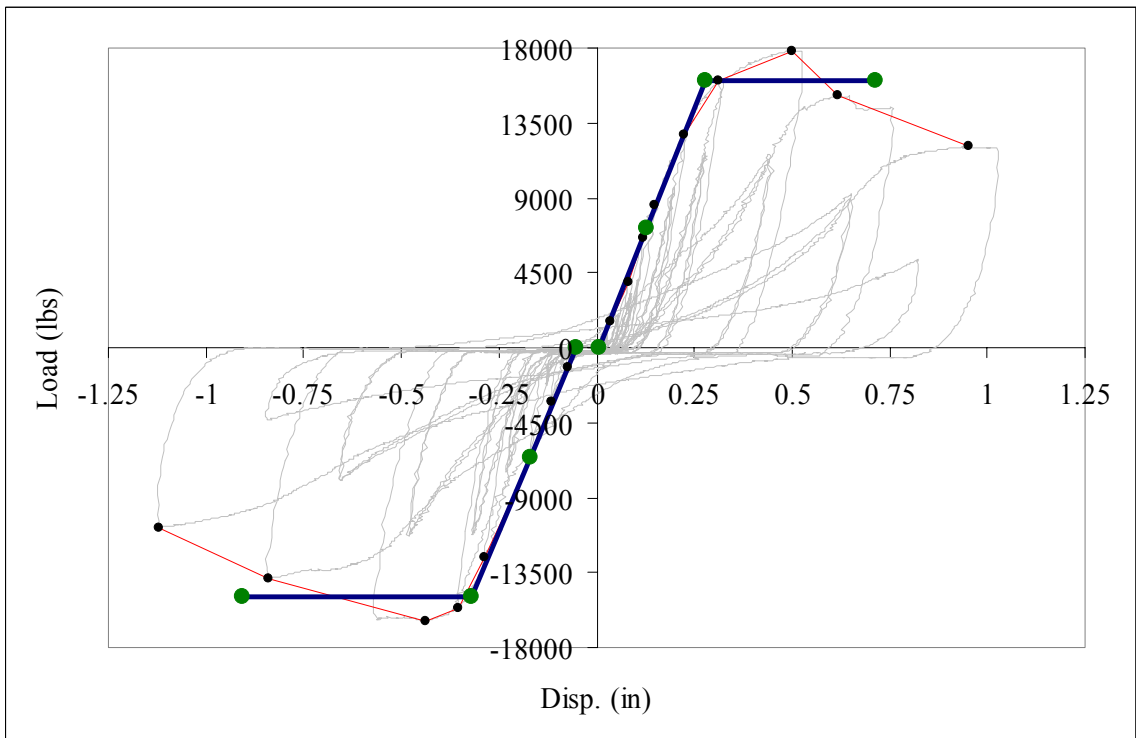


Figure B.143: Load (lbs) vs. Deflection (in.) plot. Test 462R5C02.

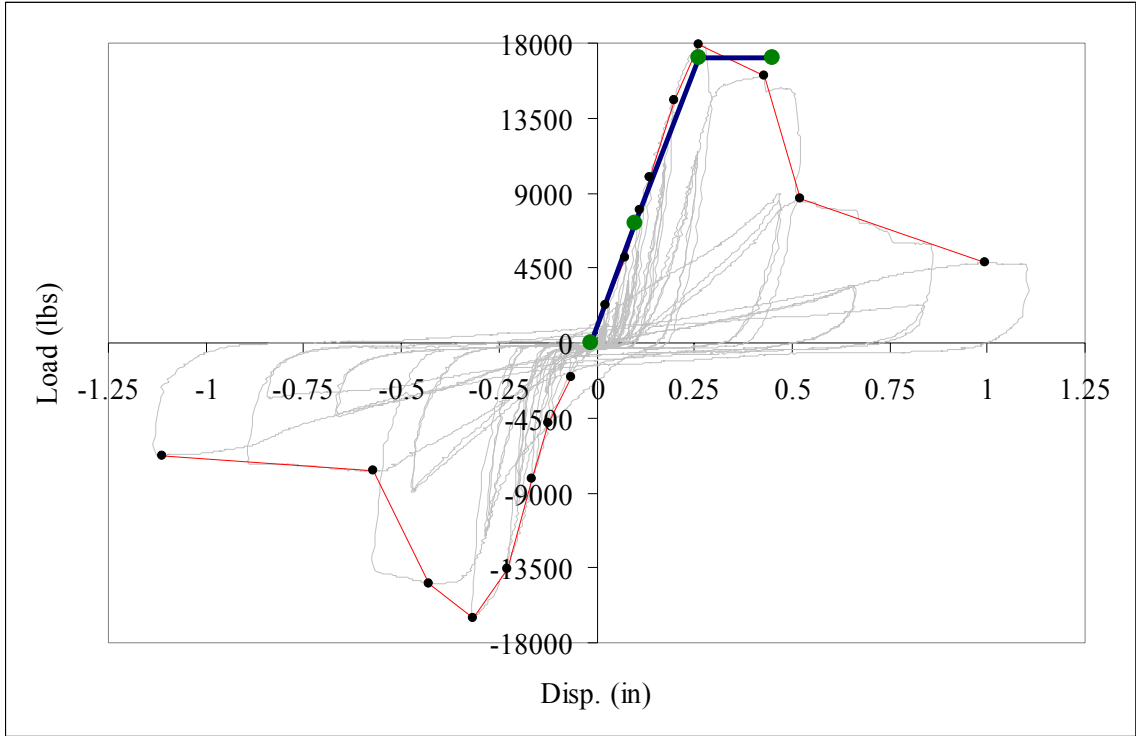


Figure B.144: Load (lbs) vs. Deflection (in.) plot. Test 462R5C03.

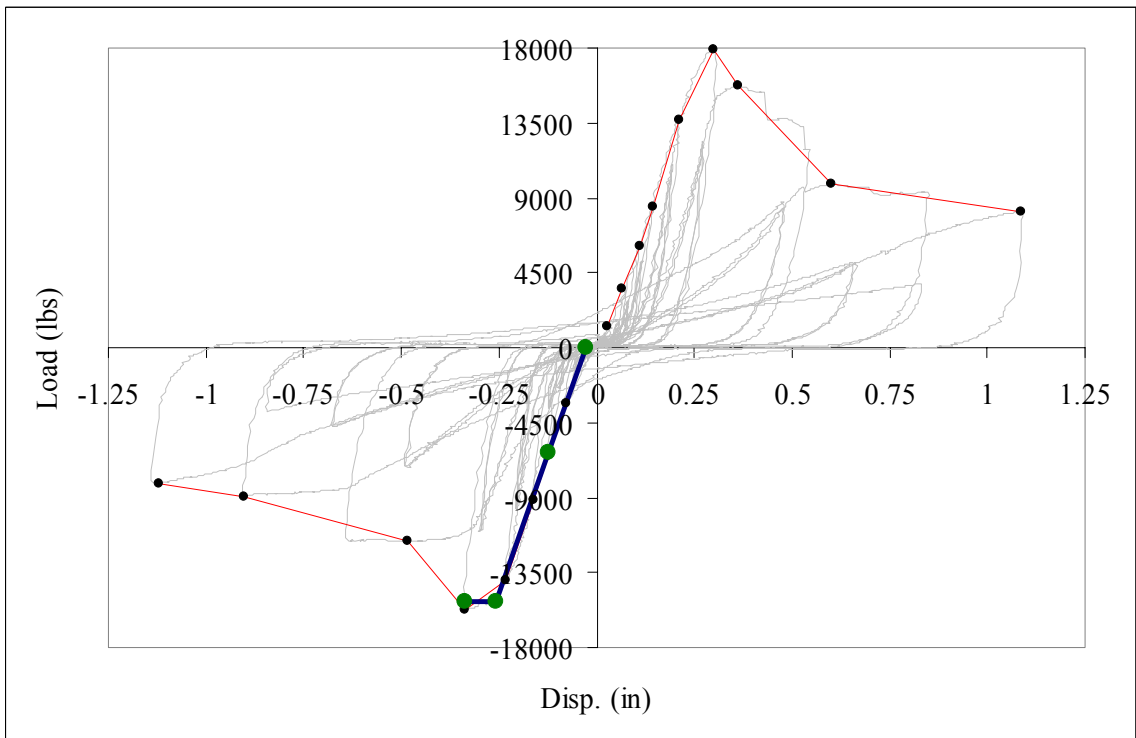


Figure B.145: Load (lbs) vs. Deflection (in.) plot. Test 462R5C04.

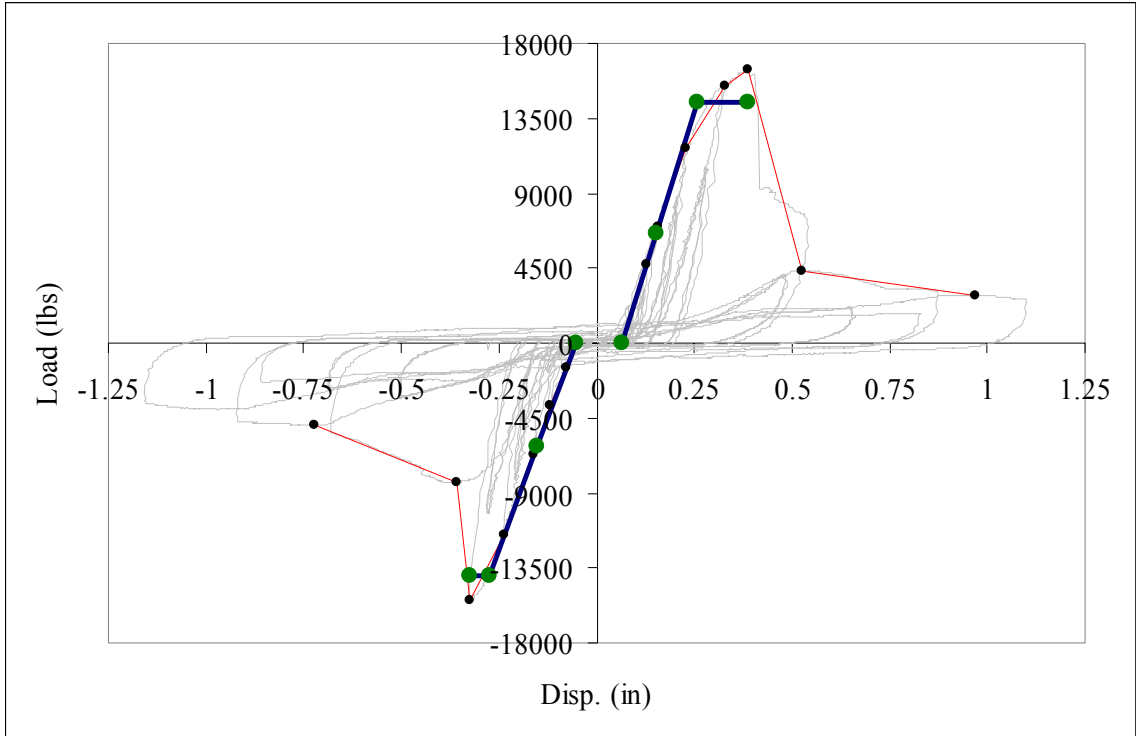


Figure B.146: Load (lbs) vs. Deflection (in.) plot. Test 462R5C05.

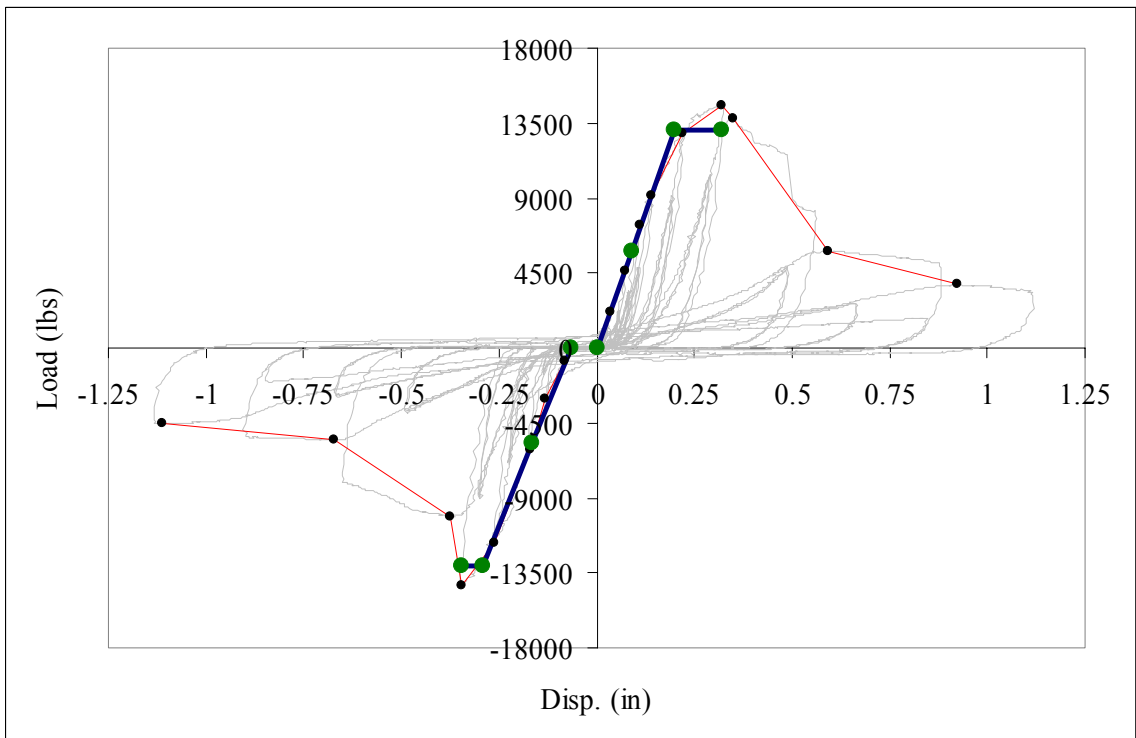


Figure B.147: Load (lbs) vs. Deflection (in.) plot. Test 462R5C06.

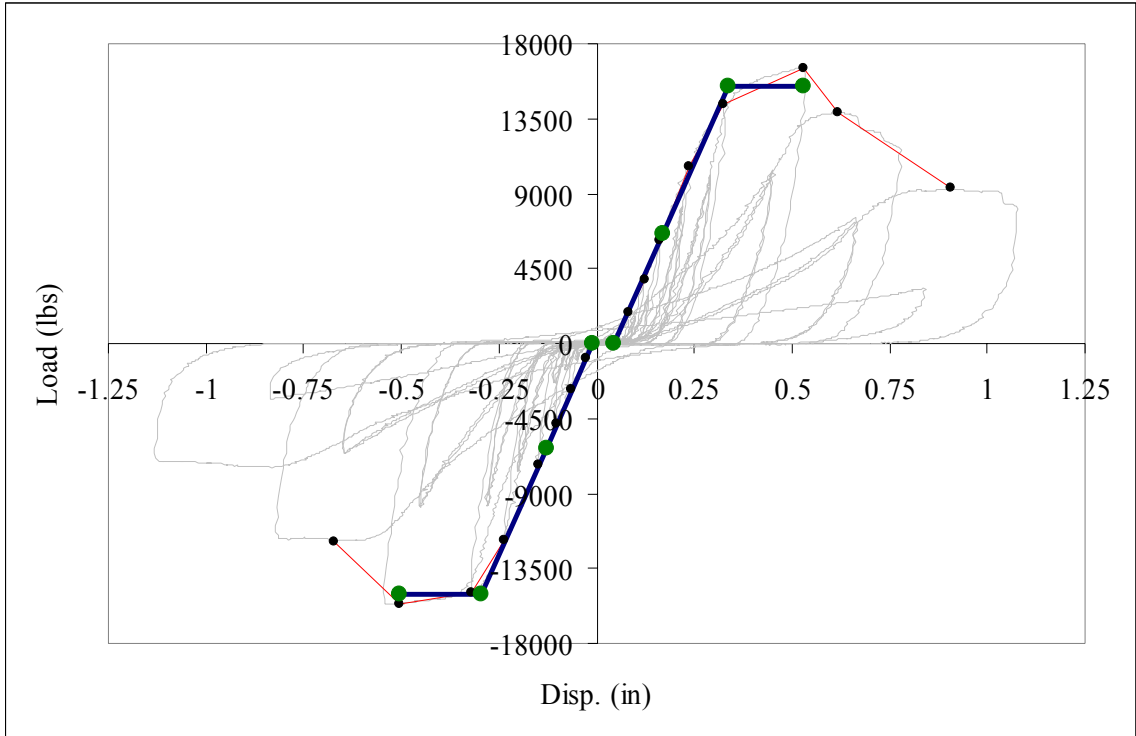


Figure B.148: Load (lbs) vs. Deflection (in.) plot. Test 462R5C07.

