

# **PSA**

## **SLOTTED INSERTS**

FOR PRE-CAST CONCRETE PANEL CONNECTIONS

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**PERFORMANCE REPORTS**

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**TEST REPORT NO. 1**  
**LOAD TESTS ON**  
**PSA SLOTTED INSERTS**

September, 1993

**NOTICE**

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September, 1993

**LOAD TESTS ON PSA SLOTTED INSERTS  
TEST REPORT NO. 1**

**INTRODUCTION**

The purpose of this test program is to establish the ultimate pull-out capacity of the various inserts developed by Paton Steenson Associates Inc., known as PSA Inserts, for use in precast concrete panel applications.

**TEST PANEL**

A concrete test panel was constructed into which several different PSA inserts were cast. The details of the test panel are shown on drawing no. 1001, included in Appendix A. This panel was manufactured at the Tri-Krete Plant in Toronto, Ontario as part of a normal days production. Load tests were conducted on the inserts when the test panel was twenty eight days old. The average concrete strength, as determined by concrete test cylinders, was 5249 psi at 14 days and 6279 psi at 28 days. The test panel was not prestressed but was reinforced for handling purposes by a nominal layer of welded wire fabric. No additional reinforcing steel was provided and the wire fabric did not affect the anchorage of the insert in any way. The concrete was cured in a normal manner (not accelerated). Details of the concrete quality control data are included in Appendix A.

**TEST METHOD**

The test load, in all cases, was applied to the inserts through their normal connection devices using a 30 ton hydraulic ram and hand operated pump. A load cell with a digital readout gauge was used to obtain an accurate direct load measurement. Recent calibration data for the load cell is included in Appendix A.

Figures 1 and 2 illustrate the conventional test arrangement used. A high strength bolt in the load transfer bracket was attached to the heavy duty nut built-into in the insert. In all cases, the load was applied when the nut was located in the center of the insert. All inserts were tested for ultimate pull-out capacity.

A visual inspection of the pattern of failure cracking was made throughout the tests. The mode of failure was determined, photographed and recorded.

### TEST PROGRAM

Inserts were both 4 1/2" and 6" long and either 2 1/2", 3 1/2" or 4 1/2" deep. Heavy duty square nuts are contained within the inserts and a 3/4" high strength bolt, located at the center of each insert, was used for these tests.

All inserts were located away from the edges and corners of the panel as shown on drawing no. 1001, in order to determine the true unreinforced capacity of these inserts.

### TEST RESULTS

A table of test results is given in Appendix A.

### DISCUSSION

1. In the case of the 2 1/2" deep inserts, the mode of failure was a typical concrete failure cone extending to the full depth of the insert. The average failure load was 13,475 lbs.
2. In the case of the 3 1/2" deep inserts, the mode of failure for two tests was a typical concrete failure cone extending to the full depth of the anchors. The other two tests, produced a typical mechanical failure of the insert lips along the slot.
3. In the case of the 4 1/2" deep inserts, the mode of failure was typically a concrete failure cone type, extending to the full depth of the anchors, except for test No. 9 which cracked the panel due to improper support. In all cases the concrete failure was initiated by the ductile yielding of the insert legs. The average failure load was 21,566 lbs.



## CONCLUSIONS AND RECOMMENDATIONS

1. The recommended design ultimate capacity of these inserts is governed by the strength of the concrete failure cone which is a function of the embedded depth of the insert and its anchors when applicable.
2. When used in minimum 5,000 psi concrete with appropriate edge distances, the recommended design ultimate pull-out capacities of these inserts are as follows:

INSERT TYPE	ANCHORAGE DEPTH	AVERAGE FAILURE LOAD	RECOMMENDED DESIGN ULT. CAPACITY
4525	2 1/2"	13,475 lb.	12,000 lb.
6025	2 1/2"	13,475 lb.	12,000 lb.
4535	3 1/2"	18,850 lb.	16,000 lb.
6035	3 1/2"	18,850 lb.	16,000 lb.
4545	4 1/2"	21,566 lb.	20,000 lb.
6045	4 1/2"	21,566 lb.	20,000 lb.

Peto MacCallum Ltd.



Gerry Pacitti, P. Eng.



September 31, 1993

## **APPENDIX A**

1. Table of Test Results.
2. Load Cell Calibration Report.
3. Concrete Cylinder Test Report.
4. Photographs - Figs. 1 through 6 incl.
5. Test Set Up - Fig. 7.
6. Drawing No. 1001 - Test Panels.
7. Data Sheet for PSA Inserts.

**TEST RESULTS****PSA SLOTTED INSERTS - TEST REPORT NO. 1**

INSERT TYPE	TEST NUMBER	INSERT LOCATION	EXTRA REINF.	BOLT LOCATION	FAILURE LOAD (lbs)	REMARKS
<b>2 1/2" INSERTS (Rated - 12 Kips Ultimate)</b>						
6025	1	Internal	None	Center	12,500	Typ. concrete cone Insert Intact
6025	3	Internal	None	Center	14,400	Typ. concrete cone Insert Intact
4525	2	Internal	None	Center	12,600	Typ. concrete cone Insert Intact
4525	4	Internal	None	Center	14,400	Typ. concrete cone Insert Intact
<b>3 1/2" INSERTS (Rated - 16 Kips Ultimate)</b>						
6035	5	Internal	None	Center	18,800	Typ. concrete cone Insert wings bent
6035	7	Internal	None	Center	18,800	Insert lips failed
4535	6	Internal	None	Center	18,900	Insert lips failed
4535	8	Internal	None	Center	18,900	Typ. concrete cone Insert wings bent
<b>4 1/2" INSERTS (Rated - 20 Kips Ultimate)</b>						
6045	9	Internal	None	Center	19,900*	Cracked test panel
6045	11	Internal	None	Center	23,200	Test bolt failed
4545	10	Internal	None	Center	21,600	Typ. concrete cone Insert wings bent
4545	12	Internal	None	Center	19,900	Typ. concrete cone Insert wings bent

\* Disregard this test result (cracked panel)

# CALIBRATION CHART

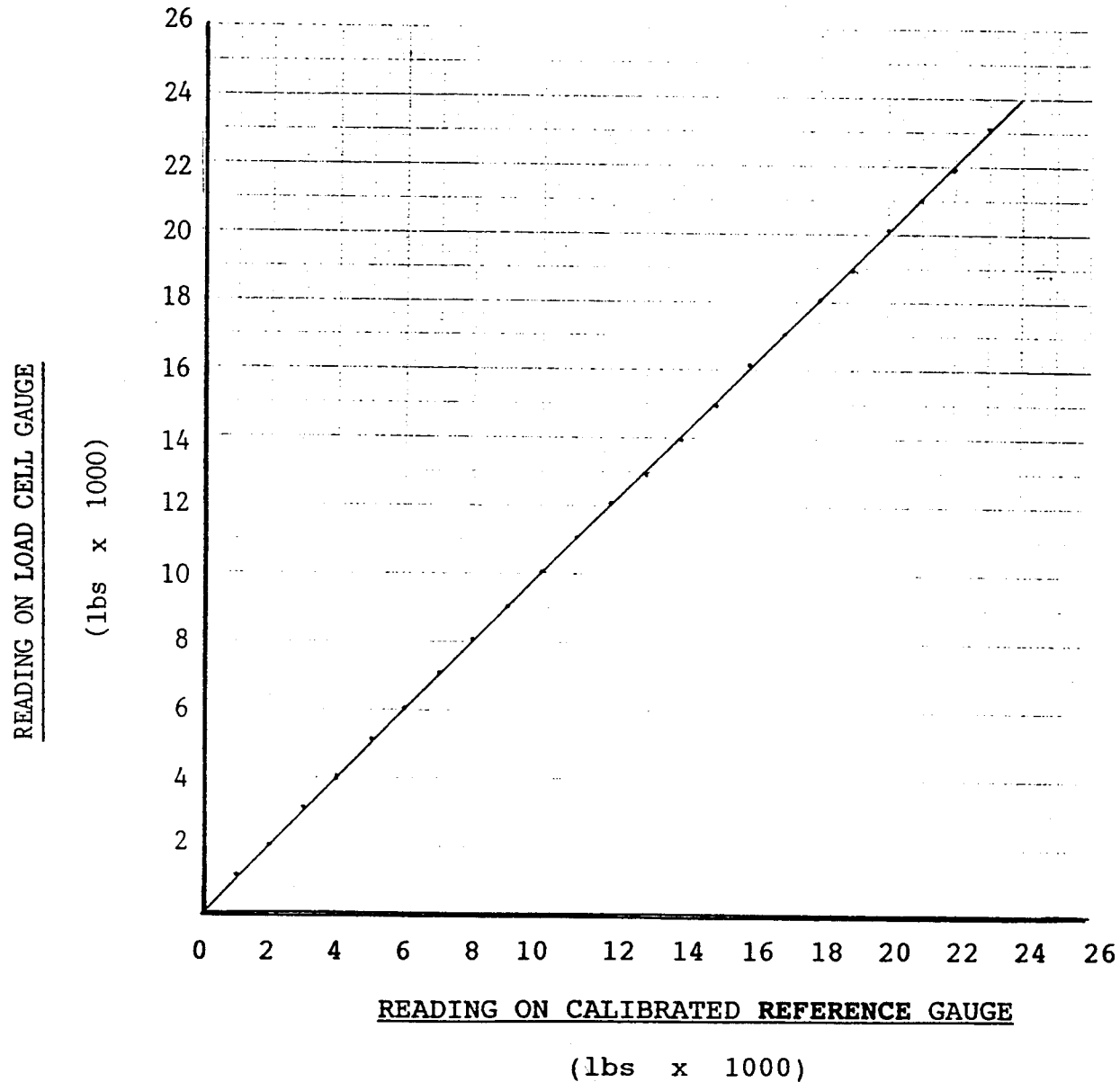
For

- STRAININSERT UNIVERSAL FLAT LOAD CELL  
MODEL FL25U(C) S/N 08908-2

Coupled with

- DORIC TRANSDUCER INDICATOR S/N 400236

DATE: September 3, 1993





# CONCRETE CYLINDER COMPRESSIVE STRENGTH TEST REPORT

Job Code: 8021		Project No.:				Laboratory Job: 2634			
Cylinder No.	Date Cast	Date Received in Lab	Date Tested	Curing	Density (kg / m <sup>3</sup> )	Specified 28 Day Strength (MPa)	7 Day Strength (MPa)	28 Day Strength (MPa)	Day Strength (MPa)
A	21JUL93	26JUL93	28JUL93	LAB	189	5000	4394		
B	21JUL93	26JUL93	04AUG93	LAB	190	5000		14 DAY	5249
C	21JUL93	26JUL93	18AUG93	LAB	190	5000		6279	

**Contractor:** N/A

**Project:** PSA

**Location on Structure:** N/A

**Concrete Supplier:** Tri-Krete

**Plant:**

**Cylinders Cast By:** F. Bertolo

**Representing:** Tri-Krete

**Time Mixer Charged:** 11:00

**Time Cylinders Cast:** 11:15

**Specified Slump (mm):** N/R

**Measured Slump (mm):** see below

**Temp. of Concrete (°C):** see below

**Air Temperature (°C):** see below

**Specified Air (%):** 5.0

**Measured Air (%):** 5.6

**Water Added on the Job (litres):** None

**By What Authority:** N/A

**Type of Mould Used:** Plastic

**Load No.:** N/R

**Nom. Size of Agg. (mm):** see below

**Truck No.:** N/R

**Type of Admixture:** MBVR Rheobuild

**Ordered 28 Day Strength (MPa):** see specified

**Initial 24 Hour Curing Temp. (°C):**

**Maximum:** N/A

**Minimum:** N/A

## REMARKS:

Nominal size of aggregate = 3/8 ins.

Measured Slump = 3.3 ins.

Air Temp. (F°) = 75

Temp of Concrete (F°) = 70

All strengths are in psi. <sup>3</sup>

All densities are in lb/ft

We hereby certify testing in accordance with CAN 3-A23. 2-M90 for that portion of the test performed by this company

## DISTRIBUTION:

2 Tri-Krete Attn: Mr. E. Romanin

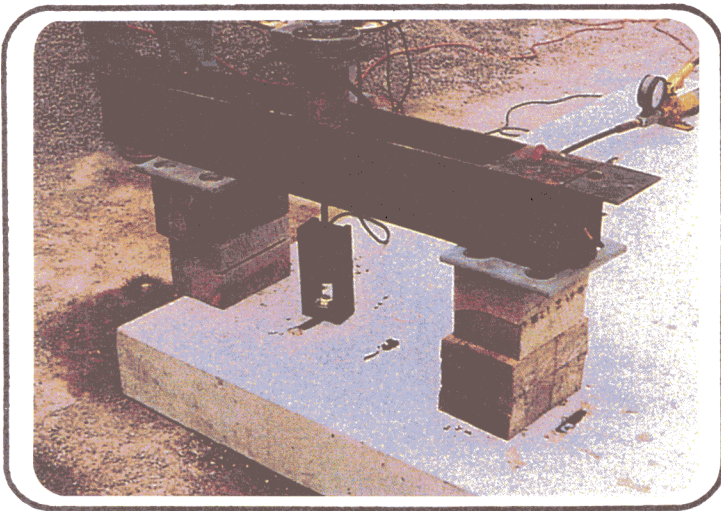
1 Paton, Steenson & Assoc. Attn: Mr. Don Paton, P.Eng.

