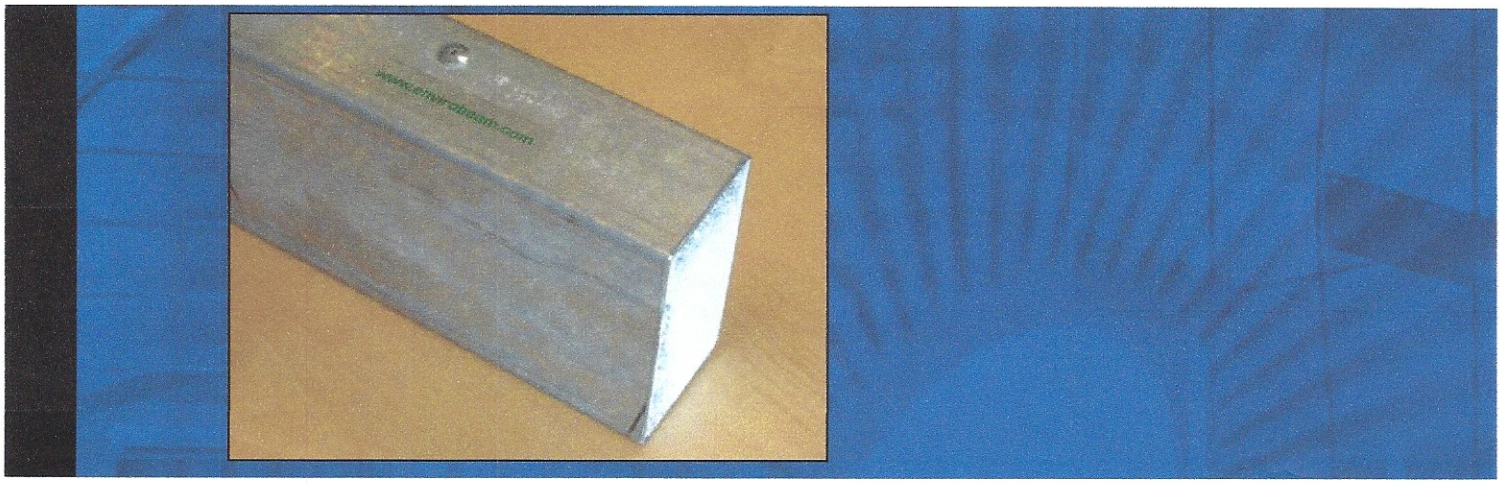
Enviro-King™

Cold-Formed Insulated Composite Structural Elements

Engineering/Analysis Report



June 2011

kpff Consulting Engineers

kpff Consulting Engineers

June 6, 2011

Mr. Duane Den Adel
Evolution 1, LLC
309 Noble Cliff
Langley, WA 98260

Subject: Enviro-King Testing Report

Dear Duane:

This is our engineering report which documents the testing program conducted at Mayes Testing Engineers Laboratories on March 15-16, 2011. The purpose of these tests was to establish the bending strength of the Enviro-King cold-formed, pre-insulated jamb elements.

The appendix of the report includes the table of section properties and bending strengths as established by this testing program.

Our report may be used in conjunction with the Mayes Testing report, dated March 17, 2011.

We appreciate the opportunity to assist you in this effort. If you have any questions, please call me at (206) 622-5822.

Sincerely,

Greg Schindler, SE
Associate

GLS:kkt

111003.10

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Seattle Everett Tacoma Lacey Portland Eugene Sacramento San Francisco Walnut Creek Los Angeles Long Beach Pasadena Irvine
San Diego Boise Phoenix St. Louis Chicago New York International offices in: Amman, Jordan Abu Dhabi, UAE

Engineering/Analysis Report

June 2011

Prepared for:
Evolution 1, LLC
309 Noble Cliff
Langley, WA 98260

Prepared by:
KPFF Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, WA 98101
(206) 622-5822
KPFF Job No. 111003.10

Introduction

The Enviro-King, as manufactured by Evolution 1, LLC, is a pre-insulated boxed member made of a gauge metal structural shell surrounding a core of polystyrene insulation. The two outer track-like cold-formed steel sections are adhered to the foam core with glue and are attached to each other along their length with either pneumatic drive pins or steel rivets. The resulting composite member exhibits increased strength over that provided by the individual steel sections alone. Figure 1 in Appendix A depicts the standard Enviro-King shapes that were tested.

The purpose of this product is to provide an insulated member as a substitution for bundled studs, typically used for door and window jamb members in cold-formed framed structures. Bundled studs are typically not insulated and thus present a thermal gap in the exterior wall of structures where they are used. Enviro-King jamb members provide a one-piece structural element that does not require build up and connection of individual wall studs and the labor involved with field insulating them.

Purpose of Testing

Since the Enviro-King is a custom shaped structural element that is not made of standard shapes established in the cold-formed industry, the design section properties must be established by calculation or testing. The purpose of the beam testing program was to establish the bending strength of these elements and to document the affect that the foam core has in increasing the available strength of these sections, which can be derived from calculation alone. The results of this testing program were then used to develop a methodology to determine, by calculation, the section properties and bending strengths of the whole family of Enviro-King shapes.

Testing Setup

The tests were configured in accordance with the American Iron and Steel Institute Testing Standard AISI 911-08 and were conducted by Mayes Testing Engineers, Inc. at their lab in Lynnwood, Washington. Refer to the Mayes Testing Report dated March 17, 2011. The test specimens consisted of 10-foot, 6-inch long Enviro-King sections of varying steel gauges. Two types of members were tested; the standard section was a 1-1/2-inch inner flange and 2-3/4-inch outer flanges, and the Heavy Duty "HD" section with both inner and outer flanges of 2-3/4-inches.

The specimens were placed in a hydraulic compression testing machine (see Figure 2 in Appendix A) so as to have a 10-foot, 0-inch span between the centers of the support bearings. Those bearings consisted of a round bar rocker bearing. The beams were loaded in a two-point configuration parallel to the strong axis with steel plate and round bar bearings at the load points which were set 28 inches apart straddling the mid-span of the member. A steel spreader beam spanned between the load points and was in turn loaded at a single mid-point location with a 10,000 pound capacity load cell. A

dial gauge was used to determine the deflection of the beam at mid-span. This configuration develops a constant bending moment in the center area between load points.

