Cement Plaster Control Joint Movement Study 2017

FINAL REPORT
10.20.2017

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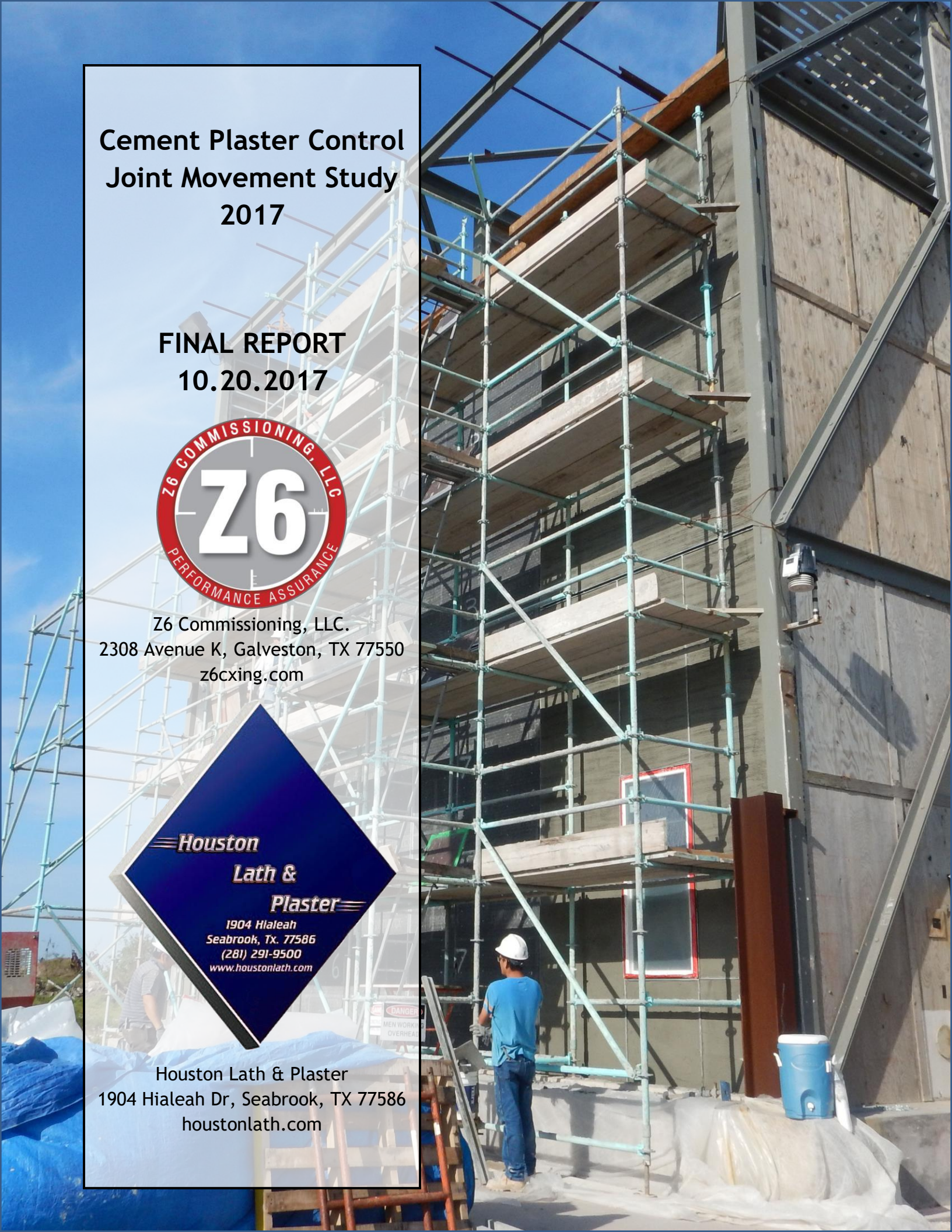

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PROJECT DATA

Testing Agency:	Z6 Commissioning, LLC ISO/IEC 17025 Certificate Number AT-2090
Project:	Cement Plaster Control Joint Movement Study 2017
Project Location:	6101 Harborside Dr. Galveston, TX 77551
Client/Requester:	Zero/Six Consulting, LLC
Contractors:	Diversified Plastering Inc
Date(s) of Testing:	1.7.2017 – 4.12.2017
Test Performed:	Control joint movement measurements & modified ASTM E330
Date of Report:	10.20.2017
Report Author(s):	Bill Coltzer Jr., AIA Jeffrey T. Bishop, PE Nick Roque

EXECUTIVE SUMMARY

Z6 Commissioning, LLC (Z6), was commissioned by Zero/Six Consulting, LLC for a long-term study of a large-scale cement plaster mockup. The purpose of the study was to employ different configurations of control joints and investigate and compare the performance of the cement plaster to assist with understanding how the standard could be improved in the future.

The mockup is approximately 32' tall, and 40' in width total. Materials on the wall were typical of residential construction, consisting of wood 2x4 studs and OSB (oriented strand board) plywood sheathing. Tyvek® building wrap was used to provide a weather barrier over the OSB sheathing. Lath was attached to the wall with screws, hitting the studs and following the current spacing requirements of the stucco standard. The east and west sides of the mockup were mirrored, with identical size panels separated by control joints (CJ). The CJs on the east side of the mockup had the lath cut behind the control joint. The CJs on the west side of the mockup had the lath continuous behind the control joints. At the center two panels, the size of each was larger than allowable (144 ft^2) by 4 ft^2. On Level 1, the joint was cut behind the CJ, on Level 2 the lath was left continuous behind the CJ. The stucco was applied over the course of 4 days, with methods consistent with typical residential construction used to ensure the specimen was built similar to current installation practices.

The stucco wall mockup was monitored by Z6 from January 7, 2017 to April 12, 2017 by measuring movement between points on either side of all of the different control joints. Measurements were taken with a DEMEC Mechanical Strain Gauge (CDI Logic IQ dial indicator installed in a multi-length strain gauge set frame from Humboldt Manufacturing). During these visits, hairline cracking was monitored and recorded to see the formation and the progression of cracks. At the conclusion of the 90 day observation period, final documentation was taken of the cracks and the team visited the mockup to see how the different configurations performed. Structural loading was performed on the specimen, bringing the chamber to pressures of +26 PSF, equivalent to 101 mph wind speed acting as a suction force on the face of the stucco. This confirmed that the backup wall was adequately designed as the recorded deflection was well below the code required limit for stucco. It can be assumed that all cracking observed was not caused by high winds near the coast of Galveston Bay. Hairline cracks were instead caused by expansion/contraction movements during the curing process. These cracks likely would not have shown through an applied finish coat, this

mock-up was performed only to the brown coat to allow the team to observe smaller cracks.

In conclusion, the large scale stucco mock-up has provided a substantial amount of data that can be interpreted to help compare control joint performance with and without cutting the lath behind the CJ. The data shows very small scale movement, but enough movement to alleviate the internal stresses that cause cracking when not properly mitigated. Leaving the lath behind the CJ appears to behave similar to cut lath (in that enough movement is allowed to relieve major internal stresses). The diamond shaped expanded metal mesh in the lath appears to have the capacity to grow and shrink in both directions when enough pressure is applied, relieving stresses within the stucco panels.

TEST CRITERIA

Our test criterion was developed during discussions with inspection experts and plaster installers. Drawing from firsthand experience and knowledge from Zero/Six inspectors and architects was an important part in developing criteria to attempt to quantify movement along the CJs. Over 100 pairs of pins were placed on either side of the control joints, as well as some intermittently placed at the center of panels. Daily readings for the first two weeks were measured, as well as two times a week after taking the initial readings. The concise measurements taken helped closely analyze the movement near the CJ, this anticipated movement relieves stress across each panel. Also, all of the cracking that developed on the panels was documented and dated. (See the attached “measurement points” document for data on the specimens)

Structural testing was performed, pressurizing the chamber outward at intervals up to 26 PSF. This was done to ensure the framing was not deflecting in high winds. Since the mock up was located near Galveston Bay, 26 PSF is the equivalent to 101 mph winds, the pressure was held for 10 seconds and deflection at the mid-span of the framing members was measured. For maximum allowable deflection, L/360 for the span comes out to about 0.25” and the maximum measured deflection was 0.193”.

TEST SPECIFICS

Test Dates: 1.7.2017 – 4.12.2017 (Plaster install began on the 1.17)

Test Methods: CJ Movement Measurements, Modified ASTM E330

Specimen

Selection Method: Zero/Six Consulting, LLC

Specimen Age: Pins were installed after the sample had cured enough to delicately drill and add epoxy. Approximately one day after brown coat. Measurements began immediately after the epoxy was cured enough to measure without disturbing the pins approximately one more day. After 90 days, structural testing was performed.

