

Report

Load Testing of Ceiling Panels

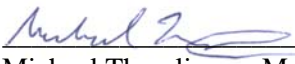
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Introduction

Domtek Building Solutions is in the process of having their materials supplier test a ceiling panel system that they have developed. Domtek is interested in measuring the deflection of the panels when loaded with various loads on top of the panels. Domtek and their supplier came to the Industrial Technology Centre (ITC) in order to test the system.

Work Description

ITC and the supplier's personnel erected a ceiling joist area approximately four feet by 12 feet in ITC's shop. The ceiling joist area consisted of ceiling panels screwed to 2 x 6 studs. The insulation used for weight was Johns Manville fibreglass insulation with an R-value of R12 for one layer of glass batten. The glass batten weighed approximately 0.2 lbs/sq. ft. Figure 1 shows the assembly of the roof panel area.

Figure 1 – Ceiling Panel Assembly



Each ceiling panel is 12 inches wide. Two lines of points were marked 4 inches from the outside of the panel, every 16 inches down the length of the panels for a total of 60 points over the test area. A height gauge was placed on a rolling granite table and moved underneath each measurement point. The elevation to the measurement points were first measured without any insulation on top of the panels. Insulation was added above the ceiling panels

and the elevation was measured again. Measurements were taken with the weights: 0.4 lbf/sq.ft., 0.8lbf/sq.ft., 1.4 lbf/sq.ft., and 2.0 lbf/sq.ft.

Figure 2 shows the panels with four layers of insulation on top.

Figure 2 – Panels Loaded with Insulation



Results

Base elevations varied by approximately 0.7 inches. This is due to the flatness of the joists and the natural variations in the ceiling panels. The change in elevation was calculated from the base points to the loaded condition. A positive deflection represents the panels bowing down under the weight. Negative deflections represent a raise in the panel caused by another portion of the panel deflecting down.

The raw data for the results of this project are given in Appendix A

Appendix A

Deflection Data

Table A.1 Base Measurements

Base		A	B	C	D	E	F	G	H
Base	1	19.100	19.015	18.970	18.985	19.075	19.026	19.075	19.075
	2	18.875	18.804	18.795	18.795	18.861	18.920	19.045	19.138
	3	18.710	18.670	18.635	18.685	18.805	18.835	19.035	19.118
	4	18.660	18.635	18.677	18.700	18.804	18.830	19.050	19.153
	5	18.567	18.535	18.600	18.650	18.750	18.815	19.020	19.126
	6	18.490	18.500	18.595	18.655	18.765	18.830	19.040	19.148
	7	18.579	18.605	18.705	18.724	18.843	18.925	19.085	19.140
	8	18.746	18.710	18.698	18.720	18.804	18.850	19.030	19.122
	9	18.865	18.805	18.800	18.800	18.855	18.910	19.040	19.171
	10	18.824	18.838	18.900	18.932	18.960	19.010	19.090	19.145
0.4lbf/sq.ft. R-value R-24	1	19.115	19.038	19.005	18.995	19.095	19.087	19.050	19.089
	2	18.875	18.810	18.760	18.800	18.852	18.888	19.040	19.118
	3	18.735	18.650	18.647	18.667	18.780	18.835	19.015	19.130
	4	18.663	18.656	18.670	18.712	18.835	18.865	19.068	19.145
	5	18.575	18.550	18.600	18.665	18.760	18.804	19.013	19.115
	6	18.510	18.500	18.600	18.660	18.754	18.825	19.025	19.138
	7	18.620	18.640	18.700	18.755	18.870	18.925	19.100	19.150
	8	18.760	18.705	18.700	18.725	18.815	18.850	19.014	19.125
	9	18.865	18.850	18.775	18.810	18.865	18.875	19.050	19.152
	10	18.850	18.889	18.930	18.910	19.005	19.010	19.100	19.145
0.8lbf/sq.ft. R-value R-48	1	19.100	19.010	18.900	18.969	19.048	19.010	19.055	19.071
	2	18.849	18.750	18.700	18.700	18.766	18.820	18.971	19.100
	3	18.685	18.615	18.550	18.595	18.715	18.740	18.950	19.075
	4	18.650	18.620	18.630	18.655	18.756	18.825	19.010	19.120
	5	18.550	18.510	18.525	18.575	18.671	18.750	18.931	19.085
	6	18.475	18.455	18.520	18.570	18.687	18.750	18.960	19.100
	7	18.580	18.605	18.670	18.665	18.775	18.875	19.040	19.120
	8	18.715	18.660	18.620	18.625	18.740	18.760	18.971	19.085
	9	18.839	18.750	18.720	18.700	18.775	18.825	18.980	19.105
	10	18.825	18.840	18.885	18.910	18.955	18.980	19.060	19.115