The beams were loaded continuously until failure while load and deflection readings were taken at 200 pound increments of load. Failure was indicated when the beam would no longer resist increasing load. Load/deflection curves were then plotted in the Mayes Testing report.

Three identical specimens were tested for each of six combinations of section and steel gauge from 33 mil. through 68 mil. A control specimen was also tested which consisted of two standard stud sections 600S162-54 welded together in the typical bundled stud configuration. In all a total of 19 specimens were tested.

To control lateral deflection and torsional distortion, lateral bracing was provided at the two load points and at the end supports. At the load points, this bracing consisted of vertical rollers so as to prevent resistance to vertical movement.

Test Results

At the failure load, all Enviro-King test specimens exhibited the same mode of distortion and failure. The compression flanges yielded and buckled along with a small portion of the side webs. As compression built up in the flanges, the outer flange distorted outward between the fasteners but the inner flange was restrained from buckling by the foam and the overlap of the outer flange (see Figure 3 in Appendix A). Failure occurred in all specimens when the inner flange buckled into the foam core (see Figures 4 and 5 in Appendix A). All specimens failed in flexure in the center area between the loading points, i.e. the constant bending moment region of the beam. No distortion of any sort was noted outside the center region.

Use of Test Results

The North American Specification of the Design of Cold-Formed Steel Structural Members (AISI S100-2007) sets forth in Section F, a methodology by which testing results can be used to establish member strength. The average of the three failure loads for each group of specimens was used as the representative loading capacity at failure. The failure moment was then determined from that load and the beam loading configuration.

Allowable Moment for the different specimens tested was developed based on Section F1.2 of the AISI S100-2007 code: Allowable Strength Design. A safety factor was determined in accordance with Eq F1.2-2 where the resistance factor from testing was used based on calculation of Eq F1.1-2. Effective section properties producing allowable moments were then calculated for the individual pieces considering them as track type elements with un-stiffened flanges. The plate buckling coefficient, k, for each flange of the composite structural elements were then determined based on the effective section properties formulas and the test data. One set of k values for the inner and outer flanges was determined for the 33 and 43 mils products while a separate set was determined for the 54 and 68

mil products based on the results of the testing. These were then used to determine the allowable properties of 4-inch, 6-inch, and 8-inch deep members. The test data showed that the Heavy Duty Enviro-King members are stronger than two bundled 600S137 studs of the same gage. Additionally, both the Standard and Heavy Duty Enviro-King members, as tested with the foam core, are stronger than calculated values of just the cold-formed steel pieces themselves. Tested members with thinner gages of 33 and 43 mils showed a minimum of a 20 percent increased moment capacity while tested members with gages of 54 and 68 mils showed a minimum increase of 8 percent.

Table A, in Appendix A, provides the summary of the gross and effective section properties including Allowable Moment (Ma) and Allowable Shear (Va) capacities of the entire family of Enviro-King sections in 4-inch, 6-inch, and 8-inch depths.

Conclusions

This testing program established the bending moment capacity at failure of 18 Enviro-King beam specimens and one bundled stud beam. The failure modes were very consistent with all Enviro-King members failing in the same manner – compression flange yielding/buckling. The load deflection curves were very linear until close to failure. Using the average failure loading from each group, the moment capacity was calculated and compared to the moment capacity derived by calculation for disconnected steel sections of the same shape. In all cases, the moment capacity of the tested shapes, when reduced by appropriate safety factors, exceeded that of the bare, disconnected shapes. This indicates that significant increase in strength is provided by the combination of the foam core and the overlapped and fastened flanges. The foam core and the overlapped flange configuration serve to delay the onset of flange buckling and thus increase the overall bending strength of the composite section.

The bending strength of the Enviro-King sections also compares favorably with that of traditional jamb member made of two standard wall studs of the same gauge steel welded in a boxed configuration.