Specimen Dimensions: See Elevation

Backup Wall:
2x4" studs at 16" OC
OSB board
Tyvek® Building Wrap

Lath:
G-60 Galvanized Steel Expanded Metal Lath
3.4 lb./sq yd. self-furring

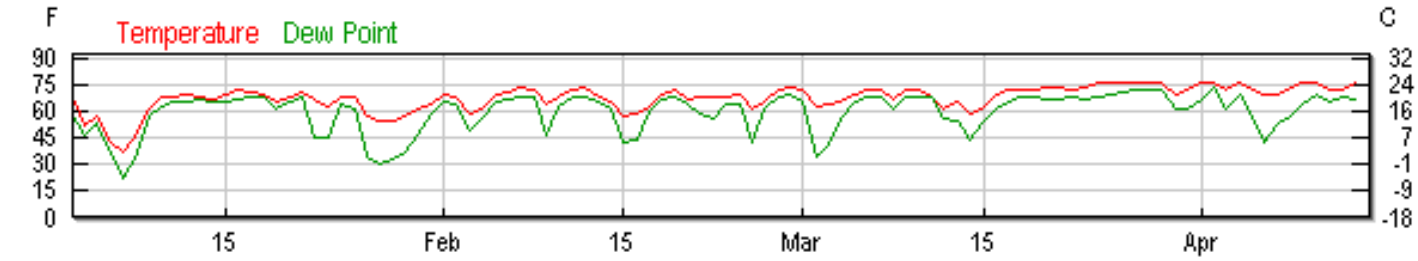
Accessories:
2 Piece EJ (not measured)
#66 Casing Bead
X-1 Corner Bead
#50 Control Joint
#15 Control Joint
FHA #7 Weep Screed
6" x 9" Butterfly Patch

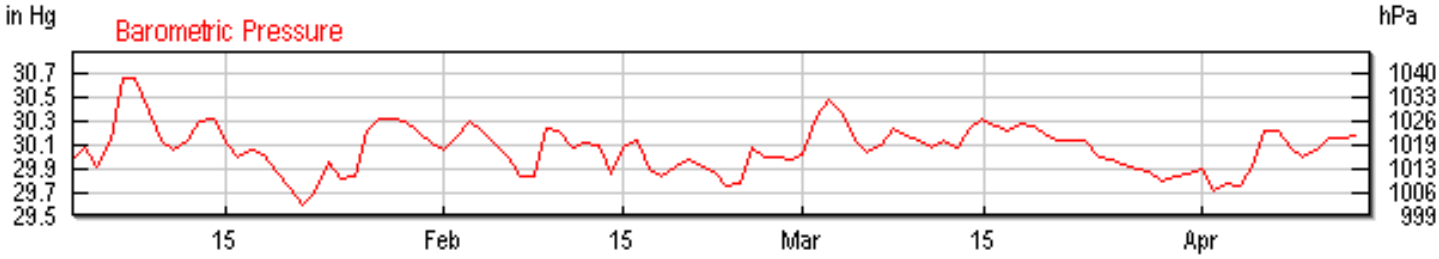
Control joints were pure zinc, which allows more movement that steel.

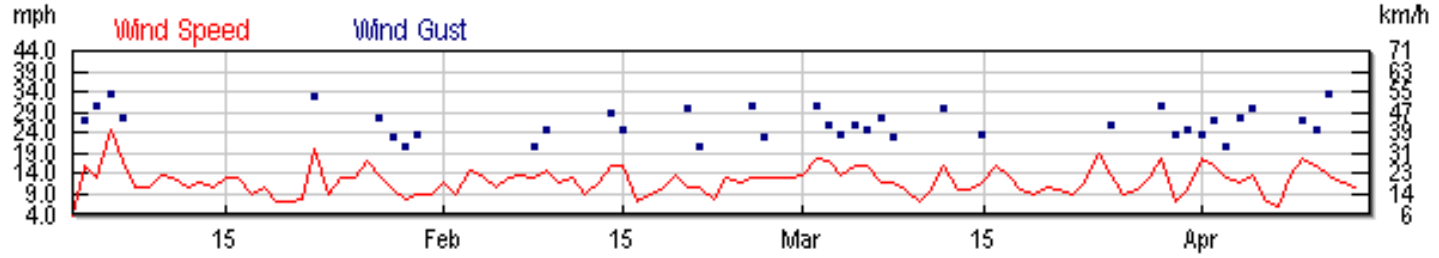
Stucco: 1 cu. ft. (92.6 lbs.) Holcim Portland Cement
1 cu. ft. (70.5 lbs.) Holcim Masonry Mix
28 shovels of sharp (torpedo) sand = 415 lbs.
(minimum sand allowable for brown coat mix)

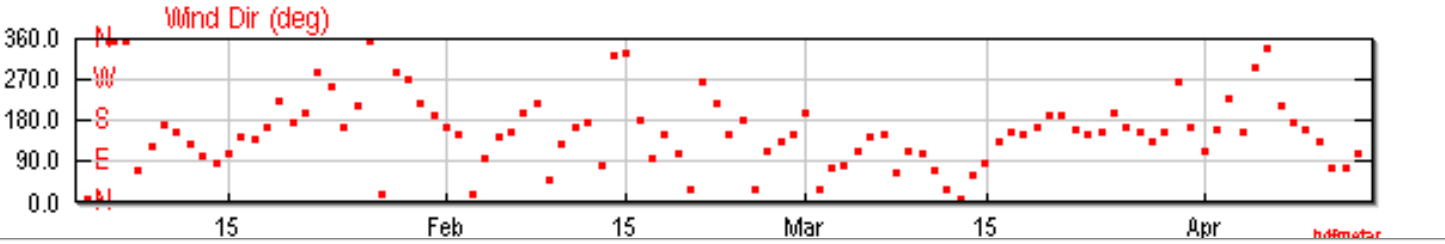
Both scratch and brown were mixed the same because we used the double back method (see ASTM C 926 or PCA's Plaster/Stucco Manual). Moist curing was only intentionally performed on panels 5 and 8, while all other panels were subjected to light rainfall during cure time. (See weather data)

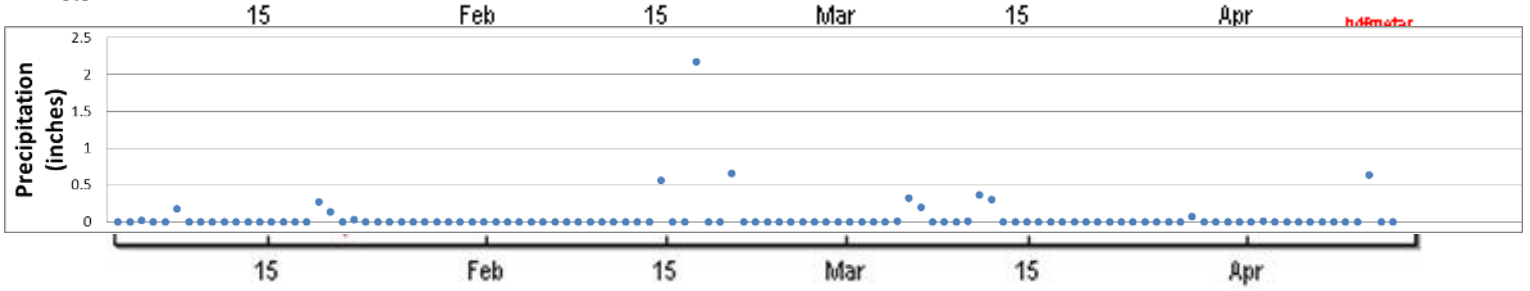
Environmental Conditions











TEST SUMMARY

The test summary for measurement points can be found in Tables 1-3 and Graphs 1-6 in the following pages. Overall, very little movement could be measured, with the continuous lath exhibiting slightly more movement in the first few days of cure time. (See Elevation T-1 for measurement point locations)

Cracking was also measured and tracked over time, while all cracking observed was minimal in width (hairline) there was an extensive amount of cracking which showed the most stressed areas in the stucco panels and where cracks could eventually show in a finish coat. (See Elevation T-2)

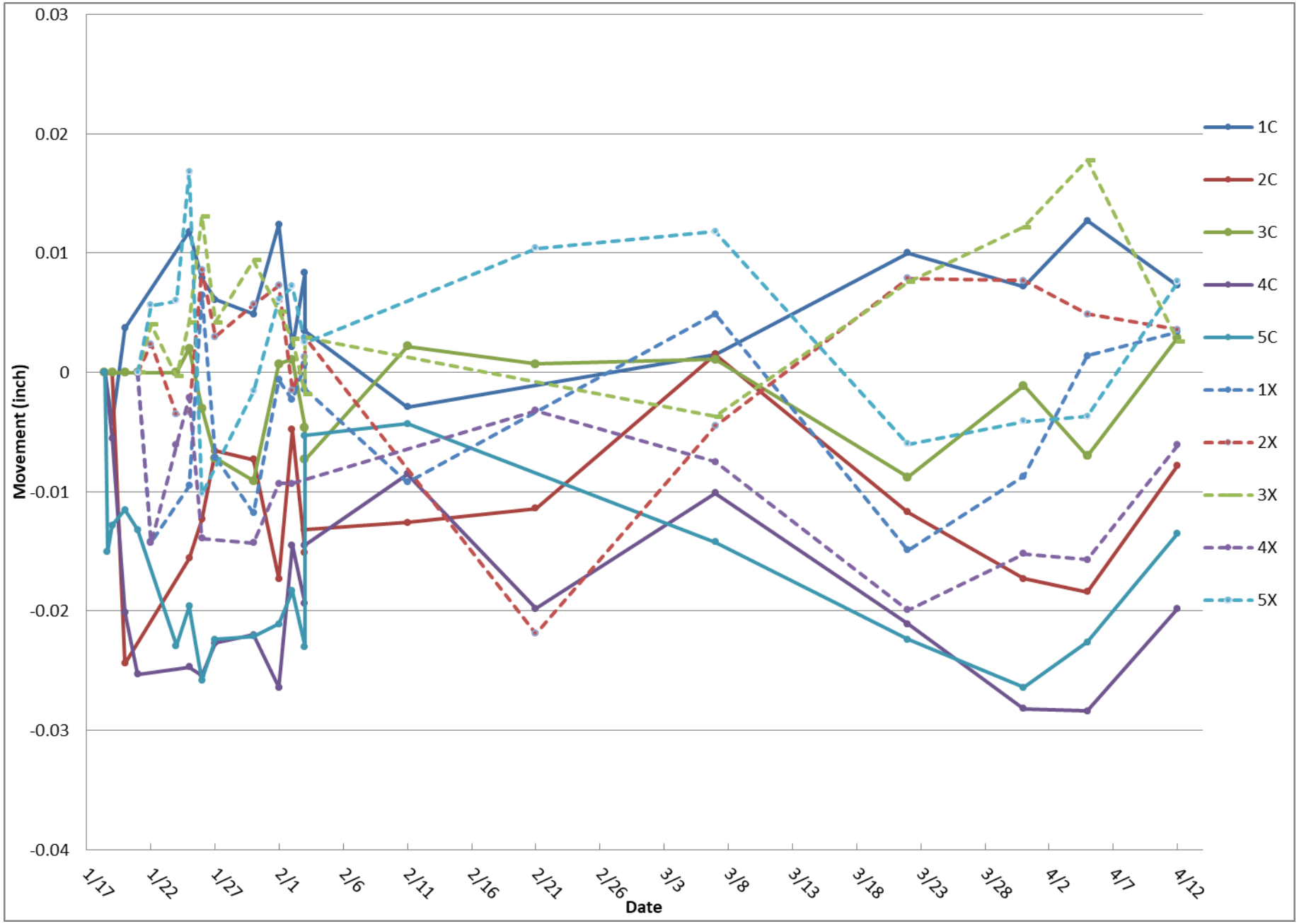
The structural loading results can be seen on Table 4 below. Maximum deflection was less than the allowable L/360. See elevation T-3 for locations.