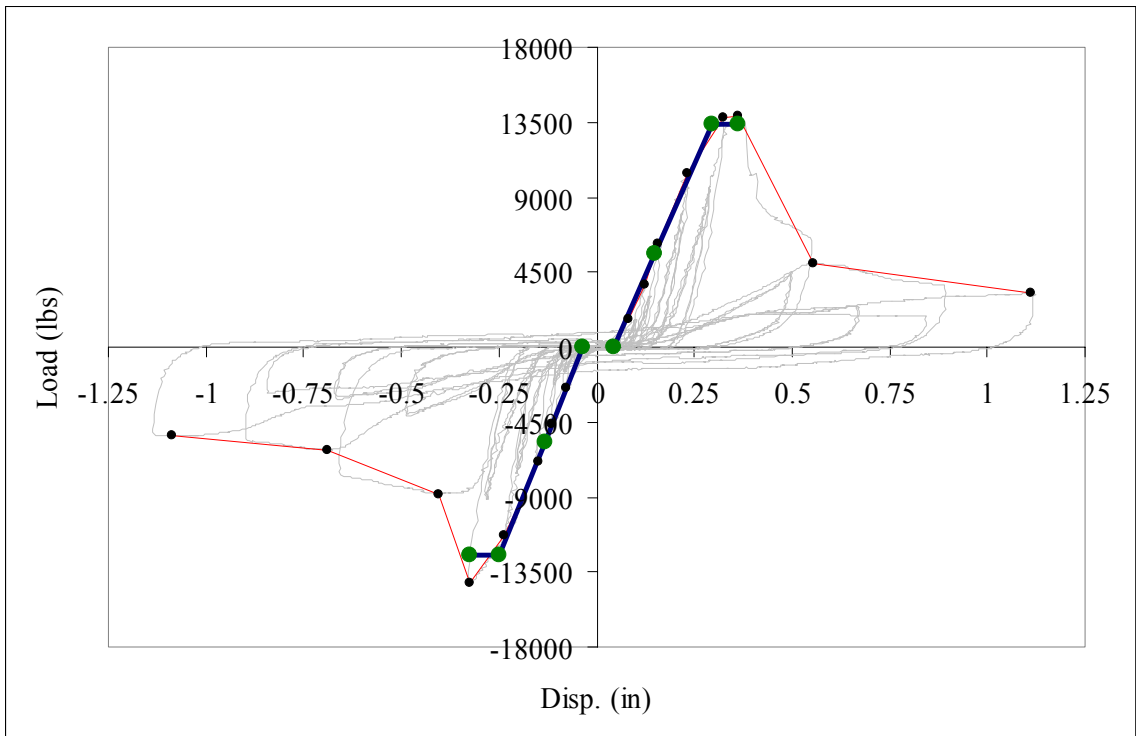


Figure B.149: Load (lbs) vs. Deflection (in.) plot. Test 462R5C08.

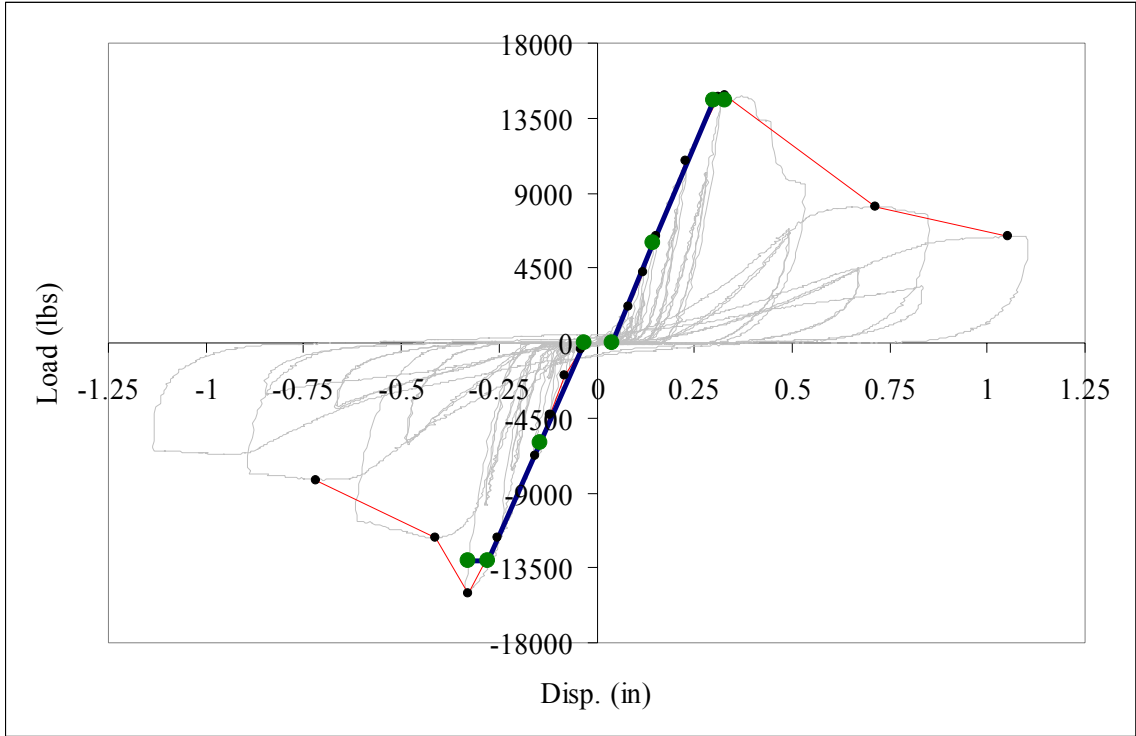


Figure B.150: Load (lbs) vs. Deflection (in.) plot. Test 462R5C09.

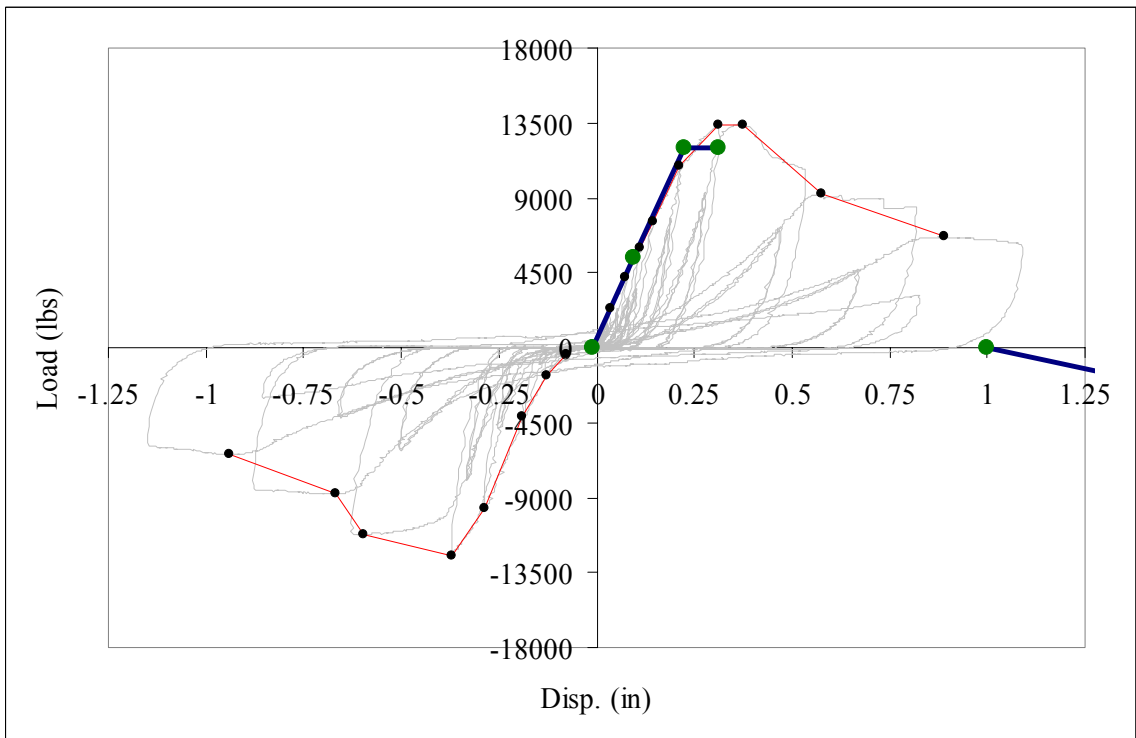


Figure B.151: Load (lbs) vs. Deflection (in.) plot. Test 462R5C10.

B.1.4 – 4X Series Cyclic

Table B.41: Connection properties, 4X1R1C Series.

Connection Properties 4X1R1C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	2750.40	3290.26	3426.35	4066.96		3093.27	4206.81	3191.76	3088.00	3528.61	3404.71	471.91	0.14
@ Displacement (in)	1.78	1.77	1.77	1.76		0.86	1.77	1.71	1.77	1.63	1.65	0.30	0.18
Failure Load (lbs)	2200.32	2632.21	2741.08	3253.57		2474.61	3365.45	2553.41	2470.40	2822.89	2723.77	377.53	0.14
@ Displacement (in)	1.78	1.77	1.77	1.76		1.51	1.77	1.71	1.77	1.63	1.72	0.09	0.05
40% Max (lbs)	1100.16	1316.10	1370.54	1626.78		1237.31	1682.72	1276.70	1235.20	1411.44	1361.89	188.77	0.14
@ Displacement (in)	0.18	0.21	0.22	0.22		0.20	0.18	0.20	0.20	0.20	0.20	0.01	0.07
Yield (lbs)	2545.80	2891.58	2883.75	3261.65		2777.36	3616.27	2777.89	2785.96	3127.36	2963.07	321.81	0.11
@ Displacement (in)	0.31	0.36	0.38	0.38		0.34	0.29	0.34	0.34	0.37	0.35	0.03	0.08
5% Offset (lbs)	1571.26	1725.13	2536.90	2038.33		2408.48	2264.13	1582.32	1567.82	2017.77	1968.02	377.17	0.19
@ Displacement (in)	0.25	0.27	1.02	0.29		0.56	0.24	0.26	0.25	0.29	0.38	0.26	0.68
Elastic Stiff. (lb/in)	11479.28	10237.28	9656.04	10738.45		10716.22	17336.28	10692.12	10973.01	10688.55	11390.80	2284.00	0.20
E.E.P. Energy (lb*in)	4029.55	4492.23	4462.32	5019.50		3575.31	5702.69	4144.18	4348.45	4401.91	4464.02	606.40	0.14
Ductility Ratio	5.77	4.93	4.74	4.82		4.37	6.01	4.95	5.23	4.52	5.04	0.54	0.11
Yield Mode	IV	IV	IV	IV	Censored	III	IV	IV	IV	IV			
Failure Mode	Crush	Crush	Crush	Crush		Splitting	Crush	Crush	Crush	Crush			
Governing Member	N.A.	N.A.	N.A.	N.A.		A	N.A.	N.A.	N.A.	N.A.			

Table B.42: Material properties, 4X1R1C Series.

Member Properties 4X1R1C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	14.31	12.44	16.61	16.97		15.84	12.78	13.88	14.61	14.84	14.70	1.57	0.11
S.G.	0.43	0.50	0.47	0.64		0.37	0.56	0.47	0.47	0.51	0.49	0.08	0.16
D.E. 5% Yield (psi)	4168.40	4755.25	4347.61	6220.57		3226.81	6234.48	3762.75	4045.22	5020.66	4642.42	1038.45	0.22
D.E. Capacity (psi)	4291.56	4755.25	4665.17	6362.05		3397.70	6354.49	3851.03	4141.97	5065.47	4764.97	1030.44	0.22
Member B													
M.C. (%)	14.02	13.84	14.90	15.95		16.31	15.09	13.38	13.27	13.95	14.52	1.10	0.08
S.G.	0.43	0.46	0.42	0.44		0.51	0.56	0.47	0.44	0.40	0.46	0.05	0.11
D.E. 5% Yield (psi)	3993.98	4435.14	3973.16	4376.32		4767.03	5963.33	4612.53	4132.58	4000.56	4472.74	628.11	0.14
D.E. Capacity (psi)	4033.53	4547.38	4168.28	4694.91		5488.25	6247.57	4716.55	4168.65	4090.03	4683.90	743.21	0.16

Table B.43: Hysteretic properties, 4X1R1C Series.

Hysteretic Connection Properties 4X1R1C Series

Indicates that at least one member failed												
Cycle I.D.	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Primary1	76.69	31.72	0.41	0.03	0.01	0.28	-17.21	24.32	1.41	-0.01	0.03	3.07
Primary2	98.58	55.03	0.56	0.04	0.03	0.78	-33.75	36.72	1.09	-0.03	0.04	1.12
Primary3	417.55	256.53	0.61	0.11	0.00	0.02	-358.07	235.77	0.66	-0.11	0.00	0.03
Primary4	1066.51	290.90	0.27	0.17	0.01	0.04	-980.80	307.96	0.31	-0.16	0.01	0.03
Primary5	1603.53	287.26	0.18	0.22	0.01	0.03	-1522.99	321.44	0.21	-0.22	0.01	0.02
Primary6	2454.83	305.46	0.12	0.39	0.01	0.01	-2376.47	320.50	0.13	-0.40	0.01	0.01
Primary7	2757.09	272.58	0.10	0.56	0.01	0.01	-2673.54	292.24	0.11	-0.58	0.01	0.02
Primary8	3040.13	310.49	0.10	0.85	0.01	0.01	-2936.71	265.14	0.09	-0.88	0.00	0.01
Primary9	3183.83	355.10	0.11	1.11	0.08	0.07	-3053.33	288.46	0.09	-1.18	0.02	0.02
Primary10	3273.55	509.17	0.16	1.43	0.08	0.05	-3176.14	378.62	0.12	-1.49	0.01	0.01
Primary11	3355.42	640.38	0.19	1.72	0.06	0.04	-3296.11	481.92	0.15	-1.78	0.02	0.01

Cycle I.D.	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
	Primary1	3.35	1.02	0.30	1.54	0.69	0.45	0.41	0.19	0.46	3729.99	3384.24
Primary2	4.88	1.66	0.34	3.15	1.65	0.52	0.31	0.19	0.63	5249.31	7693.32	1.47
Primary3	25.19	6.76	0.27	43.01	9.26	0.22	0.09	0.01	0.14	3471.71	789.69	0.23
Primary4	87.90	12.92	0.15	168.59	27.52	0.16	0.08	0.01	0.06	6183.14	1059.97	0.17
Primary5	175.01	22.01	0.13	349.38	51.92	0.15	0.08	0.00	0.04	6987.20	1072.94	0.15
Primary6	733.39	100.60	0.14	951.61	117.83	0.12	0.12	0.00	0.02	6131.04	784.16	0.13
Primary7	1179.01	212.52	0.18	1549.69	147.81	0.10	0.12	0.01	0.08	4757.46	527.42	0.11
Primary8	2349.61	437.47	0.19	2585.80	249.78	0.10	0.14	0.01	0.09	3452.76	323.84	0.09
Primary9	3121.34	607.16	0.19	3579.76	466.09	0.13	0.14	0.01	0.09	2719.25	216.05	0.08
Primary10	3758.83	758.70	0.20	4723.56	706.13	0.15	0.13	0.02	0.12	2203.48	272.04	0.12
Primary11	4293.45	951.12	0.22	5823.62	1001.70	0.17	0.12	0.02	0.15	1899.92	309.24	0.16