Appendix A

Figures, Photographs, and Tables

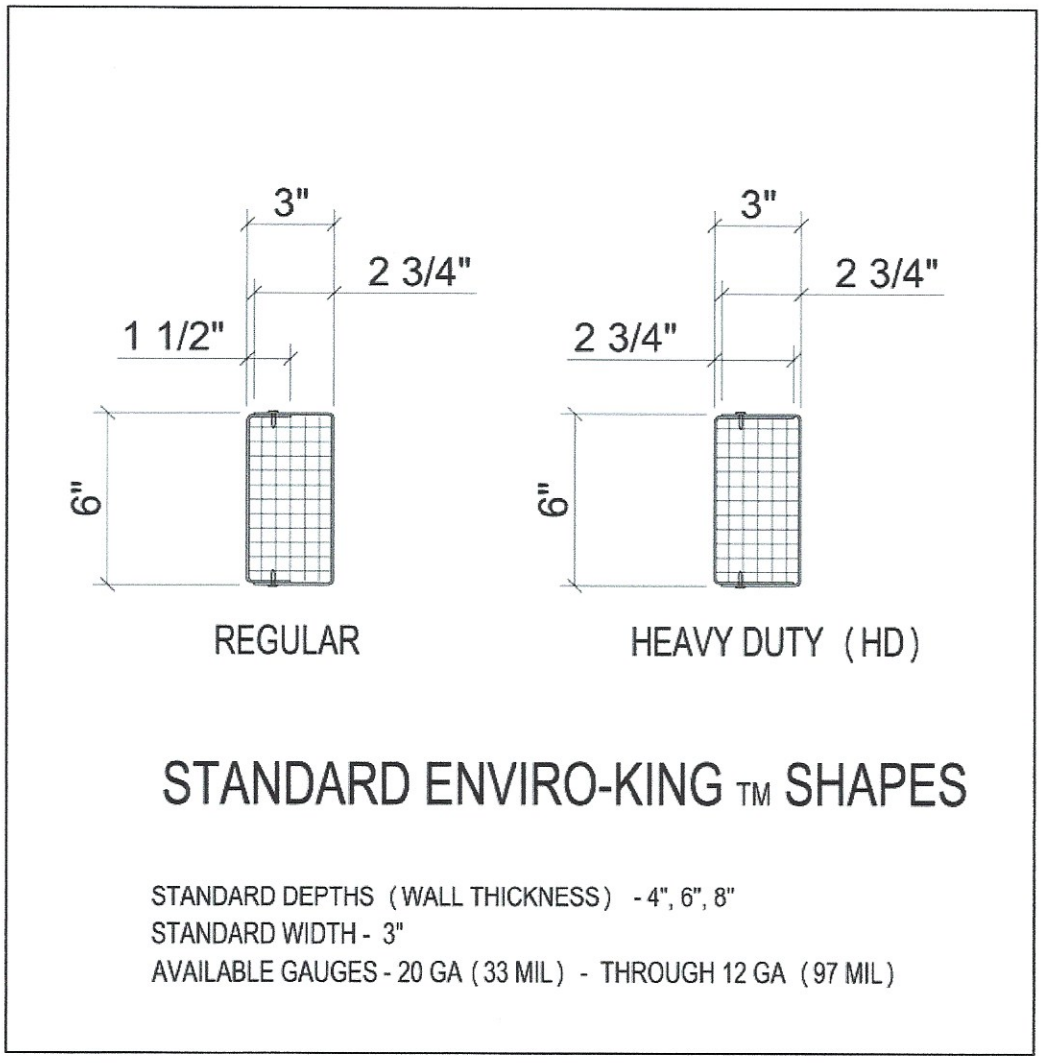

3"
2 3/4"
1 1/2"
6"
REGULAR
3"
2 3/4"
2 3/4"
6"
HEAVY DUTY (HD)
STANDARD ENVIRO-KING TM SHAPES
STANDARD DEPTHS (WALL THICKNESS) - 4", 6", 8"
STANDARD WIDTH - 3"
AVAILABLE GAUGES - 20 GA (33 MIL) - THROUGH 12 GA (97 MIL)