Pressure (PSF)			6.24	14.04	26.01	
Windspeed Eqivalent (MPH)			49	74	101	
	Gauge Location	A	.023"	.103"	.191"	.25"
		B	.015"	.062"	.121"	.25"
		C	.021"	.081"	.156"	.25"
		D	.004"	.013"	.027"	.25"
		E	.018"	.076"	.156"	.25"
		F	.012"	.048"	.091"	.25"
		G	.024"	.104"	.188"	.25"
		H	.001"	.001"	.003"	.25"
			Measured Deflection			Allowable Deflection

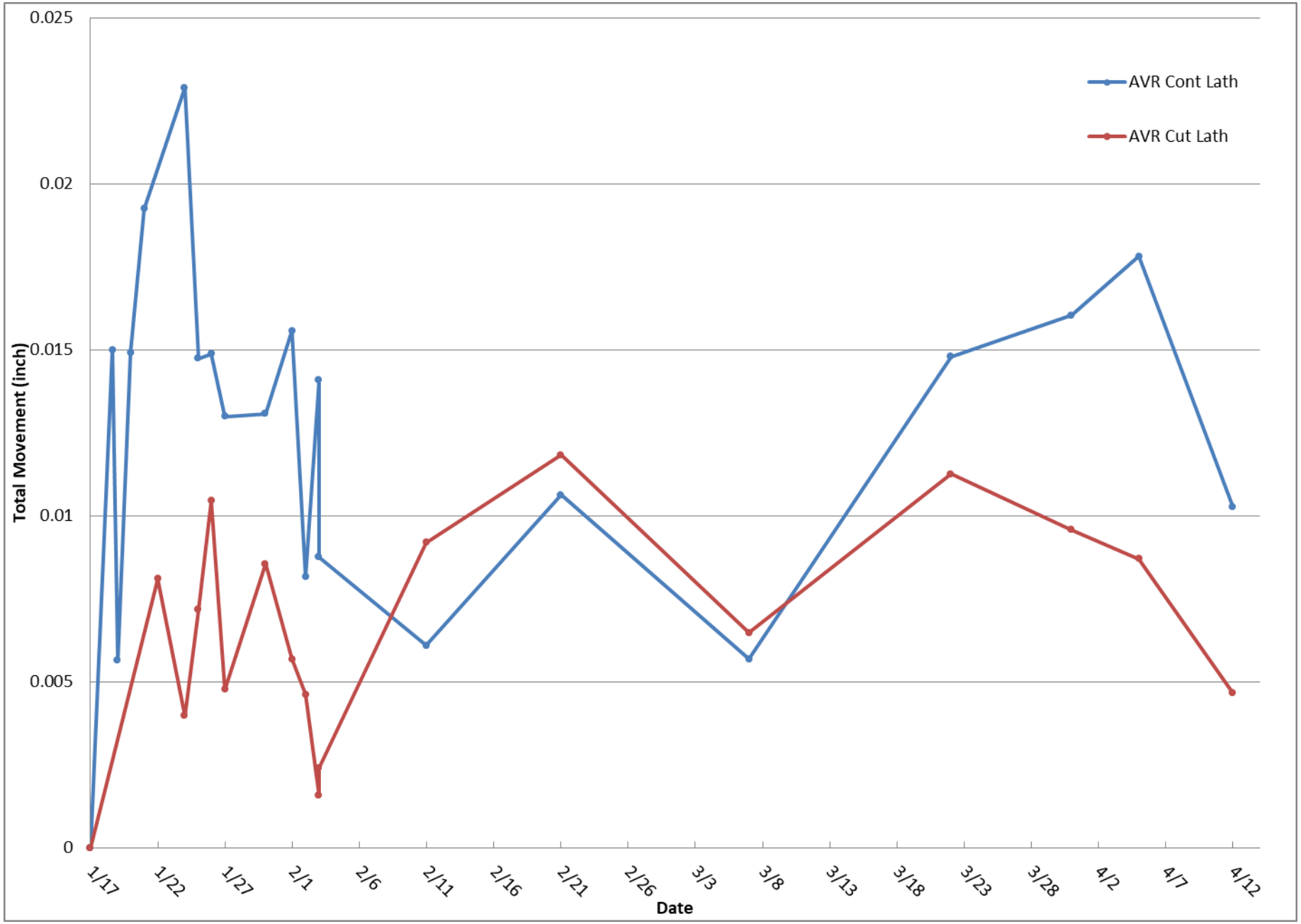
Table 4 – Deflection measurements from structural loading

Continuous Lath Control Joint (6" at Panel 2 and Panel 3)							Cut Lath Control Joint (6" at Panel 6 and Panel 7)						
Specimen #	**1C**	**2C**	**3C**	**4C**	**5C**	**AVR (abs)**	**Specimen #**	**1X**	**2X**	**3X**	**4X**	**5X**	**AVR (abs)**
Date:							**Date:**						
1/17						0	**1/17**						0
1/18	0	0	0	0	0		**1/18**						
1/18					-0.015	0.015	**1/18**						
1/19	-0.0042	-0.0001	0	-0.0055	-0.0128	0.00565	**1/19**						
1/20	0.0037	-0.0244	0	-0.0201	-0.0115	0.014925	**1/20**						
1/21			0	-0.0253	-0.0132	0.01925	**1/21**	0	0	0	0	0	
1/22							**1/22**	-0.0142	0.0024	0.004	-0.0143	0.0056	0.0081
1/24			0		-0.0229	0.0229	**1/24**		-0.0035	-0.0003	-0.0061	0.006	0.003975
1/25	0.0118	-0.0156	0.002	-0.0247	-0.0196	0.01474	**1/25**	-0.0095	-0.0033	0.0042	-0.0021	0.0168	0.00718
1/26	0.0079	-0.0123	-0.003	-0.0254	-0.0258	0.01488	**1/26**	0.0065	0.0086	0.0131	-0.0139	-0.0102	0.01046
1/27	0.0061	-0.0066	-0.0072	-0.0227	-0.0224	0.013	**1/27**	-0.0071	0.003	0.0042			0.004767
1/30	0.0049	-0.0073	-0.0091	-0.022	-0.0221	0.01308	**1/30**	-0.0118	0.0057	0.0094	-0.0143	-0.0016	0.00856
2/1	0.0124	-0.0173	0.0007	-0.0264	-0.0211	0.01558	**2/1**	-0.0006	0.0073	0.0051	-0.0093	0.0061	0.00568
2/2	0.0021	-0.0048	0.0011	-0.0145	-0.0183	0.00816	**2/2**	-0.0023	-0.0015	0.0028	-0.0093	0.0072	0.00462
2/3	0.0084	-0.0151	-0.0046	-0.0194	-0.023	0.0141	**2/3**	0.0007	0.0013	-0.0018		0.0025	0.001575
2/3	0.0035	-0.0132	-0.0073	-0.0145	-0.0053	0.00876	**2/3**	-0.0014	0.0029	0.0029			0.0024
2/11	-0.0029	-0.0126	0.0022	-0.0085	-0.0043	0.0061	**2/11**	-0.0092					0.0092
2/21		-0.0114	0.0007	-0.0198		0.010633	**2/21**		-0.0219		-0.0032	0.0104	0.011833
3/7	0.0015	0.0015	0.0011	-0.0101	-0.0142	0.00568	**3/7**	0.0049	-0.0045	-0.0037	-0.0075	0.0118	0.00648
3/22	0.01	-0.0117	-0.0088	-0.0211	-0.0224	0.0148	**3/22**	-0.0149	0.0079	0.0076	-0.0199	-0.006	0.01126
3/31	0.0072	-0.0173	-0.0011	-0.0282	-0.0264	0.01604	**3/31**	-0.0087	0.0077	0.0122	-0.0152	-0.0041	0.00958
4/5	0.0127	-0.0184	-0.007	-0.0284	-0.0226	0.01782	**4/5**	0.0014	0.0049	0.0178	-0.0157	-0.0037	0.0087
4/12	0.0073	-0.0078	0.0029	-0.0198	-0.0135	0.01026	**4/12**	0.0034	0.0036	0.0026	-0.0061	0.0076	0.00466