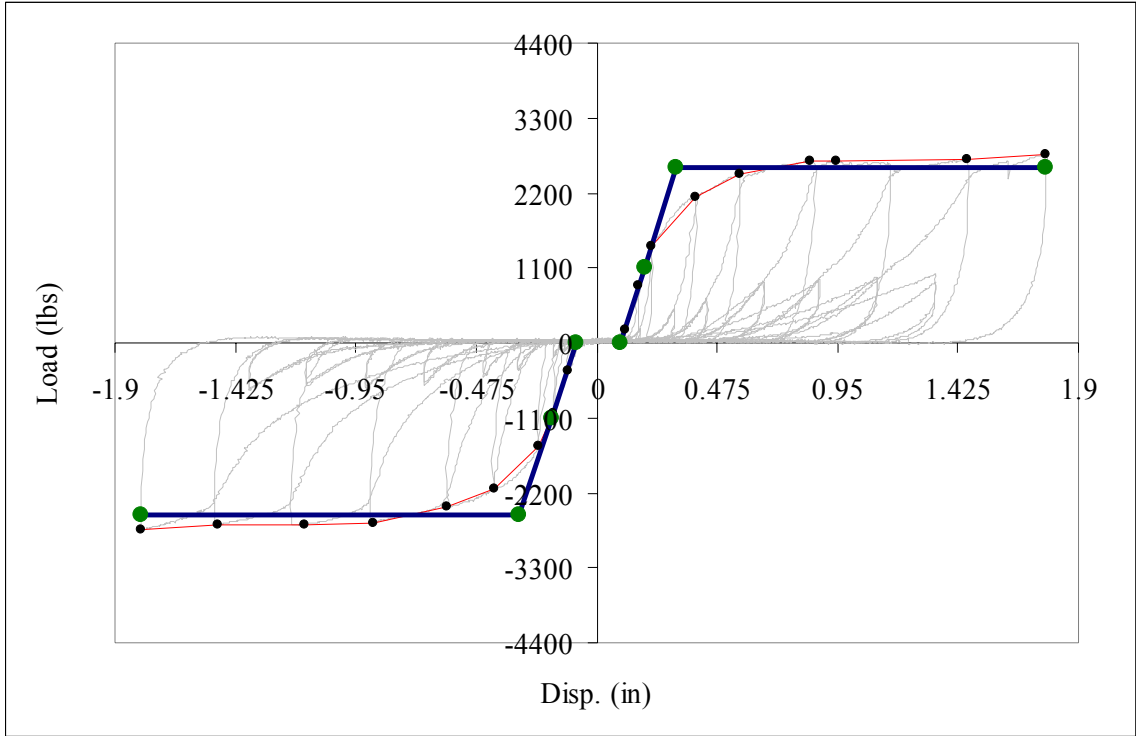


Figure B.152: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C01.

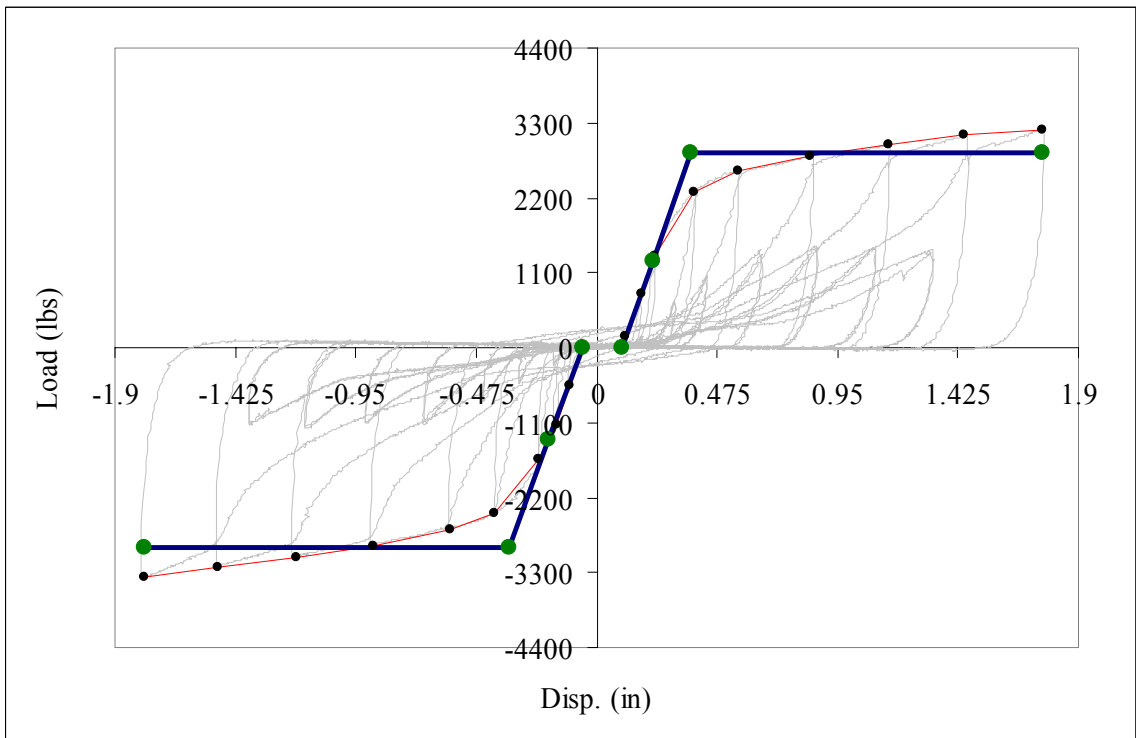


Figure B.153: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C02.

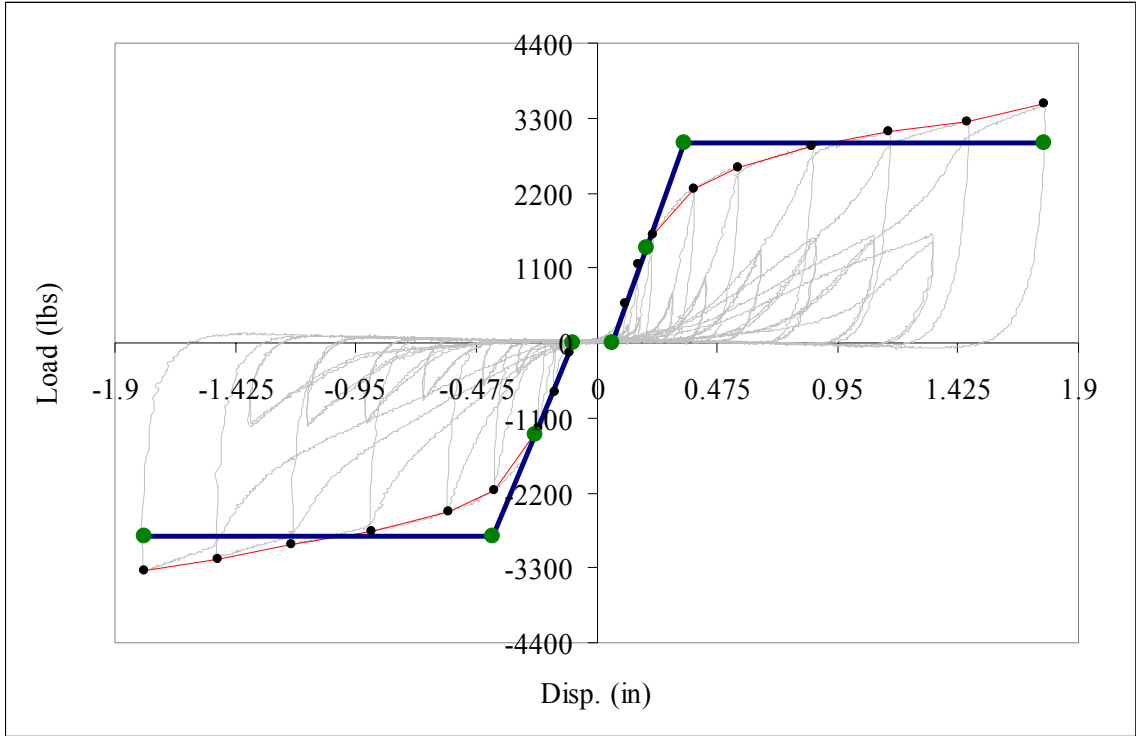


Figure B.154: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C03.

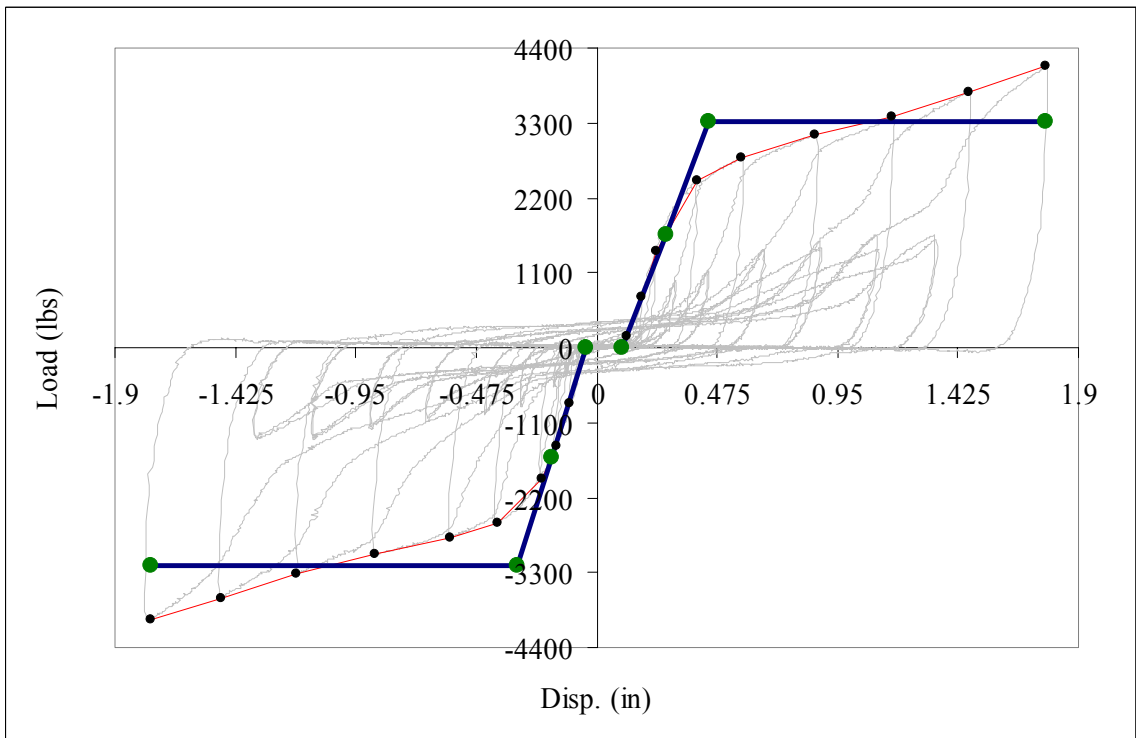


Figure B.155: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C04.

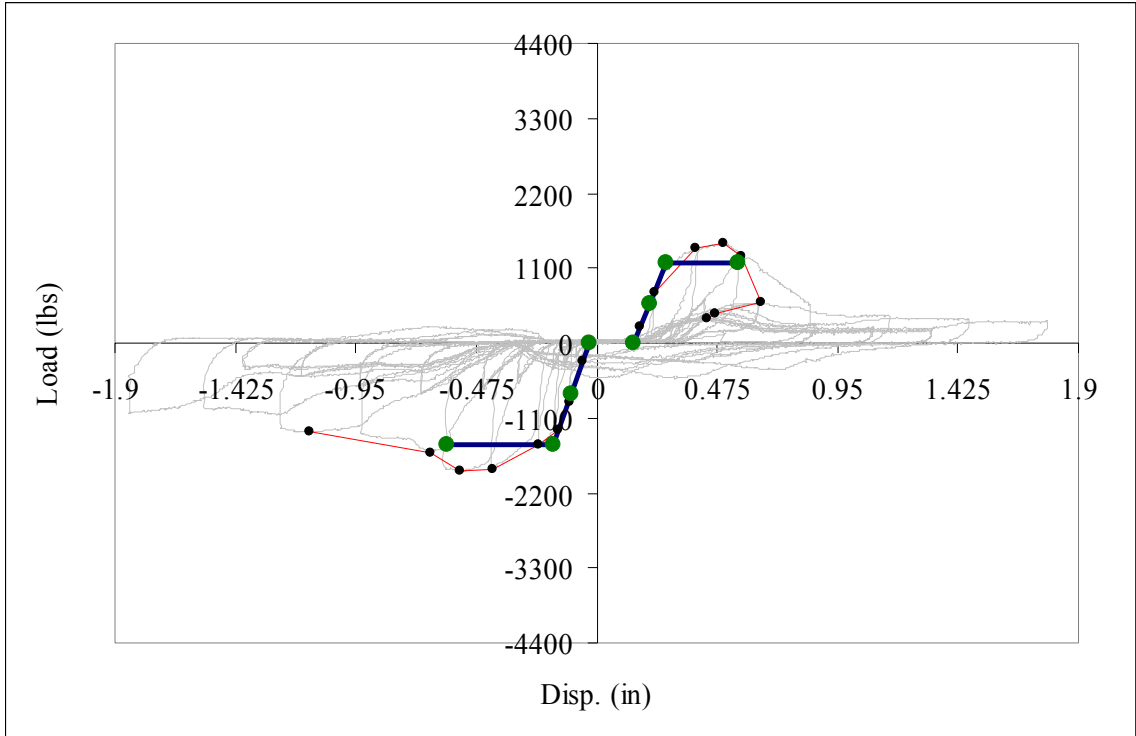


Figure B.156: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C05.

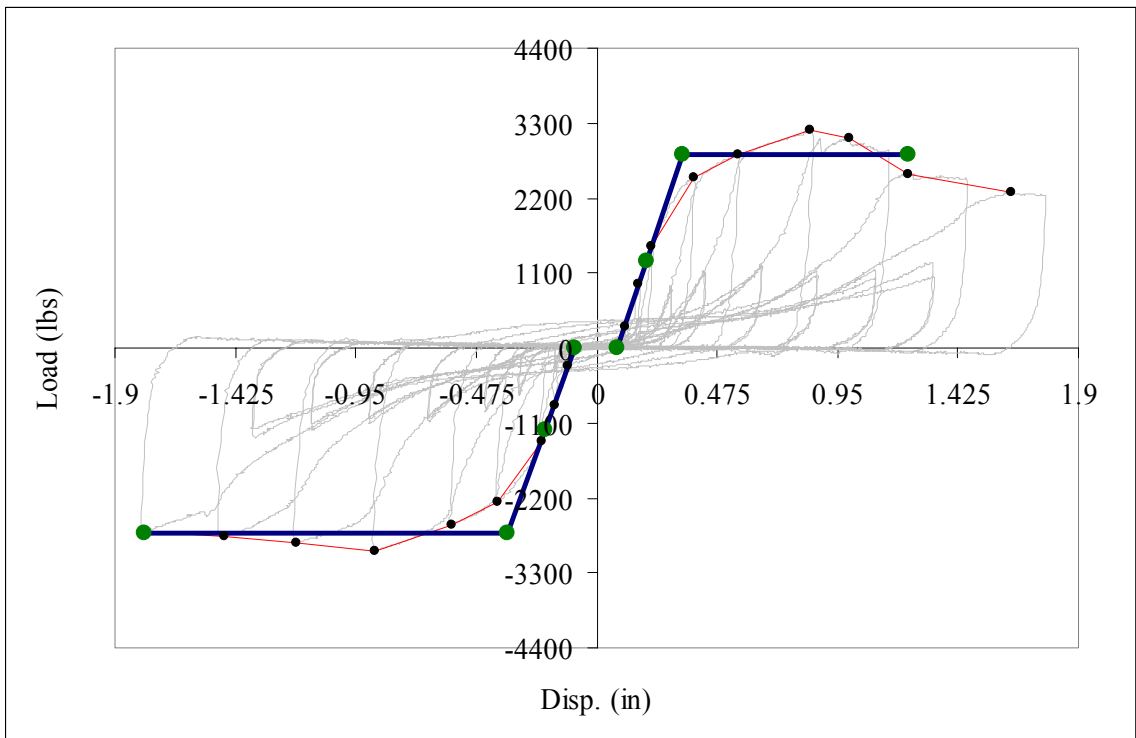


Figure B.157: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C06.