Figure 1

Figure 2 – Testing Setup

Figure 3 – Outer Flange Buckling

Figure 4 – Flange at Failure at Mid-Span

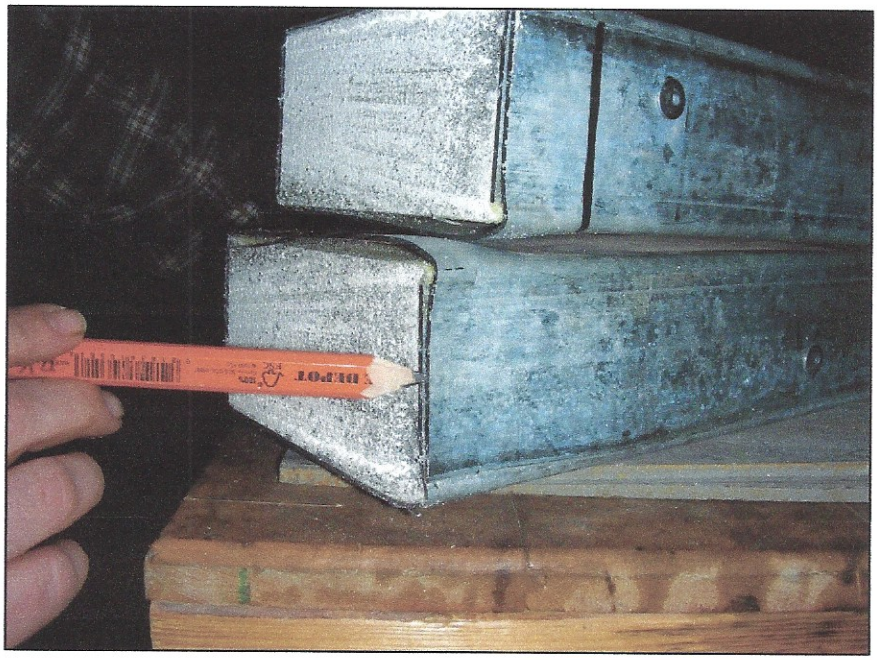


Figure 5 – Flange at Failure

ENVIRO-KING$_{TM}$ SECTION PROPERTIES TABLE

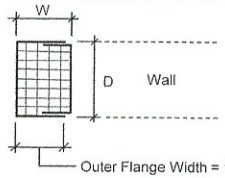
		Design Thickness	Gross Properties								Effective Properties			
			F_y	Area	Weight	I_x	S_x	R_x	I_y	R_y	I_{xe}	S_{xe}	M_a	V_a
		(in)	(ksi)	(in^2)	(lb/ft)	(in^4)	(in^3)	(in)	(in^4)	(in)	(in^4)	(in^3)	(k-in)	(lb)
4" WALL	EK4-3-33	0.0346	33	0.558	1.899	1.461	0.735	1.618	0.776	1.179	1.155	0.469	9.266	1970
	EK4-3-33 HD	0.0346	33	0.645	2.194	1.790	0.903	1.666	0.826	1.132	1.307	0.499	9.863	1970
	EK4-3-43	0.0451	33	0.725	2.466	1.881	0.949	1.611	1.001	1.175	1.606	0.707	13.979	3478
	EK4-3-43 HD	0.0451	33	0.837	2.849	2.302	1.164	1.658	1.065	1.128	1.986	0.831	16.428	3478
	EK4-3-54	0.0566	50	0.904	3.075	2.321	1.173	1.603	1.236	1.170	1.881	0.787	23.562	6743
	EK4-3-54 HD	0.0566	50	1.045	3.557	2.840	1.440	1.648	1.317	1.122	2.168	0.851	25.487	6743
	EK4-3-68	0.0713	50	1.129	3.840	2.859	1.448	1.592	1.525	1.162	2.426	1.062	31.786	9551
	EK4-3-68 HD	0.0713	50	1.307	4.446	3.498	1.780	1.636	1.626	1.115	2.869	1.168	34.974	9551
	EK4-3-97	0.1017	50	1.581	5.378	3.891	1.982	1.569	2.080	1.147	3.526	1.599	47.879	12928
	EK4-3-97 HD	0.1017	50	1.835	6.243	4.759	2.439	1.611	2.222	1.101	4.297	1.859	55.644	12928
6" WALL	EK6-3-33	0.0346	33	0.697	2.370	3.728	1.248	2.313	1.082	1.246	3.034	0.762	15.064	1284
	EK6-3-33 HD	0.0346	33	0.783	2.665	4.480	1.502	2.392	1.130	1.201	3.396	0.767	15.147	1284
	EK6-3-43	0.0451	33	0.905	3.080	4.815	1.614	2.307	1.396	1.242	4.209	1.256	24.813	2854
	EK6-3-43 HD	0.0451	33	1.018	3.463	5.784	1.942	2.384	1.459	1.197	5.085	1.450	28.652	2854
	EK6-3-54	0.0566	50	1.130	3.845	5.965	2.003	2.298	1.728	1.237	5.000	1.421	42.533	5703
	EK6-3-54 HD	0.0566	50	1.272	4.327	7.168	2.412	2.374	1.807	1.192	5.677	1.531	45.842	5703
	EK6-3-68	0.0713	50	1.414	4.811	7.387	2.485	2.286	2.138	1.230	6.431	1.920	57.486	10701
	EK6-3-68 HD	0.0713	50	1.592	5.417	8.879	2.994	2.362	2.237	1.186	7.473	2.097	62.791	10701
	EK6-3-97	0.1017	50	1.987	6.762	10.167	3.433	2.262	2.937	1.216	9.347	2.871	85.944	20556
	EK6-3-97 HD	0.1017	50	2.242	7.627	12.229	4.144	2.336	3.077	1.172	11.177	3.286	98.377	20556
8" WALL	EK8-3-33	0.0346	33	0.835	2.841	7.388	1.853	2.975	1.387	1.289	5.599	0.972	19.211	952
	EK8-3-33 HD	0.0346	33	0.922	3.136	8.736	2.193	3.079	1.435	1.248	6.244	1.025	20.261	952
	EK8-3-43	0.0451	33	1.086	3.694	9.559	2.401	2.968	1.790	1.284	8.358	1.658	32.766	2115
	EK8-3-43 HD	0.0451	33	1.198	4.077	11.302	2.841	3.071	1.853	1.244	10.074	2.005	39.613	2115
	EK8-3-54	0.0566	50	1.357	4.616	11.870	2.984	2.958	2.219	1.279	10.024	1.883	56.387	4214
	EK8-3-54 HD	0.0566	50	1.498	5.097	14.039	3.534	3.061	2.298	1.239	11.422	2.076	62.154	4214
	EK8-3-68	0.0713	50	1.699	5.781	14.743	3.712	2.946	2.751	1.272	13.042	2.875	86.088	8522
	EK8-3-68 HD	0.0713	50	1.877	6.387	17.444	4.400	3.048	2.849	1.232	14.962	3.227	96.620	8522
	EK8-3-97	0.1017	50	2.394	8.147	20.417	5.156	2.920	3.793	1.259	18.965	4.420	132.336	21771
	EK8-3-97 HD	0.1017	50	2.648	9.012	24.181	6.121	3.022	3.932	1.219	22.309	4.995	149.552	21771

Notes:

1. Section properties are based on direct testing in accordance with AISI 911-08 and the AISI S100-2007 Specification. k values used are representative of the direct testing.
   For 33 mils, k (inside flange) = 1.2 and k (outside flange) = 0.8. For 43 mils, k (inside flange) = 4 and k (outside flange) = 0.8.
   For 54 & 68 mils, k (inside flange) = 1.2 and k (outside flange) = 0.43. For 97 mils, k (inside flange) = 1.0 and k (outside flange) = 0.43.
2. User should check end reaction for web crippling.
3. Bending capacities are based on the assumption that the compression flange is adequately laterally braced on both sides.
4. Allowable Moment and Shear Values are calculated assuming a negligible axial load. Load bearing jamb studs are to be designed for combined axial and bending loads by a qualified professional.
5. Strength increase due to cold work of forming has not been incorporated.
6. The effective Moment of Inertia has been calculated for deflection based on Procedure 1 of the AISI S100-2007 Specification by using the stress at the effective section modulus of the allowable bending moment.
7. The distortional buckling limit state is not considered in this table. Consideration of distortional buckling may result in lower strengths when restraint against distortional buckling is not provided.
8. If punch-outs are used in members, values may be smaller than those listed above and shall be per the AISI S100-2007 Specification.

Table A– Section Properties

ENVIRO-KING™ NOMENCLATURE



D (Wall Thickness) — W (Width of Part)

EK 6 - 3 - 43

Mil / ga.

Example Enviro-King Size Designation

Inner Flange Width - Standard = 1 1/2"
- HD = Outer Flg. Width

CSI SPEC # 054233

The designer should specify the wall thickness (D) , the width (W) and the metal thickness (Mil) for Enviro-King.
Standard width is 3". Custom widths are available.
For Heady Duty sections, add "HD" at the end of the designation.
Structural section properties are per the Emnviro-King Section Properties Table.
The designer is responsible for determining the adequacy of tehe sections for their intended use.