Construction Control Group

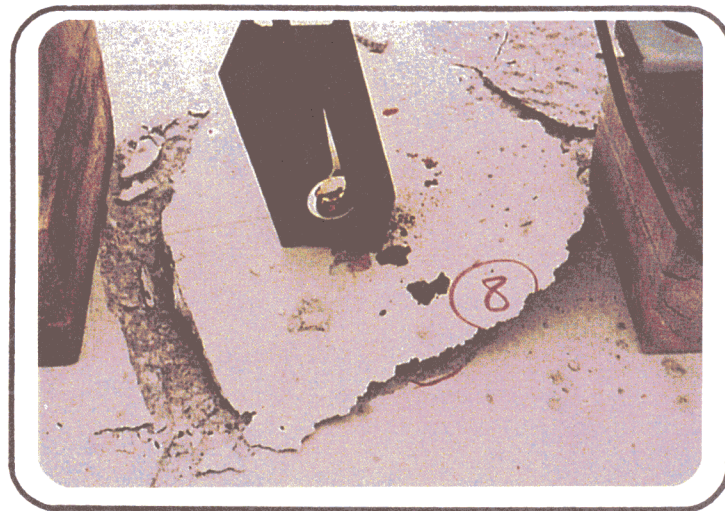
# PHOTOGRAPHS



**Fig. 1** Test Panel - Test Apparatus

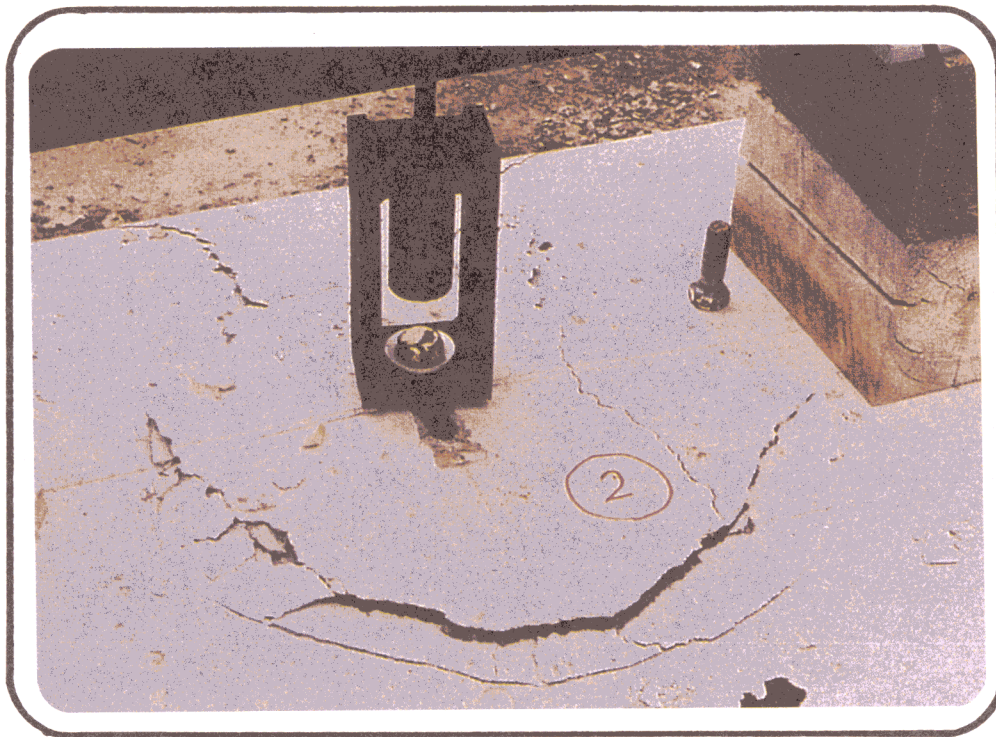


**Fig. 2** Test Set Up - Test No. 1

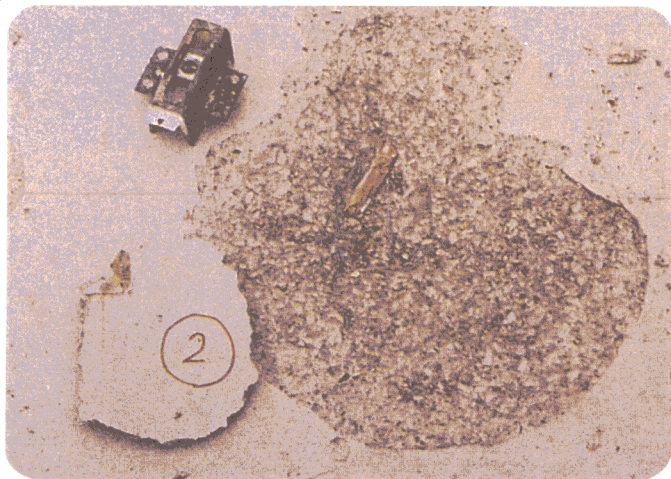


**Fig. 3** 4 1/2" x 3 1/2" Insert - 18,900 lbs.  
Typical concrete cone failure.





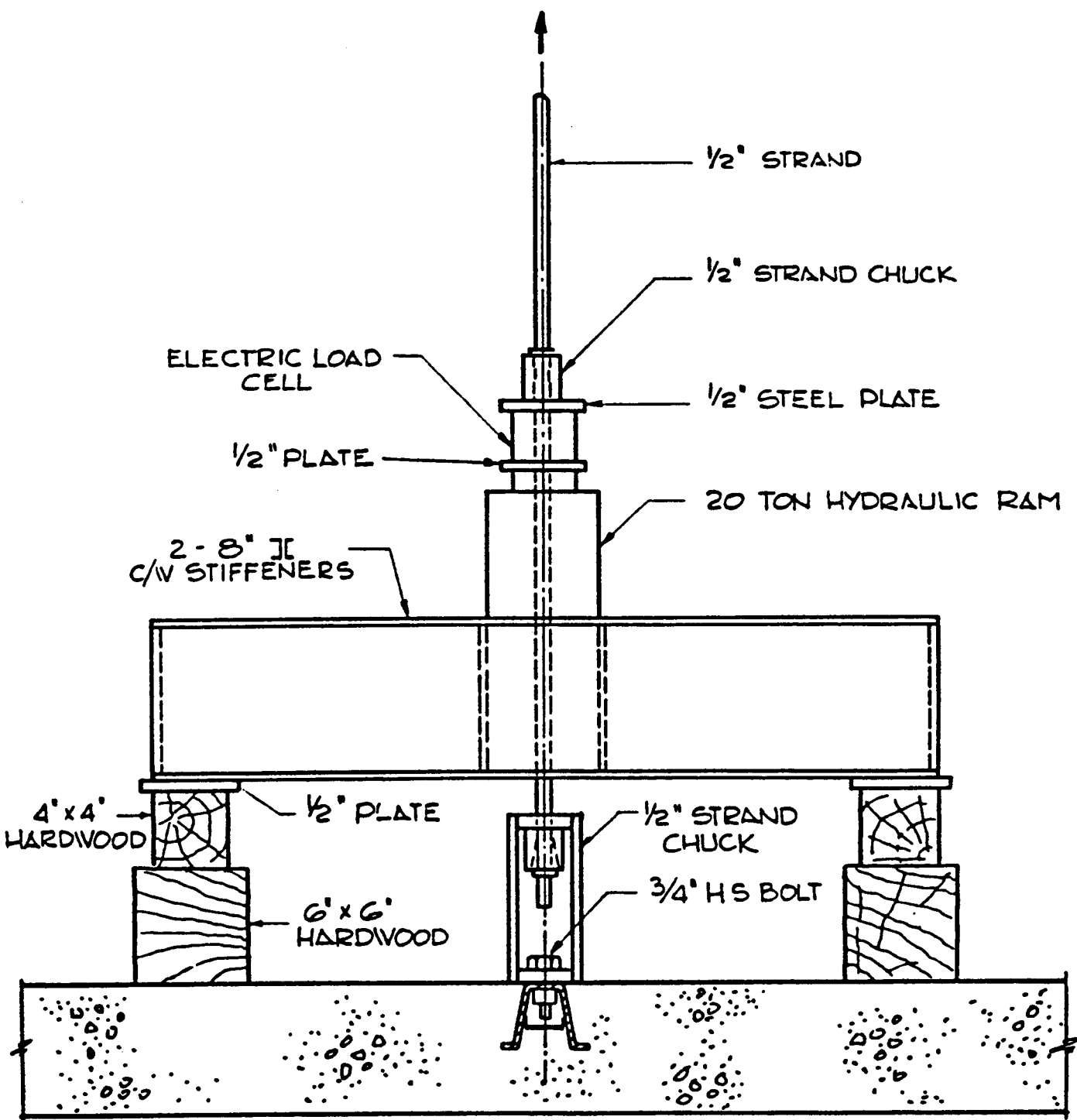
**Fig. 4** 4 1/2" x 2 1/2" Insert - 14,400 lbs.  
Typical concrete cone failure.



**Fig. 5** 4 1/2" x 2 1/2" Insert - 14,400 lbs.  
Concrete cone extends to base of insert



**Fig. 6** 6" x 3 1/2" Insert - Lips  
deformed at 18,800 lbs.



TEST SET-UP  
FOR PULLOUT TESTS  
FIG. 7



# INSERT DESCRIPTION

## TEST PANEL NO. 1

1	6025	6' x 2 1/2'
2	4525	4 1/2' x 2 1/2'
3	6025	6' x 2 1/2'
4	4525	4 1/2' x 2 1/2'
5	6035	6' x 3 1/2'
6	4535	4 1/2' x 3 1/2'
7	6035	6' x 3 1/2'
8	4535	4 1/2' x 3 1/2'
9	6045	6' x 4 1/2'
10	4545	4 1/2' x 4 1/2'
11	6045	6' x 4 1/2'
12	4545	4 1/2' x 4 1/2'
13	6030	6' x 3'
14	4530	4 1/2' x 3'
15	6040	6' x 4'
16	4540	4 1/2' x 4'

### NOTES:

CONCRETE STRENGTH AT  
TIME OF TEST = 6279 psi

TESTED AT TRIKRETE PLANT  
TORONTO, ONTARIO

DATE	ISSUE	REV.	DESCRIPTION	CHECK
------	-------	------	-------------	-------

**PSA** PATON  
STEENSON  
ASSOCIATES INC

10 West Orchard Blvd.  
P.O. Box 23309  
THORNHILL, ONT. L3T 7W9

JOB

DETAIL

PSA TEST PANEL NO. 1

DETAIL NO.



DET. REF.

DRAWN BY

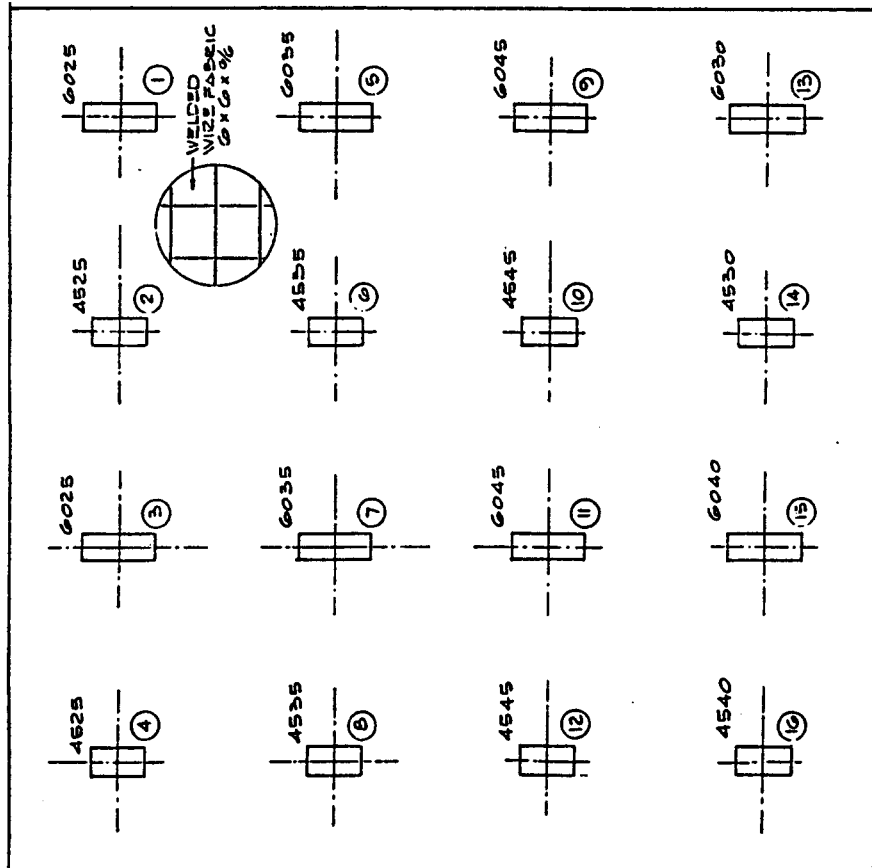
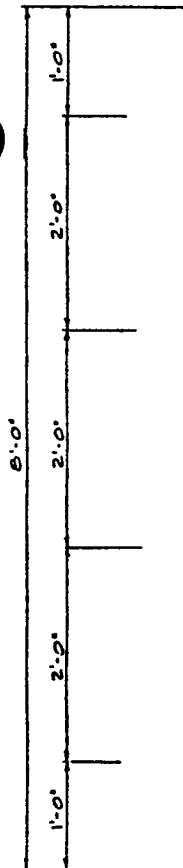
DATE

CHECKED BY

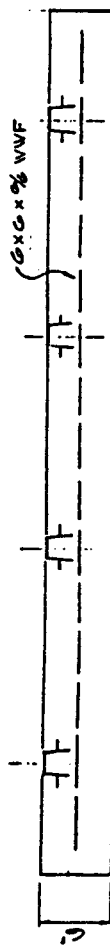
REVISION

DRAWING NO.