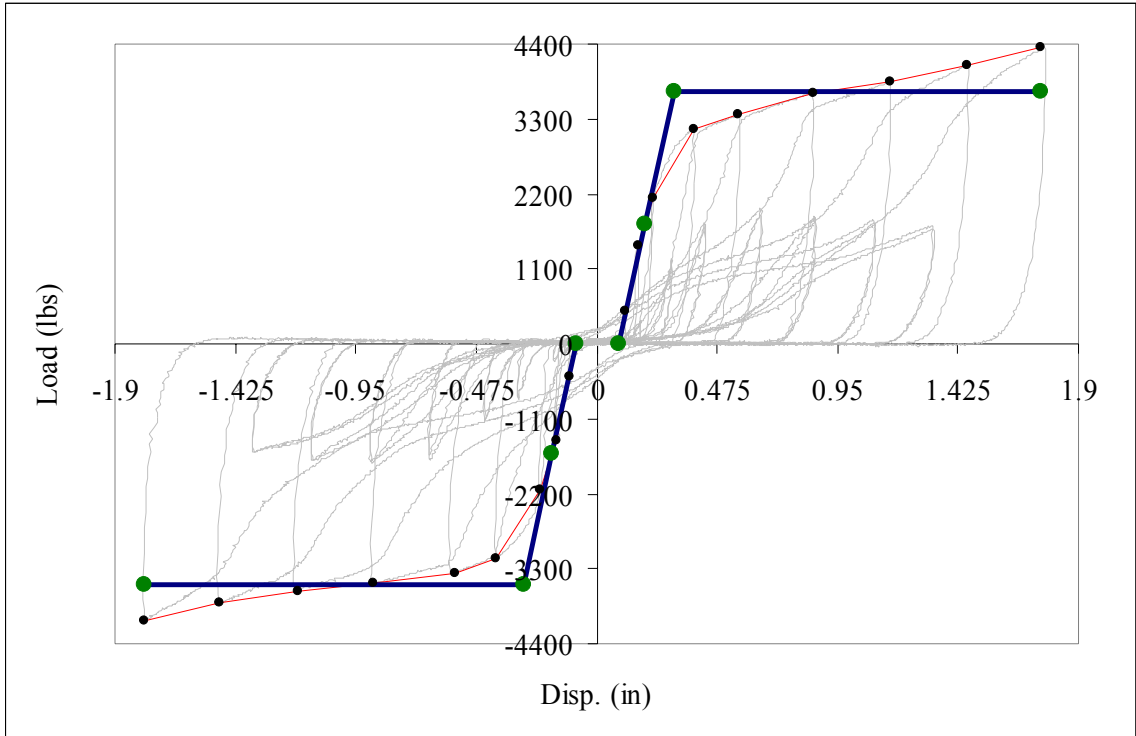


Figure B.158: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C07.

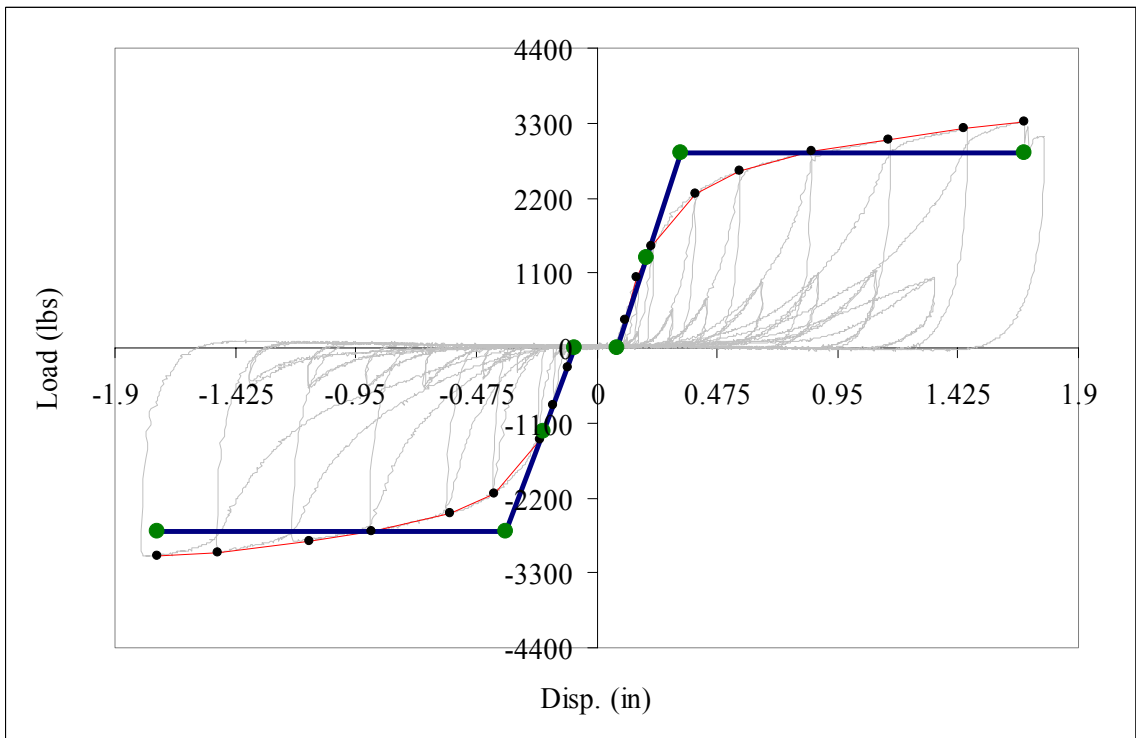


Figure B.159: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C08.

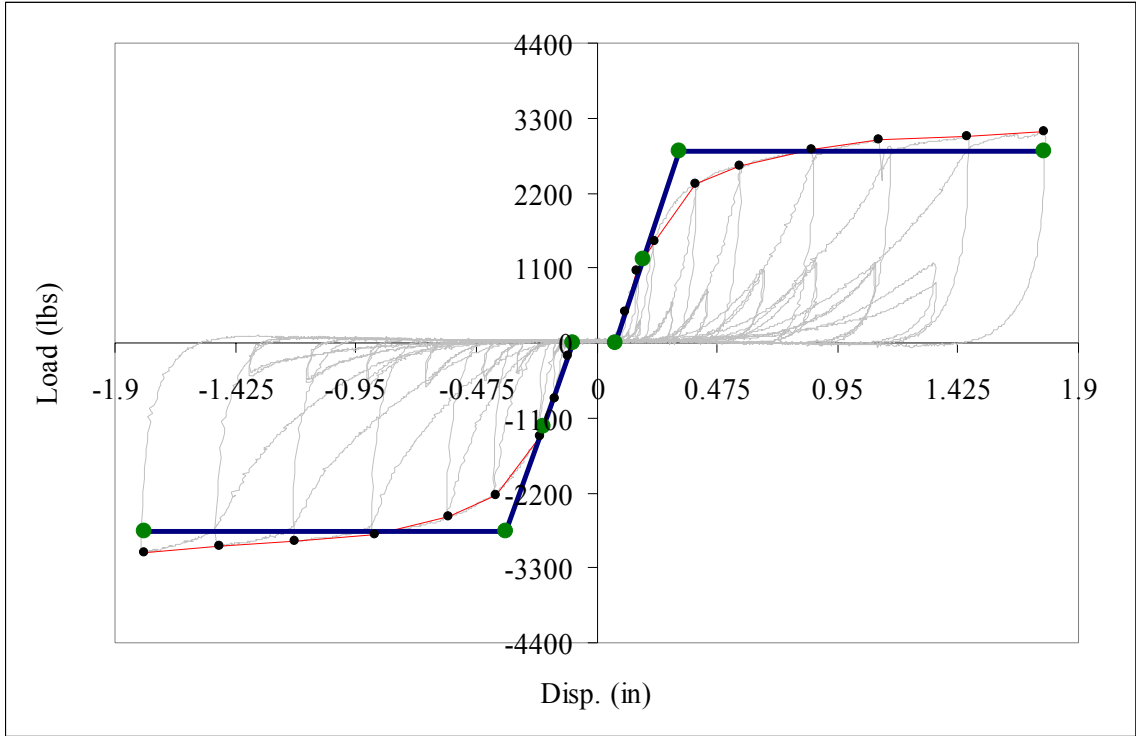


Figure B.160: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C09.

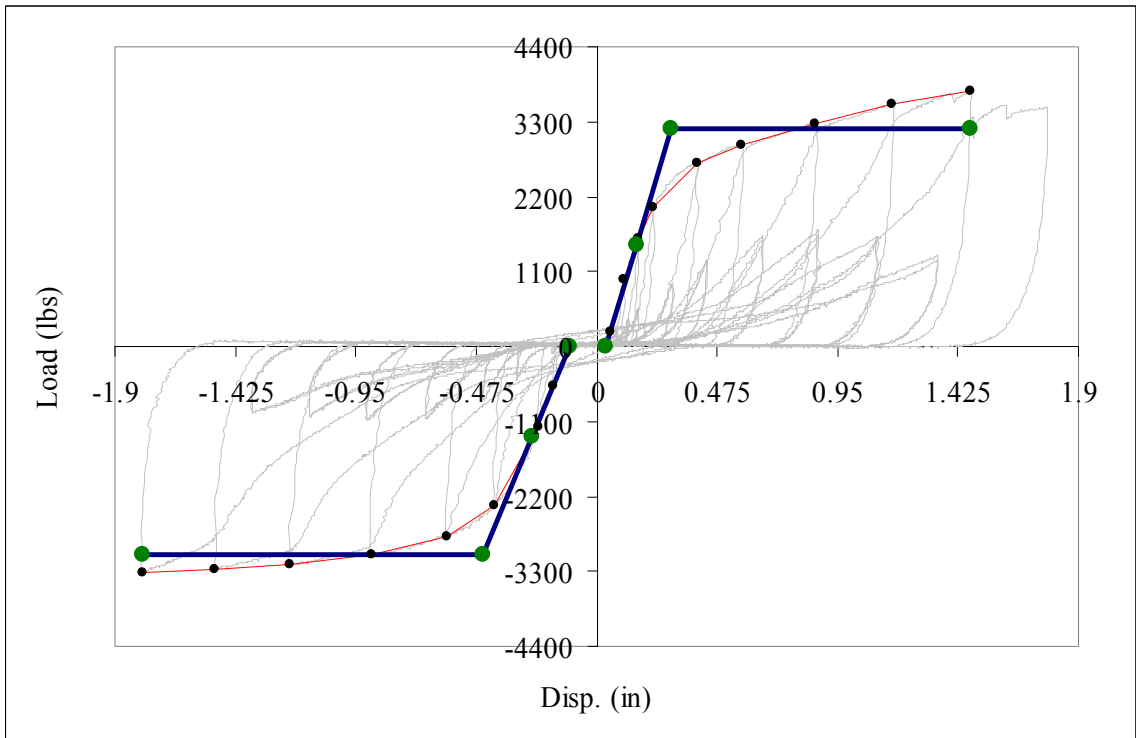


Figure B.161: Load (lbs) vs. Deflection (in.) plot. Test 4X1R1C10.

Table B. 44: Connection properties, 4X1R3C Series.

Connection Properties 4X1R3C Series													
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Mean	Standard Deviation	COV
Max Load (lbs)	6021.87	4899.30	6391.80	6602.32	6233.15	8793.32	5758.71	7059.47	7191.80		6550.19	1087.54	0.17
@ Displacement (in)	0.38	0.34	0.54	0.48	0.40	0.39	0.43	0.36	0.33		0.41	0.07	0.17
Failure Load (lbs)	4817.49	3919.44	5113.44	5281.86	4986.52	7034.66	4606.97	5647.58	5753.44		5240.15	870.04	0.17
@ Displacement (in)	0.38	0.34	0.54	0.48	0.40	0.39	0.43	0.36	0.33		0.41	0.07	0.17
40% Max (lbs)	2408.75	1959.72	2556.72	2640.93	2493.26	3517.33	2303.48	2823.79	2876.72		2620.08	435.02	0.17
@ Displacement (in)	0.18	0.17	0.20	0.17	0.17	0.15	0.18	0.17	0.15		0.17	0.01	0.08
Yield (lbs)	5226.32	4326.77	5601.77	6047.93	5273.26	7509.11	5092.52	6006.19	5905.65		5665.50	879.64	0.16
@ Displacement (in)	0.28	0.29	0.35	0.33	0.28	0.26	0.29	0.26	0.23		0.29	0.04	0.13
5% Offset (lbs)	5775.89	4899.30	4864.17	5953.65	5204.06	8793.32	5029.30	5422.99	6300.29		5804.77	1225.39	0.21
@ Displacement (in)	0.34	0.34	0.34	0.35	0.32	0.39	0.33	0.27	0.29		0.33	0.03	0.10
Elastic Stiff. (lb/in)	27149.00	19316.20	19457.94	21113.38	25773.36	37350.36	25978.61	32615.49	37912.68		27407.45	7153.69	0.26
E.E.P. Energy (lb*in)	1026.85	681.26	1883.22	1722.33	1200.97	1751.20	1237.30	1150.71	1036.90		1298.97	400.75	0.31
Ductility Ratio	1.35	1.16	1.54	1.42	1.44	1.50	1.50	1.37	1.42		1.41	0.11	0.08
Yield Mode	III	III	III	III	III	III	III	III	III				
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting				
Governing Member	A	A	A	B	B	B	A	A	B				
										Censor			
										III			
										Splitting			

Table B. 45: Material properties, 4X1R3C Series.

Member Properties 4X1R3C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	13.14	16.28	14.32	14.67	12.38	15.63	14.62	14.11	15.22		14.49	1.20	0.08
S.G.	0.41	0.38	0.49	0.50	0.37	0.57	0.49	0.49	0.60		0.48	0.08	0.17
D.E. 5% Yield (psi)	4087.01	3676.58	3540.88	4563.00	4074.76	6328.69	3922.80	4604.64	5216.77		4446.13	875.29	0.20
D.E. Capacity (psi)	4164.09	4202.92	3852.92	4965.85	4225.60	6598.78	4064.06	4644.13	5312.86		4670.14	860.82	0.18
Member B													
M.C. (%)	14.39	14.72	14.83	16.68	13.00	13.32	14.33	13.74	12.31		14.15	1.27	0.09
S.G.	0.47	0.47	0.43	0.38	0.42	0.55	0.43	0.56	0.56		0.47	0.07	0.14
D.E. 5% Yield (psi)	4019.72	4718.24	3381.18	3868.39	4301.06	5581.75	3776.22	5528.63	5729.94		4545.01	881.42	0.19
D.E. Capacity (psi)	4135.11	4812.65	3416.90	4143.69	4548.11	5904.89	3818.64	5635.12	5729.94		4682.78	899.43	0.19

Table B. 46: Hysteretic properties, 4X1R3C Series.