Table 1 - Continuous and cut lath movement at vertical CJ on middle panels



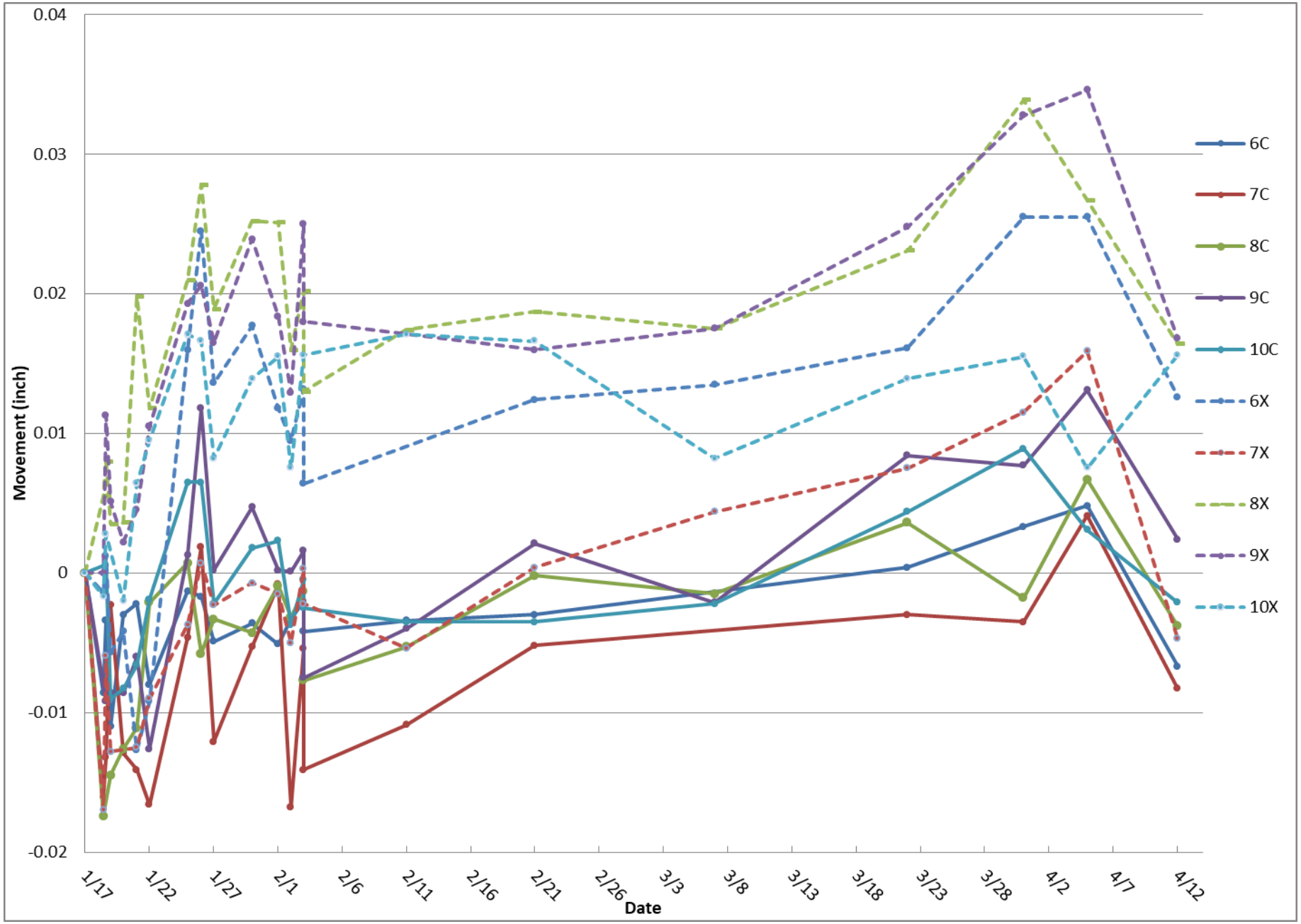
Graph 1 - Vertical CJ middle panel comparison



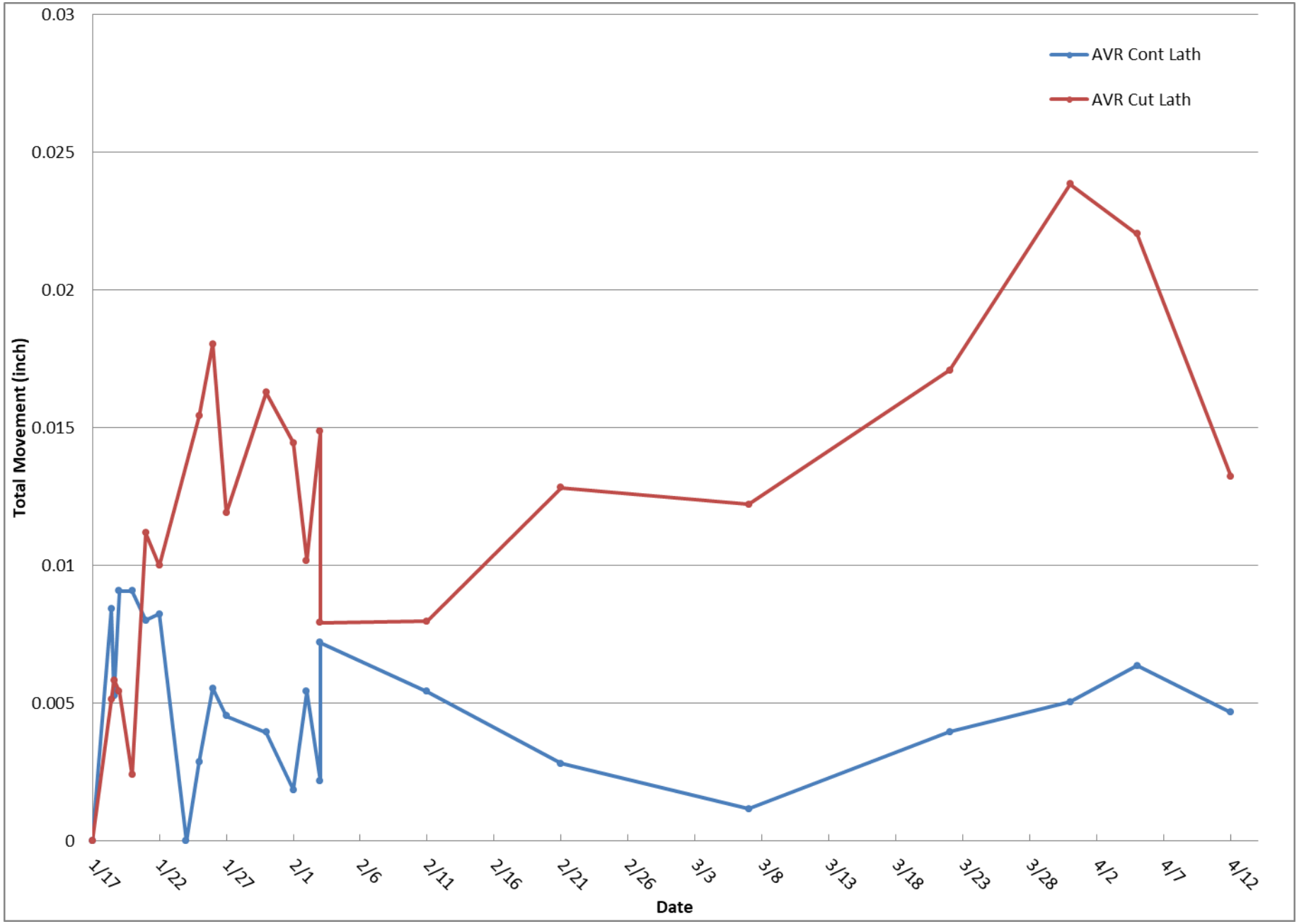
Graph 2 - Average vertical CJ middle panel comparison

