TEST REPORT ON

24 GA. TS-324 STANDING SEAM ROOF PANELS AT 5' 0" PURLIN SPACING WITH SEALED 'N' SAFE™ THERMAL BLOCKS USING 10" DEEP, 12 GA. ZEE PURLINS IN ACCORDANCE WITH AISI S908-08

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TESTING DATE: August 17 & 19, 2010
REPORTING DATE: August 27, 2010
ENCON® Project C1724-1

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9.7.10

SECTION I
TEST SUMMARY

TEST SUMMARY

1.1 SUMMARY

Tests were conducted on Building Research Systems, Inc.'s TS-324 standing seam metal roof panels at ENCON® Technology, Inc. Test Facility, Tulsa, Oklahoma. The purpose of the tests was to obtain the modification factor 'R_t' to be used in determining the nominal flexural strength of the purlin supporting the standing seam roof system fastened to the purlins through blanket insulation and Sealed 'N' Safe™ thermal block. These tests meet the provisions of AISI S908-08 *"Base Test Method for Purlins Supporting a Standing Seam Roof System"*. The tests are listed below according to their configurations and date tested.

Test #1: Nom. 10" x 2.5" x 12 ga., 55 ksi zee purlin supporting TS-324 panel at 5' 0" purlin spacing and 30' 0" purlin span. The purlins were attached to the support beam with CO Building's anti-roll purlin clips, plate and (2) bolts. Plate (7" x 5" x 0.25" thick) was inserted between purlin and anti-roll clip. Bracings (option 3) were bolted with 4 bolts to the purlins at 10' and 20' from the center of purlin support. The gravity load test was conducted on August 17, 2010.

Test #2: Nom. 10" x 2.5" x 12 ga., 55 ksi zee purlin supporting TS-324 panel at 5' 0" purlin spacing and 30' 0" purlin span. The purlins were attached to the support beam with CO Building's anti-roll purlin clips, plate and (2) bolts. Plate (7" x 5" x 0.25" thick) was inserted between purlin and anti-roll clip. Bracings (option 3) were bolted with 4 bolts to the purlins at 10' and 20' from the center of purlin support. The uplift load test was conducted on August 19, 2010.

The zee purlins were manufactured by Alliance Steel, Inc. and provided by Building Research Systems. The above defined tests were witnessed by Bala Sockalingam, Ph.D., P.E., of ENCON Technology. Test #1 was also witnessed by Craig Oberg of Sealed 'N' Safe and Leo Neyer of Building Research Systems.

1.2 ROOF SYSTEM DESCRIPTION

Building Research Systems' TS-324 roof system consisted of 24" wide, 24 ga., 50 ksi (nom.) yield panels joined together at the sidelaps to form a trapezoidal profile with 3" high seam. The panels were fastened to the purlins with MPS602 clips. The panel sidelaps were mechanically seamed in the field to form the TripleLok™ seams.

The panels were attached to zee purlins through the 4" thick blanket insulation and Sealed 'N' Safe™ thermal block with ¼"-14 x 2.5" long hex head self-drilling screws. Each panel spanned over a simple span of 5' 0" with an overhang of 12" on either side. The purlin flanges faced the same direction and the top of the flange was not braced externally. Bracings (option 3) as shown on Page 5 were bolted with 4 bolts to the purlins at 10' and 20' from the center of purlin support.

Sealed 'N' Safe™ thermal blocks consisted of two 24 ga. steel plates with polyurethane foam injected between the plates to form a 1" thick block. The length and width of these thermal blocks were 72" and 5", respectively. The blocks were fastened to the supports with #12 x 1-5/8" long pancake head self-drilling screws located at each end of the blocks.

1.3 TEST RESULTS

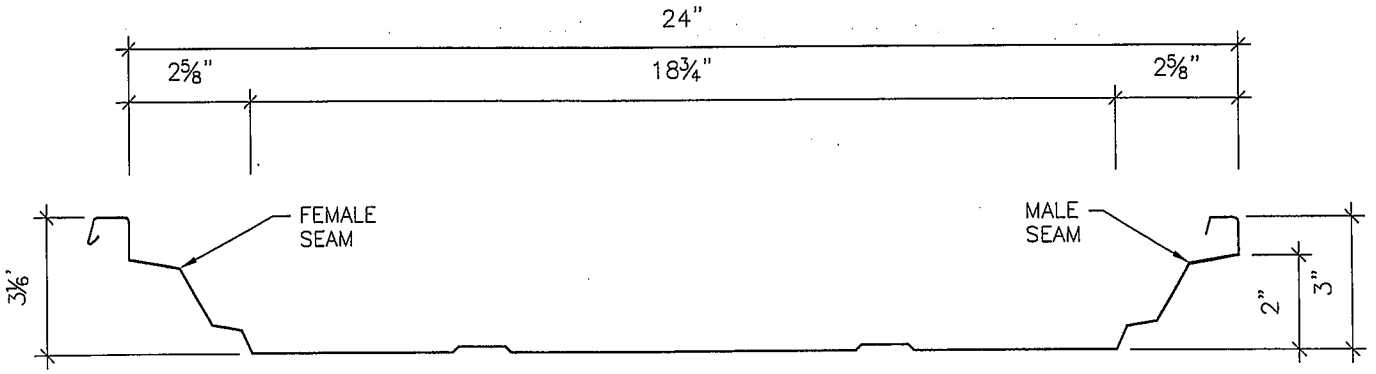
Load was applied incrementally and horizontal and vertical deflections of the test construction were recorded for 'no load' condition and at each load increment. The test results and the modification factor 'R_t' for above tests are as follows:

No.	Purlin	Span (ft)	Loading	Bracing	Purlin Attachment At Support	Failure Mode	Reduction Factor R_t
1	10Z12	30	Gravity	Bracing 3	PS4	Top flange buckled	0.80
2	10Z12	30	Uplift	Bracing 3	PS4	Excessive deflection	0.75

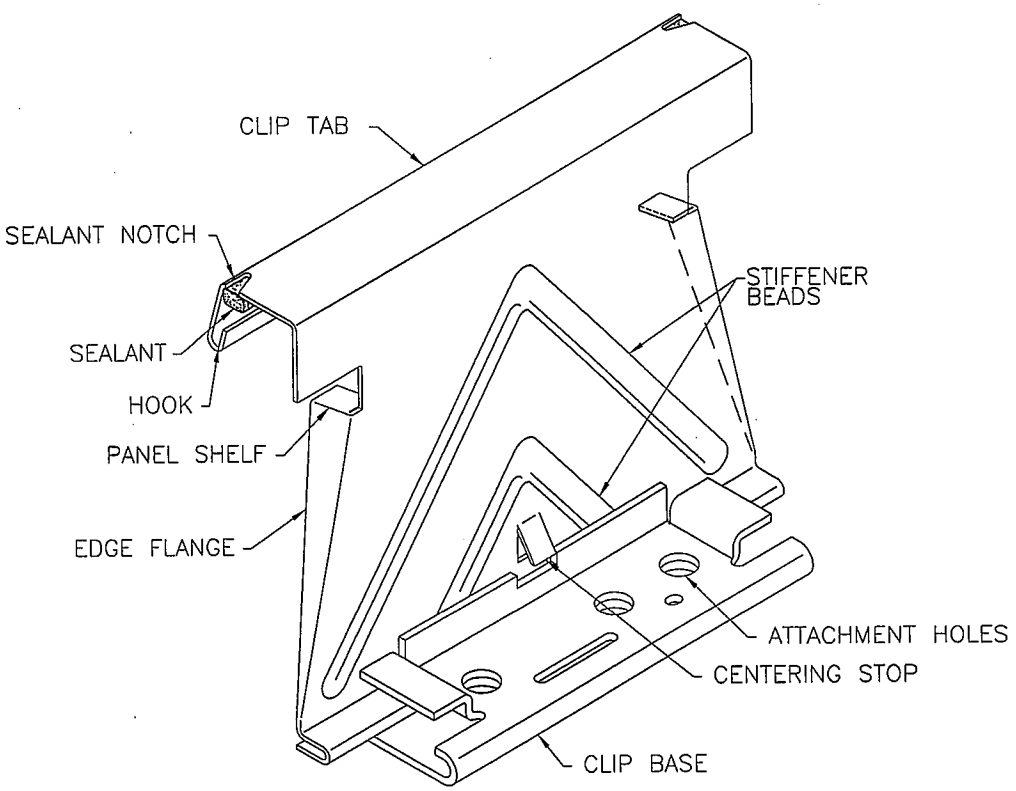
Notes:

1 PS4: CO Building anti-roll purlin clip and plate (7" x 5" x 0.25" thick) with 2 bolts (one each at top and bottom)

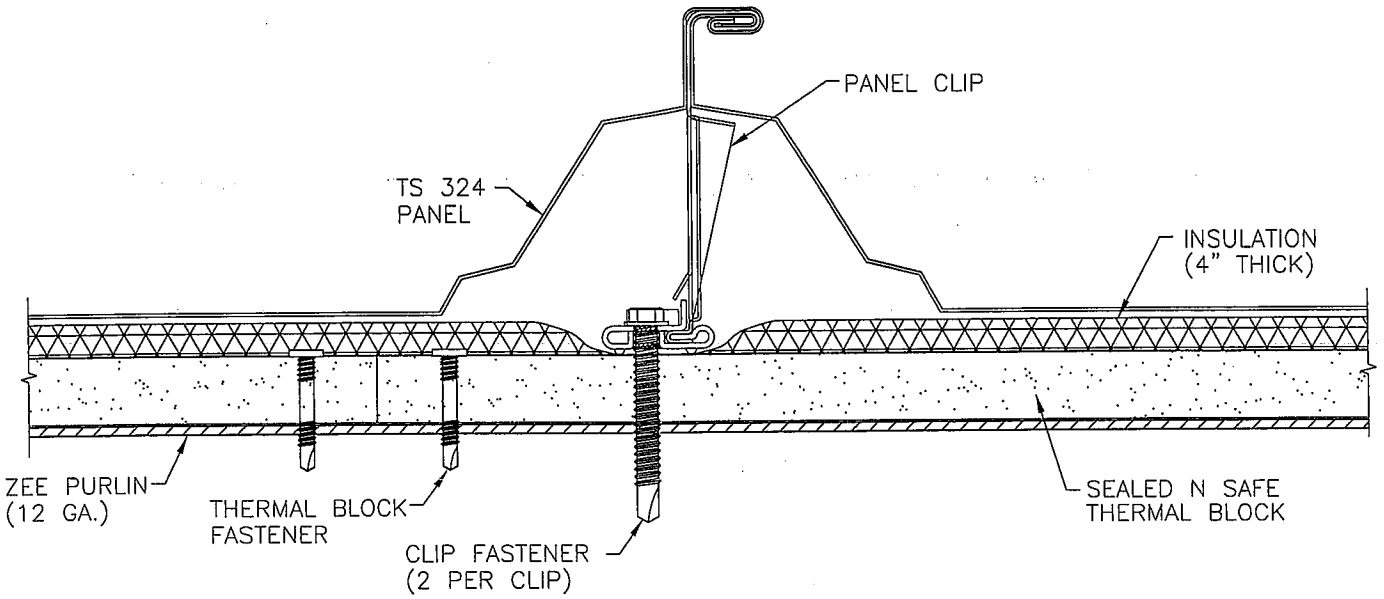
2. Bracings (option 3) located at 10' and 20' from center of purlin support.



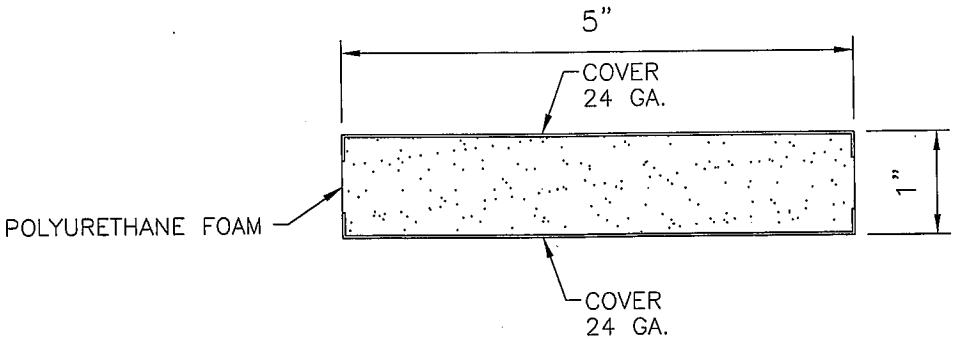
24 GA., 50 KSI TS 324 PANEL SECTION



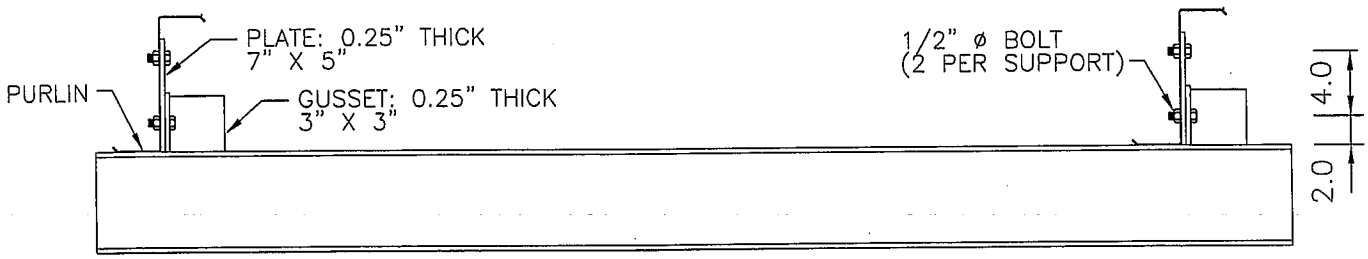
MPS CLIP



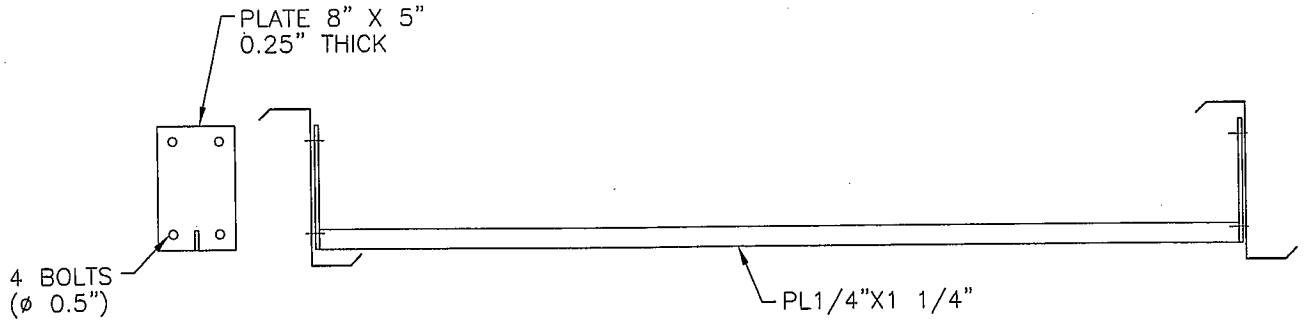
FASTENER PATTERN



SEALED 'N' SAFE THERMAL BLOCKS



ANTI-ROLL CLIP WITH PLATE



BRACING OPTION 3

SECTION II
DESCRIPTION OF TEST

2.1 DESCRIPTION OF TEST

OBJECTIVES

The purpose of this test is to obtain the reduction factor to be used in determining the nominal flexural strength of the purlin supporting a standing seam roof system. The test method consisted of the following:

1. assembling the test panels on two simply supported zee purlins;
2. loading the test panels incrementally; and
3. observing, measuring, and recording the deflections, deformations, and nature of any failures of principal or critical elements of the test construction.

The increments of load application were chosen such that a sufficient number of readings were obtained to determine the load deformation curve of the system. This test method applies to an assembly consisting of the standing seam panel, purlin and attachment devices used in the system being tested.

TEST CHAMBER

The test chamber consisted of a box as shown in the applicable drawings in the appendix. It contains one open surface in which the test specimen is installed. Two static pressure taps are located at corners to measure the chamber pressure in such a manner that the readings are not affected by the velocity of the air supply to or from the chamber or other air movement. The air supply openings into the chamber are arranged so that the air does not impinge directly on the test specimen with significant velocity.

AIR SYSTEM

The suction air supply consists of a number of individual units capable of maintaining a constant suction pressure difference for the required test period. A water manometer is used to measure the test pressure difference with accuracy of 1/100."

DEFLECTION MEASUREMENT

Vertical measurements at the midspan of both purlins were taken by means of a level and staffs calibrated to 1/100 of an inch. Horizontal measurements were taken by means of dial gauge calibrated to 1/1000 of an inch, at the seam joint nearest the center of the test specimen.

PANEL LENGTH

The length of the panels was 7' 0", which provided the necessary length for purlin spacing of 5' 0" with an overhang of 12" on either side.

DESCRIPTION OF TEST

TEST SPECIMEN

The purlins were connected to the supporting beams with anti-roll purlin clips. There were no external discrete bracings used in these tests. The panels were attached to the purlins with standard fastening system. The overall dimension of the specimen was in excess of 7' x 31' for 10" deep purlins

Plastic sheeting (max 6 mil thick) was used to keep the air pressure chamber airtight. The sheeting was placed on top of the panels for gravity load tests and between the panel and insulation for uplift load test. The sheeting between panel ribs was pleated to allow the sheeting to conform to into the panel sidelap when pressure was applied to the panels.

TEST PROCEDURE

An initial load equal to 5 psf was applied and removed to record the zero readings. The loading procedure on the test system consisted of suction pressure applied in increments. Deflection measurements and pressures were recorded at every pressure interval. Pressure intervals did not exceed 20% of the anticipated failure load.

TEST DURATION

The test was stopped when the test system was unable to carry additional load or buckling failure of purlins occurred. The pressure at which the system fails was recorded as the failure load of the system.