Hysteretic Connection Properties 4X1R3C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	127.22	74.02	0.58	0.03	0.02	0.53	-47.07	57.53	1.22	-0.02	0.01	0.56
Primary2	180.00	121.18	0.67	0.05	0.00	0.09	-72.48	104.79	1.45	-0.03	0.03	1.10
Primary3	907.23	407.33	0.45	0.10	0.00	0.04	-592.64	522.32	0.88	-0.10	0.01	0.06
Primary4	2309.35	856.60	0.37	0.15	0.00	0.03	-1852.50	1020.69	0.55	-0.15	0.01	0.04
Primary5	3691.32	1360.93	0.37	0.21	0.01	0.03	-3223.49	1194.00	0.37	-0.20	0.01	0.04
Primary6	6182.32	2247.03	0.36	0.34	0.02	0.06	-5874.80	1354.28	0.23	-0.36	0.02	0.04
Primary7	6405.33	2502.07	0.39	0.41	0.05	0.13	-5067.72	1013.01	0.20	-0.50	0.05	0.09
Primary8	3920.94	1801.80	0.46	0.58	0.06	0.11	-4171.02	817.42	0.20	-0.66	0.10	0.16
Primary9	2569.45	1304.38	0.51	0.83	0.06	0.08	-3504.30	1099.55	0.31	-0.91	0.13	0.14
Primary10	1649.98	776.11	0.47	1.06	0.13	0.13	-2997.86	1085.51	0.36	-1.24	0.13	0.11
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	5.08	1.12	0.22	2.81	1.52	0.54	0.35	0.17	0.47	3730.39	1991.36	0.53
Primary2	7.65	1.98	0.26	5.87	3.10	0.53	0.24	0.07	0.30	4168.01	3423.46	0.82
Primary3	42.00	12.87	0.31	75.10	23.92	0.32	0.09	0.02	0.18	7512.18	2736.45	0.36
Primary4	149.49	38.66	0.26	316.43	94.56	0.30	0.08	0.01	0.10	13676.86	4401.62	0.32
Primary5	319.23	73.07	0.23	709.90	171.36	0.24	0.07	0.00	0.07	16847.96	4547.53	0.27
Primary6	1412.96	224.88	0.16	2108.75	399.12	0.19	0.11	0.01	0.05	17236.28	3780.79	0.22
Primary7	2049.06	490.42	0.24	2575.39	593.15	0.23	0.13	0.02	0.12	12714.56	2633.43	0.21
Primary8	2920.10	782.55	0.27	2532.89	799.73	0.32	0.19	0.03	0.14	6541.26	1283.78	0.20
Primary9	3425.68	943.17	0.28	2712.09	1129.13	0.42	0.22	0.05	0.22	3451.27	1001.49	0.29
Primary10	4102.74	1241.01	0.30	2736.99	844.55	0.31	0.24	0.03	0.14	2045.68	764.19	0.37

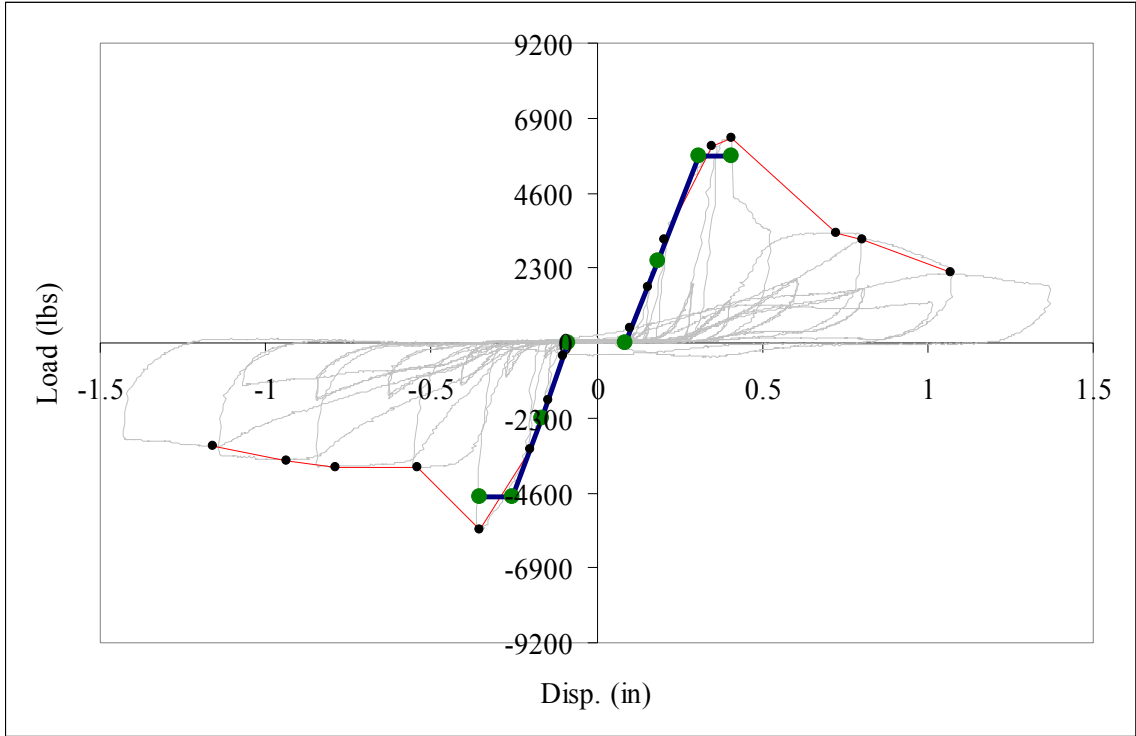


Figure B.162: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C01.

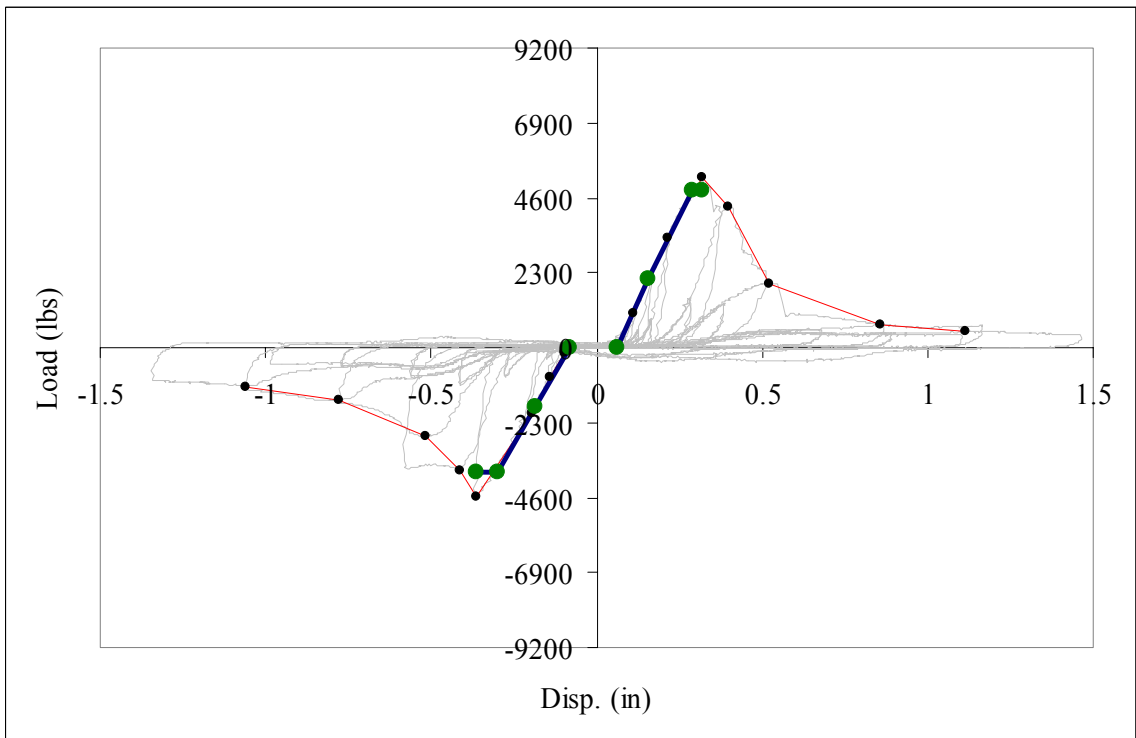


Figure B.163: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C02.

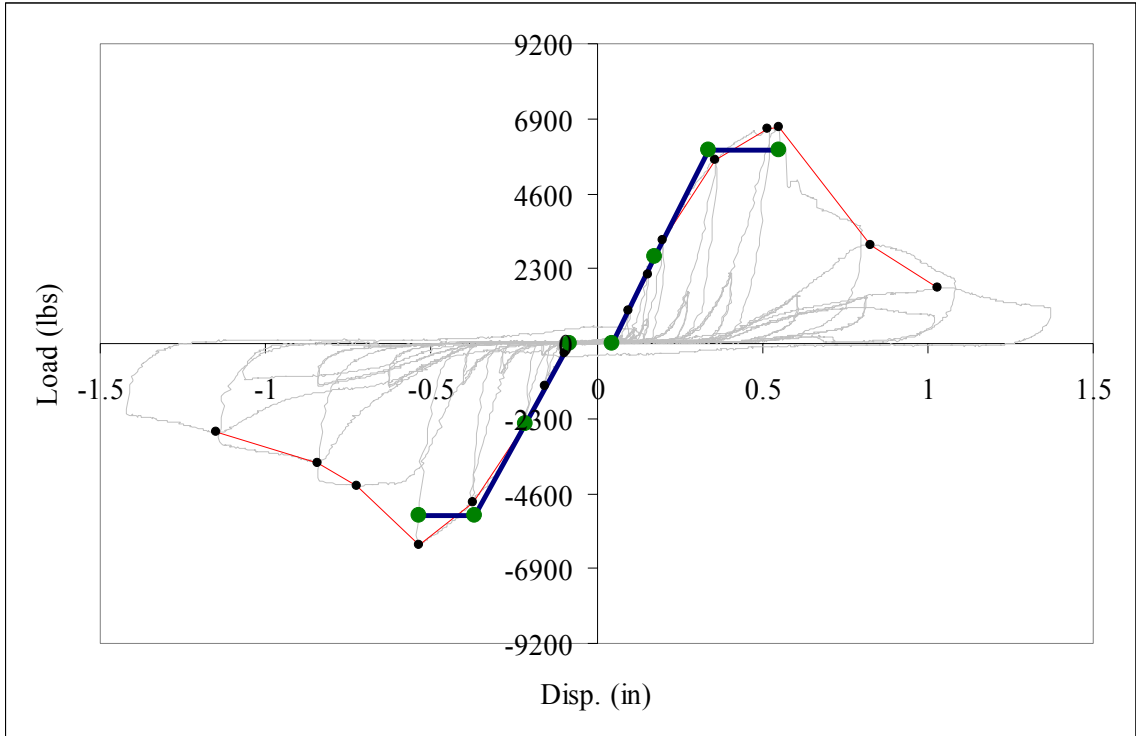


Figure B.164: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C03.

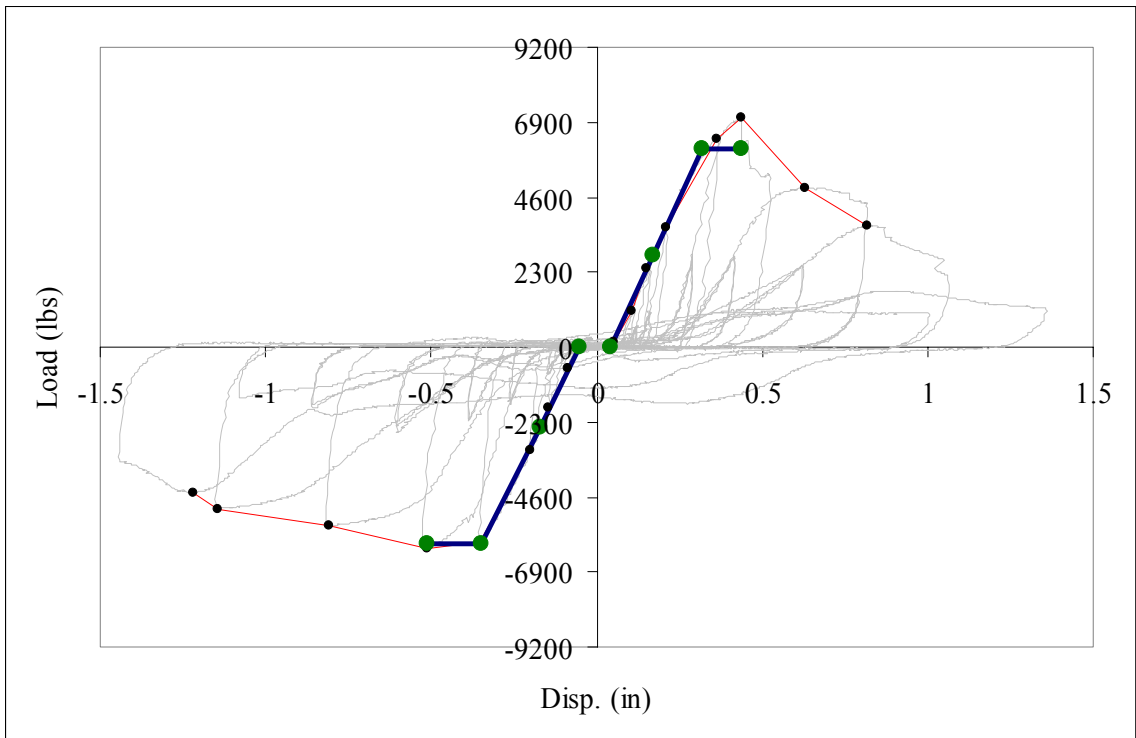


Figure B.165: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C04.

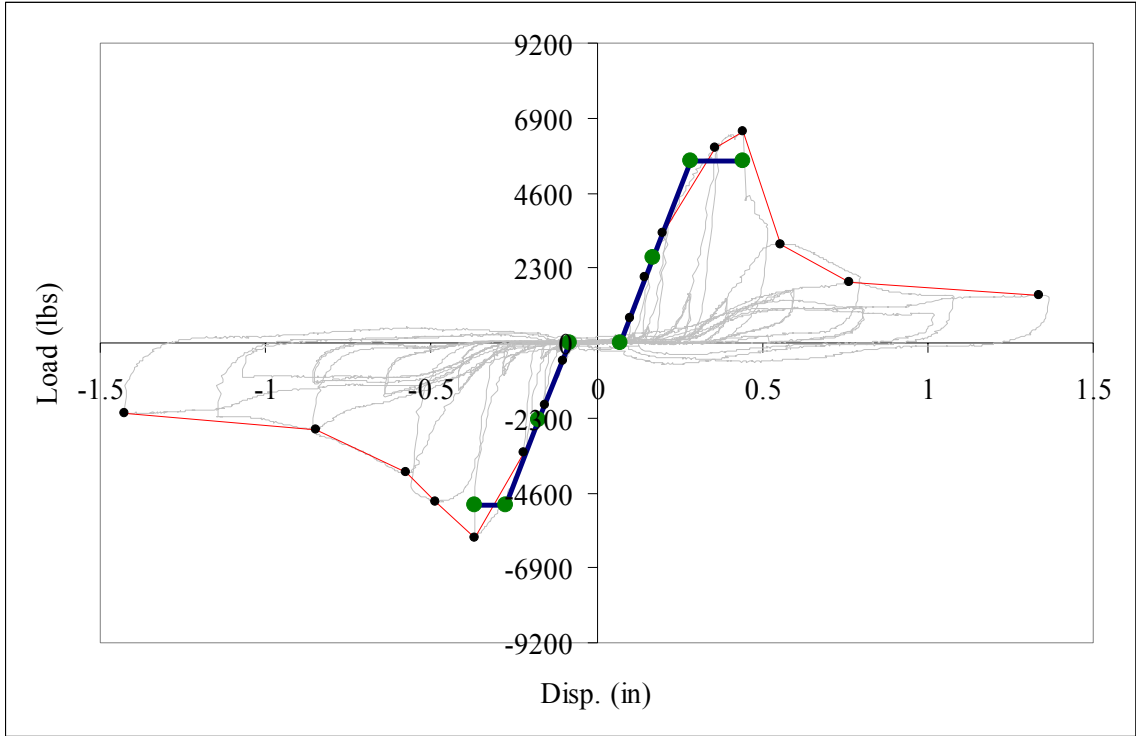


Figure B.166: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C05.