Continuous Lath Control Joint (6" at Panel 1)							Cut Lath Control Joint (6" at Panel 4)						
Specimen #	6C	7C	8C	9C	10C	AVR (abs)	Specimen #	6X	7X	8X	9X	10X	AVR (abs)
Date:							Date:						
1/17	0	0	0	0	0	0	1/17	0	0	0	0	0	0
1/18	-0.0086	-0.0161	-0.0174			0.00842	1/18	-0.0014	-0.017	0.0055	0	-0.0017	0.00512
1/18	-0.0034	-0.0132		-0.0092	0.0006	0.00528	1/18	0.0012	-0.0059	0.008	0.0113	0.0028	0.00584
1/19	-0.011	-0.0023	-0.0145	-0.0086	-0.009	0.00908	1/19	-0.0057	-0.0128	0.0035	0.0051		0.00542
1/20	-0.003	-0.0129	-0.0126	-0.0086	-0.0083	0.00908	1/20	-0.0042		0.0036	0.0022	-0.002	0.0024
1/21	-0.0022	-0.0141	-0.0111	-0.006	-0.0066	0.008	1/21	-0.0127	-0.0125	0.0198	0.0045	0.0064	0.01118
1/22	-0.008	-0.0166	-0.0021	-0.0126	-0.0019	0.00824	1/22	-0.0092	-0.009	0.0118	0.0105	0.0095	0.01
1/24						0	1/24						
1/25	-0.0013	-0.0046	0.0007	0.0013	0.0065	0.00288	1/25	0.016	-0.0037	0.021	0.0193	0.0171	0.01542
1/26	-0.0017	0.0019	-0.0058	0.0118	0.0065	0.00554	1/26	0.0245	0.0007	0.0278	0.0206	0.0166	0.01804
1/27	-0.0049	-0.0121	-0.0033	0.0002	-0.0022	0.00454	1/27	0.0136	-0.0023	0.0189	0.0165	0.0082	0.0119
1/30	-0.0036	-0.0053	-0.0043	0.0047	0.0018	0.00394	1/30	0.0177	-0.0007	0.0252	0.0239	0.0139	0.01628
2/1	-0.0051	-0.0008	-0.0009	0.0002	0.0023	0.00186	2/1	0.0118	-0.0015	0.0251	0.0184	0.0155	0.01446
2/2	-0.0033	-0.0168	-0.0032	0.0001	-0.0037	0.00542	2/2	0.0095	-0.005	0.016	0.0129	0.0075	0.01018
2/3	-0.002	-0.0054	-0.0013	0.0016	-0.0005	0.00216	2/3	0.0132	0.0003	0.0202	0.025	0.0156	0.01486
2/3	-0.0042	-0.0141	-0.0077	-0.0075	-0.0025	0.0072	2/3	0.0064	-0.0022	0.013	0.018		0.00792
2/11	-0.0034	-0.0109	-0.0053	-0.004	-0.0035	0.00542	2/11		-0.0054	0.0174		0.0171	0.00798
2/21	-0.003	-0.0052	-0.0002	0.0021	-0.0035	0.0028	2/21	0.0124	0.0004	0.0187	0.016	0.0166	0.01282
3/7			-0.0015	-0.0021	-0.0022	0.00116	3/7	0.0135	0.0044	0.0175	0.0175	0.0082	0.01222
3/22	0.0004	-0.003	0.0036	0.0084	0.0044	0.00396	3/22	0.0161	0.0075	0.0231	0.0248	0.0139	0.01708
3/31	0.0033	-0.0035	-0.0018	0.0077	0.0089	0.00504	3/31	0.0255	0.0115	0.0339	0.0328	0.0155	0.02384
4/5	0.0048	0.0041	0.0067	0.0131	0.0031	0.00636	4/5	0.0255	0.0159	0.0267	0.0346	0.0075	0.02204
4/12	-0.0067	-0.0083	-0.0038	0.0024	-0.0021	0.00466	4/12	0.0126	-0.0047	0.0164	0.0168	0.0156	0.01322