1001

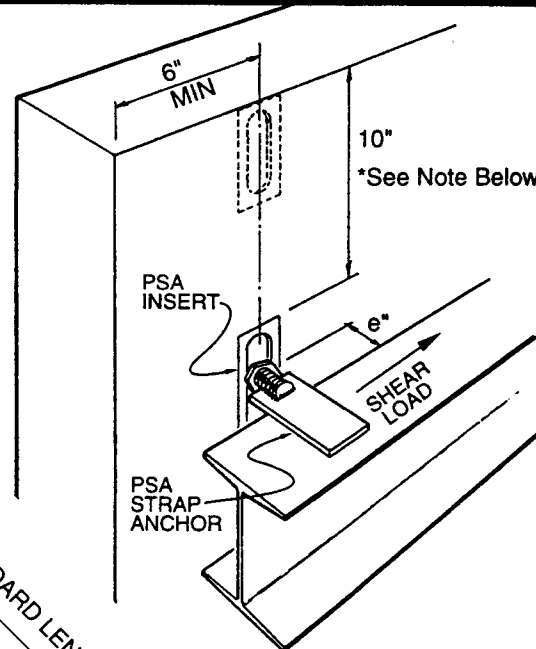
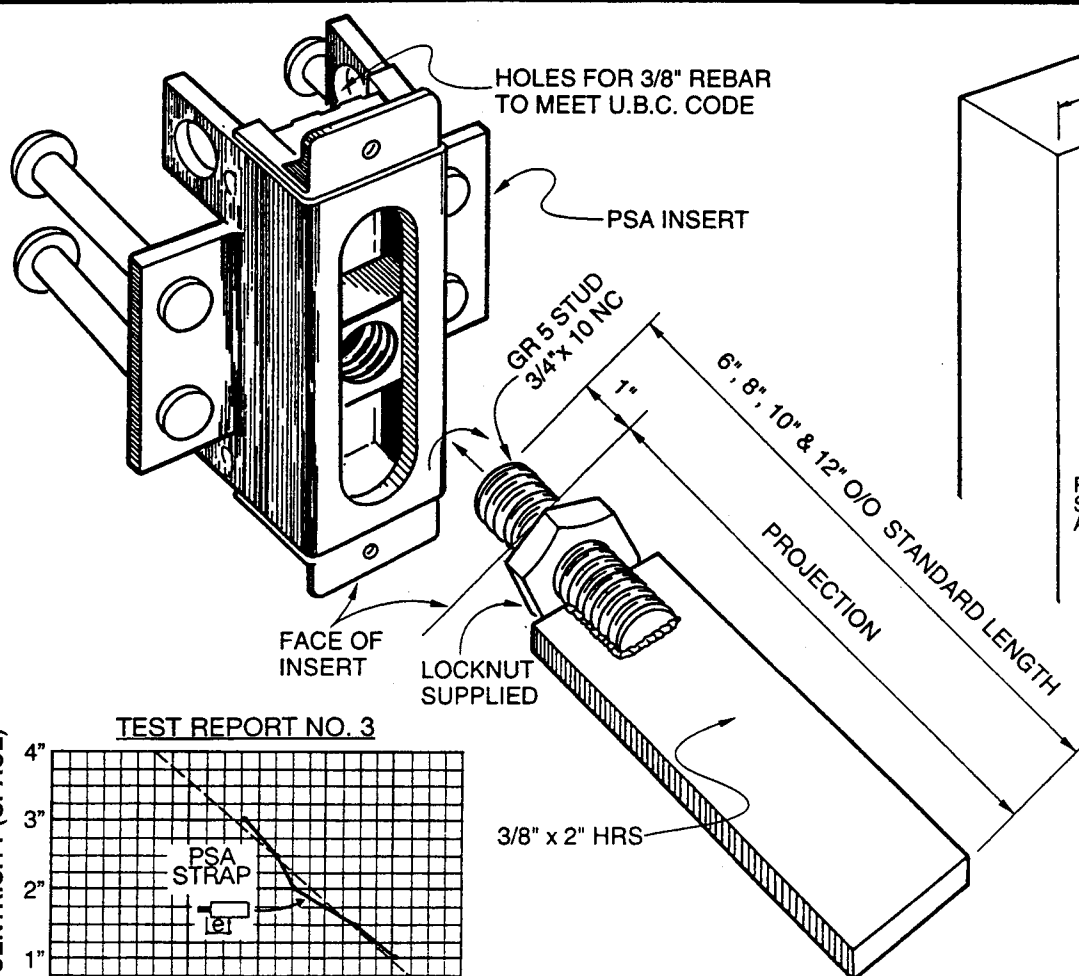


6' x 6' x 3/8" WVF



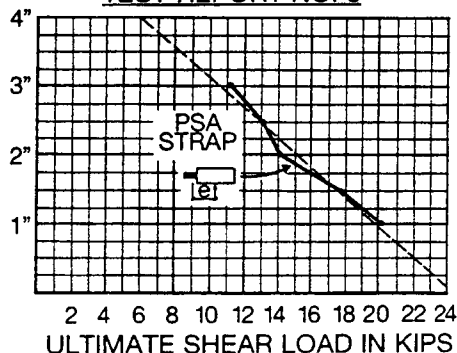
# PSA STRAP ANCHORS

# PSA



**Note:**  
\* Reduce Ultimate Load by 25% if Insert Placed at Top Edge of Panel. (Test Report No. 2)

TEST REPORT NO. 3



## FEATURES:

### • Ultimate Pull-out Capacity

Strap Anchors Develop full Ultimate Capacity of the insert

Insert Type	Depth	Length	Ult. Pull-Out Capacity
4525	2 1/2"	4 1/2"	12,000 lbs
6025		6"	
4535	3 1/2"	4 1/2"	16,000 lbs
6035		6"	
4545	4 1/2"	4 1/2"	20,000 lbs
6045		6"	

Ultimate Pull-Out Capacity Based on Tests Performed in 5,000 psi Normal Weight Concrete (Refer to PSA Test Report No.1)

### • Ultimate Shear Capacity

20,350 lbs. at 1" Eccentricity (See Graph Above)  
Ult. Shear Capacity based on Tests Performed in 6,000 psi Normal Weight Concrete (Refer to PSA Test Report No. 3)

### • Standard Strap Anchor Lengths

6", 8", 10" & 12" Out/Out

• **Available Finishes** – Epoxy or Hot Dipped Galvanized. (Stainless Steel available on Special Order)

• **Material** – High Strength weldable grade HRS Steel

• **Lock Nut** – Ensures Positive Connection in Both Directions

In the U.S.A.

## JVI

In Canada

## PSA

### ACCESSORIES, INC.

7550 North Linder Avenue  
Skokie, Illinois 60077 USA  
705/675-1560 Fax: 708/675-0083

### PATON STEENSON ASSOC. INC.

10 Royal Orchard Blvd. P.O. Box #53009  
Thornhill, Ontario L3T 7R9  
905/889-7357 Fax: 905/889-7648

**DISCLAIMER:** The use of PSA inserts should be approved by a qualified professional engineer or architect.

**TEST REPORT NO. 2**

**LOAD TESTS ON**

**PSA SLOTTED INSERTS**

Inserts Located at Edge of Panel

September, 1993

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September, 1993

**LOAD TESTS ON PSA SLOTTED INSERTS  
TEST REPORT NO. 2**

Introduction

The purpose of this limited test program is to determine how the ultimate pull-out capacity of various PSA Slotted Inserts is affected when the inserts are placed at the edge of a precast concrete panel without any additional steel reinforcement.

TEST PANEL

A concrete test panel was constructed into which several PSA inserts were cast. The details of the test panel are shown on Drawing No.1002, included in Appendix A. This panel was manufactured at the Tri-Krete plant in Toronto as part of a normal days production. Load tests were conducted on the inserts when the panel was twenty eight days old. The average concrete strength, as determined by concrete test cylinders, was 5017 psi at 14 days and 5351 psi at 28 days. The test panel was not prestressed but was reinforced for handling purposes with a nominal layer of welded wire fabric. The inserts were placed at, and perpendicular to the edges of the panel. No additional reinforcing steel was placed in or around these inserts. The concrete was cured in a normal manner (not accelerated). Details of the concrete quality control data are included in Appendix A.

TEST METHOD

The test load, in all cases, was applied to the inserts through their normal connection devices using a 30 ton hydraulic ram and hand operated pump. A load cell with a digital readout gauge was used to obtain an accurate direct load measurement. Recent calibration data for the load cell is included in Appendix A.

Figure 6 illustrates the conventional test arrangement used. A high strength bolt in the load transfer bracket was attached to the heavy duty nut built-into the insert. In all cases the load was applied when the nut was located in the center of the insert. All inserts were tested for ultimate pull-out capacity.

A visual inspection of the pattern of failure cracking was made throughout the tests. The mode of failure was determined, photographed and recorded.

## TEST PROGRAM

Inserts were both 4 1/2" and 6" long and either 2 1/2", 3 1/2" or 4 1/2" deep. Heavy duty square nuts were contained within the inserts and a 3/4" high strength bolt, located at the center of each insert, was used for these tests.

All of these inserts were located along the sides of the panel, away from the corners, but at, and perpendicular to the edges of the panel as shown on Drawing No.1002. No additional reinforcing steel was provided around or through the inserts so that the true unreinforced pull-out capacity of these edge-placed inserts could be determined.

## TEST RESULTS

A table of test results is given in Appendix A.

## DISCUSSION

1. In all cases, the mode of failure was a typical concrete failure cone extending to the full depth of the insert (and/or anchor) except that the diameter of the cone was somewhat reduced since the inserts were placed at the edge of the panel.
2. All inserts remained intact within the concrete cone. None of these inserts yielded.
3. The pull-out capacity of these edge-located inserts was reduced because of the reduced size of the failure cone. For the 2 1/2" inserts, the capacity was reduced about 20%, for the 3 1/2" inserts, about 25% and for the 4 1/2" inserts, about 27% below the capacities achieved in Test Report No. 1. where recommended edge distances were maintained.

**CONCLUSIONS AND RECOMMENDATIONS**

1. The capacity of these inserts is governed by the strength of the concrete failure cone which in turn is a function of the embedded depth of the insert, the tensile strength of the insert and the diameter of the failure cone.
2. The diameter of the failure cone is substantially reduced when inserts are placed at the edge of a panel. Other test programs may show that the full capacity of these inserts can be developed if additional reinforcing steel is used to compensate for the reduced size of the shear cone.
3. We do not recommend installing the inserts at edge distances less than recommended. These tests were conducted only to illustrate the consequences of not providing adequate edge distances or additional reinforcing steel to strengthen the smaller shear cone.
4. When compared to the results from Test Report No.1, it can be seen that the ultimate pull-out capacities of the same inserts are reduced by 20% to 27% when the inserts are located at the edge of a panel as follows:

INSERT DEPTH	AVE. TEST RESULTS INSERTS NOT LOCATED AT EDGE OF PANEL (TEST REPORT NO.1)	AVE. TEST RESULTS INSERTS LOCATED AT EDGE OF PANEL (TEST REPORT NO.2)
2 1/2"	13,475 lbs.	10,850 lbs.
3 1/2"	18,850 lbs.	14,150 lbs.
4 1/2"	21,566 lbs.	15,800 lbs.

Peto MacCallum Ltd.



Gerry Pacitti, P. Eng.



September 31, 1993

## **APPENDIX A**

- 1. Table of Test Results.**
- 2. Load Cell Calibration Report.**
- 3. Concrete Cylinder Test Report.**
- 4. Photographs - Figs. 1 through 5 incl.**
- 5. Test Set Up - Fig. 6.**
- 6. Drawing No. 1002 - Test Panels.**
- 7. Data Sheet for PSA Inserts**

**TEST RESULTS****PSA INSERTS - TEST REPORT NO. 2****ALL INSERTS LOCATED AT EDGE OF PANEL**

INSERT TYPE	TEST NUMBER	INSERT TYPE	EXTRA REINF.	BOLT LOCATION	FAILURE LOAD (lbs)	REMARKS
<b>2 1/2" INSERTS - (Rated 12 Kips Ultimate)</b>						
6025	1	Perp to edge	None	Center	12,200	Concrete failed Insert intact
4525	2	Perp to edge	None	Center	11,500	Concrete failed Insert intact
<b>3 1/2" INSERTS - (Rated 16 Kips Ultimate)</b>						
6035	12	Perp to edge	None	Center	14,500	Concrete failed Insert intact
4535	5	Perp to edge	None	Center	13,800	Concrete failed Insert intact
<b>4 1/2" INSERTS - (Rated 20 Kips Ultimate)</b>						
6045	14	Perp to edge	None	Center	17,500	Concrete failed Insert intact
4545	15	Perp to edge	None	Center	14,100	Concrete failed Insert intact