2.2 CALCULATIONS

For Z purlins tested with the flange facing the same direction and with the top flanges of the purlins not braced externally, then

$w_{ts} = (p_{ts} \pm p_d)s + 2P_L(d/B)$ if the eave purlin fails and (1)

$= (p_{ts} \pm p_d)s$ if the ridge purlin fails (2)

where

w_{ts} = failure load (lb/ft) of the single span purlins tested,
p_{ts} = failure load (psf) of the single span purlins tested,
p_d = weight of the specimen (psf),
s = tributary width of purlins tested (ft),
d = purlin depth (in),
B = maximum anticipated purlin spacing (in).
P_L = lateral anchorage force (lb/ft) in accordance with Section D6.3.1 of the AISI Specifications,

$$0.5\left(\frac{C2}{1000}\frac{I_{xy}L}{I_x d} + C3\frac{0.25bt}{d^2}\right)(p_{ts} + p_d)s \quad (3)$$

b = flange width of the purlin (in),
t = purlin thickness (in),
I_x = moment of inertia of full unreduced section (in^4):
I_{xy} = product moment of inertia of full unreduced section (in^4):
L = purlin span (in)
C2 = 8.3
C3 = 28

From the single span failure load, W_{ts}, the maximum single span failure moment M_{ts} is calculated as

$$M_{ts} = w_{ts} L^2/8 \quad (4)$$

Using Section C3.1.1(a) of the AISI Specification, the flexural strength of each tested purlin, M_{nt}, of a fully constrained beam is calculated as

$$M_{nt} = S_{et}F_{yt} \quad (5)$$

where S_{et} is the section modulus of the effective section calculated using the measured cross-sectional dimensions and F_{yt} is the measured yield strength.

The modification factor, R_t, is calculated for each purlin tested as

$$R_t = M_{ts}/M_{nt} \quad (6)$$

SECTION III
TEST RESULTS

3.1 SPECIMEN IDENTIFICATION

Manufacturer:	Building Research Systems Inc.
Model Type:	TS-324 Standing Seam Roof
Dimensions:	3" high seam and 24" wide trapezoidal profile
Panel Gauge:	24 Ga.
Panel Clip:	MPS 602 clip
Clip Fasteners:	(2) 1/4"-14 x 2.5" long hex head self drilling screws
Thermal Blocks:	Sealed 'N' Safe™ - consisted of two 24 ga. steel plates with polyurethane foam injected between the plates to form a 1" thick block. The length and width of the thermal block were 72" and 5", respectively. Polyurethane foam was manufactured by Utah Foam and designated as X10324.
Thermal Blocks Fasteners:	#12 x 1-5/8" long pancake head self-drilling screws (DB Building Fasteners, Inc.)
Insulation:	4" thick blanket insulation
Purlin Manufacturer:	Alliance Steel, Inc.
Purlin Profile:	Z 10" x 2.5" (Typical)
Purlin Thickness:	12 Ga.

Note:

1. **Purlin, panel and other accessories were supplied by Building Research Systems and were not sampled by ENCON.**
2. **Thermal blocks were supplied by Sealed 'N' Safe and were not sampled by ENCON.**

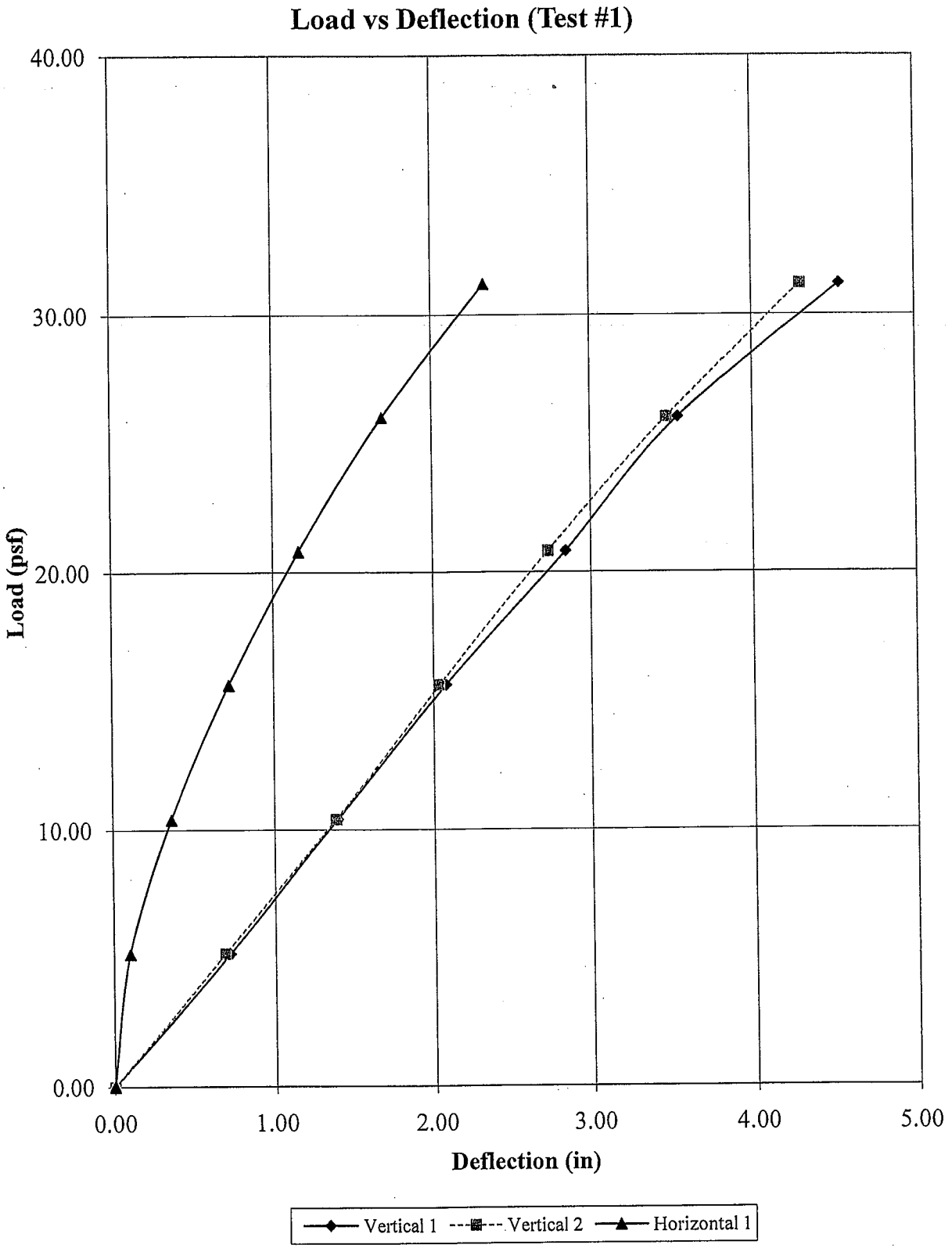
3.2 Test #1: 10Z12 for Gravity Load

Date:	8.17.10
Test Number:	1 Gravity
Panel Type:	BRS TS324 Panel
Panel Fasteners:	MPS 602
Sidelap Fasteners	(2) 1/4"-14 x 2.5" long SDS
Panel Span (ft):	5' 0"
Panel Length (ft):	7' 0"
Insulation:	4" Insulation and Sealed N Safe
Purlin Size:	Zee 10" x 2.5"
Purlin Thickness:	12 ga.
Yield Stress (ksi):	57.5
Purlin Span (ft):	30
Panel Weight (psf):	1.20
Purlin Weight (lb/ft):	5.50
Purlin-Frame Attachment:	Welded antiroll clip at eave & ridge with 7" high plate with 1 bolt at bottom and top
Bracing:	Bracing (option 3) at 10' and 20'

No	Pressure (psf)	Deflection Reading (in)			Remarks
		Vertical 1	Vertical 2	Horizontal 1	
1	0.00	0.00	0.00	0.000	
2	5.20	0.72	0.69	0.100	
3	10.40	1.39	1.38	0.358	
4	15.60	2.08	2.04	0.723	
5	20.80	2.84	2.73	1.162	
6	26.00	3.55	3.48	1.682	
7	31.20	4.54	4.30	2.337	
8	35.97				Failure Load