Table 2 - Continuous and cut lath movement at horizontal CJ on upper side panels



Graph 3 – Horizontal CJ upper side panels comparison

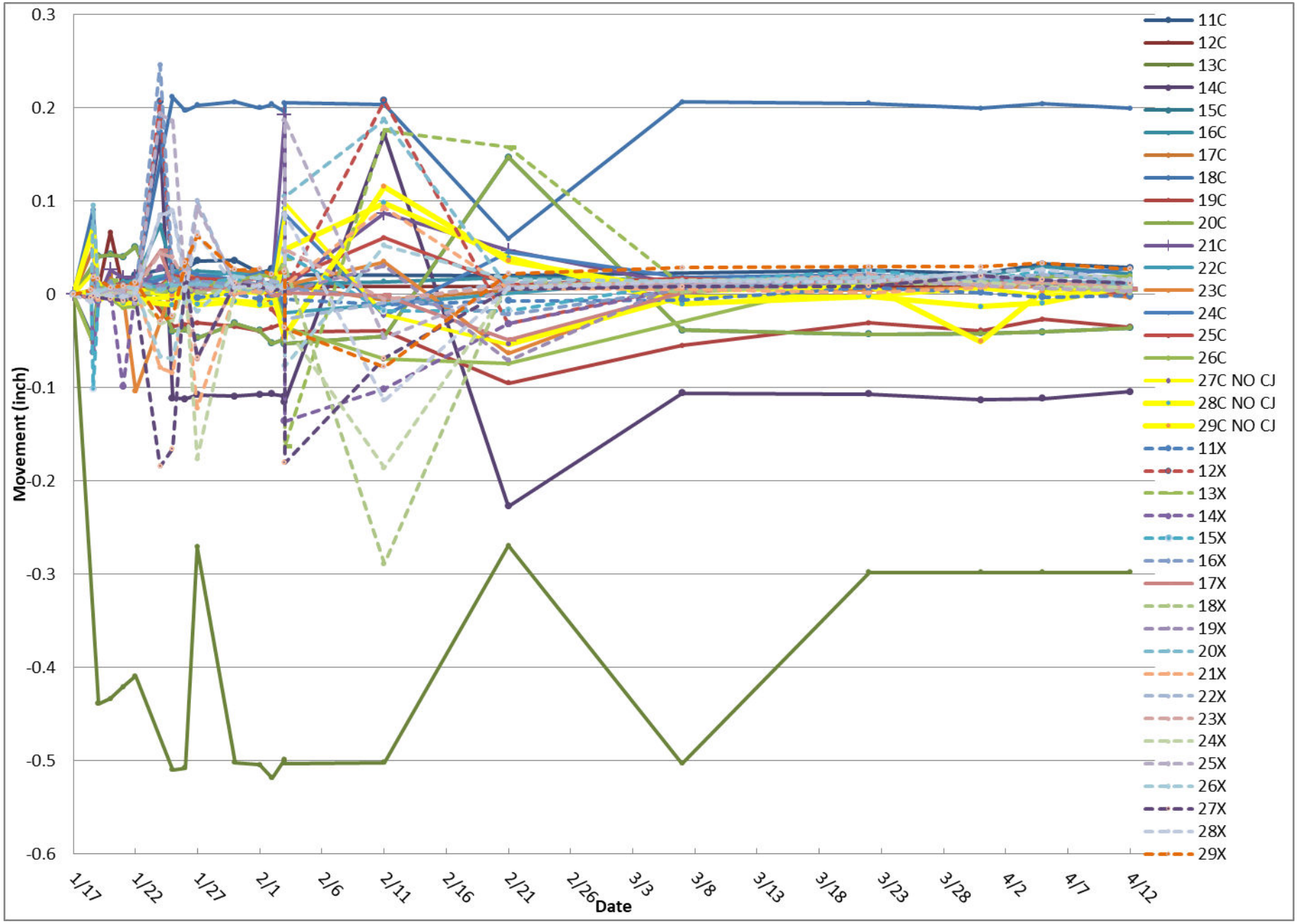


Graph 4 - Average horizontal CJ upper side panels

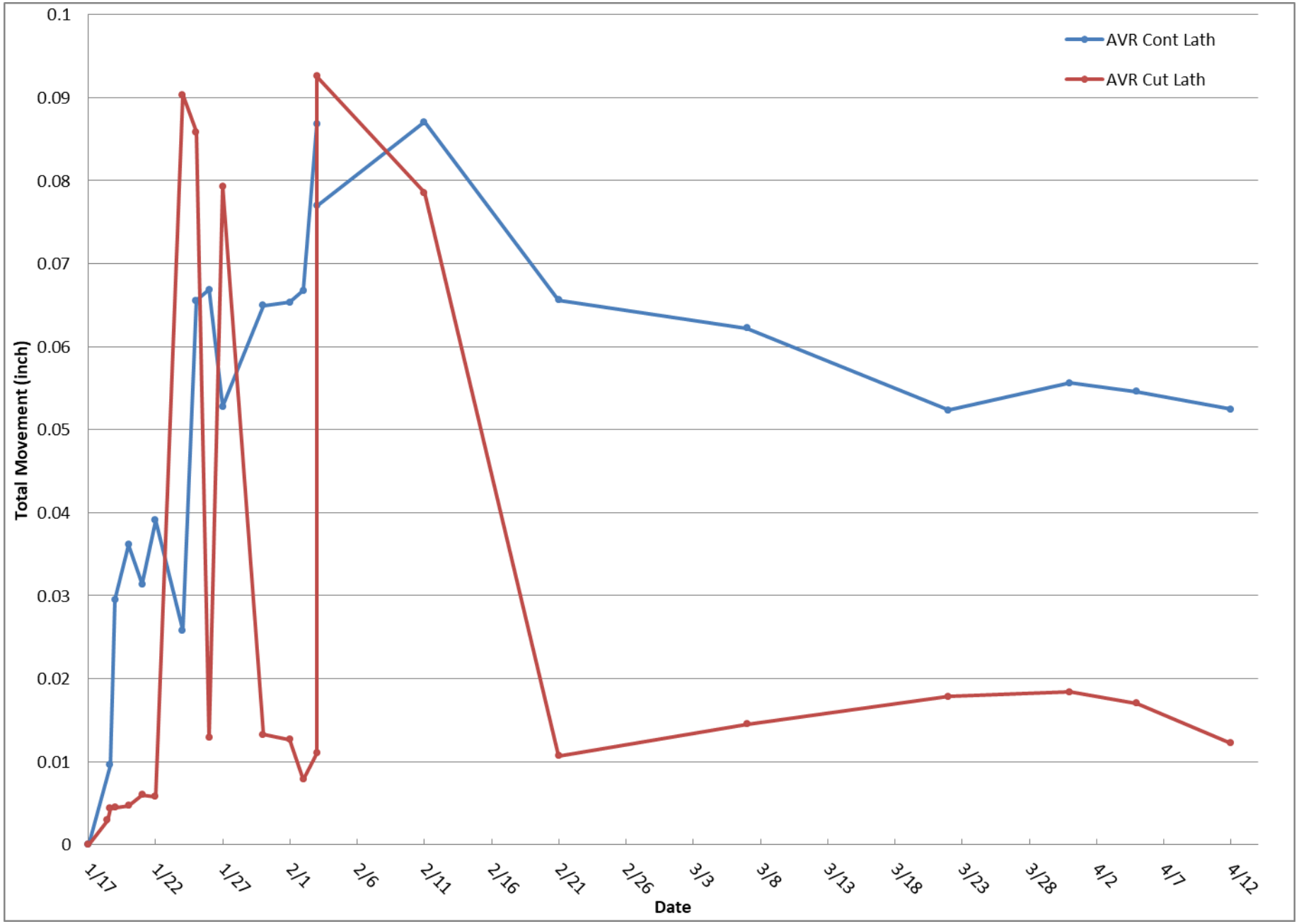
Continuous Lath Control Joint (6" at Panel 5)																	No CJ @ 28C-29C			
Specimen #	**11C**	**12C**	**13C**	**14C**	**15C**	**16C**	**17C**	**8C**	**19C**	**20C**	**21C**	**22C**	**23C**	**24C**	**25C**	**26C**	**27C**	**28C**	**29C**	**AVR (abs)**
Date:																				
1/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/18																				
1/18	-0.0479						0.0488	0.0906	-0.0045				-0.0518		-0.0018	-0.0522	0.0229	0.0707		0.00958
1/19	0.0106	0.0063	-0.4389	-0.0023	0.0043	-0.0053	-0.0066	0.0052	0.0095	0.0409	-0.0028	0.0033	-0.0021	0.0069	-0.0008	0.0044		-0.0063	0.0047	0.029537
1/20	0.0114	0.0666	-0.4333	0.0029	0.0153	0.0066	0.0204	0.0109	0.0077	0.0426	0.0262	0.0074	-0.0037	0.0024	0.0136		-0.0064	0.0005	0.009	0.036153
1/21	0.0127	0.0064	-0.4211	0.0081	0.0033	0.0095	-0.0085		0.0106	0.0401	0.0181	0.0137	0.0009	0.0053	0.0109	-0.0139	-0.0011	-0.0096	0.0023	0.031374
1/22	0.0207	0.0066	-0.4091	0.0104	0.0128	0.0164	-0.0031	0.0099	0.0165	0.0508	0.0185	0.0142	-0.1041	0.0086	-0.0107	-0.0132	-0.0043	-0.0072	0.0056	0.039089
1/24		0.0084		0.1707	0.237	0.0741														0.0258
1/25	0.0291		-0.5096	-0.1112	-0.1622	0.024	0.0107	0.2118	-0.0342	-0.0395	0.0063	0.0224	0.0085	0.0201	0.0206	0.0184	-0.0042	-0.011	-0.0012	0.065526
1/26	0.0268		-0.508	-0.112	-0.173	0.0227	0.0236	0.1973	-0.0327	-0.0381	0.0229	0.0305	0.0359	0.0261			0.0081	0.0028	0.0097	0.066853
1/27	0.0357		-0.2708	-0.1077	-0.1667	0.0246	0.0147	0.2031	-0.0304	-0.0464	0.0085	0.0198	0.0081	0.021	0.0168	0.0092	-0.0034	-0.0107	-0.0049	0.052763
1/30	0.0363		-0.5017	-0.1091	-0.1644	0.0227	0.0261	0.2061	-0.0345	-0.031	0.0134	0.0229	0.0063	0.0164	0.0156	0.0149		-0.008	0.005	0.064968
2/1	0.0234		-0.5042	-0.1072	-0.1673	0.0212	0.0232	0.2	-0.0395	-0.039	0.0103	0.0196	0.0048	0.0231	0.0172	0.0197	-0.0085	-0.0116	0.0012	0.065316
2/2	0.0274		-0.5182	-0.107	-0.1642	0.0236	0.0184	0.2039	-0.0355	-0.0523	0.0131	0.0207	0.0069	0.0223	-0.0167	0.0203	-0.002	-0.0099	0.0056	0.066737
2/3	0.0216		-0.4985	-0.1091	-0.1631	0.0178	0.0118	0.1961	-0.0307	-0.0476	0.1926	-0.02		0.0924	-0.0316	-0.0404	0.0858	0.0437	-0.0476	0.086863
2/3	0.0209		-0.5031	-0.1152	-0.1689	0.0118	0.0101	0.2054	-0.0396	-0.0529	0.0076			0.0864	0.0151	-0.0348	0.0981	0.0484	-0.0442	0.076974
2/11			-0.5017	0.1711	-0.1646	0.0137	-0.0057	0.2037	-0.0393	-0.0452	0.0868		0.0349	-0.0227	0.0606	-0.0693	-0.0218	0.0979	0.1155	0.087079
2/21	0.0198		-0.2695	-0.227	0.0375	0.0178	0.0047	0.0596	-0.0953	0.1472	0.0469		-0.0631	0.0458	0.0102	-0.0742	-0.0534	0.0391	0.0359	0.065632
3/7			-0.5031	-0.106	-0.1651	0.0148	0.0092	0.2064	-0.0549	-0.0385	0.0107	0.017	0.0054	0.0184	0.0169		-0.0024	-0.01	0.0032	0.062211
3/22	0.0264		-0.298	-0.107	-0.1575	0.0195	0.0111	0.2048	-0.0305	-0.0426	0.0113	0.0175	0.0045	0.0213	0.0103	0.0192	-0.002	-0.0019	0.0095	0.052363
3/31	0.0225		-0.298	-0.1133	-0.1607	0.0197	0.0148	0.1993	-0.0387	-0.0416	0.0141	0.0108	0.0076	0.0146	0.0209	0.0108	0.0065	-0.013	-0.0503	0.055642
4/5	0.0325		-0.298	-0.1117	-0.1756	0.0303	0.0138	0.2041	-0.0268	-0.0401	0.0109	0.0197	0.0081	0.0197	0.0128	0.0193	-0.0009	-0.0093	0.0035	0.054584
4/12	0.0286	0.0084	-0.298	-0.1046	-0.1607	0.0222	0.0054	0.1993	-0.0352	-0.0359	0.0044	0.0175	-0.0035	0.0281	#REF!	0.0193	0.007	0.0099	0.0129	0.052468

Cut Lath Control Joint (6" at Panel 8)																				
Specimen #	**11X**	**12X**	**13X**	**14X**	**15X**	**16X**	**17X**	**18X**	**19X**	**20X**	**21X**	**22X**	**23X**	**24X**	**25X**	**26X**	**27X**	**28X**	**29X**	**AVR (abs)**
Date:																				
1/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/18	-0.0034	0.0024	-0.0024	-0.0059	0.0023	-0.0005	-0.003	-0.0035	-0.0019	-0.0018	-0.0045	-0.0005	-0.0012	-0.0005	-0.0023	0.0002	-0.0035	-0.0082	0.0046	0.002929
1/18	-0.0004	0.0097	0.0039	-0.0623	-0.1017	0.0084	0.0046	-0.0028	0.0283	0.0956	-0.0003	0.0044	-0.0012	0.0015	0.0018	0.0031	-0.002	0.0027	0.0184	0.004386
1/19	-0.0025	0.0065	0.0036	-0.008	-0.0008	0.0036	-0.0022	-0.0029	0.0043	0.0019	-0.0057		0.0034	-0.0023	0.002	0.003	-0.0032	-0.0008	0.0166	0.004471
1/20	0.0019	0.0079	0.0144	0.0036	0.0025	0.0124	0.003	-0.0011	0.0064	0.0018	0.0027	0.0044	-0.0032	0.0028	0.0049	0.008	-0.0051	-0.0017	0.0072	0.0047
1/21	-0.0042	-0.0067	0.0031	-0.0992	0.0036	0.0004	0.0037	-0.0082	0.0043	0.0098	0.0082	-0.0002	0.0071	0.0041	0.0033	0.0092	-0.0062	-0.003	0.0091	0.006
1/22	-0.0045	-0.0033	0.0098	0.0063	0.0111	0.0028	0.0086	-0.0004	0.0129	0.0138	0.0085	0.0001	0.0055	0.0011	-0.0095	0.0052	-0.0045	0.0014	0.0132	0.005771
1/24	0.1894	0.2067	0.0033	0.0285	0.0071	0.2459	0.0464	0.0034	0.0089	0.0049	-0.0785	0.0847	0.0441	-0.0313	0.1933	-0.0665	-0.1845	0.0841	-0.0285	0.090329
1/25	0.0045	0.0165	0.0148	0.0095	0.0129	0.0178	0.0086	0.0053	0.0111	0.0098	-0.0841	0.0898	0.0396	-0.0276	0.1858	-0.0696	-0.1657	0.0897	-0.0231	0.085871
1/26	0.0082	0.0111	0.0123	0.0059	0.0107	0.0114	0.0049	0.0079	0.0113	0.0101	0.0035	0.02	0.0121	0.014	0.0026	0.0002	0.0229	0.0045	0.034	0.0129
1/27	-0.0034	0.0089	0.0125	0.0045	0.0117	0.0144	0.0036	0.002	0.0085	0.0112	-0.1219	0.0998	-0.0693	-0.1762	0.0939	-0.0183	-0.068	0.0662	0.0632	0.0793
1/30	0.0011	0.0103	0.0124	0.0095	0.017	0.0102	0.0083	0.0059	0.008	0.0064	0.0005	0.0097	0.0116	0.0057	0.0117	0.0188	0.0117	0.0071	0.0263	0.013271
2/1	-0.0047	0.0128	0.01	0.0052	0.0097	0.0123	0.0105	0.0018	0.018	0.0043	0.0034	0.0062	0.009	0.0089	0.0082	0.0174	0.0087	0.0092	0.0274	0.012686
2/2	-0.0006	0.0104	0.0112	0.0098	0.0098	0.0095	-0.0008	0.0069	0.0096	0.0079	0.0071	0.0142	0.0072	0.0059	0.0024	0.0077	0.004	0.0063	0.0215	0.007857
2/3	-0.0094	0.0031	0.0377	0.0084	0.0091	0.0045	0.0015	0.0043	0.0088	0.0018	0.006	0.0123	0.0097	0.0093	0.0079	0.011	0.0073	0.0072	0.0249	0.011043
2/3	-0.0053	0.0047	-0.1627	-0.1358	0.0436	0.0064	0.0017	0.0308	0.0031	0.1049	0.009	-0.0268	0.0482	-0.0336	0.1868	-0.0768	-0.1807	0.0861	-0.0357	0.092557
2/11	-0.0108	0.2079	0.1757	-0.1013	-0.0182	-0.0027	-0.001	-0.2888	0.0304	0.1872	0.0934		-0.0053	-0.1858	-0.0464	0.0525	-0.0683	-0.1137	-0.0778	0.078543
2/21	-0.0068	-0.0318	0.1578	-0.0316	-0.0174	-0.0216	-0.0486	0.0162	-0.0709	0.0073	0.007	0.0132	0.0086	0.0077	0.0077	0.0163	0.006	0.0061	0.0224	0.010686
3/7	-0.006	0.0082	0.0101	0.0062	0.0127	0.0057	0.0017	0.0023	0.0119	0.0071	0.0057	0.0083	0.0122	0.0149	0.0091	0.0145	0.0081	0.0141	0.0288	0.014529
3/22	0.0075	0.0175	0.016	0.0155	0.0259	0.0135	0.0163	0.0111	0.0167	0.0157	0.0012	0.0205	0.0211	0.0167	0.0173	0.0181	0.0086	0.0135	0.0298	0.017871
3/31	0.0018	0.0177	0.0133	0.0205	0.0157	0.0183	0.0105	0.0115	0.0193	0.0164	0.0072	0.0171	0.0101	0.0133	0.0098	0.022	0.02	0.0238	0.0298	0.0184
4/5	-0.0027	0.0093	0.0069	0.0091	0.0245	0.0134	0.0142	0.0122	0.0143	0.0125	0.0129	0.0215	0.0142	0.0075	0.0064	0.0153	0.0157	0.0267	0.0334	0.017029
4/12	-0.0017	0.0074	0.0052	0.0084	0.0102	0.0099	0.0058	0.0014	0.0114	0.0113	0.0066	0.0153	0.0063	0.0074	0.0033	0.014	0.0119	0.0155	0.027	0.0122