ENVIRO-KING™ TABLE 3: KING STUD - ALLOWABLE UNIFORM LOADS, lbs/ft

DEFLECTION LIMITS L/ 360

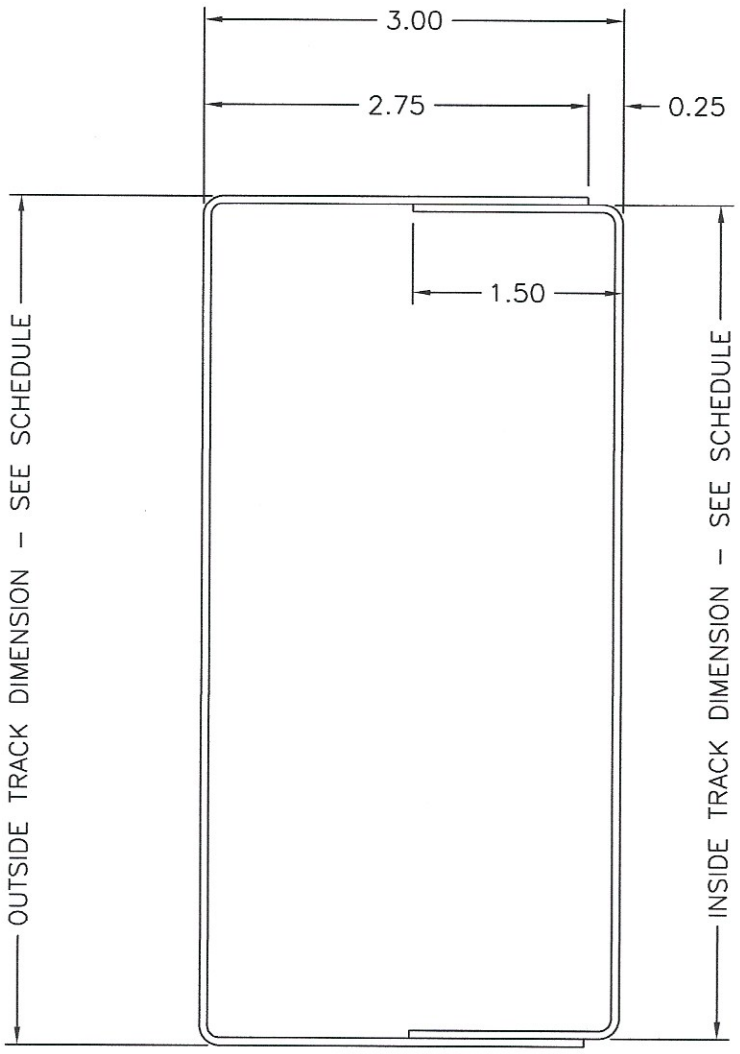
Member Designation	Wt. lbs/ft	Ma k-in	Ixe in^4	Va kips	KING STUD HEIGHT, ft																					
					8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
EK4-3-33	1.899	9.266	1.155	1.970	97	69	50	38	29	23	18	15	12	10													
EK4-3-33 HD	2.194	9.863	1.307	1.970	103	78	57	43	33	26	21	17	14	12	10												
EK4-3-43	2.466	13.979	1.606	3.478	137	96	70	53	41	32	26	21	17	14	12	10											
EK4-3-43 HD	2.849	16.428	1.986	3.478	170	119	87	65	50	40	32	26	21	18	15	13	11										
EK4-3-54	3.075	23.562	1.881	6.743	161	113	82	62	48	37	30	24	20	17	14	12	10										
EK4-3-54 HD	3.557	25.487	2.168	6.743	185	130	95	71	55	43	35	28	23	19	16	14	12	10									
EK4-3-68	3.840	31.786	2.426	9.551	207	145	106	80	61	48	39	31	26	22	18	15	13	11	10								
EK4-3-68 HD	4.446	34.974	2.869	9.551	245	172	125	94	73	57	46	37	31	26	21	18	16	14	12	10							
EK4-3-97	5.378	47.879	3.526	12.928	301	211	154	116	89	70	56	46	38	31	26	22	19	17	14	13	11	10					
EK4-3-97 HD	6.243	55.644	4.297	12.928	367	258	188	141	109	85	68	56	46	38	32	27	23	20	18	15	14	12	11	10			
EK6-3-33	2.370	15.064	3.034	1.284	157	124	100	83	70	59	48	39	32	27	23	19	17	14	12	11	10						
EK6-3-33 HD	2.665	15.147	3.396	1.284	158	125	101	83	70	60	52	44	36	30	25	22	19	16	14	12	11						
EK6-3-43	3.080	24.813	4.209	2.854	258	204	165	137	106	84	67	55	45	37	32	27	23	20	17	15	13	12	10				
EK6-3-43 HD	3.463	28.652	5.085	2.854	298	236	191	158	129	101	81	66	54	45	38	32	28	24	21	18	16	14	13	11	10		
EK6-3-54	3.845	42.533	5.000	5.703	427	300	219	164	126	99	80	65	53	44	37	32	27	24	21	18	16	14	12	11	10		
EK6-3-54 HD	4.327	45.842	5.677	5.703	478	340	248	186	144	113	90	74	61	50	43	36	31	27	23	20	18	16	14	13	11	10	
EK6-3-68	4.811	57.486	6.431	10.701	549	386	281	211	163	128	102	83	69	57	48	41	35	30	26	23	20	18	16	14	13	12	10
EK6-3-68 HD	5.417	62.791	7.473	10.701	638	448	327	245	189	149	119	97	80	66	56	48	41	35	31	27	24	21	19	17	15	13	12
EK6-3-97	6.762	85.944	9.347	20.566	798	560	408	307	236	186	149	121	100	83	70	60	51	44	38	34	30	26	23	21	19	17	15
EK6-3-97 HD	7.627	98.377	11.177	20.556	954	670	488	367	283	222	178	145	119	99	84	71	61	53	46	40	35	31	28	25	22	20	18
EK8-3-33	2.841	18.642	5.599	0.952	194	153	124	103	86	74	63	55	49	43	38	34	31	26	23	20	18	16	14	12	11	10	
EK8-3-33 HD	3.136	19.314	6.244	0.952	201	159	129	106	89	76	66	57	50	45	40	36	32	29	26	22	20	17	16	14	12	11	10
EK8-3-43	3.694	32.766	8.358	2.115	341	270	218	181	152	129	111	97	85	74	63	53	46	39	34	30	26	23	21	19	17	15	14
EK8-3-43 HD	4.077	39.613	10.074	2.115	413	326	264	218	183	156	135	117	103	90	75	64	55	48	41	36	32	28	25	22	20	18	16
EK8-3-54	4.616	56.387	10.024	4.214	587	464	376	311	254	199	160	130	107	89	75	64	55	47	41	36	32	28	25	22	20	18	16
EK8-3-54 HD	5.097	62.154	11.422	4.214	647	512	414	342	288	227	182	148	122	102	86	73	62	54	47	41	36	32	28	25	23	20	18
EK8-3-68	5.781	86.088	13.042	8.522	897	709	570	428	330	259	208	169	139	116	98	83	71	62	54	47	41	36	32	29	26	23	21
EK8-3-68 HD	6.387	96.620	14.962	8.522	1006	795	644	491	378	298	238	194	160	133	112	95	82	71	61	54	47	42	37	33	30	27	24
EK8-3-97	8.147	132.366	18.965	21.771	1379	1089	829	623	480	377	302	246	202	169	142	121	104	89	78	68	60	53	47	42	38	34	31
EK8-3-97 HD	9.012	149.552	22.309	21.771	1558	1231	975	733	564	444	355	289	238	198	167	142	122	105	92	80	71	62	55	50	44	40	36