Failure Mode: Top flange of eave purlin buckled near mid span

TEST RESULTS

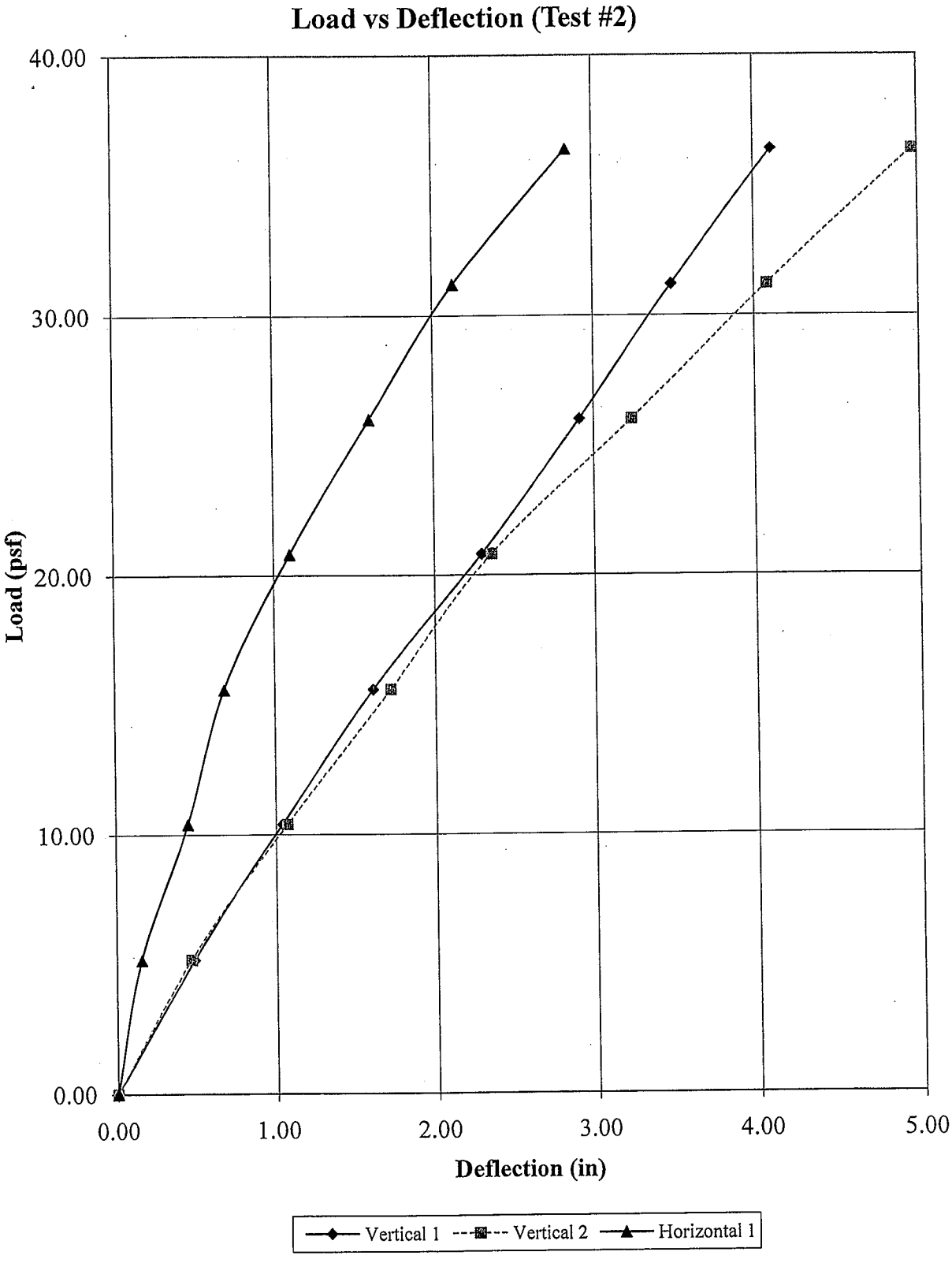


3.3 Test #2: 10Z12 for Uplift Load

Date:	8.19.10
Test Number:	2 Uplift
Panel Type:	BRS TS324 Panel
Panel Clip:	MPS 602
Clip Fasteners:	(2) 1/4"-14 x 2.5" long SDS
Panel Span (ft):	5' 0"
Panel Length (ft):	7' 0"
Insulation:	4" Insulation and Sealed N Safe
Purlin Size:	Zee 10" x 2.5"
Purlin Thickness:	12 ga.
Yield Stress (ksi):	60
Purlin Span (ft):	30
Panel Weight (psf):	1.20
Purlin Weight (lb/ft):	5.47
Purlin-Frame Attachment:	Welded antiroll clip at eave & ridge with 7" high plate with 1 bolt at bottom and top
Bracing:	Bracing option 3 at 10' and 20'

No	Pressure (psf)	Deflection Reading (in)			Remarks
		Vertical 1	Vertical 2	Horizontal 1	
1	0.00	0.00	0.00	0.000	
2	5.20	0.49	0.47	0.155	
3	10.40	1.04	1.07	0.454	
4	15.60	1.61	1.72	0.690	
5	20.80	2.29	2.35	1.099	
6	26.00	2.91	3.24	1.600	
7	31.20	3.49	4.08	2.126	
8	36.40	4.11	4.97	2.834	
9	41.18				Failure Load

Failure Mode: Excessive deflection due to elastic failure of the eave purlin


Load vs Deflection (Test #2)
40.00
30.00
20.00
10.00
0.00
Load (psf)
0.00
1.00
2.00
3.00
4.00
5.00
Deflection (in)
Vertical 1
Vertical 2
Horizontal 1

3.4 MODIFICATION FACTOR CALCULATION

3.4.1 MODIFICATION FACTOR FOR TEST #1

Purlin depth 'd' (in):		10.000
Purlin flange width 'b' (in):		2.625
Purlin thickness 't' (in):		0.101
Measured yield stress 'F_{yt}' (ksi):		57.5
Purlin span 'L' (ft):		30.000
Maximum anticipated purlin spacing 'B' (ft):		5.000
Tributary width of purlin tested 's' (ft):		3.737
Failure load of single span system tested 'p_{ts}' (psf):		35.974
Specimen weight 'p_d' (psf):		2.771
Effective section modulus 'S_{et}' (in^3):		4.295
Moment of inertia of full unreduced section I_x (in^4):		22.814
Product moment of inertia of full unreduced section I_{xy} (in^4):		5.160
C2	from Specification Table D6.3.1-1	8.3
C3	from Specification Table D6.3.1-1	28.0
P_L (lb/ft)	$0.5\left(\frac{C2}{1000}\frac{I_{xy}L}{I_x d}+C3\frac{0.25bt}{d^2}\right)(p_{ts}+p_d)s$	6.21
w_{ts} (lb/ft)	$(p_{ts}+p_d)s+2P_L(d/B)$	146.86
M_{ts} (kip.in)		198.26
M_{nt} (kip.in)		246.94
Modification Factor 'R_t':		0.803

3.4.2 MODIFICATION FACTOR FOR TEST #2

Purlin depth 'd' (in):	10.000
Purlin flange width 'b' (in):	2.625
Purlin thickness 't' (in):	0.100
Measured yield stress 'F_{yt}' (ksi):	60.0
Purlin span 'L' (ft):	30.000
Maximum anticipated purlin spacing 'B' (ft):	5.000
Tributary width of purlin tested 's' (ft):	3.789
Failure load of single span system tested 'p_{ts}' (psf):	41.184
Specimen weight 'p_d' (psf):	2.763
Effective section modulus 'S_{et}' (in^3):	4.387
Moment of inertia of full unreduced section I_x (in^4):	22.652
Product moment of inertia of full unreduced section I_{xy} (in^4):	5.591
C2 from Specification Table D6.3.1-1	8.3
C3 from Specification Table D6.3.1-1	28.0
P_L (lb/ft) $0.5\left(\frac{C2}{1000}\frac{I_{xy}L}{I_x d}+C3\frac{0.25bt}{d^2}\right)(p_{ts}-p_d)s$	6.71
w_{ts} (lb/ft) $(p_{ts}-p_d)s$	145.58
M_{ts} (kip.in)	196.53
M_{nt} (kip.in)	263.24
Modification Factor 'R_t':	0.747

SECTION IV
PHOTOGRAPHS

PHOTOGRAPHS

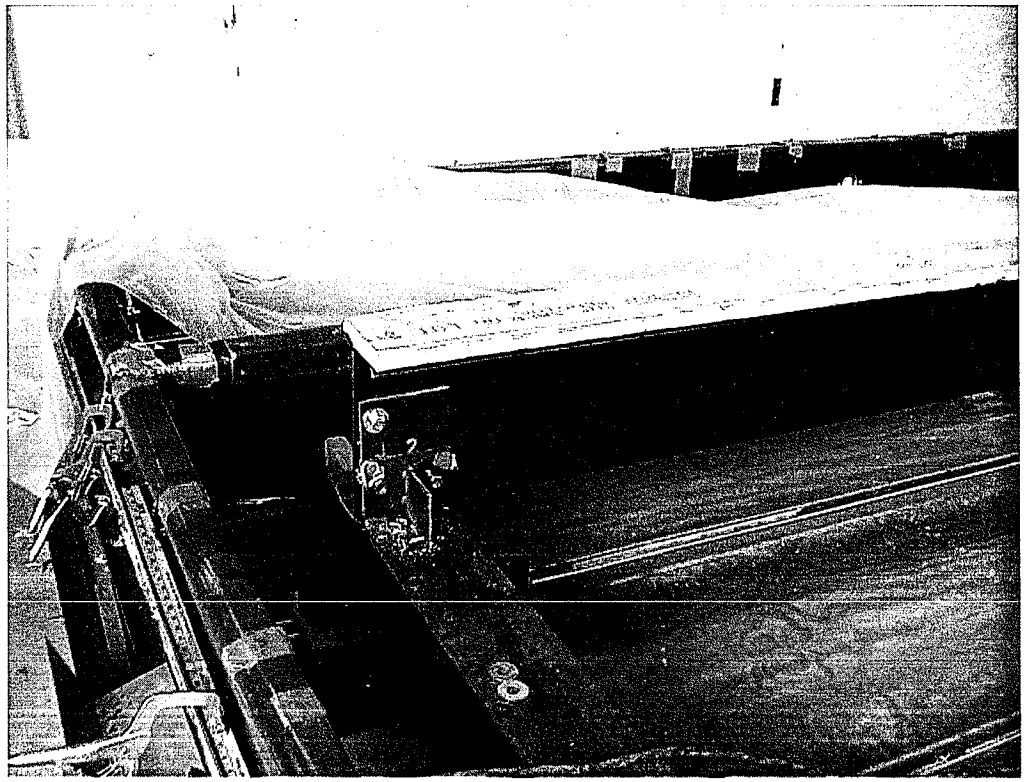


PHOTO 1 View of the purlin-frame attachment.
(DSC00084)