Table 3 – Movement at CJ around windows at lower side panels

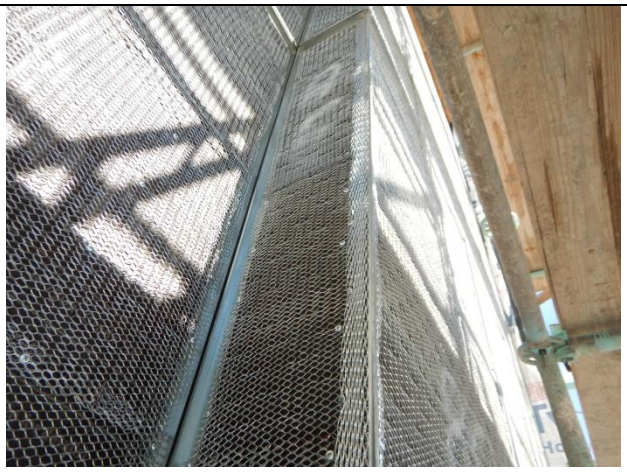


Graph 5 – CJ around windows at lower side panels

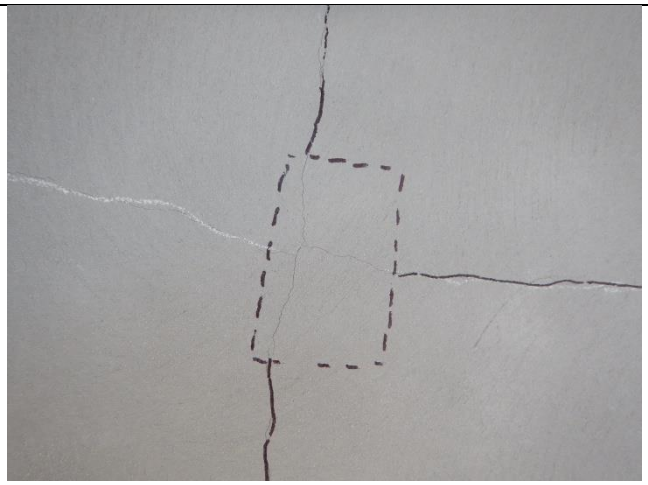


Graph 6 - Average CJ around windows at lower side panels

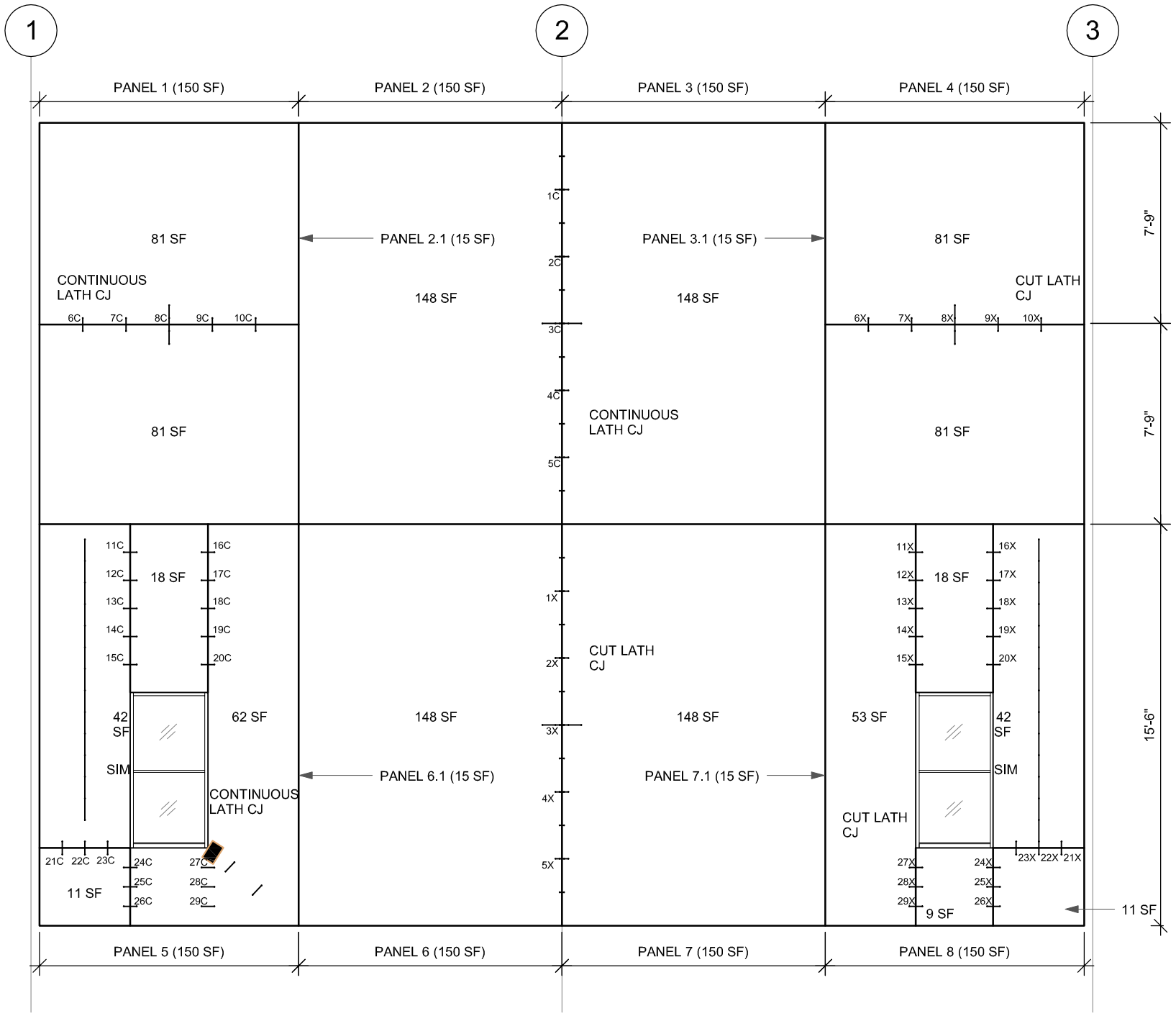
PHOTOGRAPHS

Lath and accessories attached to studs per ASTM C 1063. Half of the control joints had continuous lath behind the CJ and half have cut lath behind the CJ. The two sides are mirrored for comparison.	
1 **Panel 5 1.3.2017**	
Panels 2.1, 3.1, 6.1, 7.1 are sized with larger than allowable proportions per ASTM C1063. The length-to-width ratio is beyond 2.5 : 1.	
2 **Panel 3.1 1.3.2017**	
Panels 2, 3, 6, 7 are sized with an overall square footage of 146, larger than the allowable 144 sf per ASTM C1063.	
3 **Panel 7 1.3.2017**	

Overview of entire mock up, inspected by the team and ready to receive cement-based plaster.		
4	**Overall Mock Up 1.3.2017**	
Measurement points installed 6” apart at control joints to measure movement over time.		
5	**Panel 8 1.17.2017**	
Moist curing only on panels 5 and 8 was performed 3 times daily for a week.		
6	**Panel 8 1.17.2017**	