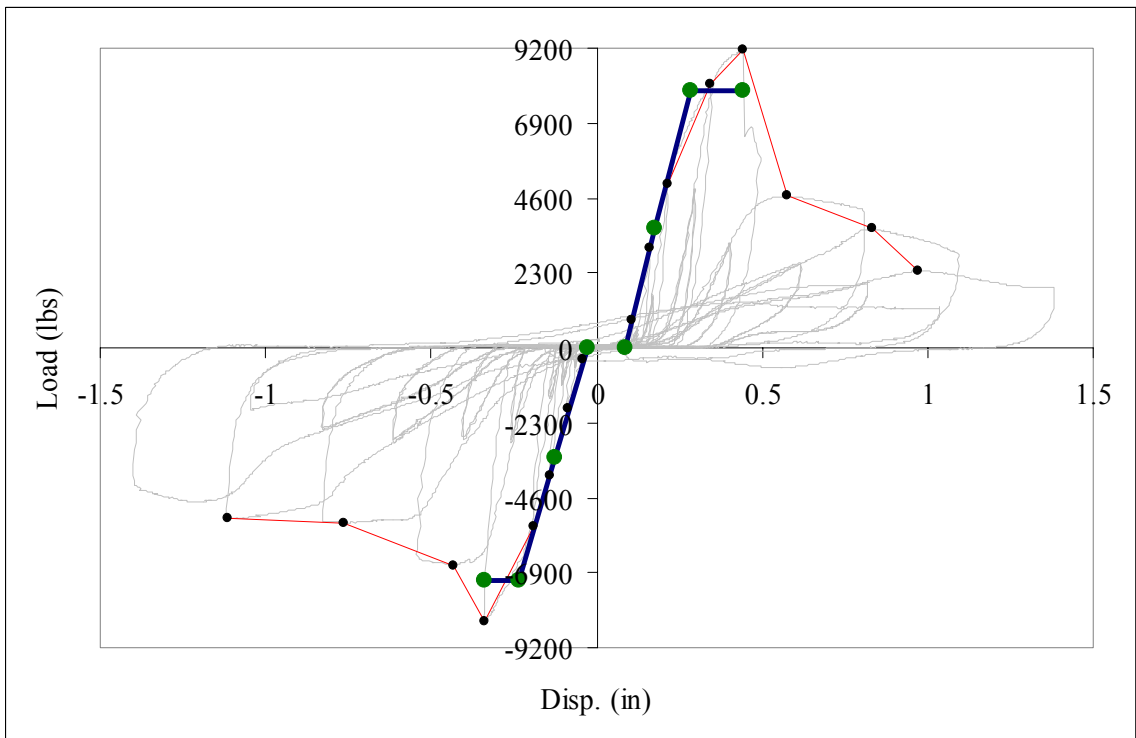


Figure B.167: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C06.

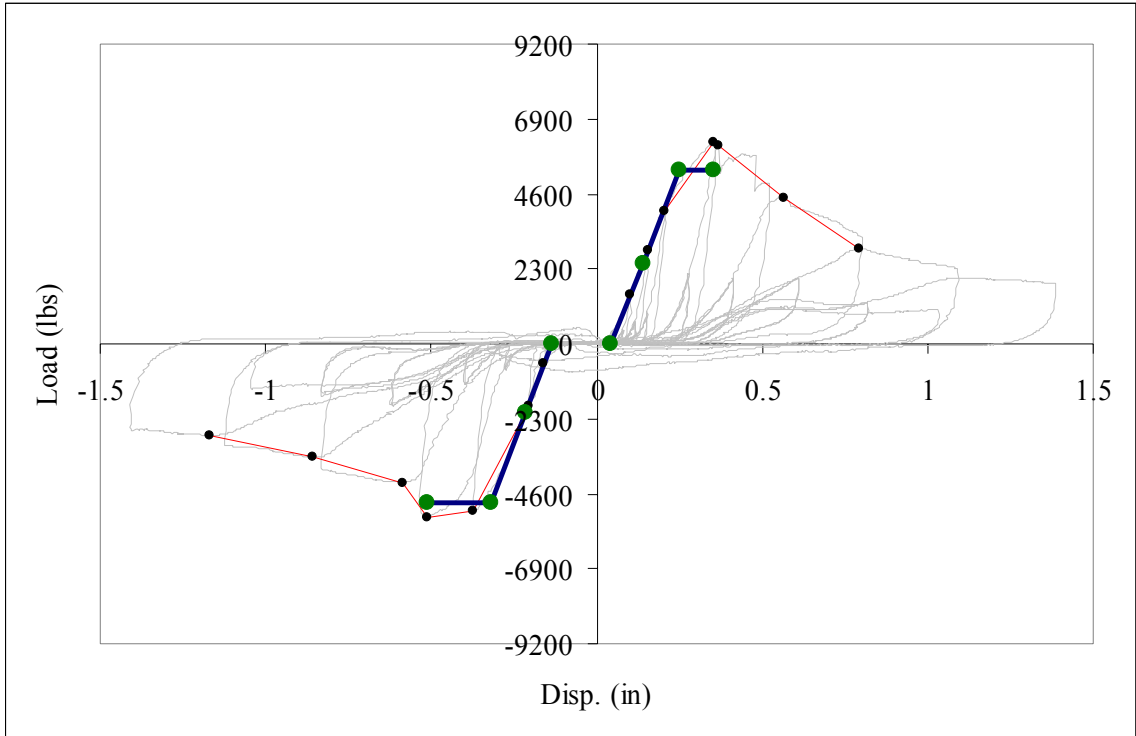


Figure B.168: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C07.

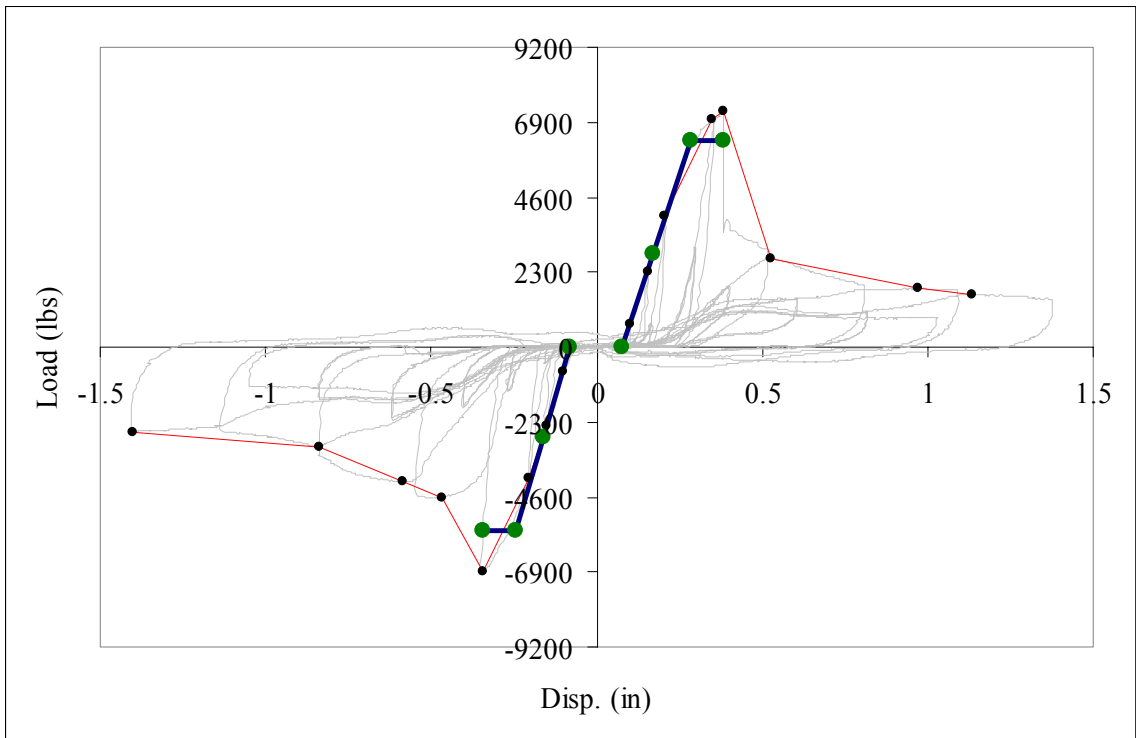


Figure B.169: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C08.

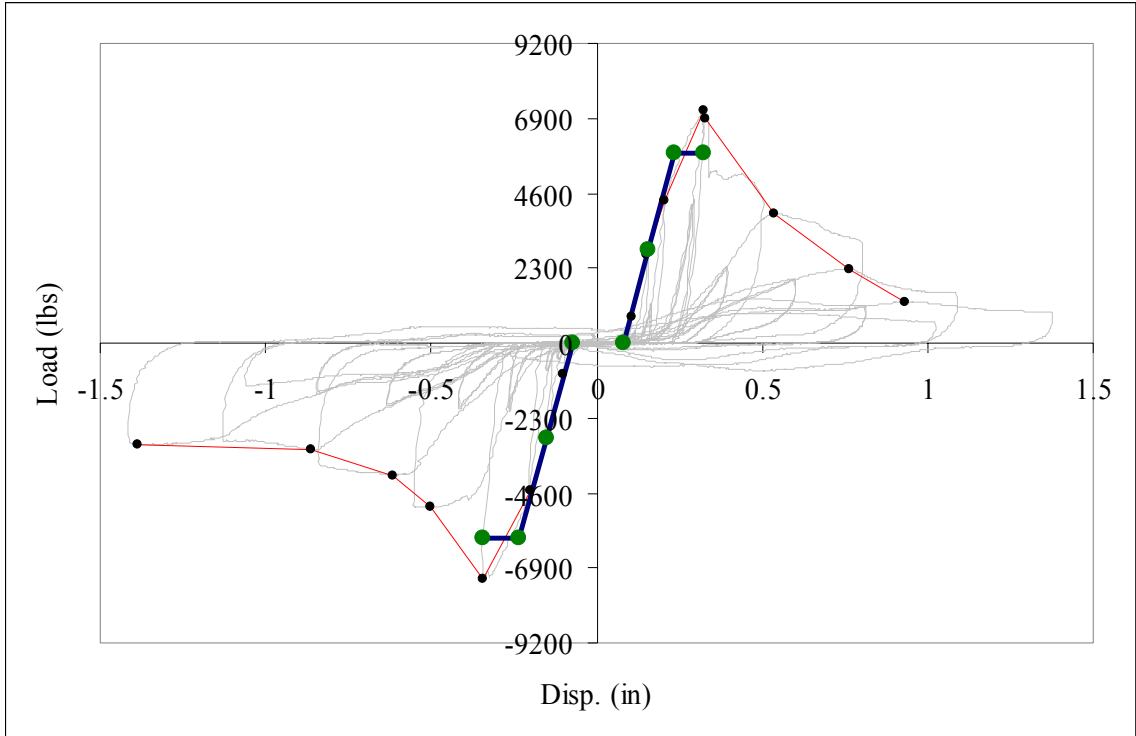


Figure B.170: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C09.

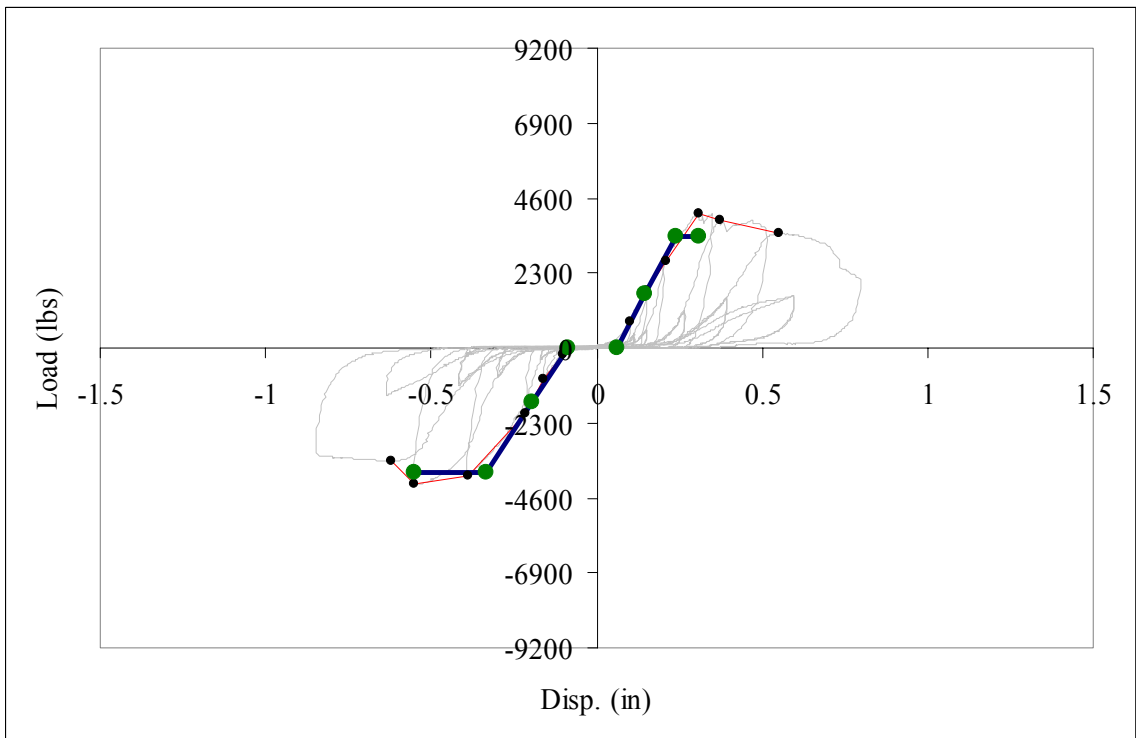


Figure B.171: Load (lbs) vs. Deflection (in.) plot. Test 4X1R3C10.

Table B.47: Connection properties, 4X1R5C Series.

Connection Properties 4X1R5C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard		
	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
Max Load (lbs)	10248.98	10346.72	7686.55	9909.88	10473.79	11213.65	13093.37	9558.75	8182.79	9233.18	9994.77	1523.65	0.15
@ Displacement (in)	0.32	0.37	0.36	0.39	0.29	0.48	0.29	0.32	0.35	0.34	0.35	0.06	0.16
Failure Load (lbs)	8199.18	8277.38	6149.24	7927.90	8379.03	8970.92	10474.69	7647.00	6546.23	7386.54	7995.81	1218.92	0.15
@ Displacement (in)	0.32	0.37	0.36	0.39	0.29	0.48	0.29	0.32	0.35	0.34	0.35	0.06	0.16
40% Max (lbs)	4099.59	4138.69	3074.62	3963.95	4189.52	4485.46	5237.35	3823.50	3273.12	3693.27	3997.91	609.46	0.15
@ Displacement (in)	0.15	0.19	0.17	0.19	0.14	0.18	0.14	0.18	0.16	0.17	0.17	0.02	0.11
Yield (lbs)	9136.92	8979.92	6352.77	8616.22	9248.06	10029.04	10857.32	8226.07	7111.58	7833.64	8639.15	1331.99	0.15
@ Displacement (in)	0.26	0.31	0.26	0.32	0.22	0.32	0.21	0.27	0.27	0.26	0.27	0.04	0.13
5% Offset (lbs)	9308.95	9659.12	7477.94	9909.88	9576.72	9642.58	11342.36	9558.75	6831.23	8750.73	9205.83	1271.96	0.14
@ Displacement (in)	0.29	0.33	0.35	0.39	0.26	0.34	0.25	0.32	0.29	0.32	0.31	0.04	0.14
Elastic Stiff. (lb/in)	47256.67	41719.04	37190.82	36259.79	59895.30	40705.31	82491.70	45480.17	34608.14	43442.94	46904.99	14428.10	0.31
E.E.P. Energy (lb*in)	1438.15	1577.16	1161.34	1686.27	1319.63	2858.95	1587.61	1102.30	1279.00	1304.44	1531.48	503.48	0.33
Ductility Ratio	1.23	1.21	1.39	1.23	1.31	1.51	1.38	1.16	1.28	1.29	1.30	0.10	0.08
Yield Mode	II, III	II, III	II, III	II, III	III	III	III	III	II, III	II, III			
Failure Mode	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting	Splitting			
Governing Member	A	B	B	B	A	A	A	B	B	B			

Table B.48: Material properties, 4X1R5C Series.