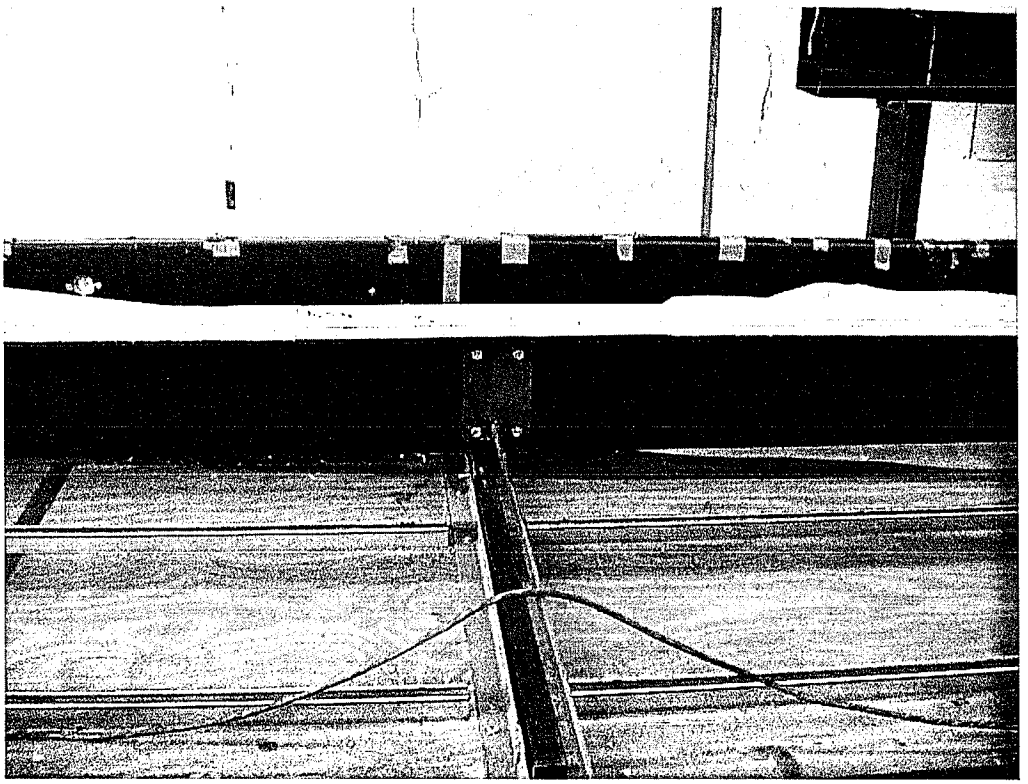


PHOTO 2 View of the bracing attachment.
(DSC00085)

PHOTOGRAPHS

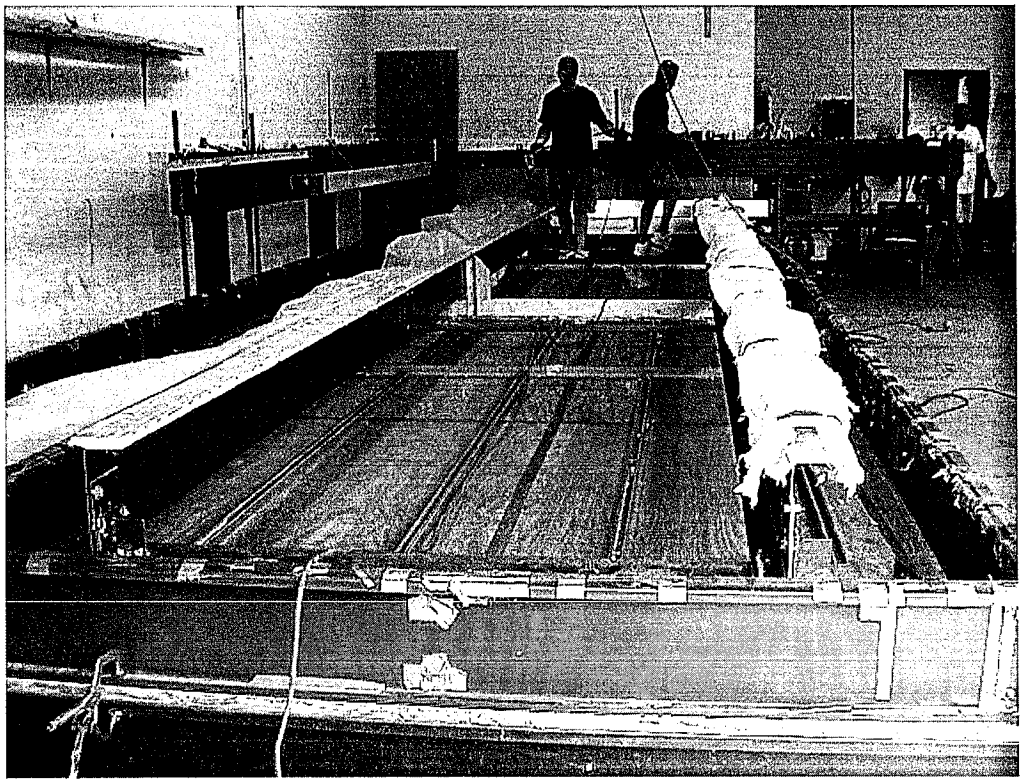


PHOTO 3 View of the thermal block and insulation installation (DSC00086)

PHOTO 4 View of the panel clip attachment. (DSC00087)

PHOTOGRAPHS

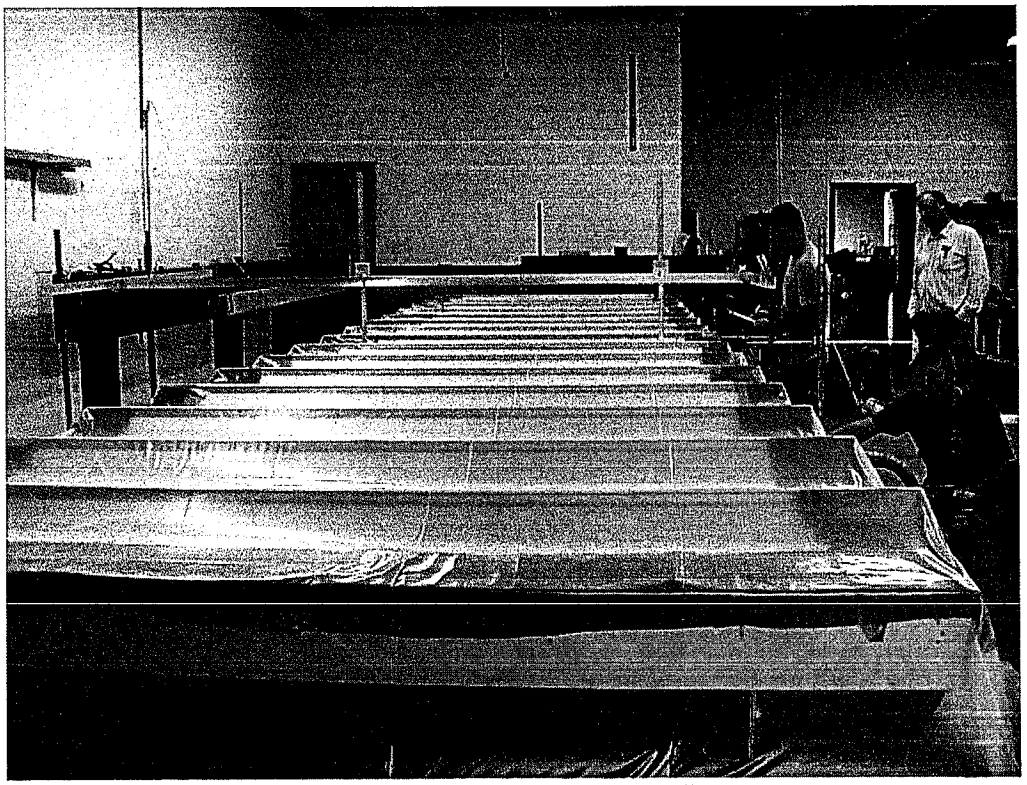


PHOTO 5 View of the test setup under gravity load (Test #1). (DSC00079)

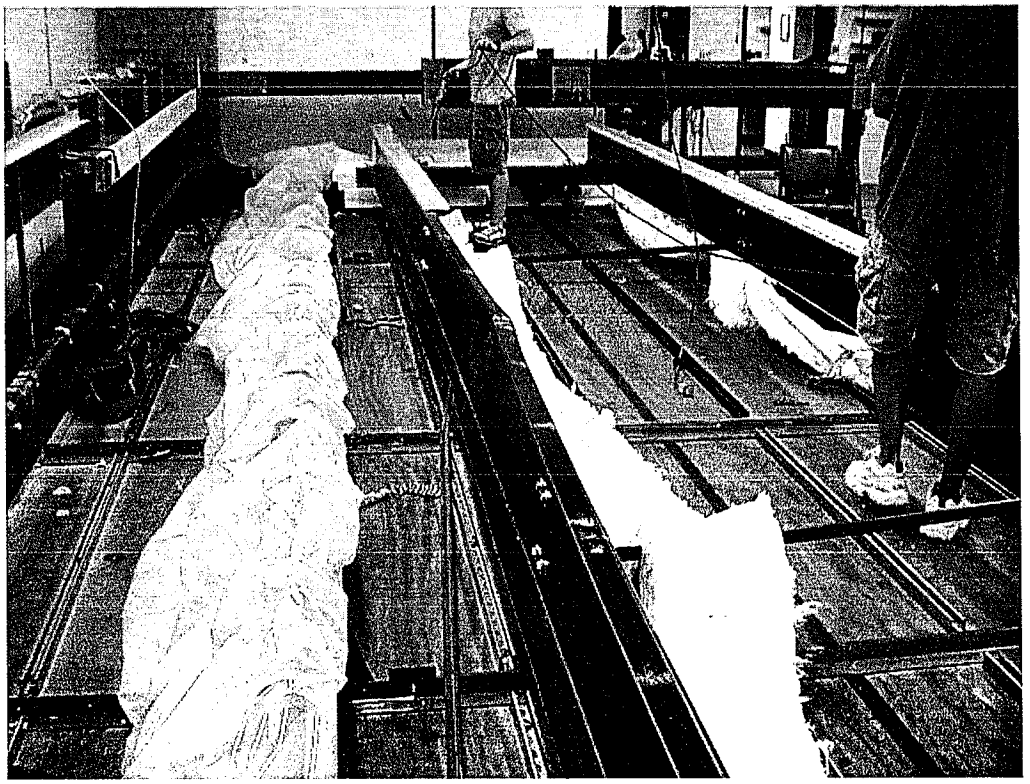


PHOTO 6 View of the top flange buckling failure of 12 ga. 10" deep Zee purlin (Test #1). (DSC00082)