Cracks were monitored and marked; red indicates 1/17, while the green indicates cracks seen on 1/21. Hairline cracks were growing everywhere on the mock up.		
7	**Panel 2.1 1.21.2017**	
Cracking was monitored and studied, but cracks were never large enough to show through an elastomeric coating, elastomeric acrylic finish or an acrylic finish. They would likely show though a cement finish coat. 3 & 5 mil cracks were observed.		
8	**Overall Mock Up 1.23.2017**	
Testing technician showing how measurements were taken with the with a DEMEC Mechanical Strain Gaug		
9	**Overall Mock Up 6.16.2017**	

KEYED ELEVATIONS



SCALE: 1/2" = 1'-0"

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2017 STUCCO STUDY

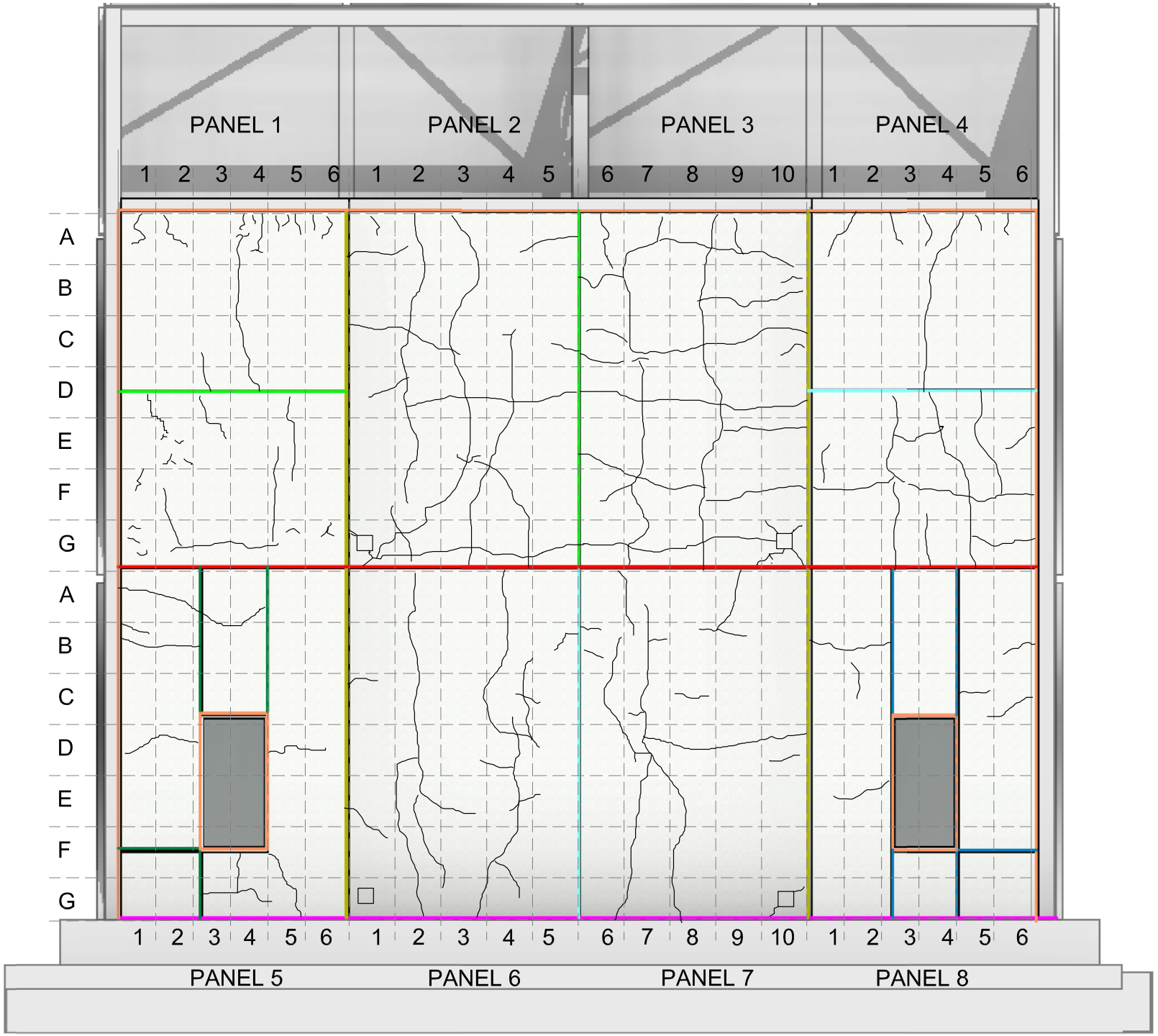
MEASUREMENT POINTS

DRAWN BY: PG
CHKD. BY: JTB

6/14/2017

T-1

File: X:\Z6\Plaster Test 2017\New Measurement points.dwg



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LEGEND

- 2 PEICE EJ
- #66 CASING BEAD
- CONTINOUS LATH BEHIND #50 JOINTS
- CJT LATH BEHIND #50 JOINTS
- WEEP SCREED
- CORNER BEAD
- CJT LATH BEHIND #15 JOINTS
- CONTINOUS LATH BEHIND #15 JOINTS

2017 STUCCO STUDY

ELEVATION WITH CRACK MAP

DRAWN BY: JTB
CHKD. BY: BC Jr.

9/18/2017

T-2

Date: Sep 18, 2017, 11:56am User ID: JBishop
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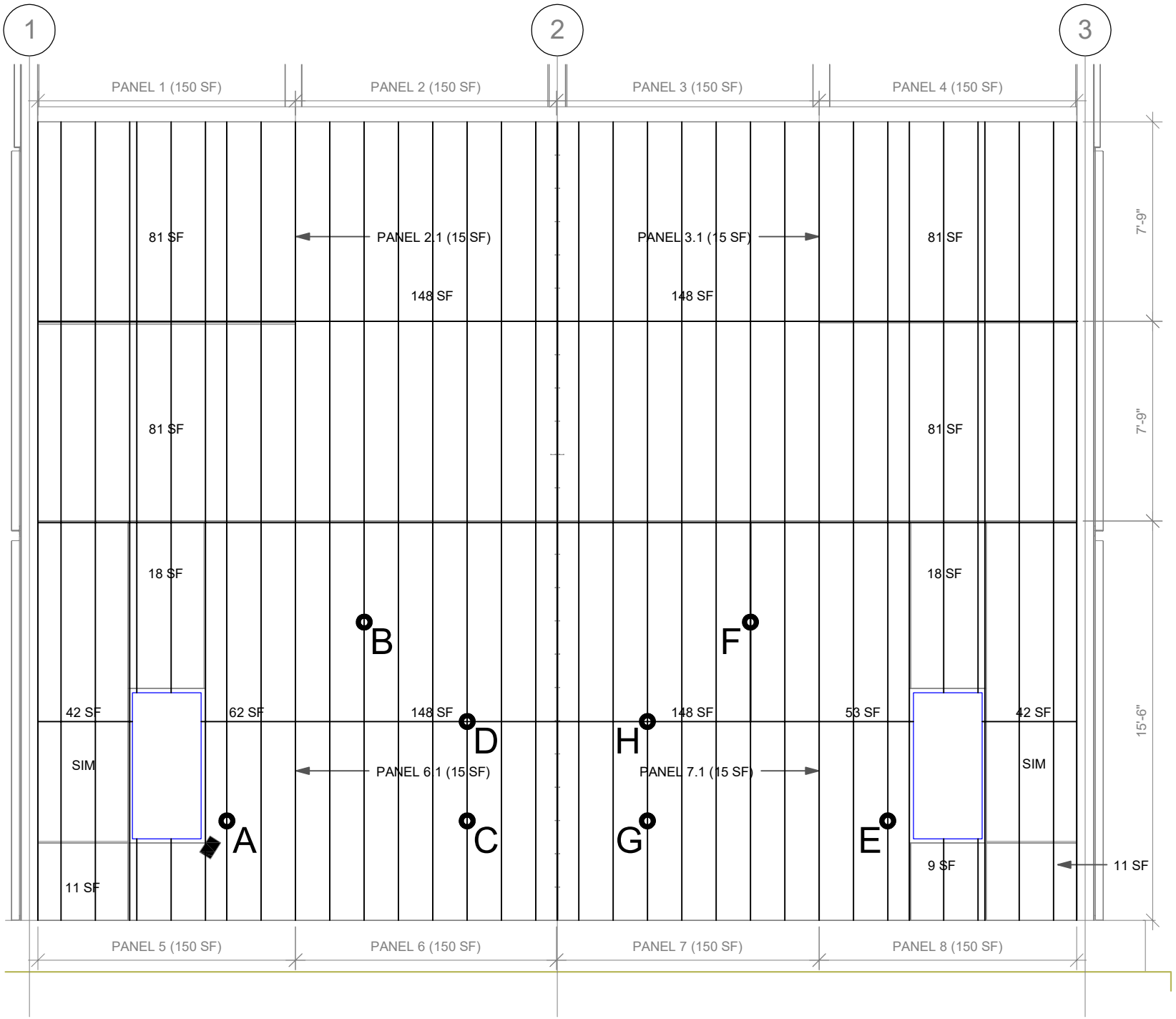

SCALE: 1/2" = 1'-0"

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2017 STUCCO STUDY

FRAMING ELEVATION WITH DEFLECTION GAUGE LOCATIONS

DRAWN BY: JTB
CHKD. BY: BC Jr.

9/18/2017

T-3

Date: Sep 18, 2017, 11:54am User ID: JBishop
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END OF REPORT

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