1.4lbf/sq.ft. R-value R-84	1	19.075	19.000	18.941	18.927	19.021	19.017	19.010	19.100
	2	18.785	18.700	18.600	18.635	18.695	18.738	18.959	19.075
	3	18.660	18.540	18.485	18.500	18.615	18.680	18.922	19.065
	4	18.610	18.583	18.575	18.612	18.735	18.760	19.010	19.100
	5	18.515	18.470	18.460	18.507	18.625	18.690	18.932	19.060
	6	18.450	18.420	18.595	18.490	18.608	18.697	18.942	19.080
	7	18.560	18.552	18.550	18.625	18.760	18.825	19.040	19.105
	8	18.677	18.600	18.615	18.540	18.650	18.715	18.930	19.070
	9	18.785	18.725	18.625	18.637	18.710	18.744	18.955	19.100
	10	18.823	18.875	18.875	18.890	18.940	18.950	19.050	19.113
2.0lbf/sq.ft. R-value R-120	1	19.089	18.990	18.920	18.935	18.910	18.975	19.061	19.050
	2	18.775	18.638	18.510	18.550	18.631	18.685	18.910	19.065
	3	18.614	18.510	18.413	18.435	18.587	18.617	18.900	19.045
	4	18.610	18.505	18.550	18.570	18.704	18.750	19.975	19.100
	5	18.496	18.429	18.425	18.460	18.575	18.660	18.896	19.060
	6	18.424	18.371	18.400	18.455	18.576	18.650	18.907	19.066
	7	18.545	18.530	18.576	18.570	18.677	18.806	18.914	19.090
	8	18.655	18.568	18.475	18.525	18.562	18.660	18.900	19.050
	9	18.775	18.660	18.570	18.550	18.612	18.710	18.910	19.085
	10	18.815	18.815	18.850	18.875	19.010	18.945	19.038	19.105

Table A.2 Calculated Deflections at Insulation Loads

Width (in.)		4	8	16	20	28	32	40	44
Length (in.)	0	-0.015	-0.023	-0.035	-0.010	-0.020	-0.061	0.025	-0.014
	16	0.000	-0.006	0.035	-0.005	0.009	0.032	0.005	0.020
	32	-0.025	0.020	-0.012	0.018	0.025	0.000	0.020	-0.012
	48	-0.003	-0.021	0.007	-0.012	-0.031	-0.035	-0.018	0.008
	64	-0.008	-0.015	0.000	-0.015	-0.010	0.011	0.007	0.011
	80	-0.020	0.000	-0.005	-0.005	0.011	0.005	0.015	0.010
	96	-0.041	-0.035	0.005	-0.031	-0.027	0.000	-0.015	-0.010
	112	-0.014	0.005	-0.002	-0.005	-0.011	0.000	0.016	-0.003
	128	0.000	-0.045	0.025	-0.010	-0.010	0.035	-0.010	0.019
144	-0.026	-0.051	-0.030	0.022	-0.045	0.000	-0.010	0.000	
Average Deflection -		0.007			Max. Deflection			0.035	
Width (in.)		4	8	16	20	28	32	40	44
Length (in.)	0	0.000	0.005	0.070	0.016	0.027	0.016	0.020	0.004
	16	0.026	0.054	0.095	0.095	0.095	0.100	0.074	0.038
	32	0.025	0.055	0.085	0.090	0.090	0.095	0.085	0.043
	48	0.010	0.015	0.047	0.045	0.048	0.005	0.040	0.033
	64	0.017	0.025	0.075	0.075	0.079	0.065	0.089	0.041
	80	0.015	0.045	0.075	0.085	0.078	0.080	0.080	0.048
	96	-0.001	0.000	0.035	0.059	0.068	0.050	0.045	0.020
	112	0.031	0.050	0.078	0.095	0.064	0.090	0.059	0.037
	128	0.026	0.055	0.080	0.100	0.080	0.085	0.060	0.066
144	-0.001	-0.002	0.015	0.022	0.005	0.030	0.030	0.030	
Average Deflection		0.066			Max. Deflection			0.100	
Width (in.)		4	8	16	20	28	32	40	44
Length (in.)	0	0.025	0.015	0.029	0.058	0.054	0.009	0.065	-0.025
	16	0.090	0.104	0.195	0.160	0.166	0.182	0.086	0.063
	32	0.050	0.130	0.150	0.185	0.190	0.155	0.113	0.053
	48	0.050	0.052	0.102	0.088	0.069	0.070	0.040	0.053
	64	0.052	0.065	0.140	0.143	0.125	0.125	0.088	0.066
	80	0.040	0.080	0.000	0.165	0.157	0.133	0.098	0.068
	96	0.019	0.053	0.155	0.099	0.083	0.100	0.045	0.035
	112	0.069	0.110	0.083	0.180	0.154	0.135	0.100	0.052
	128	0.080	0.080	0.175	0.163	0.145	0.166	0.085	0.071
144	0.001	-0.037	0.025	0.042	0.020	0.060	0.040	0.032	
Average Deflection		0.117			Max. Deflection			0.190	