# CALIBRATION CHART

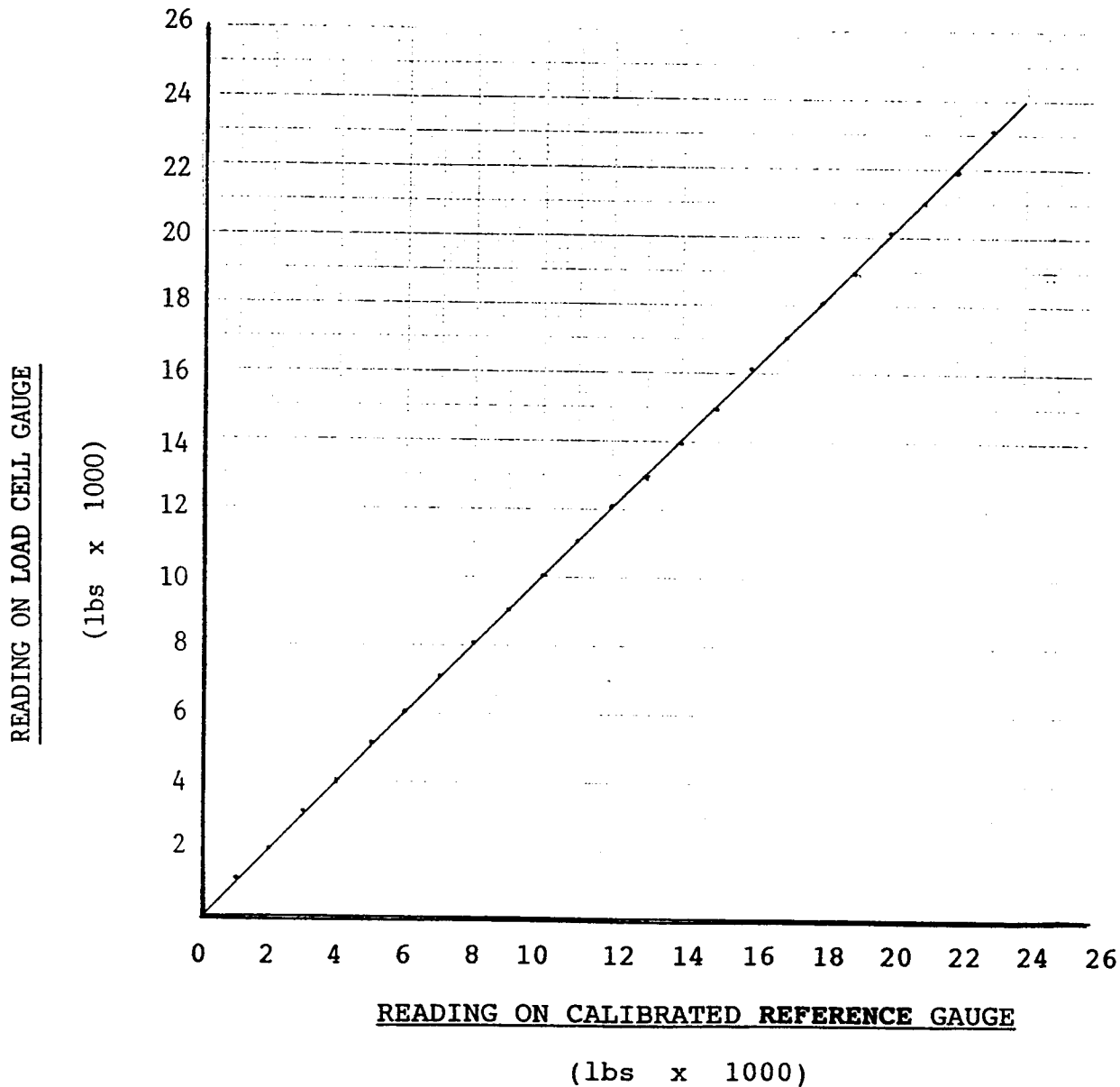
For

- STRAINERT UNIVERSAL FLAT LOAD CELL  
MODEL FL25U(C) S/N 08908-2

Coupled with

- DORIC TRANSDUCER INDICATOR S/N 400236

DATE: September 3, 1993



# CONCRETE CYLINDER COMPRESSIVE STRENGTH TEST REPORT

Job Code: 8021		Project No.:				Laboratory Job: 2635			
Cylinder No.	Date Cast	Date Received in Lab	Date Tested	Curing	Density (kg / m <sup>3</sup> )	Specified 28 Day Strength (MPa)	7 Day Strength (MPa)	28 Day Strength (MPa)	Day Strength (MPa)
A	22JUL93	26JUL93	29JUL93	LAB	183	5000	4713		
B	22JUL93	26JUL93	05AUG93	LAB	183	5000		14 DAY	5017
C	22JUL93	26JUL93	19AUG93	LAB	183	5000		5351	

Contractor: N/A

Project: PSA

Location on Structure: N/A

Concrete Supplier: Tri-Krete

Plant:

Cylinders Cast By: F. Bertolo

Representing: Tri-Krete

Time Mixer Charged: 10:30

Time Cylinders Cast: 10:40

Specified Slump (mm): N/R

Measured Slump (mm): see below

Temp. of Concrete (°C): 21

Air Temperature (°C): see below

Specified Air (%): 5.0

Measured Air (%): 5.0

Water Added on the Job (litres): None

By What Authority: N/A

Type of Mould Used: Plastic

Load No.: N/R

Nom. Size of Agg. (mm): see below

Truck No.: N/R

Type of Admixture: MBVR RHEOBUILD

Ordered 28 Day Strength (MPa): see specified

Initial 24 Hour Curing Temp. (°C):

Maximum: N/A

Minimum: N/A

## REMARKS:

Nominal size of aggregate = 3/8 inch

Measured slump = 3.0 ins.

Temperature of concrete (F°) = 70

Air temp. (F°) = 75

All strengths are in psi.  
All densities are in lb/ft<sup>3</sup>.

We hereby certify testing in accordance with CAN 3-A23. 2-M90 for that portion of the test performed by this company

## DISTRIBUTION:

2 Tri-Krete Mr. E. Romanin

1 Paton, Steenson & Associates

Attn: Mr. Don Paton, P. Eng.

Construction Control Group

# PHOTOGRAPHS



**Fig. 1** 6" x 2 1/2" Insert at edge - 10,200 lbs.  
Typical reduced concrete cone failure.



**Fig. 3** 4 1/2" x 3 1/2" Insert at edge, 13,800 lbs.  
Cone extends to base of anchors.



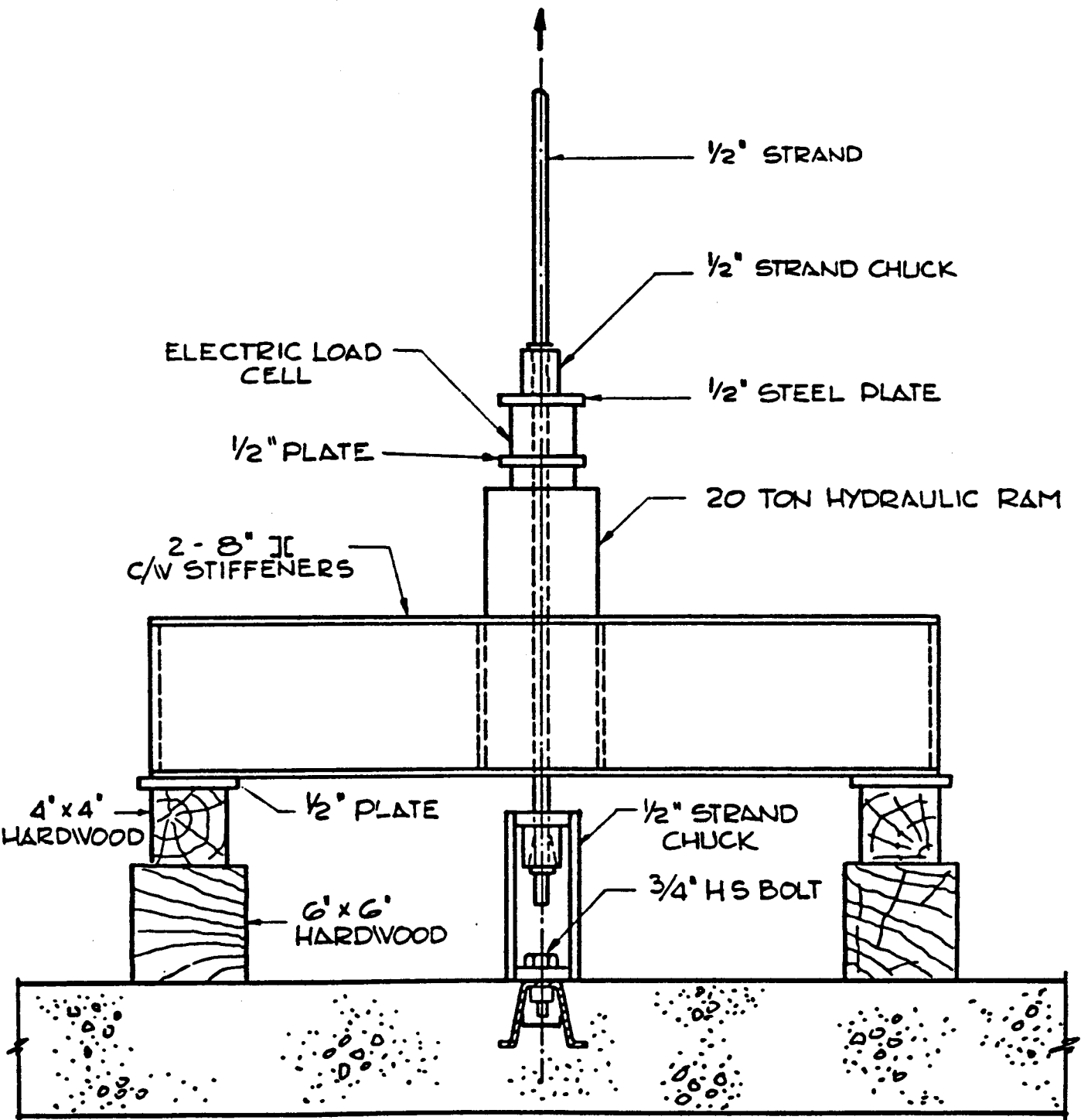
**Fig. 2** 4 1/2" x 2 1/2" Insert at edge, 11,500 lbs.  
Typical concrete cone failure.  
Cone extends to base of anchors.



**Fig. 4** 4 1/2" x 4 1/2" Insert at edge, 14,100 lbs.  
Cone extends to base of anchors.



**Fig. 5** 4 1/2" x 4 1/2" Insert at edge. 14,100 lbs.  
Typical concrete failure. Insert intact.



## TEST SET-UP

FOR PULLOUT TESTS

FIG. 6

INSERT DESCRIPTION

TEST PANEL NO. 2

1	6025	6" x 2 1/2"	
2	4525	4 1/2" x 2 1/2"	
3	4550	4 1/2" x 5"	SPECIAL BOLTS
4	4545	4 1/2" x 4 1/2"	2-HAIRPINS
5	4535	4 1/2" x 3 1/2"	
6	6045	6" x 4 1/2"	2-HAIRPINS
7	NOT CAST		
8	4545	4 1/2" x 4 1/2"	SPEC. BOLTS & NUT
9	4550	4 1/2" x 5"	SPECIAL NUT
10	4545	4 1/2" x 4 1/2"	2-HAIRPINS
11	4545	4 1/2" x 4 1/2"	2-HAIRPINS
12	6025	6" x 3 1/2"	SPEC. NUT
13	4545	4 1/2" x 4 1/2"	SPECIAL BOLTS
14	6045	6" x 4 1/2"	
15	4545	4 1/2" x 4 1/2"	

NOTES.

CONCRETE STRENGTH AT  
TIME OF TEST - 5551 PSI  
TESTED AT TRIKRETE PLANT  
TORONTO, ONTARIO

**PSA** PATON  
STEINSON  
ASSOCIATES INC

16 Spadina Drive, 4th Fl.  
P.O. Box 15000  
TORONTO, ONT. M5T 1W9

JOB

DETAIL

PSA TEST PANEL NO. 2

DETAIL No. DRAWN BY DATE

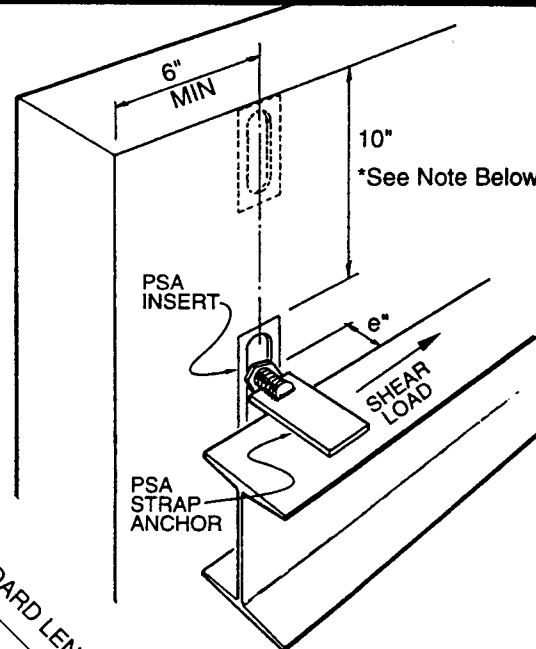
6-SEPT. 75

REVISION

DET. REF. 1002



# PSA



\* Reduce Ultimate Load by 25% if Insert Placed at Top Edge of Panel.  
(Test Report No. 2)



- **Ultimate Pull-out Capacity**

<b><u>Insert Type</u></b>	<b><u>Depth</u></b>	<b><u>Length</u></b>	<b><u>Ult. Pull-Out Capacity</u></b>
4525	2 1/2"	4 1/2"	12,000 lbs
6025		6"	
4535	3 1/2"	4 1/2"	16,000 lbs
6035		6"	
4545	4 1/2"	4 1/2"	20,000 lbs
6045		6"	

- **Ultimate Shear Capacity**

Ult. Shear Capacity based on Tests Performed in 6,000 psi  
Normal Weight Concrete (Refer to PSA Test Report No. 3)

- **Standard Strap Anchor Lengths**

• **Available Finishes** – Epoxy or Hot Dipped Galvanized. (Stainless Steel available on Special Order)

- **Material** – High Strength weldable grade HRS Steel

- **Lock Nut** – Ensures Positive Connection in Both Directions

**JVI**

**PSA**

7550 North Linder Avenue  
Skokie, Illinois 60077 USA  
705/675-1560 Fax: 708/675-0083

10 Royal Orchard Blvd. P.O. Box #53009  
Thornhill, Ontario L3T 7R9  
905/889-7357 Fax: 905/889-7648

**DISCLAIMER:** The use of PSA inserts should be approved by a qualified professional engineer or architect.

**TEST REPORT NO. 3**

**SHEAR TESTS ON**

**PSA SLOTTED INSERTS**

At Metromont Materials Plant

MAY, 1994

**ACKNOWLEDGEMENT**

Special thanks to HARRY GLEICH AND JIM JUSTUS of Metromont Materials Corp. for their help and advice in making this test program possible.