Notes:
1. See ENVIRO-KING™ SECTION PROPERTY TABLE for additional information.
2. Blank spaces indicate allowable uniform loads are less than 10 lbs/ft

Design Example for EVIRO-KING STUD

Framed opening width for16x12 OHD=	16.00 ft		
Wall height =	14 ft		
Stud spacing adjacent to jamb =	24 in o.c.		
Exterior non-bearing wall design loading=	20 psf		
Deflection limits L/D, where D=	360		
Tributary load width =	9.00 ft		
Design Lateral loading =	180.0 lbs/ft		
Use: EK8-3-54 HD, Allow. uniform load =	182 lbs/ft	greater than	180.0 lbs/ft OK

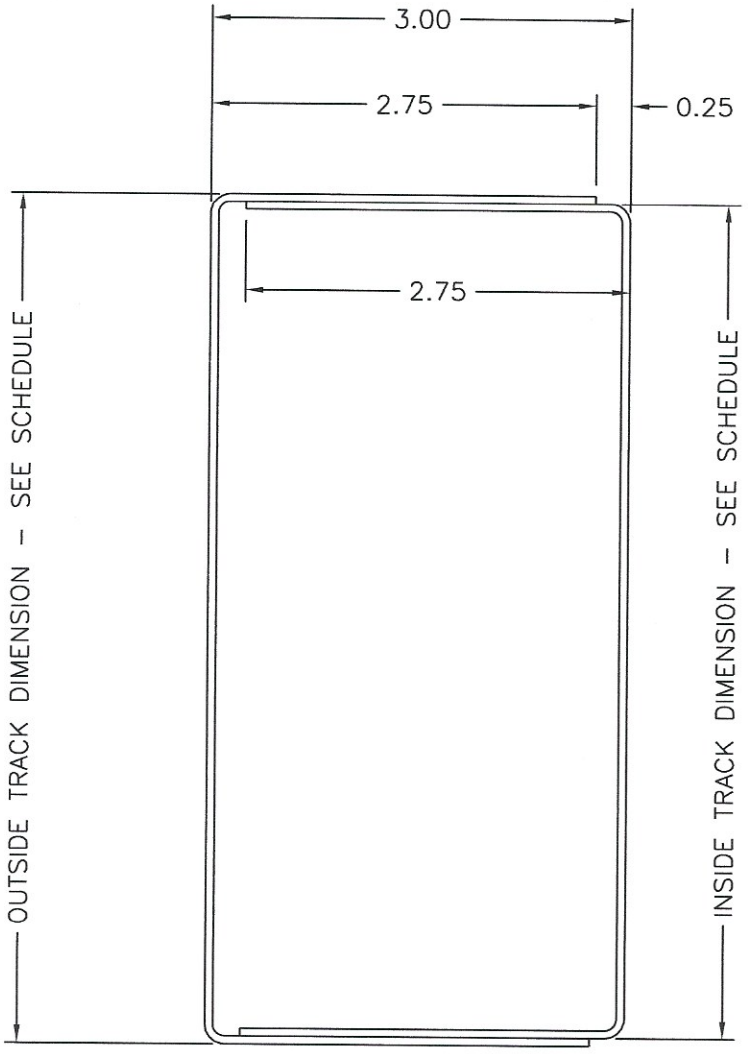
ENVIRO-BEAM ™
A PRODUCT OF EVOLUTON 1 LLC
www.envirobeam.com 206-455-1978



DETAIL 1 – ENVIROBEAM KING STUD

SCALE: NONE

ENVIROBEAM KING– STUD DETAILS	DATE: 12–12–2013
EVOLUTION 1, LLC, 309 NOBEL CLIFF, LANGLEY, WA 98260	SHEET: SK–1



DETAIL 2 – ENVIROBEAM KING STUD HD

SCALE: NONE

ENVIROBEAM KING– STUD DETAILS	DATE: 12–12–2013
EVOLUTION 1, LLC, 309 NOBEL CLIFF, LANGLEY, WA 98260	SHEET: SK–2

SECTION 054023
THERMALLY INSULATED COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Manufactured, structurally engineered, thermally insulated, thermally-broken, cold-formed metal framing boxed channel assemblies for exterior perimeter wall framing, parapets, and roof curbs.

1. Insulated, thermally broken box header framing.
2. Insulated king boxed stud framing.
3. Insulated boxed header & sill framing
4. Connection plates.
5. Insulated boxed roof parapet and roof curb units and pre-insulated Skylight curbs.

B. Related Requirements:

1.	Section 054000	-	Cold-Formed Metal Framing: For installation of work of this Section
2.	Section 072113	-	Rigid Foam Board Insulation
3.	Section 072115	-	Semi-Rigid Mineral Board Insulation

1.2 REFERENCES

A. Reference Standards: Conform to provision of Section [014219 -] .

B. American Iron and Steel Institute (AISI): http://www.steel.org/

1.	AISI S100	-	North American Specification for the Design of Cold-Formed Steel Structural Members
2.	AISI S200	-	North American Cold-Formed Steel Framing Standard - General Provisions
3.	AISI S211	-	North American Cold-Formed Steel Framing Standard - Wall Stud Design
4.	AISI S212	-	North American Standard for Cold-Formed Steel Framing - Header Design
5.	AISI S213	-	North American Standard for Cold-Formed Steel Framing - Lateral Design
6.	AISI 911-08	-	Testing by Mayes Testing Laboratory, Lynnwood, WA.