Member Properties 4X1R5C Series													
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Standard	
Member A	1	2	3	4	5	6	7	8	9	10	Mean	Deviation	COV
M.C. (%)	12.98	13.07	14.66	12.80	12.86	15.89	14.13	13.21	13.59	11.80	13.50	1.14	0.08
S.G.	0.45	0.44	0.40	0.46	0.59	0.57	0.58	0.46	0.44	0.49	0.49	0.07	0.14
D.E. 5% Yield (psi)	5483.63	5026.70	4029.02	4394.77	5947.56	4225.10	5588.65	3720.49	3608.92	4794.44	4681.93	815.91	0.17
D.E. Capacity (psi)	5599.12	5153.31	4117.14	4570.98	5985.78	4238.90	5695.74	4187.82	3685.44	4988.83	4822.31	778.40	0.16
Member B													
M.C. (%)	14.24	13.40	14.57	14.49	13.97	14.29	14.62	10.91	15.69	13.20	13.94	1.27	0.09
S.G.	0.53	0.51	0.40	0.42	0.60	0.56	0.67	0.47	0.49	0.52	0.52	0.08	0.16
D.E. 5% Yield (psi)	4854.84	4105.74	4020.99	3656.03	4484.82	4955.68	5830.44	4944.25	4478.57	5055.81	4638.72	624.98	0.13
D.E. Capacity (psi)	5179.26	4253.25	4090.53	3679.30	4803.27	5019.49	6201.76	5051.87	4870.18	5102.74	4825.16	696.73	0.14

Table B.49: Hysteretic properties, 4X1R5C Series.

Hysteretic Connection Properties 4X1R5C Series

Indicates that at least one member failed												
	Pull Stroke						Push Stroke					
	Max Load (pounds)			Displacement (inches)			Max Load (pounds)			Displacement (inches)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	351.58	42.02	0.12	0.03	0.01	0.21	-71.58	52.64	0.74	-0.03	0.00	0.11
Primary2	472.49	62.62	0.13	0.04	0.01	0.14	-124.66	81.39	0.65	-0.04	0.02	0.51
Primary3	1455.95	713.13	0.49	0.10	0.01	0.09	-1056.40	509.71	0.48	-0.10	0.01	0.07
Primary4	3453.57	1585.31	0.46	0.15	0.01	0.08	-3169.21	948.73	0.30	-0.15	0.01	0.07
Primary5	5677.35	2288.17	0.40	0.19	0.02	0.09	-5525.47	1048.41	0.19	-0.20	0.02	0.08
Primary6	10071.38	3474.11	0.34	0.32	0.04	0.13	-9362.95	1474.56	0.16	-0.33	0.03	0.08
Primary7	8076.47	3543.60	0.44	0.37	0.06	0.15	-5955.25	1958.13	0.33	-0.44	0.08	0.18
Primary8	4116.43	2770.44	0.67	0.53	0.03	0.06	-4291.62	1526.28	0.36	-0.56	0.05	0.09
Primary9	2414.46	973.90	0.40	0.85	0.21	0.25	-3354.47	1241.66	0.37	-0.93	0.20	0.22
Primary10	2125.74	884.20	0.42	1.22	0.30	0.24	-3224.85	1251.34	0.39	-1.31	0.14	0.10
	Hysteretic Energy (lb*in)			Strain Energy (lb*in)			E.V.D.			Cyclic Stiffness (lb/in)		
	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV	Mean	Standard Deviation	COV
Cycle I.D.												
Primary1	8.65	6.15	0.71	7.27	13.98	1.92	0.37	0.15	0.41	6699.74	10950.05	1.63
Primary2	12.59	8.52	0.68	12.94	21.20	1.64	0.25	0.10	0.40	13525.62	32467.27	2.40
Primary3	63.29	38.04	0.60	120.72	68.30	0.57	0.09	0.02	0.19	12694.88	8015.10	0.63
Primary4	197.74	40.50	0.20	483.75	139.19	0.29	0.07	0.01	0.10	22162.86	7657.38	0.35
Primary5	433.47	68.80	0.16	1096.15	238.55	0.22	0.06	0.01	0.08	28361.54	7849.38	0.28
Primary6	1970.53	231.65	0.12	3149.70	312.03	0.10	0.10	0.01	0.13	30054.41	6718.45	0.22
Primary7	2460.36	540.81	0.22	2872.03	1175.11	0.41	0.15	0.04	0.25	17114.10	3315.21	0.19
Primary8	3332.59	1125.38	0.34	2302.59	1019.27	0.44	0.24	0.04	0.18	7683.84	3686.30	0.48
Primary9	4103.36	1295.84	0.32	2741.87	1160.49	0.42	0.28	0.12	0.43	3129.75	843.94	0.27
Primary10	4943.17	1619.93	0.33	3548.67	1475.55	0.42	0.25	0.08	0.32	2043.64	630.52	0.31

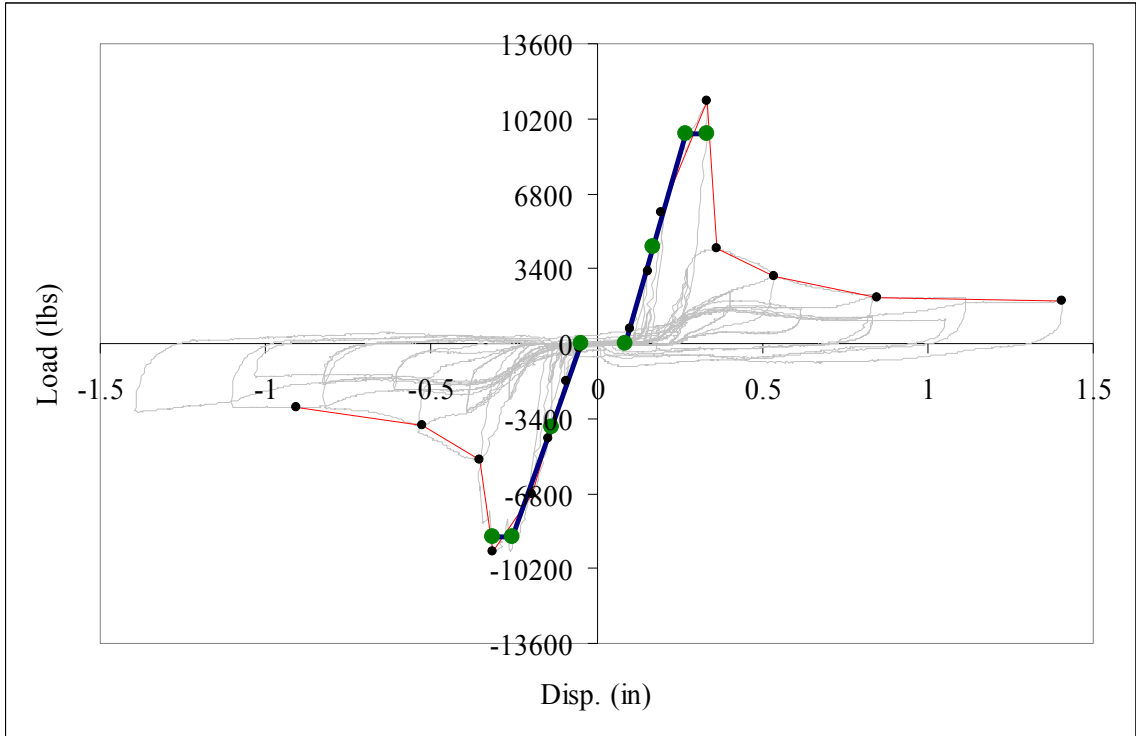


Figure B.172: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C01.

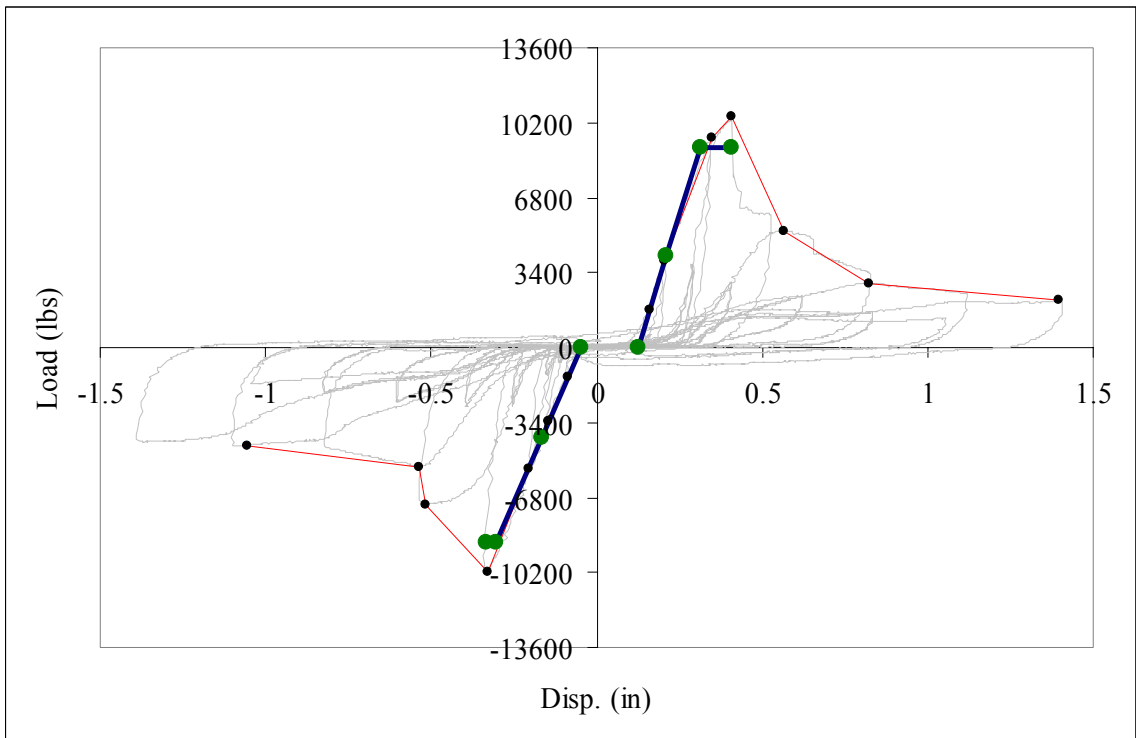


Figure B.173: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C02.

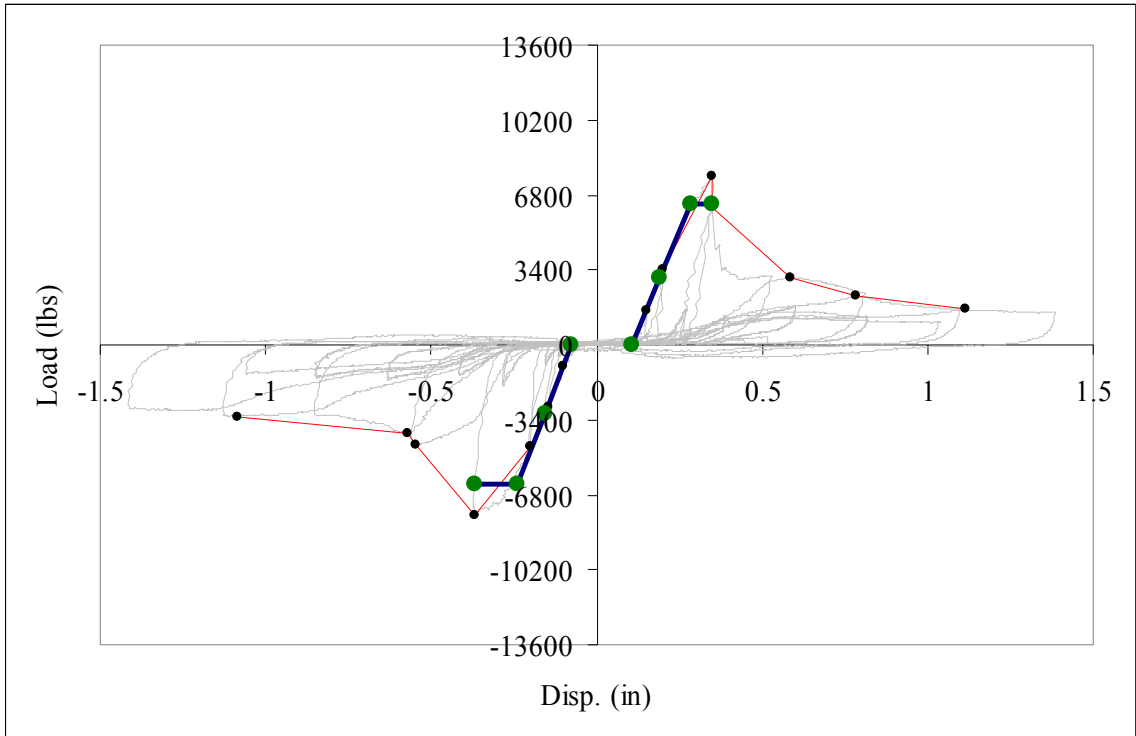


Figure B.174: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C03.

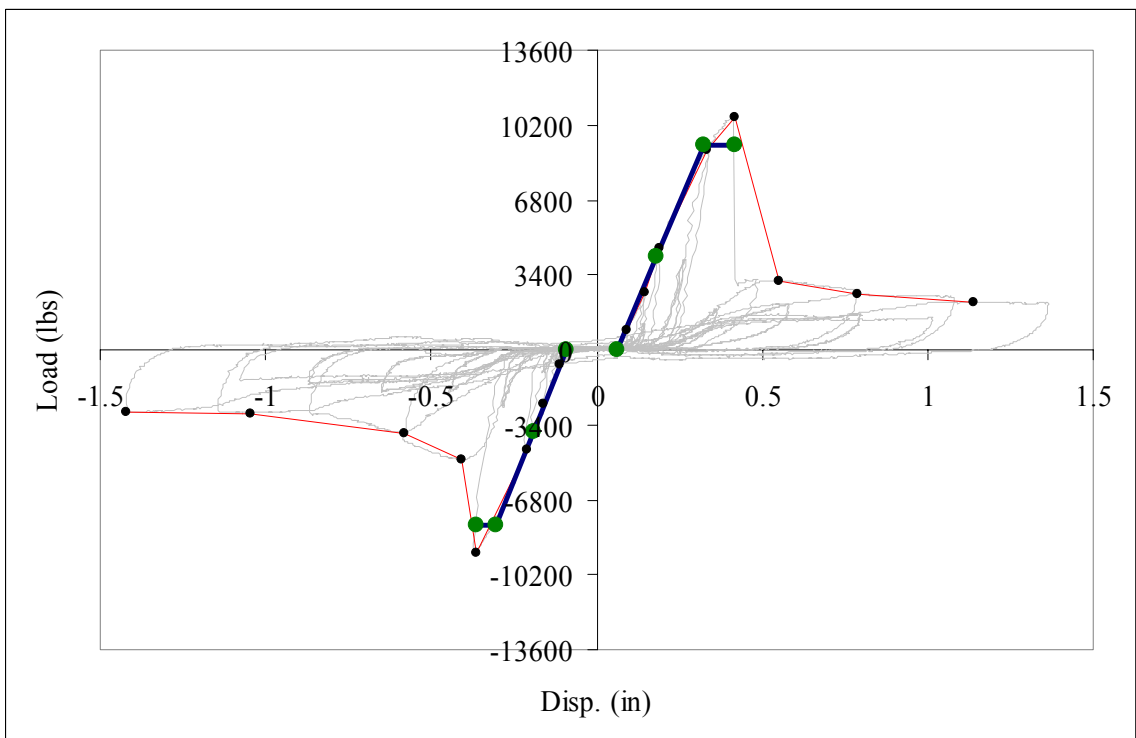


Figure B.175: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C04.