**NOTICE**

*This publication is intended for the use of professional personnel, competent to evaluate the significance and limitations of its contents and who will accept responsibility for the application of the material it contains. JVI Accessories Inc., Metromont Materials Corp., and Paton Steenson Associates Inc. disclaim any and all responsibility for the application of the stated principles or for the accuracy of the information contained herein.*



March, 1994

**SHEAR TESTS ON PSA SLOTTED INSERTS**  
**TEST REPORT NO. 3**

**INTRODUCTION**

The purpose of this test program was to determine the lateral shear capacity of welded strap anchor connections using PSA slotted inserts and strap anchors. The shear force was applied at various eccentricities from 1" to 3" away from the face of the insert so as to simulate actual construction conditions. The "fixed-end" effect of the weld on the strap anchor was taken into consideration.

**TEST PANEL**

The details of the test panel are shown on Drawing No. 1003 included in Appendix A. The panel was manufactured in the Metromont Materials plant in Greenville, S.C., as part of a normal days production. Inserts were "plunged" into the wet concrete in order to simulate actual production procedures for this type of prestressed concrete wall panel. The concrete was cured using normal accelerated curing procedures. The load test was made on January 11, 1994 when the panel was 7 days old. The average concrete strength at time of testing was 6,200 psi. as determined by two concrete test cylinders. An 8" x 8" steel box beam, welded to embedded weld plates served as a reaction beam to resist the design load of 30 kips at 4" eccentricity.

**TEST METHOD**

The test load was applied to the connection through a special test beam using a 20 ton hydraulic ram and hand operated pump. Recent calibration data for the pump and pressure gauge is included in Appendix A. The test beam was specially fabricated to rigidly restrain the ends of the strap anchors so as to simulate the fixed-end effect of a 2" weld on the strap anchor. This is the minimum length of weld usually used with this type of connection. Each strap anchor was tested individually. In all cases the jam nut was just finger tight (not torqued down). The eccentricity of the applied load was measured from the face of the insert to the bottom of the test beam to simulate the usual clearance between the back of a panel and the edge of the roof beam, all as shown on Drawing No. 1003 in Appendix A. Tests were made at five different eccentricities - 1", 1 1/2", 2", 2 1/2" and 3".

## TEST RESULTS

A Table of Test Results is given in Appendix A.

## DISCUSSION

- (1) The test beam effectively transmitted the axial load along the centre line of the jack. The levelling screws on the test beam maintained the alignment of the jack such that no secondary moments were introduced.
- (2) The test beam effectively simulated the fixed-end condition of the welded strap anchor as illustrated in Figs. 2 and 4.
- (3) Initial failure in all cases resulted from the ductile yielding of the steel strap as the load translated. Final failure occurred as the lips of the insert failed and the nut rotated out of the insert. Minor concrete spalling occurred as shown in Fig. 3.
- (4) It would appear that the shear capacity of these connections could be increased by using a wider (stiffer) steel strap, 2 1/2" or 3" wide to delay initial yielding. However it may be more cost effective for unusual loading conditions to weld extension plates onto the structural frame at connection points in order to reduce the eccentricity and utilize standard strap anchors.
- (5) In no case was there any bending or yielding of the high strength studs in the strap anchor. The exposed length of the stud was minimal and it would appear that the stud was effectively fixed-ended in both the insert and the strap anchor.

## CONCLUSIONS AND RECOMMENDATIONS

- (1) The 2" x 3/8" standard steel strap anchor provides adequate shear resistance for normal loading conditions.
- (2) Although a wider strap (2 1/2" or 3") would increase shear resistance it is recommended that for unusual loading conditions, an extension plate be welded onto the structural frame at connection points so that standard strap anchors can be used. The shear load is then transferred to the strap anchors at the eccentricity of the extension plate rather than the structural frame.

**TEST RESULTS****PSA INSERTS - TEST REPORT NO.3****LATERAL SHEAR TESTS ON STRAP ANCHORS****METROMONT MATERIALS PLANT - GREENVILLE, SC.**

<b>INSERT TYPE</b>	<b>TEST NUMBER</b>	<b>INSERT DESC.</b>	<b>LOAD ECCENT.</b>	<b>GAUGE READING</b>	<b>FAILURE LOAD (lbs)</b>	<b>REMARKS</b>
6025	2	6" x 2 1/2"	1"	4300 psi.	20,253	Concrete spalled Insert lips failed
6025	1	6" x 2 1/2"	1 1/2"	3800 psi.	17,900	Nut rotated out Insert lips failed
6025	3	6" x 2 1/2"	2"	3000 psi.	14,200	Insert lips failed Min. spalling (washer)
6025	4	6" x 2 1/2"	2 1/2"	2800 psi.	13,200	Same
6025	5	6" x 2 1/2"	3"	2400 psi	11,300	Same

**NOTES**

- (1) Ram area = 4.71 sq. in.
- (2) Refer to Drawing No. 1004 in Appendix A  
for a graph of Test Results.

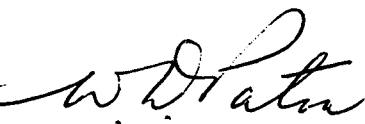
- (3) The test results of standard PSA Strap Anchors when tested in lateral shear in 6000 psi. concrete are summarized in the following table:

INSERT TYPE	STRAP TYPE	LOAD ECCENTRICITY	FAILURE LOAD
6" x 2 1/2"	3/8" X 2"	1"	20,253 lb.
6" x 2 1/2"	3/8" X 2"	1 1/2"	17,900 lb.
6" x 2 1/2"	3/8" X 2"	2"	14,200 lb.
6" x 2 1/2"	3/8" X 2"	2 1/2"	13,200 lb.
6" x 2 1/2"	3/8" X 2"	3"	11,300 lb.

NOTE:

Please refer to Drawing No. 1004 in Appendix A for a graphical presentation of these test results.

PATON STEENSON ASSOCIATES INC



Don Paton, P. Eng.

March 31, 1994

## APPENDIX A

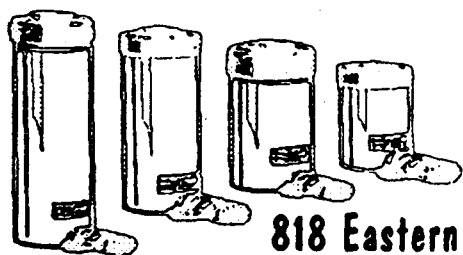
1. Table of Test Results.
2. Calibration Report.
3. Photographs - Figs. 1 through 4 incl.
4. Drawing No. 1003 - Test Set Up  
- Test Panel
5. Drawing No. 1004 - Graph of Test Results  
- Strap Anchor Assembly
6. Drawing No. 1005 - PSA Strap Anchors
7. Tensile Test on Strap Anchors
8. Data Sheet for PSA Strap Anchors
9. Data Sheet for PSA Inserts.

**TEST RESULTS****PSA INSERTS - TEST REPORT NO.3****LATERAL SHEAR TESTS ON STRAP ANCHORS****METROMONT MATERIALS PLANT - GREENVILLE, SC.**

<b>INSERT TYPE</b>	<b>TEST NUMBER</b>	<b>INSERT DESC.</b>	<b>LOAD ECCENT.</b>	<b>GAUGE READING</b>	<b>FAILURE LOAD (lbs)</b>	<b>REMARKS</b>
6025	2	6" x 2 1/2"	1"	4300 psi.	20,253	Concrete spalled Insert lips failed
6025	1	6" x 2 1/2"	1 1/2"	3800 psi.	17,900	Nut rotated out Insert lips failed
6025	3	6" x 2 1/2"	2"	3000 psi.	14,200	Insert lips failed Min. spalling (washer)
6025	4	6" x 2 1/2"	2 1/2"	2800 psi.	13,200	Same
6025	5	6" x 2 1/2"	3"	2400 psi	11,300	Same

**NOTES**

- (1) Ram area = 4.71 sq. in.
- (2) Refer to Drawing No. 1004 in Appendix A  
for a graph if Test Results.



# Hydraquip Sales & Service

818 Eastern Avenue, Unit 2, Toronto, ON, M4L 1A1

## Calibration Test Certificate

Customer: Paton Steenson Associates  
Gauge Description: Enerpac Gauge 0-10,000 psi, serial G93-496

Standard Used: Mansfield & Green, Type #R-50  
Dead Weight Serial #: 1315  
Dead Weight Accuracy: 0.1%

**\*\*Note:** Instruments have been tested against a dead weight tester serial # as above, which is traceable to the National Research Council in Ottawa, as per their report # 722.0329, dated August 18, 1989.

Hydraquip Sales & Service Ltd. certifies that the below item(s) have been tested to comply in every way with the requirements of the above purchase order.

Master Test Gauge	Above Gauge
-------------------	-------------

1000 PSI	1000 PSI
3000	3000
5000	5000
7000	7025
9000	9025

Date Tested: Dec 6, 1993  
Technician: Pat Mahon

Phone 416-461-3573 Fax 416-461-2979  
Out of town callers 1-800-463-4168

# PHOTOGRAPHS



Fig. 1 Jack & Test Beam (Test # 2)  
 $e = 1"$  20,253 lbs.

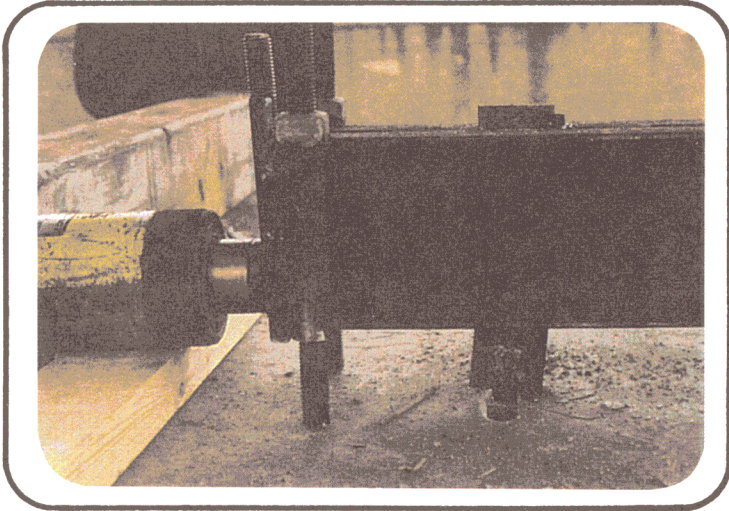


Fig. 2 Jack & Test Beam (Test # 4)  
 $e = 2 \frac{1}{2}"$  13,200 lbs.



Fig. 3 Typical failure (Test # 1)  
 $e = 1 \frac{1}{2}"$  17,900 lbs.

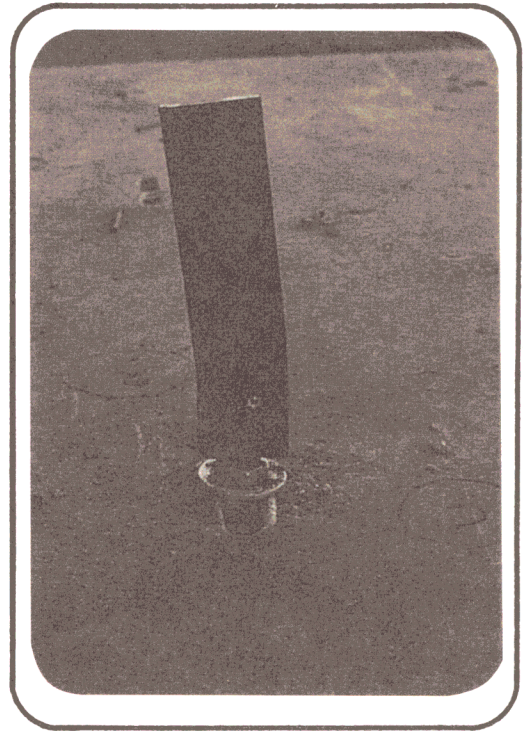
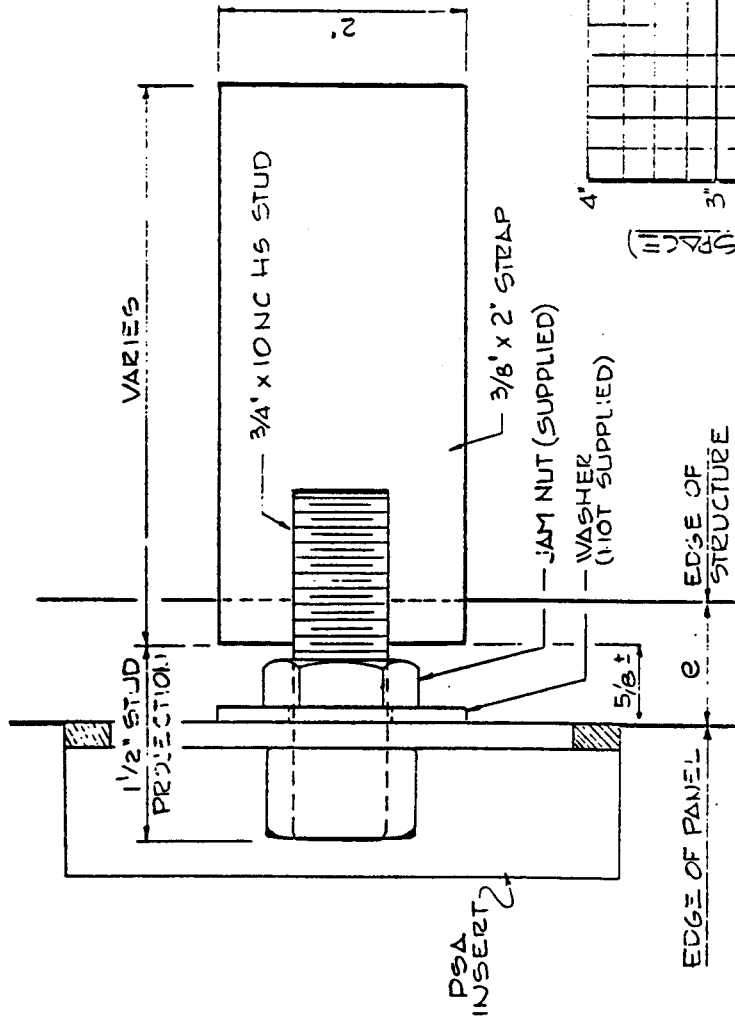


Fig. 4 Effective fixed-end  
of strap. (Test # 3)  
 $e = 2"$  14,200 lbs.