C. ASTM International (ASTM): http://www.astm.org/

1.	ASTM A123	-	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2.	ASTM A653	-	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
3.	ASTM A792	-	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
4.	ASTM A875	-	Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy-Coated by the Hot-Dip Process.
5.	ASTM A1003	-	Standard Specification for Steel Sheet, Carbon, Metallic- and –Nonmetallic-Coated for Cold-Formed Framing Members.
6.	ASTM C272	-	Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
7.	ASTM C203	-	Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
8.	ASTM C303	-	Standard Test Method for Dimensions and Density of Preformed Block and Board–Type Thermal Insulation

9. ASTM C518 - Standard Test Method for Steady-State Thermal Means of the Heat Flow Meter Apparatus
10. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
11. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
12. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
13. ASTM C1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.
14. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics
15. ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
16. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics
17. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
18. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials

1.3 International Code Commission (ICC) Evaluation Services:

1. ICC ES AC46 - Acceptance Criteria for Cold-Formed Framing Members
2. ICC ES AC261 - Acceptance Criteria for Connectors used with Cold-Formed Steel Structural Members

B. Steel Stud Manufacturers Association (SSMA): Product Technical Information. http://www.ssma.com

1. SSMA ICC-ES Legacy Report ER-4943P, Revised Aug 2003 after revision.
2. SSMA Product Technical Information.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Conform to Section 013113 for coordination with work of related Sections.

1. Section 054000 for integrating and installing thermally insulated framing specified by this Section into cold-formed metal framing systems

1.5 SUBMITTALS

A. Conform to submittal requirements of Section 013300.

B. Product Data:

1. Detailed description and fabrication drawings showing configurations, and design criteria for each manufactured product specified by this Section (See website; envirobeam.com for drawings of Installation Instructions for each individual Enviro-Component).
2. Accessories: Include connection plates, and anchoring devices.
3. Light Gage Steel
4. Block Foam & Insulation filler material
5. Adhesive
6. Connection devices

C. Test Results: Include:

1. Structural: Base on AISI S100 Section F methodology by independent testing laboratory. Stamp and sign written report by licensed professional engineer, registered with [the State of Washington] (See Mayes Testing Test Reports included in KPFF Engineering Reports)
    a. Strong Axis in Bending.
    b. Weak Axis in Bending.
2. Thermal Resistance (R-Value) per Insulation Mfg published test data.

D. Structural Design Calculations: Stamp and sign by licensed professional engineer, registered with [the State of Washington].
1. Comprehensive analysis of design loads,

E. Thermal Resistance (R-Value): Insulation type and thermal properties for each fabricated assembly.

F. Manufacturer's Instructions: Include installation instructions, special procedures, and conditions requiring special attention.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Employ licensed professional engineering personnel experienced in work of this Section and registered in State of Washington.
2. Maintain locally available technical product representation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Conform to provisions of Section 016510 and manufacturers instructions.

B. Ordering: Conform to manufacturer’s ordering instructions and lead time requirements to avoid construction delays.

C. Delivery: Deliver materials on manufacturer’s pallets with identification labels intact.

D. Deliver in bundles, clearly identified with manufacturer's labels intact. Verify undamaged conditions.

E. Store off ground and handle to keep clean, dry, and protected from damage due to weather and construction activities.

1.8 [FIELD CONDITIONS

A. Site Environmental Requirements: Do not install materials until site conditions conform to manufacturer installation instructions.]

B. Installers must strictly adhere to Manufactures written Installation Instructions

1.9 [WARRANTY

A. Cold Formed Framing: Manufacturer’s standard 20-year materials warranty covering defective materials of cold-formed metal framing members.]

B. Installers must strictly adhere to Manufactures written Installation Instructions

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Evolution 1, Envirobeam, specified as basis of design.
1. Cell (206) 455-1978, Email duane@envirobeam.com (Duane Den Adel, Operations Manager)
2. Cell (425) 344-1371, Email ron@envirobeam.com (Ron Den Adel, Production Manager)

3. Website http://www.envirobeam.com

B. Substitution Requests: Conform to provisions of Section 012500. Submit product data indicating conformance to specified provisions of this Section.

2.2 PERFORMANCE / DESIGN CRITERIA

A. See KPFF Engineering Reports ; Enviro-King June 2011, E-Header / Sill January 2012, E-Beam HD February 2012.

B. Thermal Insulation: [Semi-rigid mineral insulation board] [Expanded polystyrene insulation board (EPS)] [Extruded polystyrene insulation board (XPS)] Polyisosanurate insulation board.

1. Design thickness and type of insulation into system assembly.
2. Thermal analysis to be determined by thermal U-factor published by individual Mfg.Iinsulation type .

C. Load Bearing Cold Rolled Steel Framing Members: ASTM C955.

1. Minimum Effective Physical and Structural Properties: As published by the Steel Stud Manufactures Association (SSMA) Product Technical Information, conforming to ICC ER-4943P.
2. Grades:

a. ASTM A1003, Structural Grade 50 Type H (ST50H) (F_y = 50 ksi) for 97, 68, and 54 mil (12, 14 and 16 gauge) framing members.
b. ASTM A1003, [ASTM A792, or ASTM A875] Structural Grade 33 Type H (ST33) (F_y = 33 ksi) for 43 and 33 mil (18 and 20 gauge) framing members.

D. Hot-Dip Aluminum-Zinc Alloy-Coating: Galvanized ASTM A653 G60 [Hot-Dip Aluminum-Zinc Alloy-Coating: ASTM A792, Structural Steel (SS), Grade 50, Class 1 or 4, Coating Destination AZ55].

2.3 THERMALLY INSULATED COLD-FRAMED STEEL WALL PRODUCTS

A. Refer to Enviro-Beam Span Load Tables, suggested installation instructions, and parts list section properties.

1. Thermal Resistance (R-Value): Approximately R-4 per inch of wall thickness

B. E-Beam HD - Pre-Insulated Steel Header Beam:

1. Standard Widths: 6 and 8 inch.
2. Standard Depths: Varies.
3. Available Steel Thickness: 18 gauge (43 mil) through 12 gauge (97 mil).

C. E-Header Sill – Pre-Insulated Steel Header Sill: A lighter duty option to the E-Beam HD

D. E-King – Pre-Insulated Alternative To Standard Dual Stud:

1. Standard Depths: For 4, 6, and 8 inch wall depths.
2. Standard Width: 3 ¼”inch.
3. Available Steel Thickness: 20 gauge (33 mil) through 12 gauge (97 mil).