Width (in.)		4	8	16	20	28	32	40	44	
Length (in.)	0	0.011	0.025	0.050	0.050	0.165	0.051	0.014	0.025	
	16	0.100	0.166	0.285	0.245	0.230	0.235	0.135	0.073	
	32	0.096	0.160	0.222	0.250	0.218	0.218	0.135	0.073	
	48	0.050	0.130	0.127	0.130	0.100	0.080	0.075	0.053	
	2.0 lbf/sq.ft.	64	0.071	0.106	0.175	0.190	0.175	0.155	0.124	0.066
		80	0.066	0.129	0.195	0.200	0.189	0.180	0.133	0.082
		96	0.034	0.075	0.129	0.154	0.166	0.119	0.071	0.050
	112	0.091	0.142	0.223	0.195	0.242	0.190	0.130	0.072	
	128	0.090	0.145	0.230	0.250	0.243	0.200	0.130	0.086	
144	0.009	0.023	0.050	0.057	-0.050	0.065	0.052	0.040		
Average Deflection		0.165			Max. Deflection			0.285		

Figure A1 - 0.4 lbs/sq.ft. Load

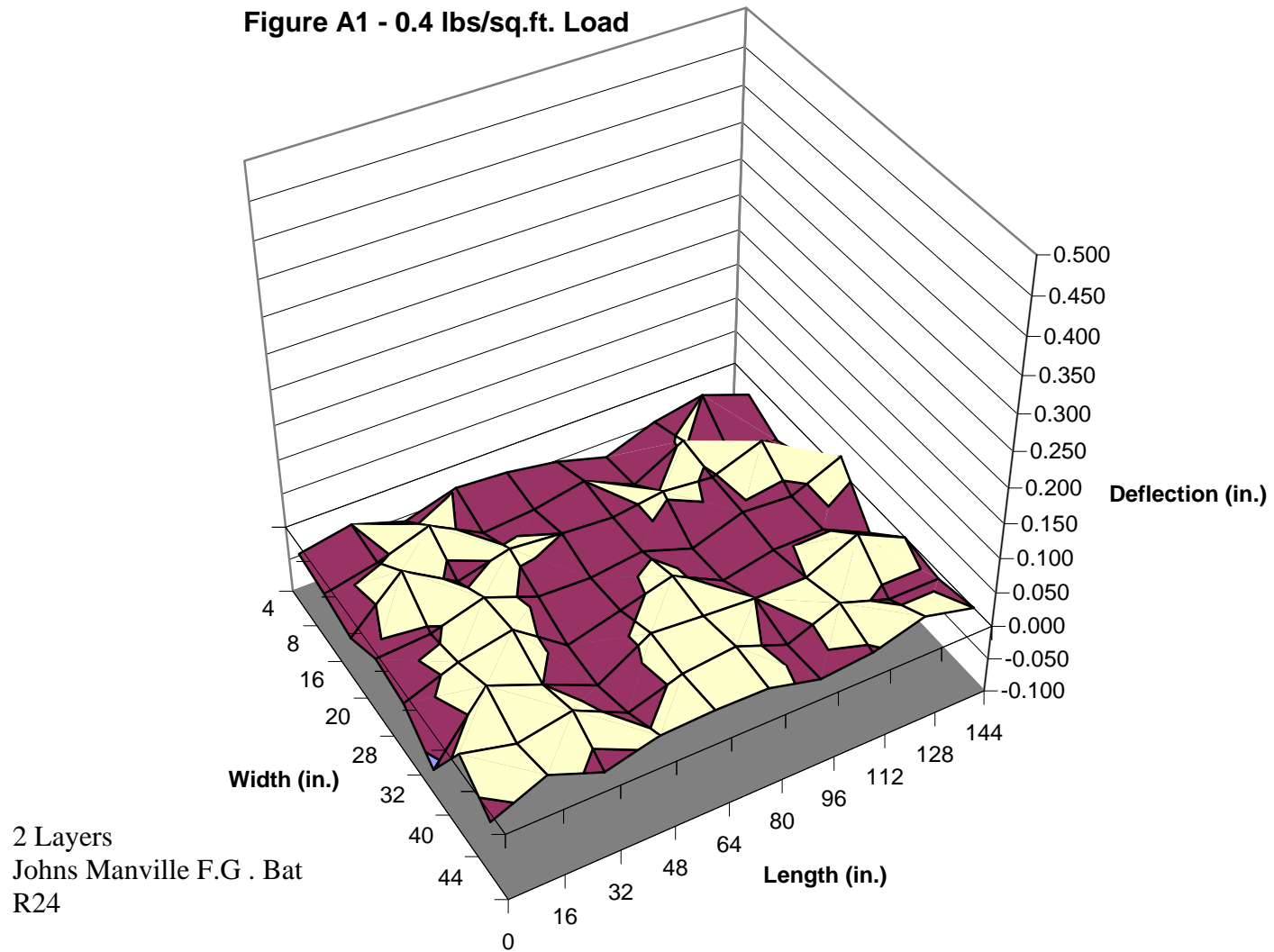


Figure A2 - 0.8 lbs/sq.ft. Load

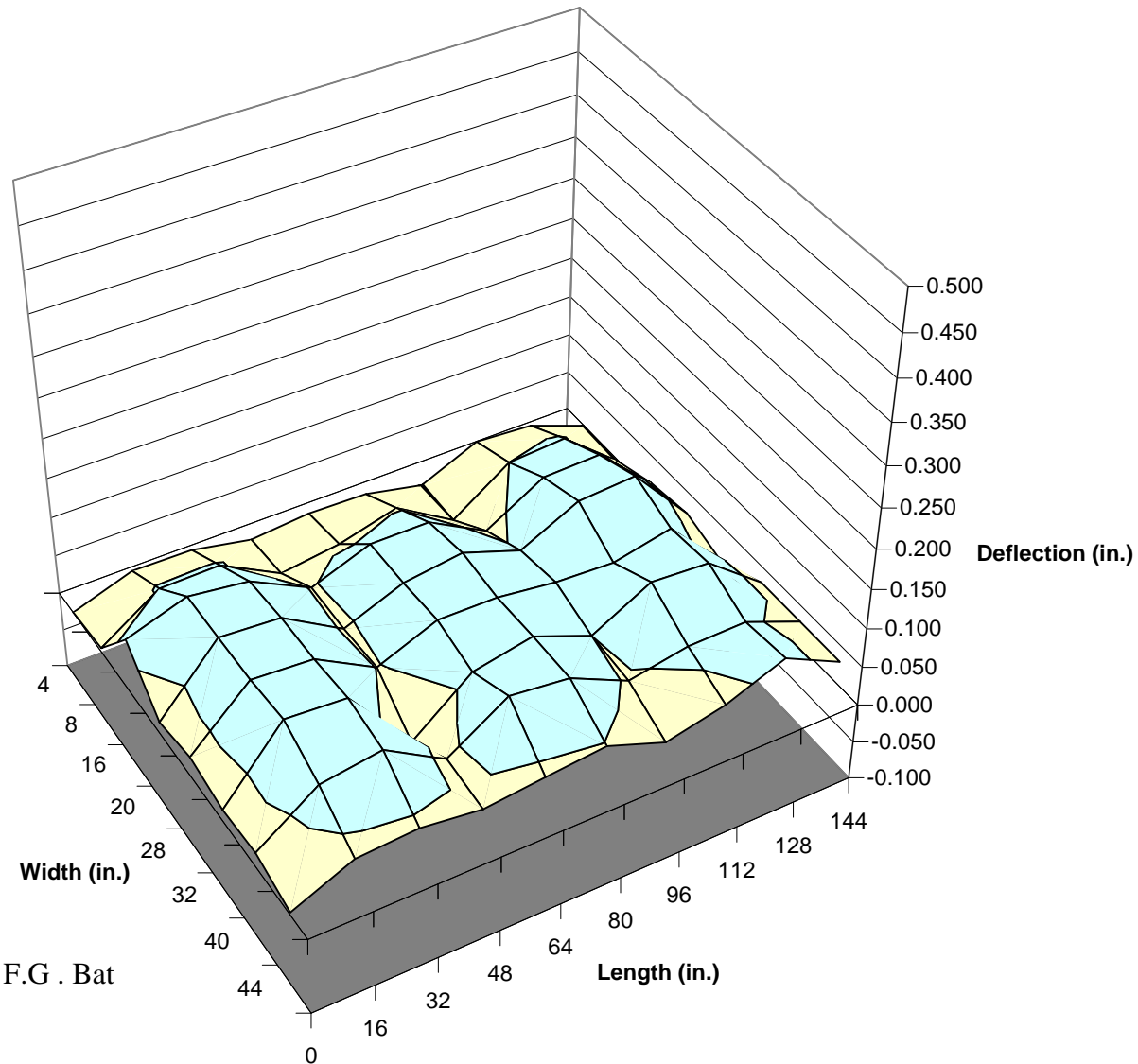


Figure A3 - 1.4 lbs/sq.ft. Load

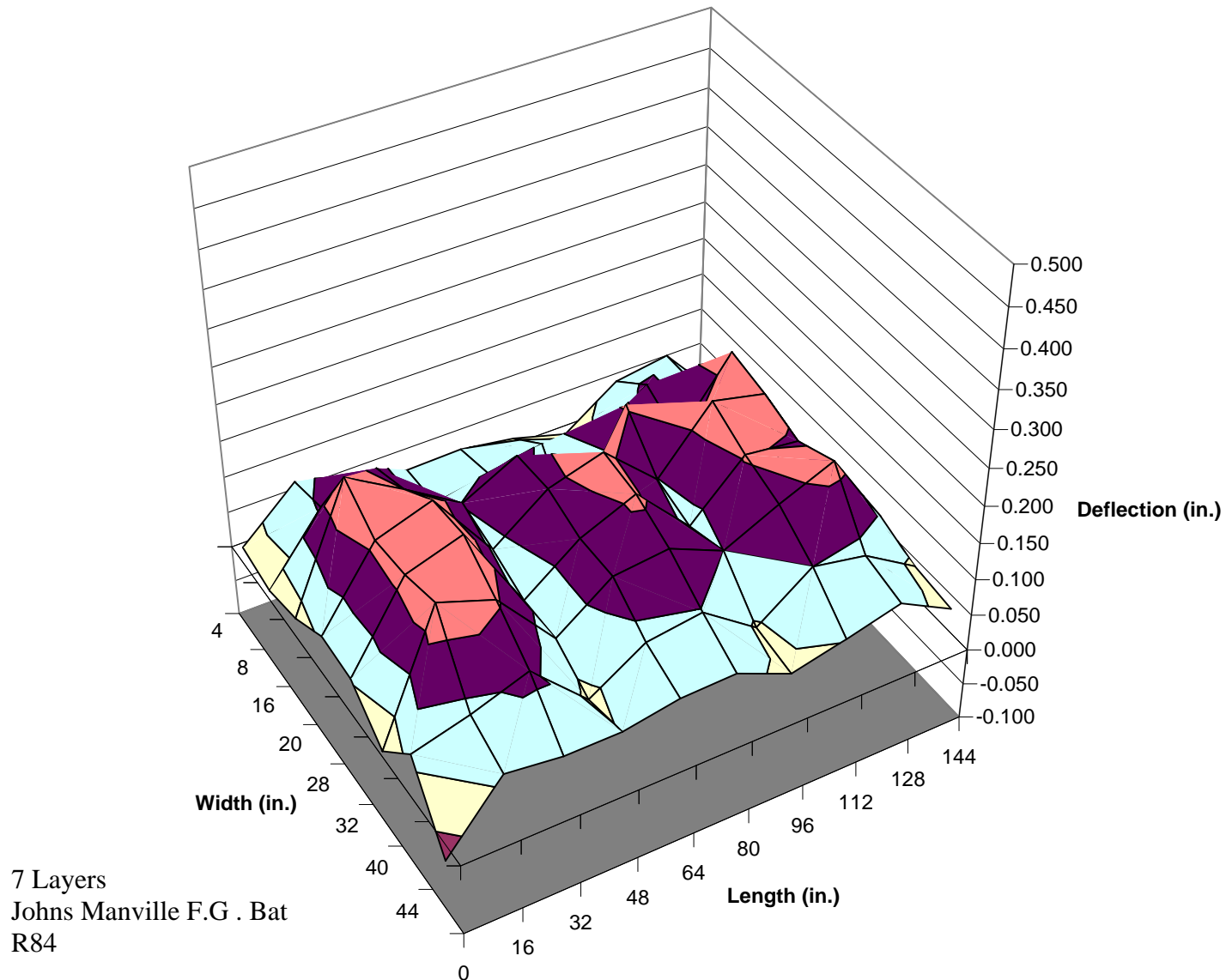


Figure A4 - 2.0 lbs/sq.ft. Load