PHOTOGRAPHS

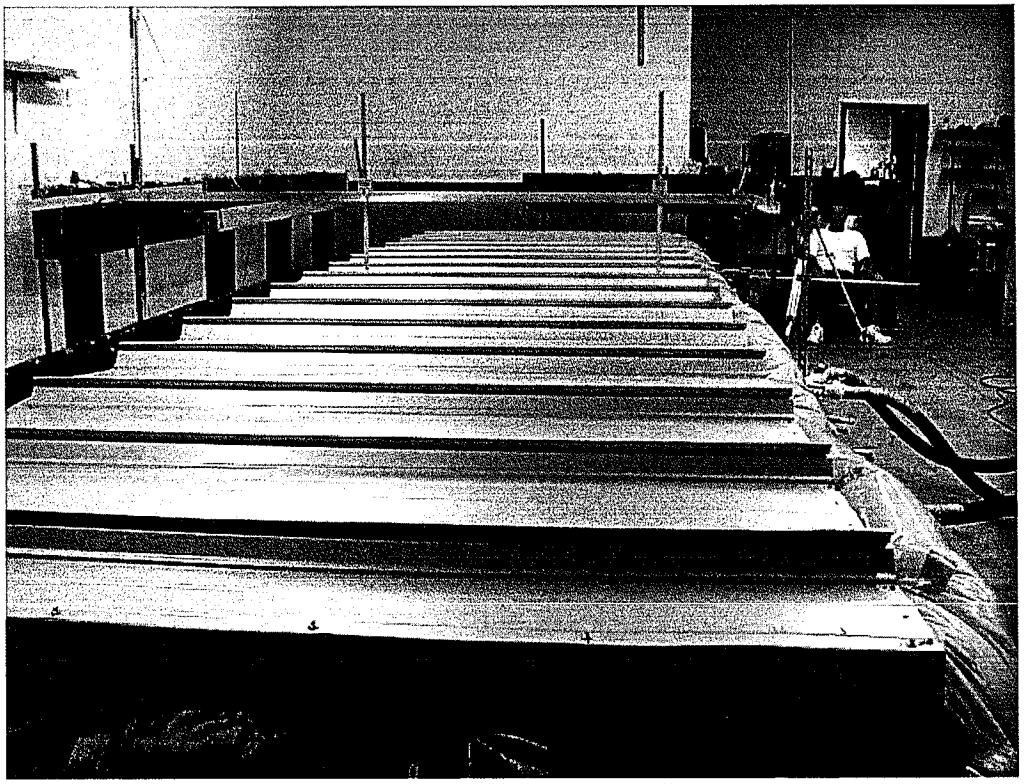


PHOTO 7 View of the test setup under uplift load (Test #2). (DSC00088)

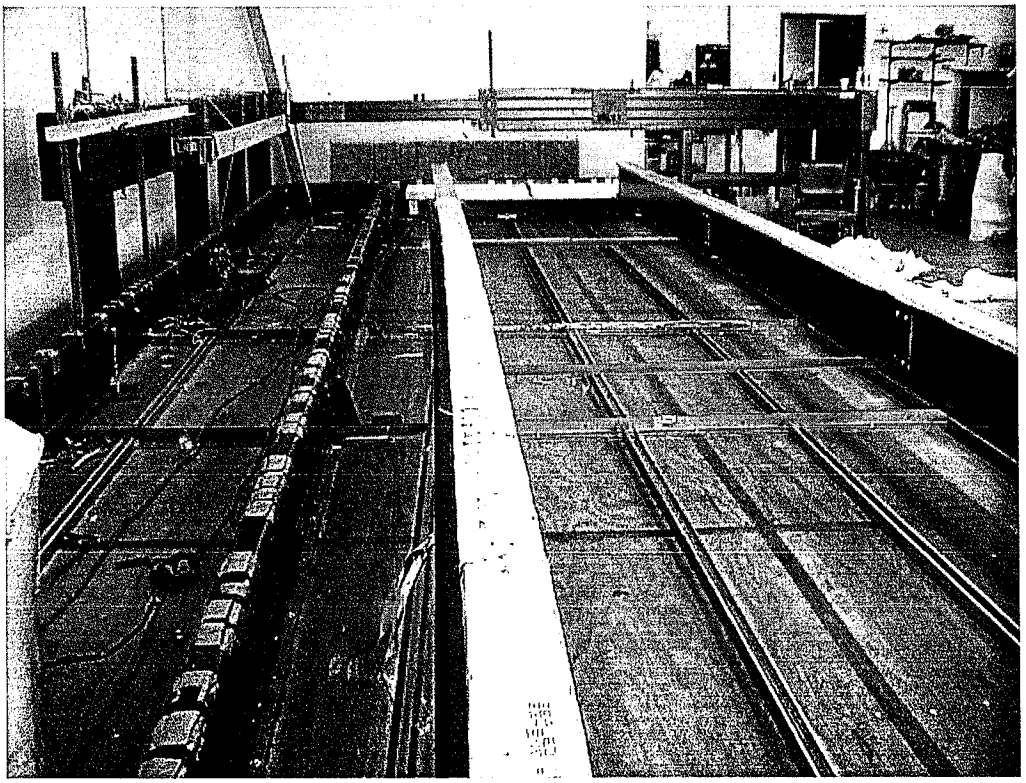
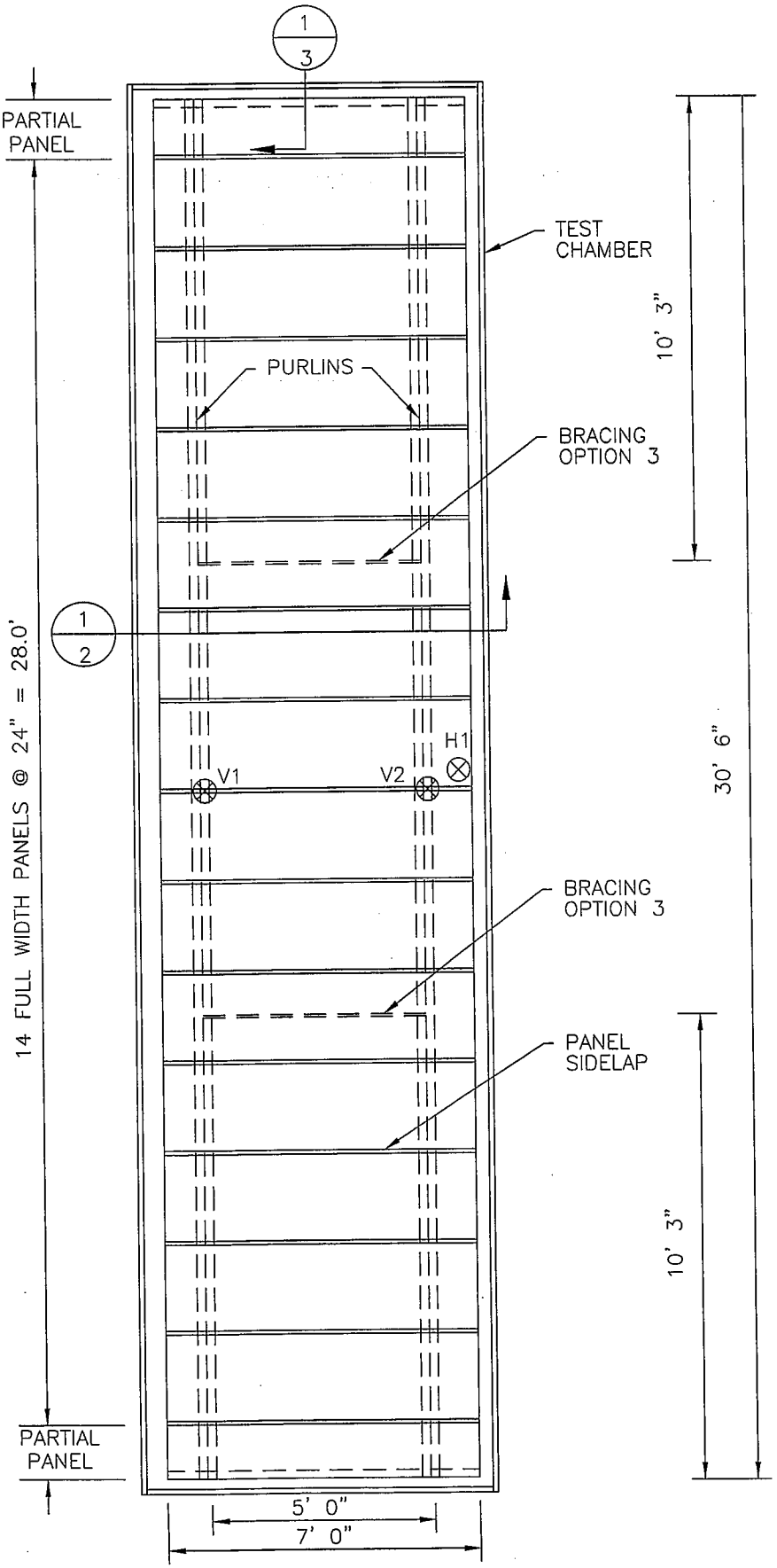