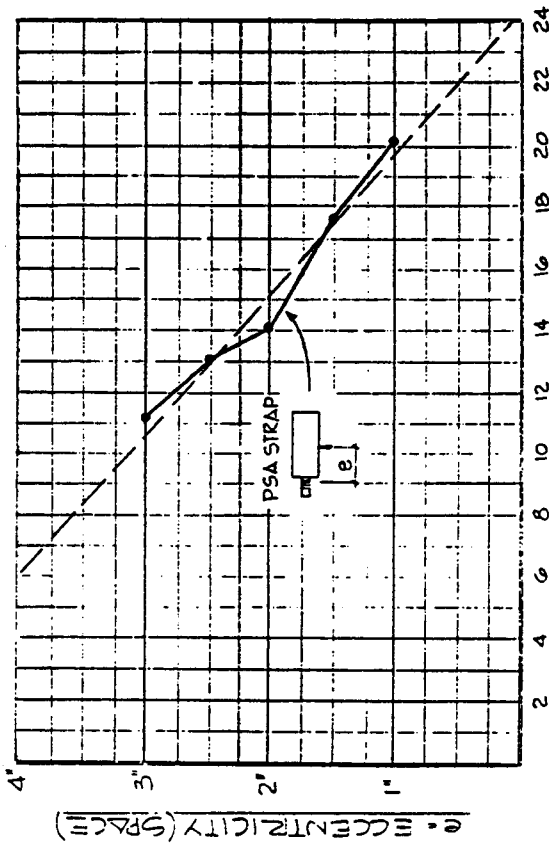


# INSERT DESCRIPTION

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PSA STRAP ANCHOR



ULTIMATE SHEAR LOAD IN KIPS

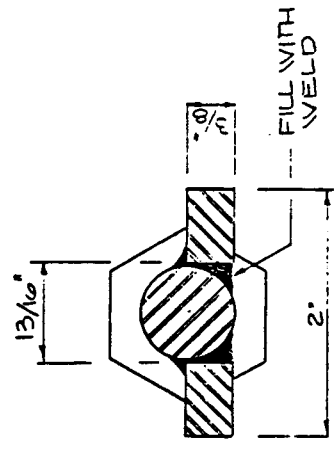
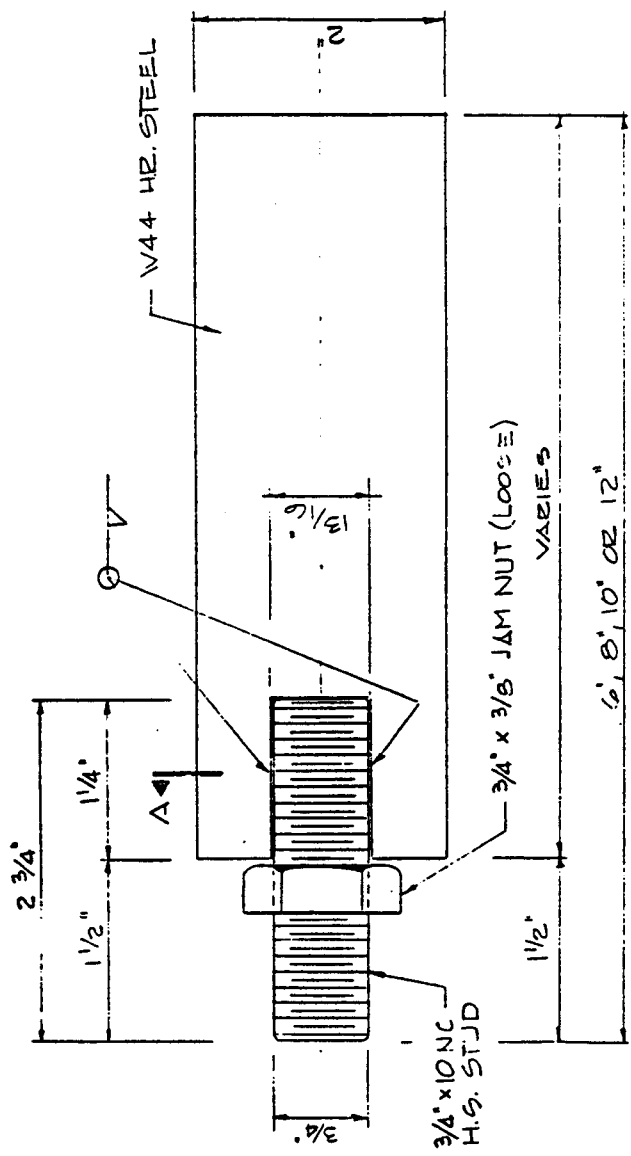
DATE	ISSUE	REVISION	DESCRIPTION	CHECK

**PSA**  
**RATON**  
**STENSON**  
**ASSOCIATES INC**  
 10000 100th Ave  
 7200 100th Ave  
 10000 100th Ave

**JOB** STRAP ANCHOR  
 SHEAR TEST

**DETAIL**  
 ULTIMATE SHEAR LOAD

DETAIL NO.	DRAWN BY	DATE	REVISION	DRAWING NO.
	E.A.	MAR/94		1004
	CHECKED BY			



SECT. 'A'

DATE	ISSUE	REVISED	DESCRIPTION	CHECK
<b>PSA</b> PAYTON ASSOCIATES INC 10000 W. 10th Ave. Suite 100 Greenwood, CO 80022				
JOB				
DETAIL				
THREADED STRAP ANCHOR				
DETAIL NO.	DRAWN BY	DATE	CHECKED BY	REVISION
	EE	MAR. 94		
DET. REF.	DRAWING NO. 1005			

Chemical Analysis of  
Malleable, Meehanite, Ductile  
and Cast Irons; Plain,  
Alloyed and Stainless Steels;  
Zinc and Aluminum Alloys;  
Brass and Bronze;  
Coal, Coke, Limestone  
Slags, Etc.

## CHEMISTS and METALLURGISTS

MAILING:  
P.O. BOX 367  
CAMBRIDGE, ONTARIO  
N1R 5V5

SHIPPING:  
15 HIGH RIDGE CRT.  
CAMBRIDGE, ONTARIO  
N1R 7L3

Mechanical Testing:  
Tension, Hardness, Bend,  
Notched Bar Impact.  
Metallography:  
Sand Testing:  
Reports

Paton Steenson Associates Inc.  
10 Royal Orchard Blvd.  
P.O. Box #53009  
Thornhill, Ontario  
L3T 7R9  
Attention: Don Paton

Customer P.O.: 1077

Laboratory Sample I.D. #: 40561  
4 Strap Anchors

Report Date: April 12, 1994

Four strap anchors were placed in a direct tensile load and pulled to failure. Specimens were tested as received.

In all cases, the specimen fractured outside of the weld in the threaded area. The following results were obtained:

48,300 lbf, 45,700 lbf, 44,400 lbf, and 44,100 lbf.

Test were conducted in accordance with The Galt Testing Laboratories' in house testing procedures.

Samples returned at customer's request and expense; otherwise samples retained one year from date of test.

This report relates only to the specimen or specimens tested and does not guarantee the bulk material, etc. to be equal quality. The testing and inspection of instruments, materials, and other articles is only undertaken by the Galt Testing Laboratories Limited subject to the express stipulation that no liability or responsibility of any kind or however arising shall attach to the Galt Testing Laboratories Limited, or any employee of the Galt Testing Laboratories Limited, in respect of any loss, injury or damage arising directly or indirectly out of, or in connection with any such inspection or testing or any failure or omission in regard thereto.

The Galt Testing Laboratories

Bill Bartlett  
Senior Technician

Graham Payne  
P. Eng.

Per

TELEPHONE 519-621-8191  
FAX 519-621-7700

# The Galt Testing Laboratories Limited

ESTABLISHED 1929

Chemical Analysis of  
Malleable, Meehanite, Ductile  
and Cast Irons; Plain,  
Alloyed and Stainless Steels;  
Zinc and Aluminum Alloys;  
Brass and Bronze;  
Coal, Coke, Limestone  
Slags, Etc.

## CHEMISTS and METALLURGISTS

MAILING:  
P.O. BOX 367  
CAMBRIDGE, ONTARIO  
N1R 5V5

SHIPPING:  
15 HIGH RIDGE CRT.  
CAMBRIDGE, ONTARIO  
N1R 7L3

Mechanical Testing  
Tension, Hardness, Bend  
Notched Bar Impact  
Metallography  
Sand Testing  
Reports

Paton Steenson Associates Inc.  
10 Royal Orchard Blvd.  
P.O. Box #53009  
Thornhill, Ontario  
L3T 7R9  
Attention: Don Paton

Laboratory Sample I.D. #: 71189

Report Date: July 25, 1994

Strap Anchor Sample, Marked #2 by Galt Testing  
Laboratories

One PSA Strap Anchor was placed in a direct tensile load and  
pulled to failure using a crosshead rate of 0.100"/min.

Specimen fractured in the threads of the 3/4 x 10 stud at  
a maximum load of 40,200 lbf.

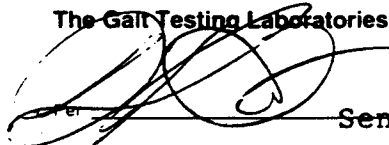
Specimen was tested as received.

Test conducted in accordance with the Galt Testing  
Laboratories' in house testing procedures.

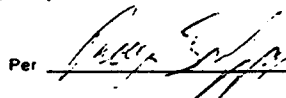
Samples returned at customer's request and expense; otherwise  
samples retained one year from date of test.

This report relates only to the specimen or specimens tested and does not guarantee  
the bulk material, etc. to be equal quality. The testing and inspection of instruments,  
materials, and other articles is only undertaken by the Galt Testing Laboratories  
Limited subject to the express stipulation that no liability or responsibility of any kind  
or however arising shall attach to the Galt Testing Laboratories Limited, or any  
employee of the Galt Testing Laboratories Limited, in respect of any loss, injury or  
damage arising directly or indirectly out of, or in connection with any such inspection  
or testing or any failure or omission in regard thereto

The Galt Testing Laboratories



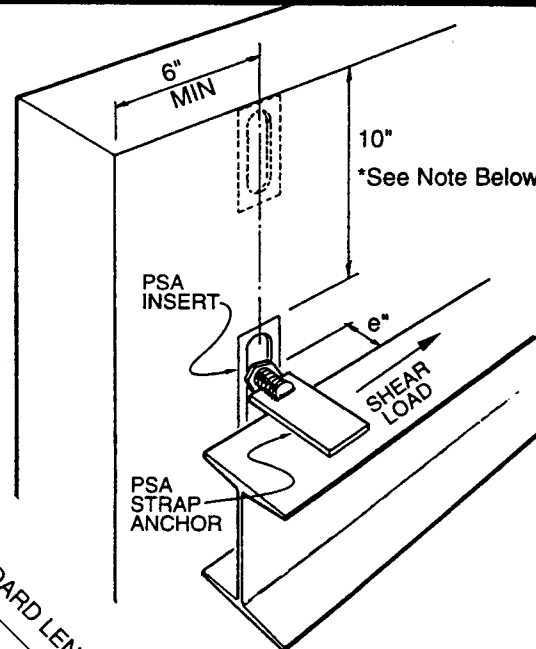
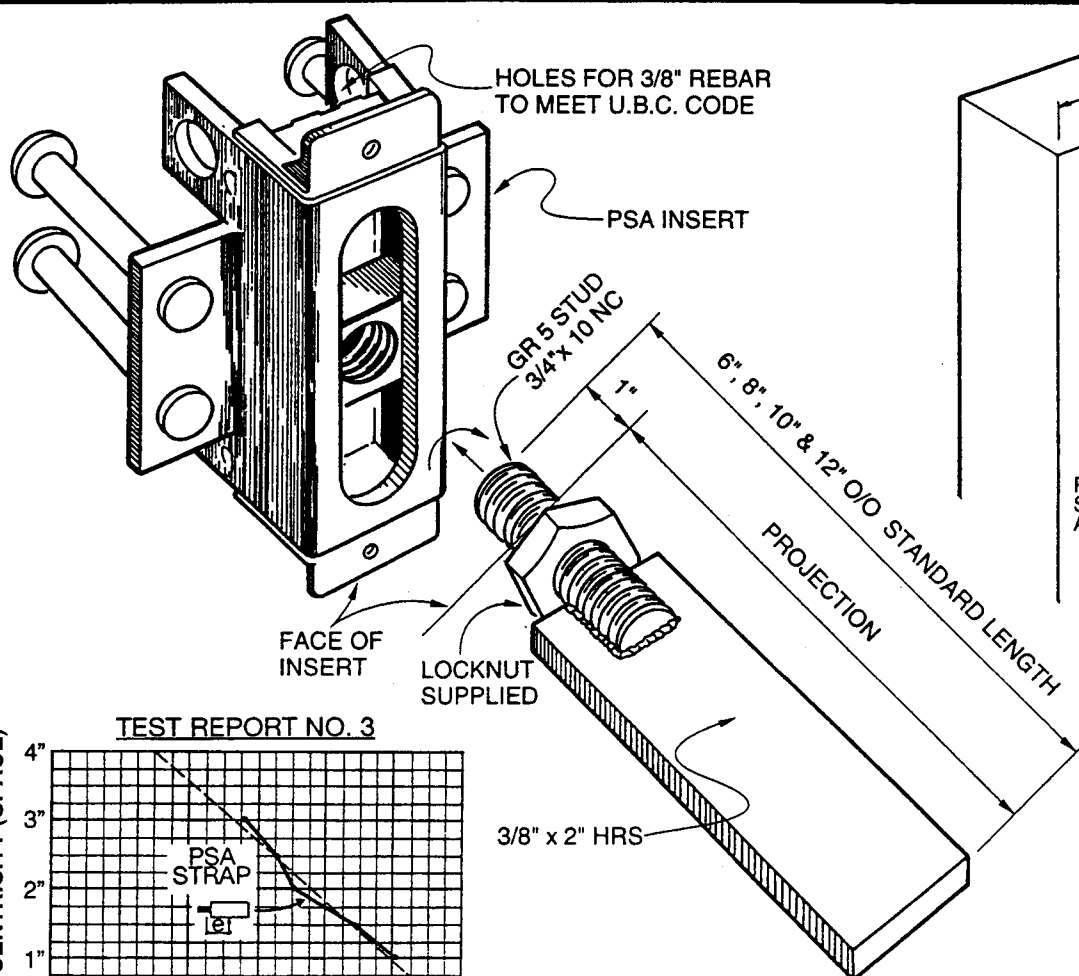
Bill Bartlett  
Senior Technician



Roger Trefzger  
P. Eng.