E. Connection Plate – Connection Plate with Pre-Punched Holes: Refer to manufacturer’s table.

1. Steel Grade: Minimum 33,000 psi.
2. Punched Holes: 25 each plate for No. 10 and No. 8 self-drilling, self-tapping screws.
3. Capacities: As published by manufacturer and as determined by professional engineer of record. [694 pounds to 2836 pounds, two plates on each side of header depending on screw placement, designed to AISI S100 (NAS) 2001 <2012 is current edition> Section E4.3 (Shear).]
4. Thickness: 16 or 14 gauge (54 or 68 mils).

5. Width: 7-1/2 inch.
6. Height: 5-1/2 and 7-1/2 inch.

2.4 THERMALLY INSULATED COLD-FRAMED ROOFING PRODUCTS

A. E-Roof Curb:

B. E-Skylight Curb:

C. E - Mechanical Curb.

2.5 FASTENERS, , CONNECTORS, ANCHORAGE, AND ACCESSORIES

A. Steel Drill Screws: Corrosion-resistant with minimum 3/8 minimum penetration into steel members.

1. Steel Tapping Screws: ASTM C1513 for steel framing connections.
2. Steel Drill Screws: ASTM C954 for connections of gypsum panel products to steel framing members

B. Connector and Anchorage Devices:

1. Power driven and powder actuated anchors, bolts, nuts, and washers [as shown on Structural Drawings, or] as accepted for transfer of design loads, conforming to ICC ES AC308.
2. Galvanize to 1.25 ounce psf conforming to ASTM A123.

2.6 THERMAL INSULATION CORE

A. Semi-Rigid Mineral Insulation Board:

Property	Result	Test Method
Density	4 psf [8 psf] [13 PSF]	ASTM C303
Thermal Resistance (R-Value) at 75 degrees F	R - 4.3 per inch	ASTM C518
Water Vapor Transmission (desiccant method)	30 - 50 perms	ASTM E96
Combustion Characteristics	Non-Combustible	ASTM E136
Surface Burning Characteristics	UL 723 / IBC Class A	ASTM E84
Flame Spread	0	
Smoke Developed	0	
Moisture Resistance	Non-hydroscopic (does not absorb/hold water)	
Sorption	0.03 percent[1] or less	ASTM C1104
Absorption	1.0 percent or less	ASTM E136
Fungi and Bacteria	Does not promote growth	ASTM C1338
Corrosion Resistance	Passes	ASTM C665

[1] ASTM C1104 specifies less than 1 percent.

****OR****

B. Expanded Polystyrene (EPS) Insulation Board: ASTM C578, Type IX.

Property	Result	Test Method
Compressive Resistance	25 psi	ASTM D1621
Thermal Resistance (R-Value) @ 75 degrees F	4.2 per inch	ASTM D518 or ASTM C177
Flexural Strength	50 psi	ASTM C203
Water Vapor Permeance	2.5 perms	ASTM E96
Water Absorption	2 percent	ASTM C272
Dimensional Stability	2 percent max	ASTM D2126
Density	1.60 pcf	ASTM C303
Flame Spread	Less than 20	ASTM E84

Smoke Developed	150-300	ASTM E84

****OR****

C. Extruded Polystyrene (XPS) Insulation Board: ASTM C578, Type IV.

Property	Result	Test Method
Compressive Resistance	25 psi	ASTM D1621
Thermal Resistance (R-Value) @ 75 degrees F	5.0 per inch	ASTM D518 or ASTM C177
Flexural Strength	50 psi	ASTM C203
Water Vapor Permeance	1.5 perms	ASTM E96
Water Absorption	0.3 percent	ASTM D2842
Dimensional Stability	2 percent max	ASTM D2126
Density	1.55 pcf	ASTM C303
Maximum Use Temperature	165 degrees F	

2.7 ACCESSORIES

A. Typically for Field conditions encountered and the responsibility of the installer of Evolution 1 / Enviro-Beam Components. Evolution 1 LLC is not responsible for these conditions. The Field Installer is required to strictly adhere to Evolution 1 Installation Instructions for each individual Enviro-Component published on the envirobeam.com web site

B. Galvanic Protection: Utilize tapes and other methods as necessary to separate and prevent contact between dissimilar metals.

C. [Insulation Board Joint Tape: Dow Chemical Company, WEATHERMATE, 6 inch and 9 inch wide butyl adhesive tape, or equal and as instructed by manufacturer.]

D. [Insulation Board Gap Filler: Dow Chemical Company, FROTH-PAK, two-component, quick-cure polyurethane foam, or equal and as instructed by manufacturer.]

E. See Installation Instructions for Enviro-Roof Curbs regarding sheet metal covers for safety rail posts and exposed corner conditions.

2.8 SOURCE QUALITY CONTROL

A. Single Source Responsibility: Furnish engineered design and fabrication by or under direct responsibility of single manufacturer; Evolution 1 LLC.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify conditions ready to receive work of this Section before beginning.

3.2 PREPARATION

A. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

3.3 INSTALLATION

A. Conform to manufacturer's instructions, ASTM C1007, and provisions of Contract Documents.

B. Strictly Adhere to Evolution 1 LLC Installation Instructions published on envirobeam.com web site for each individual Enviro-Component.

C. Touch-up shop-applied protective coatings damaged during handling and installation.

3.4 ERECTION TOLERANCES

A. Maximum Framing Member Variation from True Position: 1/8 inch.

B. Maximum Framing Member Variation from Plane:

1. Individual Framing Members: Do not exceed 1/8 inch in 10 foot.
2. Accumulative Over-all Variation for Wall and Floor System: Do not exceed 1/8 inch.

C. Conformance subject to Project Architect and General Contractor for Individual Projects

3.5 FIELD QUALITY CONTROL

A. Manufacturer’s Field Technical Service:.

1. Evolution 1 Field Technical Service available on request for site visits to be paid for by the requester, typically the General Contractor, Project Architect or the Owners Rep.

3.6 ADJUSTING

A. Inspect and adjust after installation. Replace or repair defective work.

END OF SECTION