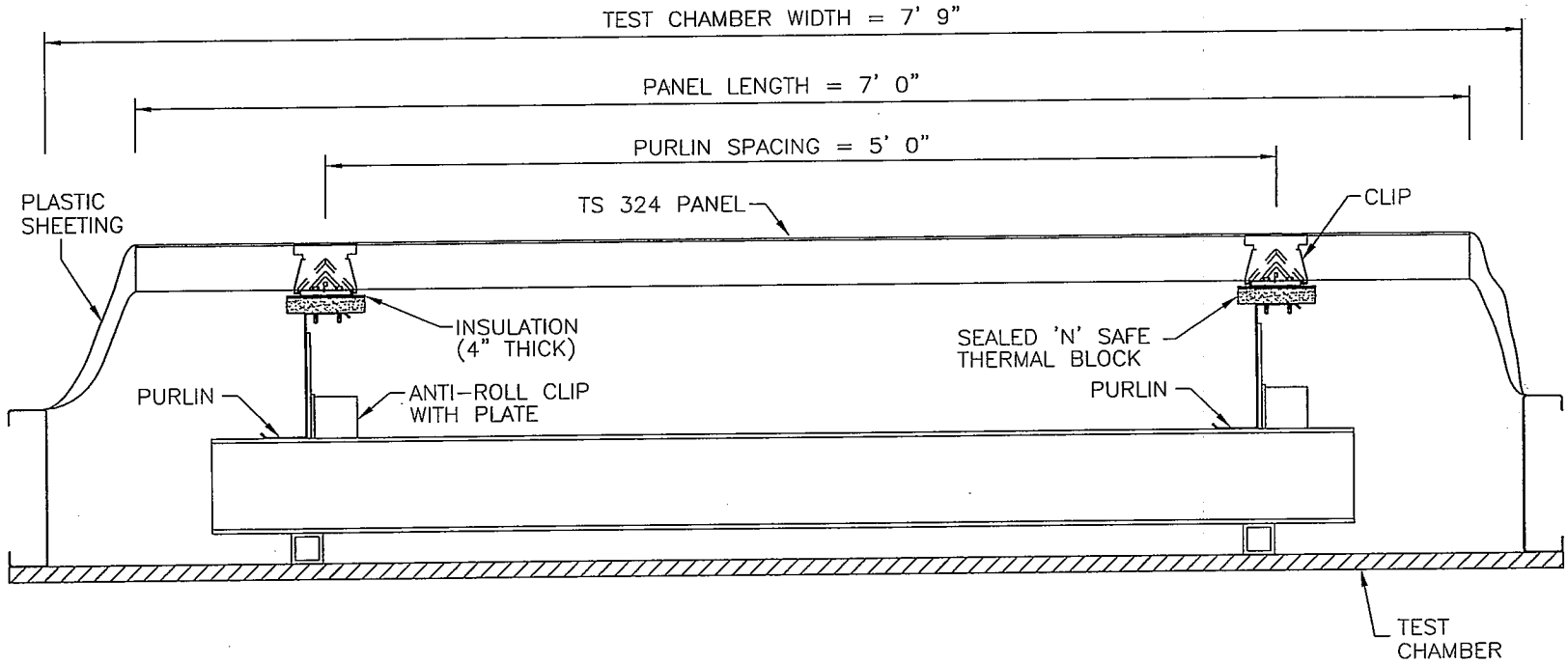
PHOTO 8 View of the excessive deflection due to elastic failure of purlin under uplift load (Test #2). (DSC00092)

SECTION V
APPENDIX

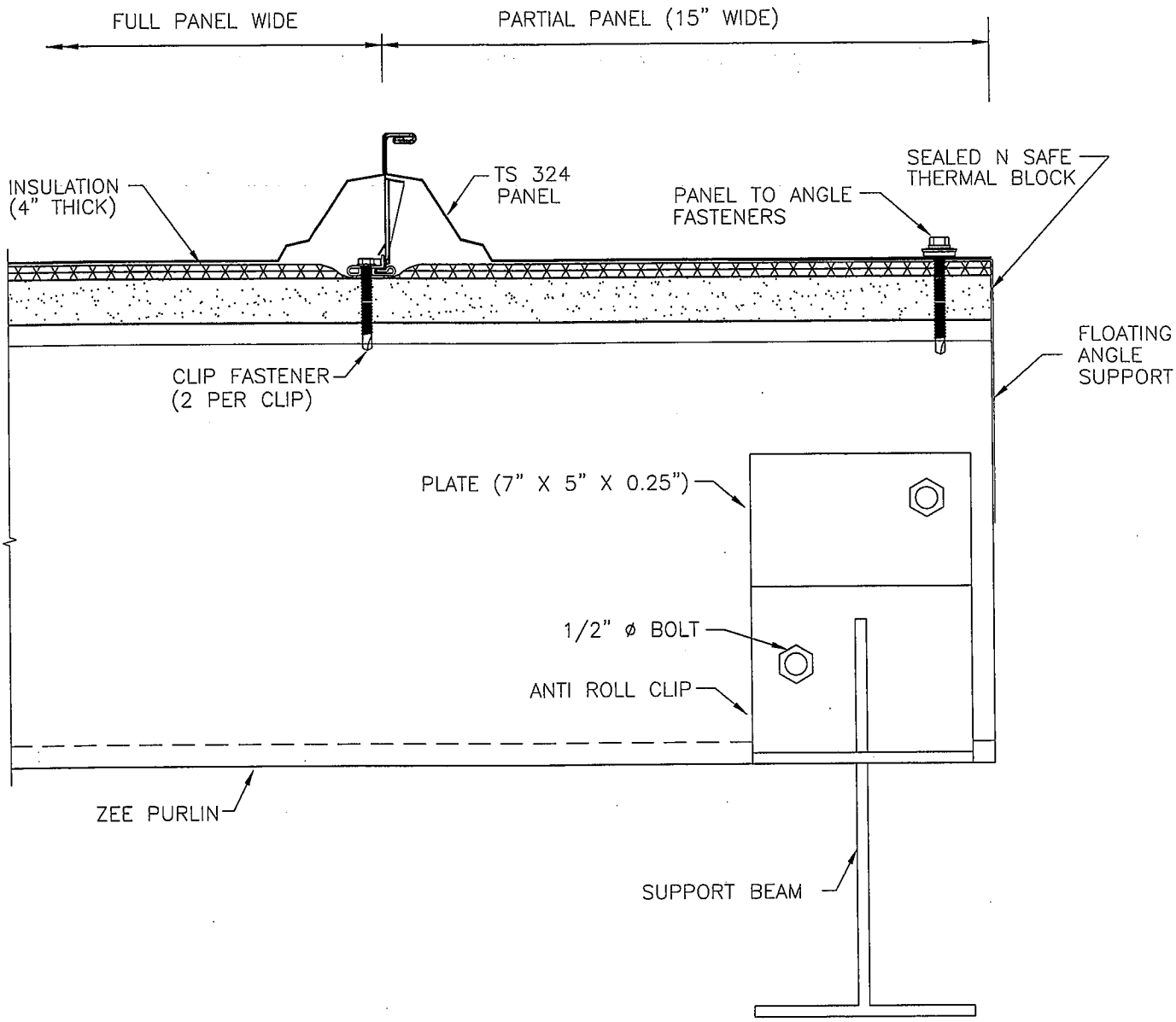


⊗ DEFLECTION MEASUREMENT LOCATIONS
V – VERTICAL DEFLECTION
H – HORIZONTAL DEFLECTION

1/1 PLAN VIEW



1/2 SECTION VIEW



1/3 DETAIL OF "PURLIN SUPPORTS"

SHERRY LABORATORIES

TESTING TODAY, PROTECTING TOMORROW

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LABORATORY REPORT

Attn: Bala Sockalingam
ENCON Technology, Inc.
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Tulsa, OK 74106

Report No.: 10080726-001-v1
Date Received: 8/19/2010
Date Reported: 8/24/2010
P.O. No.: Verbal

Sample Description: (1) Test Sample, CO Building 10Z Gravity, Sample No.: 1

Tensile Test (Rectangular) per ASTM E8-09

Parameter	Result
Orientation	Parallel to Length of the Specimen
Thickness, inch	0.101
Width, inch	0.504
Tensile Strength, psi	79,000
Yield Strength, psi at 0.2% offset	57,500
Elongation in 2 inches, % (After Fracture)	23

Approved by: Maurice Cochran

Maurice Cochran, Supervisor of Mechanical Testing
Sherry Laboratories

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LABORATORY REPORT

Attn: Bala Sockalingam
ENCON Technology, Inc.
1216 N. Lansing Ave.
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Tulsa, OK 74106

Report No.: 10080726-002-v1
Date Received: 8/19/2010
Date Reported: 8/24/2010
P.O. No.: Verbal

Sample Description: (1) Test Sample, CO Building 10Z Uplift, Sample No.: 2

Tensile Test (Rectangular) per ASTM E8-09

Parameter	Result
Orientation	Parallel to Length of the Specimen
Thickness, inch	0.100
Width, inch	0.502
Tensile Strength, psi	80,000
Yield Strength, psi at 0.2% offset	60,000
Elongation in 2 inches, % (After Fracture)	23

Approved by: Maurice Cochran

Maurice Cochran, Supervisor of Mechanical Testing
Sherry Laboratories

Section: Test#1.sct
Zee 12 ga Test #1
SS 10Z Gravity
Rev. Date: 8/24/2010 3:07:36 PM
By: Bala Sockalingam, Ph.D., P.E

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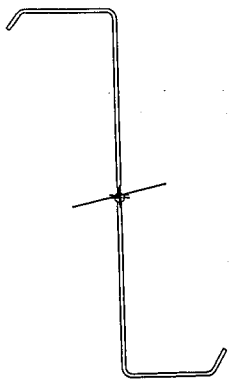

Section Inputs

Material: [N/A]
No strength increase from cold work of forming.