# PSA STRAP ANCHORS

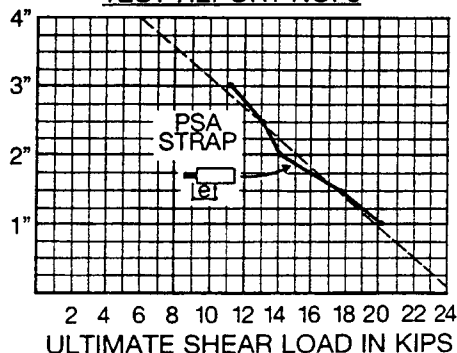
# PSA



## Note:

\* Reduce Ultimate Load by 25% if Insert Placed at Top Edge of Panel. (Test Report No. 2)

TEST REPORT NO. 3



## FEATURES:

### • Ultimate Pull-out Capacity

Strap Anchors Develop full Ultimate Capacity of the insert

Insert Type	Depth	Length	Ult. Pull-Out Capacity
4525	2 1/2"	4 1/2"	12,000 lbs
6025		6"	
4535	3 1/2"	4 1/2"	16,000 lbs
6035		6"	
4545	4 1/2"	4 1/2"	20,000 lbs
6045		6"	

Ultimate Pull-Out Capacity Based on Tests Performed in 5,000 psi Normal Weight Concrete (Refer to PSA Test Report No.1)

### • Ultimate Shear Capacity

20,350 lbs. at 1" Eccentricity (See Graph Above)

Ult. Shear Capacity based on Tests Performed in 6,000 psi Normal Weight Concrete (Refer to PSA Test Report No. 3)

### • Standard Strap Anchor Lengths

6", 8", 10" & 12" Out/Out

• **Available Finishes** – Epoxy or Hot Dipped Galvanized. (Stainless Steel available on Special Order)

• **Material** – High Strength weldable grade HRS Steel

• **Lock Nut** – Ensures Positive Connection in Both Directions

In the U.S.A.

# JVI

In Canada

# PSA

## ACCESSORIES, INC.

7550 North Linder Avenue  
Skokie, Illinois 60077 USA  
705/675-1560 Fax: 708/675-0083

## PATON STEENSON ASSOC. INC.

10 Royal Orchard Blvd. P.O. Box #53009  
Thornhill, Ontario L3T 7R9  
905/889-7357 Fax: 905/889-7648

**DISCLAIMER:** The use of PSA inserts should be approved by a qualified professional engineer or architect.

**TEST REPORT NO. 4**

**PULL-OUT TESTS ON**

**PSA SLOTTED INSERTS**

**At Metromont Materials Plant**

**MARCH, 1994**

**ACKNOWLEDGEMENT**

Special thanks to HARRY GLEICH AND JIM JUSTUS of Metromont Materials Corp. for their help and advice in making this test program possible.

**NOTICE**

*This publication is intended for the use of professional personnel, competent to evaluate the significance and limitations of its contents and who will accept responsibility for the application of the material it contains. JVI Accessories Inc., Metromont Materials Corp., and Paton Steenson Associates Inc. disclaim any and all responsibility for the application of the stated principles or for the accuracy of the information contained herein.*

March, 1994

## **LOAD TESTS ON PSA SLOTTED INSERTS TEST REPORT NO. 4**

### **INTRODUCTION**

The purpose of this test program was to establish the ultimate pull-out capacity of PSA Inserts in the 2" concrete wythe of a 6" prestressed concrete sandwich panel. The effect of increasing the concrete thickness to 3" (by reducing the insulation thickness directly underneath some inserts), was also studied.

### **TEST PANEL**

The details of the test panel are shown on Drawing No. 1003 included in Appendix A. The panel was manufactured in the Metromont Materials plant in Greenville S.C. as part of a normal days production of 6" prestressed concrete sandwich panels (2/2/2 sandwich). Inserts were "plunged" into the top surface of the wet concrete in order to simulate actual production procedures. The top wythe of concrete was only 2" thick but was thickened to 3" in a 12" x 12" area directly underneath some inserts, by reducing the thickness of insulation by 1". For other inserts, the 2" concrete thickness was maintained and legs of these inserts (which are 2 1/2" deep) were pushed 1/2" into the insulation. The panel was prestressed to a standard P/A of 225 psi. The panel was cured using normal accelerated curing procedures. The load tests were made on January 11, 1994 when the panel was 7 days old. The average strength of concrete at time of testing was approximately 6200 psi. as determined by two concrete test cylinders.

### **TEST METHOD**

The test load in all cases was applied to the inserts through their normal connection devices using a 20 ton hydraulic ram and hand operated pump. Recent calibration data for the pump and pressure gauge is included in Appendix A.

Figure 1 illustrates the conventional test arrangement used. A high strength bolt in the load transfer bracket was attached to the heavy duty nut built into the insert. In all cases, the load was applied with the bolt located in the centre of the insert. All inserts were tested for ultimate pull-out capacity. A visual inspection of the pattern of failure cracking was made throughout the tests. The mode of failure was determined, photographed and recorded.



## TEST PROGRAM

All inserts were 6" long and 2 1/2" deep (Type 6025). Four inserts were placed near a prestressing strand. Two of these inserts were in 2" of concrete and two were in 3" of concrete.

Five other inserts were placed at least 12" clear of any prestressing strands. Three of these inserts were in 2" of concrete and two were in 3" of concrete.

All inserts were located away from the edges and corners of the panel as shown on Drawing No. 1003 in order to determine the true unreinforced capacity of these inserts.

## TEST RESULTS

A table of Test Results is given in Appendix A.

## DISCUSSION

1. For inserts in 3" of concrete, the mode of failure was a typical concrete failure cone extending to the full depth of the insert. A large failure cone as shown in Fig. 4, was developed even though the 3" concrete thickness was localized in a 12" x 12" area under the insert. The average failure load was 14,000 lbs. for inserts clear of a prestressing strand, and 16,500 lbs for inserts adjacent to a prestressing strand. Fig. 3 illustrates the large failure cone developed when a prestressing strand was located adjacent to an insert.
2. For inserts in 2" of concrete, the mode of failure was a typical concrete failure cone extending to the full 2" depth of the concrete as shown in Fig. 2. The failure cone was somewhat smaller than for other inserts in 3" of concrete. The average failure load was 9,930 lbs. for inserts clear of a prestressing strand, and 12,950 lbs. for inserts adjacent to a prestressing strand.


## CONCLUSIONS AND RECOMMENDATIONS

1. The tests on inserts located adjacent to a prestressing strand were included for general information only. It is not recommended that such test results be used for design purposes.

2. The test results for inserts in 3" of concrete compare closely with the results of previous tests on these inserts. (Refer to PSA Test Report No. 1). It is recommended that an appropriate  $\phi$  factor be applied to these test results for ultimate design purposes.
3. It is not recommended that PSA inserts be used in a 2" wythe of concrete unless it is thickened to at least 3" in the vicinity of the insert.
4. When tested in minimum 6,000 psi. prestressed concrete with appropriate edge distances, the average ultimate pull-out capacities of these inserts were as follows:

INSERT TYPE	ANCHORAGE DEPTH	LOCATION	AV. FAILURE LOAD IN 2" CONCRETE	AV. FAILURE LOAD IN 3" CONCRETE
6025	2 1/2"	Clear of strand	9,950 lbs.	14,000 lbs.
6025	2 1/2"	Adjacent to strand	12,950 lbs.	16,500 lbs.

PATON STEENSON ASSOCIATES INC



W. D. Paton P. Eng.

March 31, 1994

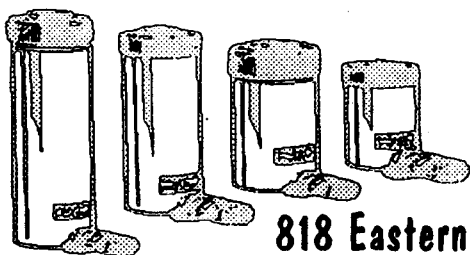
## APPENDIX A

1. Table of Test Results.
2. Calibration Report.
3. Photographs - Figs. 1 through 4 incl.
4. Fig. 5 Test Setup.
5. Drawing No. 1003 - Test Panel
6. Data Sheet for PSA Inserts.

**TEST RESULTS****PSA INSERTS - TEST REPORT NO. 4****LOAD TESTS AT METROMONT MATERIALS PLANT**

<b>INSERT TYPE</b>	<b>TEST NUMBER</b>	<b>INSERT DESC.</b>	<b>CONC. THICKNESS</b>	<b>GAUGE READING (psi.)</b>	<b>FAILURE LOAD (Lbs.)</b>	<b>REMARKS</b>
<b>NO STRANDS NEAR INSERT</b>						
6025	10	6" X 2 1/2"	3"	2850 psi	13,400	Honeycomb at insert. Concrete failure
6025	11	6" x 2 1/2"	3"	3100 psi	14,600	Same comments.
<b>NO STRANDS NEAR INSERT</b>						
6025	12	6" X 2 1/2"	2"	2600 psi	12,300	Cracked test panel. Test discontinued.
6025	14	6" x 2 1/2"	2"	1800 psi	8,500	Concrete failure.
6025	13	6" 2 1/2"	2"	9,000 psi	9,000	Same comments
<b>ONE STRAND BESIDE INSERT</b>						
6025	9	6" X 2 1/2"	2"	2300 PSI	10,800	Insert lips failed. Concrete failed
6025	8	6" x 2 1/2"	2"	3200 psi	15,100	Same comments
<b>ONE STRAND BESIDE INSERT</b>						
6025	7	6" X 2 1/2"	3"	3500 PSI	16,500	Large concrete cone. Insert yielded
6025	6	6" x 2 1/2"	3"	3500 psi	16,500	Same comments

**NOTE:** Ram area = 4.71 sq. in.



# Hydraquip Sales & Service

818 Eastern Avenue, Unit 2, Toronto, ON, M4L 1A1

## Calibration Test Certificate

Customer: Paton Steenson Associates  
Gauge Description: Enerpac Gauge 0-10,000 psi, serial G93-496

Standard Used: Mansfield & Green, Type #R-50  
Dead Weight Serial #: 1315  
Dead Weight Accuracy: 0.1%

**\*\*Note:** Instruments have been tested against a dead weight tester serial # as above, which is traceable to the National Research Council in Ottawa, as per their report # 722.0329, dated August 18, 1989.

Hydraquip Sales & Service Ltd. certifies that the below item(s) have been tested to comply in every way with the requirements of the above purchase order.

Master Test Gauge	Above Gauge
D.W.	

1000 PSI	1000 PSI
3000	3000
5000	5000
7000	7025
9000	9025

Date Tested: Dec 6, 1993  
Technician: Pat Mahon

Phone 416-461-3573 Fax 416-461-2979  
Out of town callers 1-800-463-4168



# PHOTOGRAPHS

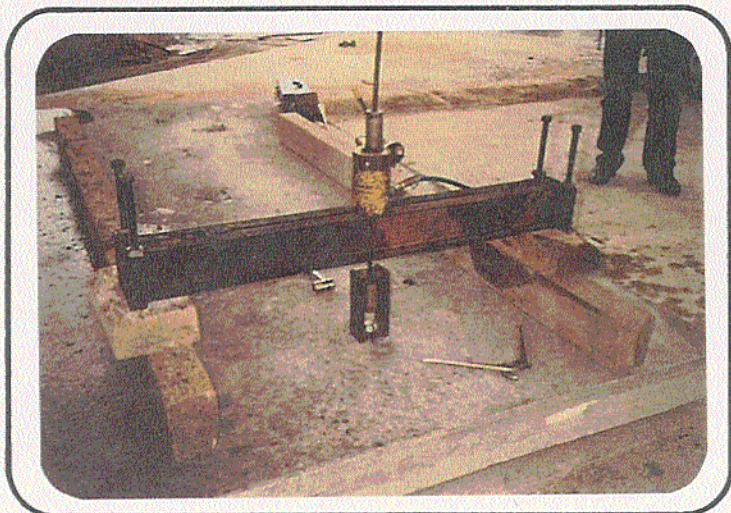


Fig. 1 Test Panel & Set-Up



Fig. 2 Insert in 2" Concrete  
(Test # 14) - 9,000 lbs.