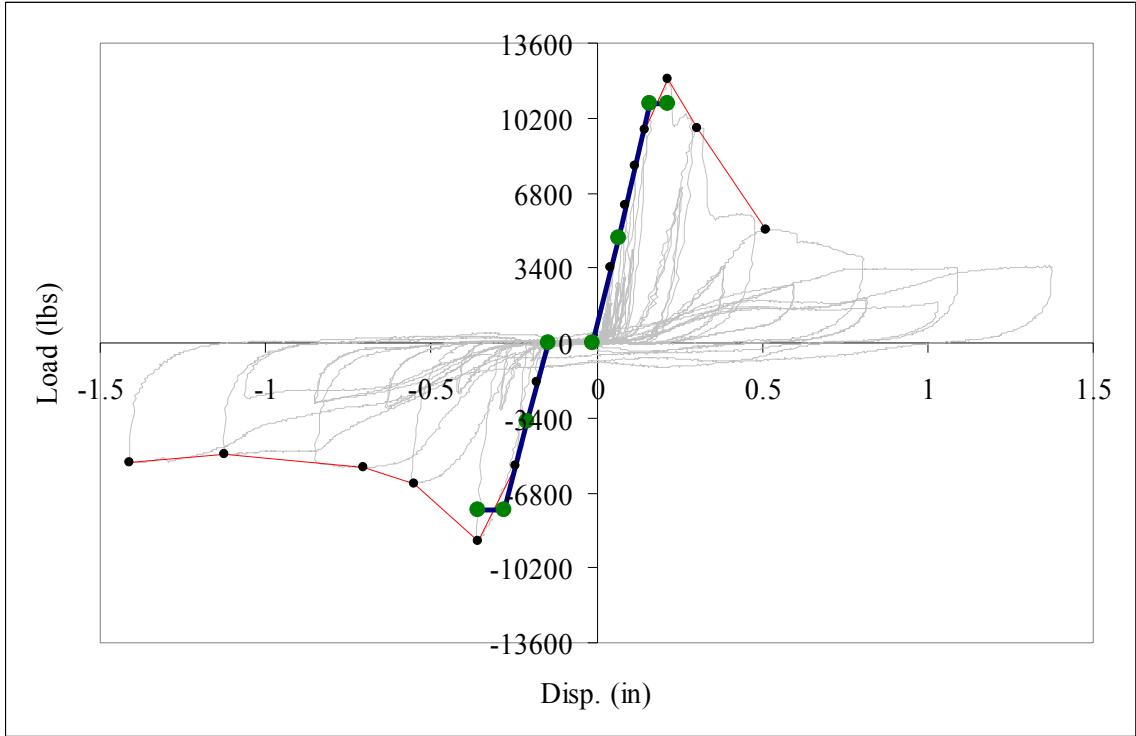


Figure B.176: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C05.

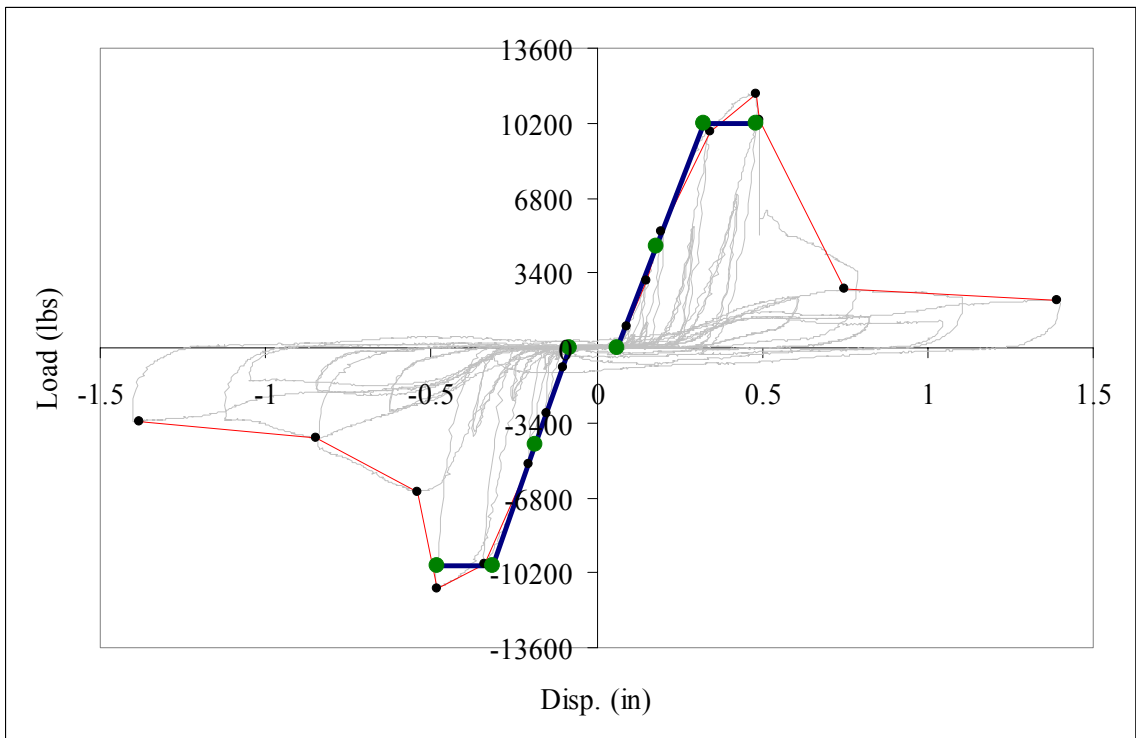


Figure B.177: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C06.

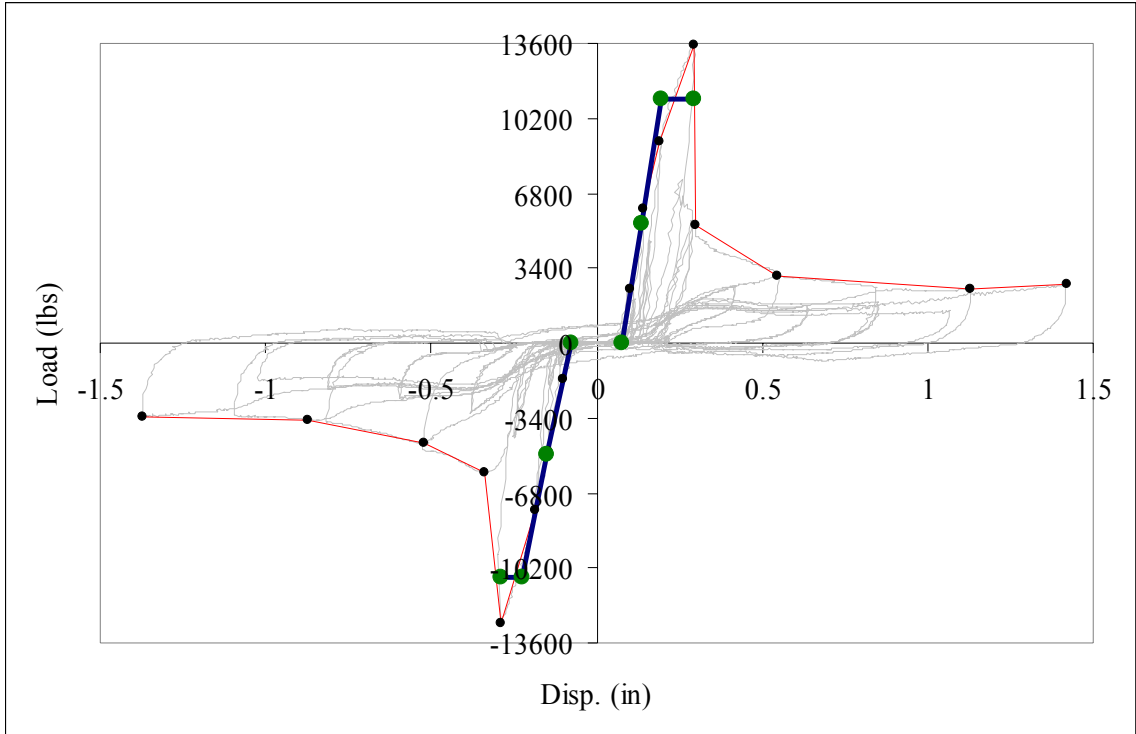


Figure B.178: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C07.

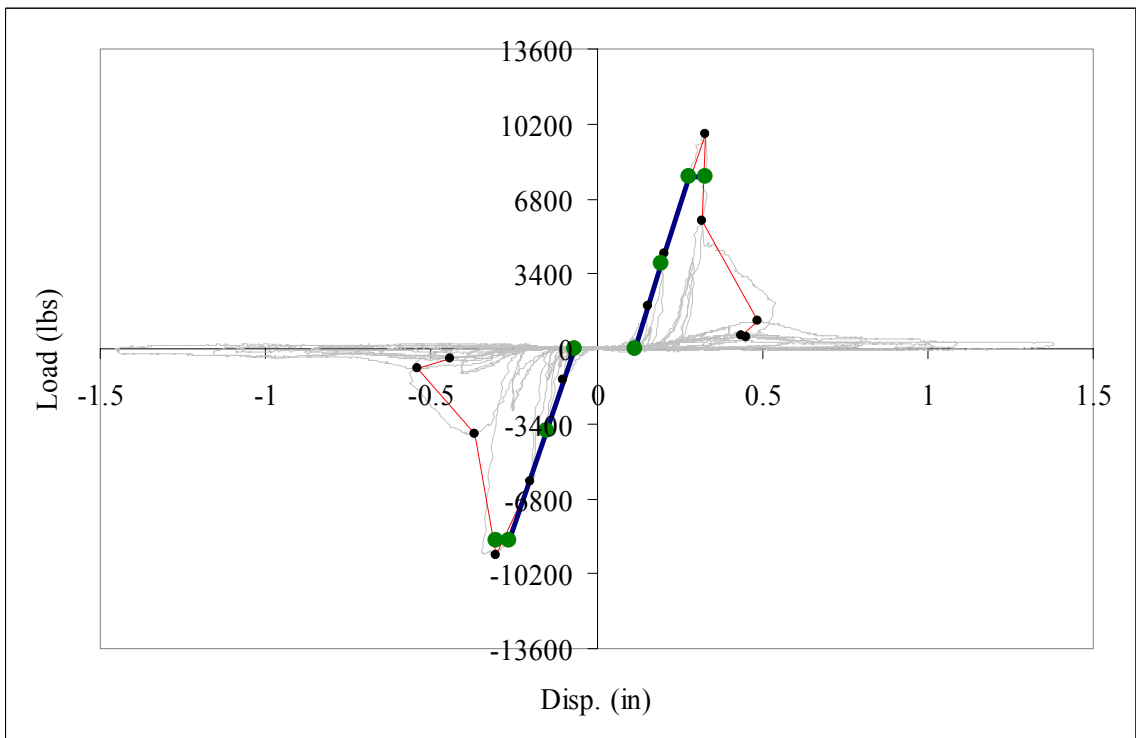


Figure B.179: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C08.

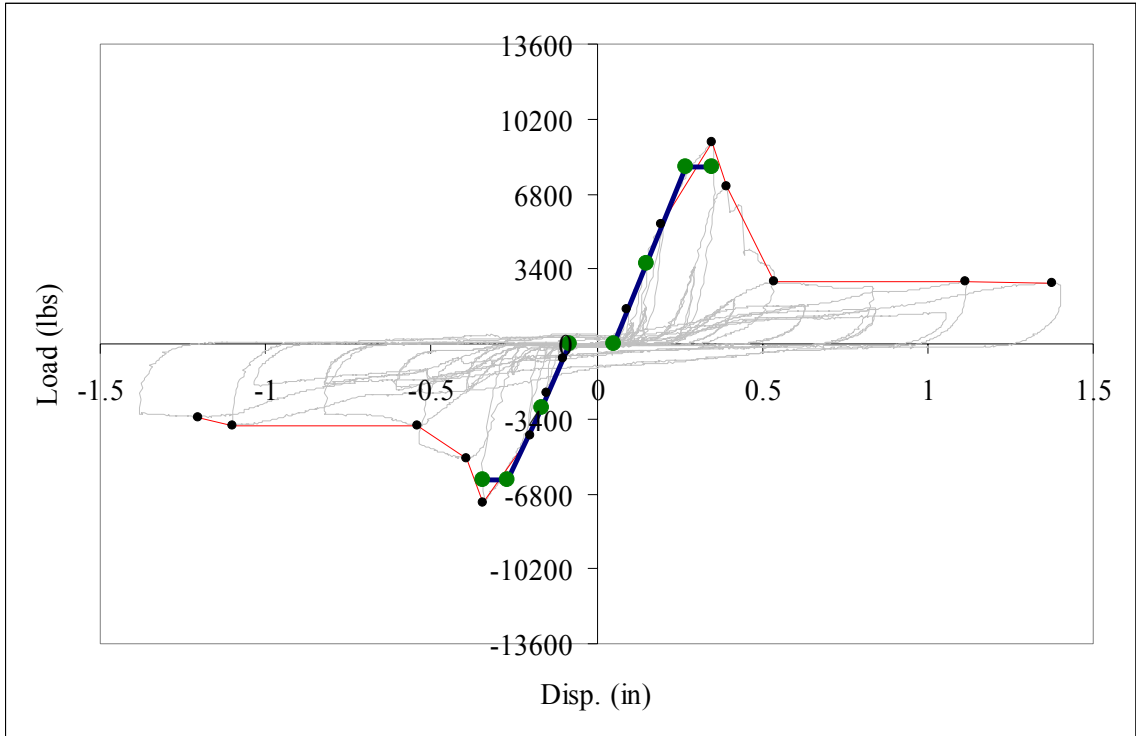


Figure B.180: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C09.

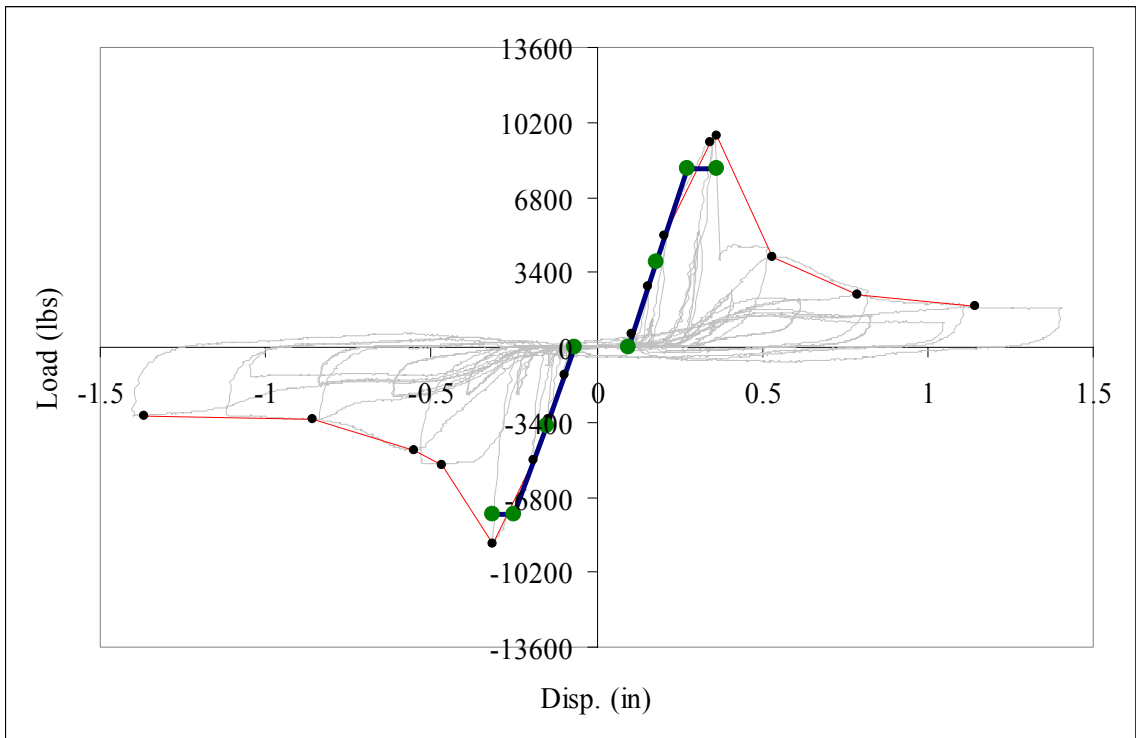


Figure B.181: Load (lbs) vs. Deflection (in.) plot. Test 4X1R5C10.

Vita

(December, 2001)

Guy T. Anderson was born on April 11, 1977 in Fontana, California. After completing High School in Paso Robles, California he went on to obtain an Associate of Science degree in 1997 from Cuesta Community College in San Luis Obispo. In June of 2000, Guy graduated Cum Laude from California Polytechnic State University San Luis Obispo with a Bachelor of Science degree in Civil Engineering. He came to Virginia Polytechnic Institute and State University, Blacksburg, VA, in August of 2000 to pursue graduate studies in Structural Engineering.