Modulus of Elasticity, E	29500000 psi
Yield Strength, Fy	57500 psi
Tensile Strength, Fu	79000 psi
Warping Constant Override, Cw	0 in^6
Torsion Constant Override, J	0 in^4

Stiffened Zee, Thickness 0.101 in
Placement of Part from Origin:

X to center of gravity	0 in
Y to center of gravity	0 in

Outside dimensions, Open shape

	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	0.6250	53.000	0.18750	None	0.000	0.0000	0.3125
2	2.6250	0.000	0.18750	Single	0.000	0.0000	1.3125
3	10.0000	-89.000	0.18750	Single	0.000	0.0000	5.0000
4	2.5310	1.000	0.18750	Single	0.000	0.0000	1.2655
5	0.7800	61.000	0.18750	None	0.000	0.0000	0.3900

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Full Section Properties

Area	1.6169 in^2	Wt.	5.4975 lb/ft	Width	16.009 in
Ix	22.814 in^4	rx	3.7563 in	Ixy	-5.160 in^4
Sx(t)	4.5626 in^3	y(t)	5.0003 in	α	13.289 deg
Sx(b)	4.5674 in^3	y(b)	4.9950 in		
		Height	9.9952 in		
Iy	2.184 in^4	ry	1.1623 in	Xo	0.0070 in
Sy(l)	0.7179 in^3	x(l)	3.0426 in	Yo	-0.0634 in
Sy(r)	0.7427 in^3	x(r)	2.9408 in	jx	-0.0972 in
		Width	5.9834 in	jy	0.0840 in
I1	24.033 in^4	r1	3.8553 in		
I2	0.965 in^4	r2	0.7727 in		
Ic	24.998 in^4	rc	3.9320 in	Cw	36.443 in^6
Io	25.005 in^4	ro	3.9325 in	J	0.005498 in^4

Fully Braced Strength - 2007 North American Specification - US (ASD)

Material Type: [N/A], Fy=57500 psi

Compression		Positive Moment		Positive Moment	
Pao	31851 lb	Maxo	147869 lb-in	Mayo	24717 lb-in
Ae	0.99707 in^2	Ixe	21.963 in^4	Iye	2.184 in^4
		Sxe(t)	4.2946 in^3	Sye(l)	0.7179 in^3
Tension		Sxe(b)	4.4995 in^3	Sye(r)	0.7427 in^3
Ta	55672 lb				
		Negative Moment		Negative Moment	
		Maxo	152722 lb-in	Mayo	21103 lb-in
Shear		Ixe	22.411 in^4	Iye	1.902 in^4
Vay	9724 lb	Sxe(t)	4.5340 in^3	Sye(l)	0.6129 in^3
Vax	9312 lb	Sxe(b)	4.4356 in^3	Sye(r)	0.6601 in^3

Section: Test#2.sct
Zee 12 ga Test #2
SS 10Z Gravity
Rev. Date: 8/24/2010 3:13:09 PM
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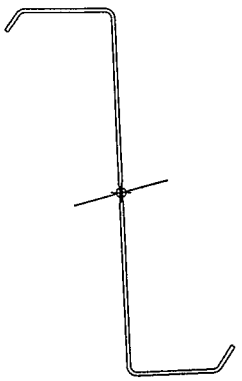

Section Inputs

Material: [N/A]
No strength increase from cold work of forming.

Modulus of Elasticity, E	29500000 psi
Yield Strength, Fy	60000 psi
Tensile Strength, Fu	80000 psi
Warping Constant Override, Cw	0 in^6
Torsion Constant Override, J	0 in^4

Stiffened Zee, Thickness 0.1 in
Placement of Part from Origin:

X to center of gravity	0 in
Y to center of gravity	0 in

Outside dimensions, Open shape

	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	0.6875	54.000	0.18750	None	0.000	0.0000	0.3438
2	2.6250	0.000	0.18750	Single	0.000	0.0000	1.3125
3	10.0000	-88.000	0.18750	Single	0.000	0.0000	5.0000
4	2.5000	2.000	0.18750	Single	0.000	0.0000	1.2500
5	0.8125	57.000	0.18750	None	0.000	0.0000	0.4063

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Full Section Properties

Area	1.6092 in^2	Wt.	5.4713 lb/ft	Width	16.092 in
Ix	22.652 in^4	rx	3.7519 in	Ixy	-5.591 in^4
Sx(t)	4.5498 in^3	y(t)	4.9787 in	α	14.469 deg
Sx(b)	4.5224 in^3	y(b)	5.0089 in		
		Height	9.9875 in		
Iy	2.427 in^4	ry	1.2280 in	Xo	0.0085 in
Sy(l)	0.7704 in^3	x(l)	3.1496 in	Yo	0.0063 in
Sy(r)	0.7905 in^3	x(r)	3.0696 in	jx	-0.1136 in
		Width	6.2192 in	jy	0.0101 in
I1	24.095 in^4	r1	3.8695 in		
I2	0.984 in^4	r2	0.7819 in		
Ic	25.079 in^4	rc	3.9477 in	Cw	37.445 in^6
Io	25.079 in^4	ro	3.9477 in	J	0.005364 in^4

Fully Braced Strength - 2007 North American Specification - US (ASD)

Material Type: [N/A], Fy=60000 psi

Compression		Positive Moment		Positive Moment	
Pao	32661 lb	Maxo	153321 lb-in	Mayo	27680 lb-in
Ae	0.97982 in^2	Ixe	21.762 in^4	Iye	2.427 in^4
		Sxe(t)	4.2674 in^3	Sye(l)	0.7704 in^3
Tension		Sxe(b)	4.4523 in^3	Sye(r)	0.7905 in^3
Ta	57816 lb				
		Negative Moment		Negative Moment	
		Maxo	157626 lb-in	Mayo	23831 lb-in
Shear		Ixe	22.237 in^4	Iye	2.130 in^4
Vay	9428 lb	Sxe(t)	4.5208 in^3	Sye(l)	0.6633 in^3
Vax	9614 lb	Sxe(b)	4.3873 in^3	Sye(r)	0.7079 in^3

5.4 TEST CONDITIONS

A. OWNERSHIP OF ENCON WORK PRODUCT

All test results developed as a part of this work shall be CUSTOMER's property. All samples submitted to ENCON for testing shall become the property of ENCON. CUSTOMER understands that any test program including procedures and test machines incorporated as a part of this work is a result of continuing long-term research and development by ENCON and because of this all ENCON test procedures, test drawings and other intellectual property relating to this work is and shall remain the property of ENCON. Test samples were disposed of shortly after completion of the tests unless other arrangements were agreed to in writing prior to the test.

ENCON will use its normal procedures to retain copies of the information developed as a part of this test for a period of three years from the date the work was done. This material may be routinely destroyed thereafter.

B. ENCON GUARANTEE

ENCON guarantees it used its best effort to accomplish this test work. Work done by ENCON was carefully completed by personnel believed to be competent. ENCON tests were based on what was currently believed to be good engineering practices in use at the time of the test.

The safety factors used are generally accepted as suitable to produce safe results. However, good engineering practices and applicable codes and insurance requirements must be taken into consideration in determining if a test procedure is satisfactory for a specific end use. Applicable specifications, good engineering practices and applicable safety factors may change in the future. CUSTOMER should be alert to these changes.

The information and test results presented by ENCON in this test report are offered in good faith based on information ENCON believes to be reliable. This information is offered as a guide to assist CUSTOMER in CUSTOMER's endeavors and does not contain any warranties as to fitness by ENCON. No REPRESENTATION OF WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE are made by ENCON, and more specifically, ENCON hereby expressly disclaim such. In no event shall ENCON be liable for ANY CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES, including, without limitation, labor, transportation, loss of use, loss of profits, harm, personnel injury and damage to property.

If any doubt exists as to the proper means of interpreting or using the test results contained herein, contact ENCON for clarification. CUSTOMER should assure themselves through careful evaluations that test results are suitable for those end uses to which CUSTOMER intends to put them.

APPENDIX

Information and material provided by CUSTOMER to ENCON was reviewed by an ENCON executive. However, ENCON does not accept the responsibility for accuracy or verification of CUSTOMER's information or the suitability of CUSTOMER materials. Materials supplied by CUSTOMER were tested as received and were not evaluated for code or insurance compliance. CUSTOMER is expected to review the ENCON drawings, tables, test results and other information provided by ENCON to CUSTOMER critically so as to assure CUSTOMER that these presentations, formulas, drawings and other information are accurate and meaningful for the purpose intended.

No other warranties or guarantees shall be issued, implied, delivered or otherwise construed to be issued, implied or delivered.