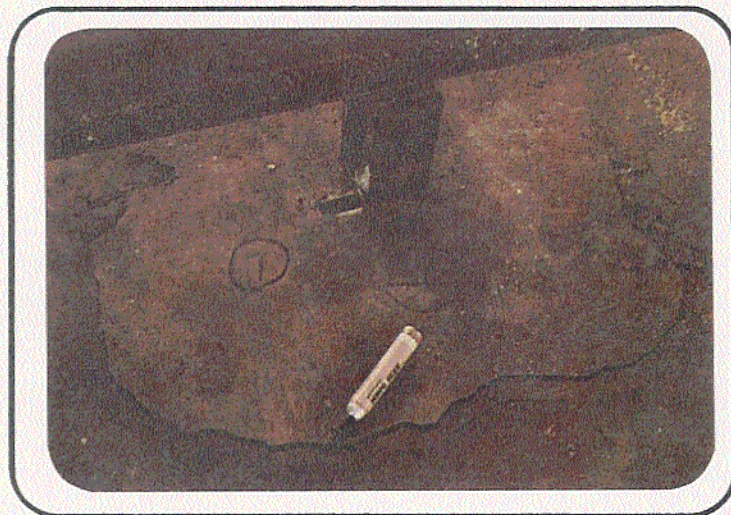
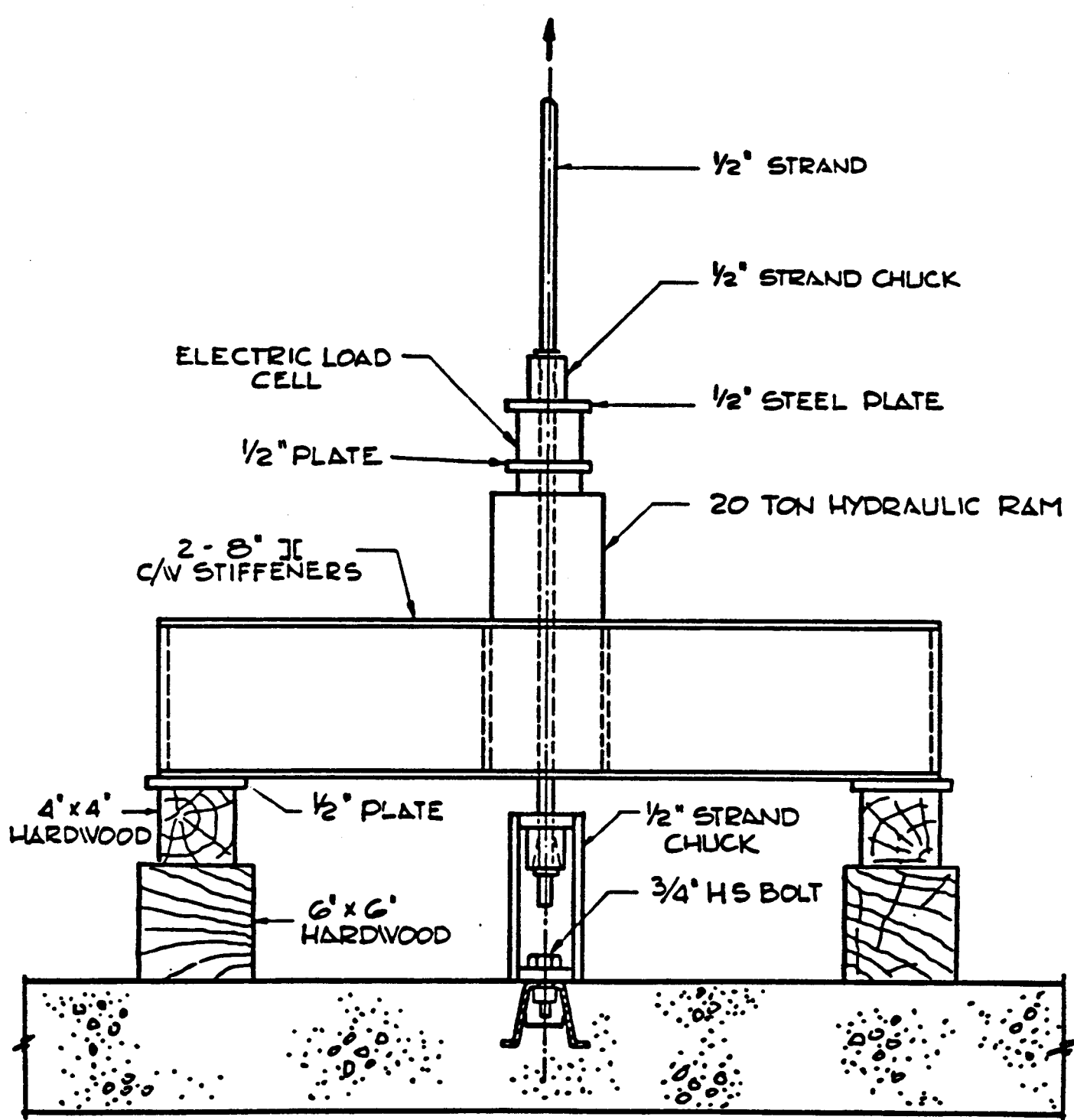


Fig. 3 Insert in 3" Concrete  
Near a strand  
(Test # 7) - 16,500 lbs.



Fig. 4 Insert in 3" Conc.  
No strand (Test #11)  
14,600 lbs.





## TEST SET-UP

FOR PULLOUT TESTS

FIG. 5

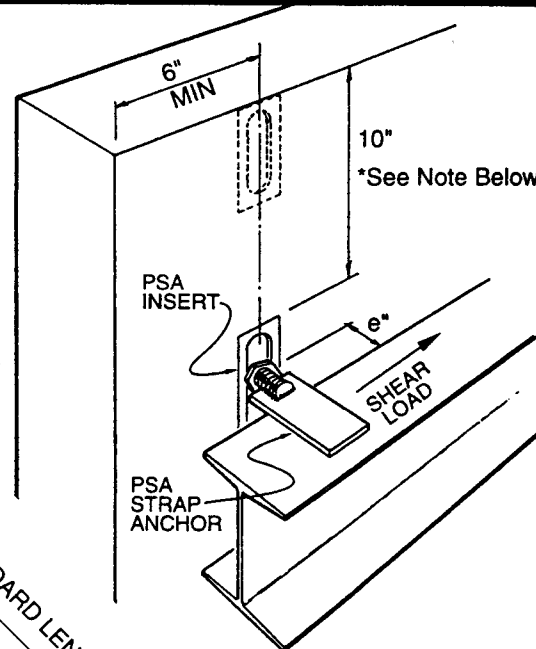
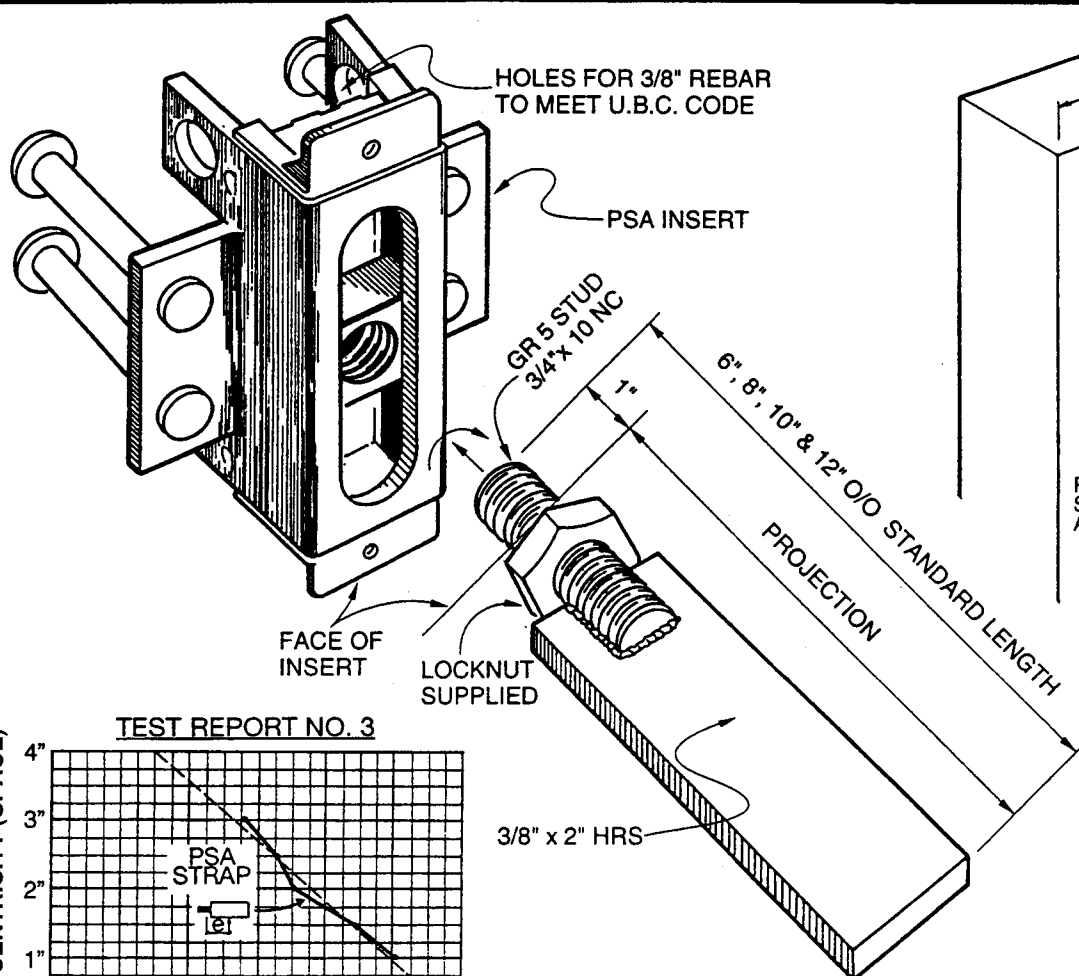
INSERT DESCRIPTION

Q225	Q226	Q227	Q228	Q229	Q230	Q231	Q232	Q233	Q234	Q235	Q236	Q237	Q238	Q239	Q240	Q241	Q242	Q243	Q244	Q245	Q246	Q247	Q248	Q249	Q250	Q251	Q252	Q253	Q254	Q255	Q256	Q257	Q258	Q259	Q260	Q261	Q262	Q263	Q264	Q265	Q266	Q267	Q268	Q269	Q270	Q271	Q272	Q273	Q274	Q275	Q276	Q277	Q278	Q279	Q280	Q281	Q282	Q283	Q284	Q285	Q286	Q287	Q288	Q289	Q290	Q291	Q292	Q293	Q294	Q295	Q296	Q297	Q298	Q299	Q300	Q301	Q302	Q303	Q304	Q305	Q306	Q307	Q308	Q309	Q310	Q311	Q312	Q313	Q314	Q315	Q316	Q317	Q318	Q319	Q320	Q321	Q322	Q323	Q324	Q325	Q326	Q327	Q328	Q329	Q330	Q331	Q332	Q333	Q334	Q335	Q336	Q337	Q338	Q339	Q340	Q341	Q342	Q343	Q344	Q345	Q346	Q347	Q348	Q349	Q350	Q351	Q352	Q353	Q354	Q355	Q356	Q357	Q358	Q359	Q360	Q361	Q362	Q363	Q364	Q365	Q366	Q367	Q368	Q369	Q370	Q371	Q372	Q373	Q374	Q375	Q376	Q377	Q378	Q379	Q380	Q381	Q382	Q383	Q384	Q385	Q386	Q387	Q388	Q389	Q390	Q391	Q392	Q393	Q394	Q395	Q396	Q397	Q398	Q399	Q400	Q401	Q402	Q403	Q404	Q405	Q406	Q407	Q408	Q409	Q410	Q411	Q412	Q413	Q414	Q415	Q416	Q417	Q418	Q419	Q420	Q421	Q422	Q423	Q424	Q425	Q426	Q427	Q428	Q429	Q430	Q431	Q432	Q433	Q434	Q435	Q436	Q437	Q438	Q439	Q440	Q441	Q442	Q443	Q444	Q445	Q446	Q447	Q448	Q449	Q450	Q451	Q452	Q453	Q454	Q455	Q456	Q457	Q458	Q459	Q460	Q461	Q462	Q463	Q464	Q465	Q466	Q467	Q468	Q469	Q470	Q471	Q472	Q473	Q474	Q475	Q476	Q477	Q478	Q479	Q480	Q481	Q482	Q483	Q484	Q485	Q486	Q487	Q488	Q489	Q490	Q491	Q492	Q493	Q494	Q495	Q496	Q497	Q498	Q499	Q500	Q501	Q502	Q503	Q504	Q505	Q506	Q507	Q508	Q509	Q510	Q511	Q512	Q513	Q514	Q515	Q516	Q517	Q518	Q519	Q520	Q521	Q522	Q523	Q524	Q525	Q526	Q527	Q528	Q529	Q530	Q531	Q532	Q533	Q534	Q535	Q536	Q537	Q538	Q539	Q540	Q541	Q542	Q543	Q544	Q545	Q546	Q547	Q548	Q549	Q550	Q551	Q552	Q553	Q554	Q555	Q556	Q557	Q558	Q559	Q560	Q561	Q562	Q563	Q564	Q565	Q566	Q567	Q568	Q569	Q570	Q571	Q572	Q573	Q574	Q575	Q576	Q577	Q578	Q579	Q580	Q581	Q582	Q583	Q584	Q585	Q586	Q587	Q588	Q589	Q590	Q591	Q592	Q593	Q594	Q595	Q596	Q597	Q598	Q599	Q600	Q601	Q602	Q603	Q604	Q605	Q606	Q607	Q608	Q609	Q610	Q611	Q612	Q613	Q614	Q615	Q616	Q617	Q618	Q619	Q620	Q621	Q622	Q623	Q624	Q625	Q626	Q627	Q628	Q629	Q630	Q631	Q632	Q633	Q634	Q635	Q636	Q637	Q638	Q639	Q640	Q641	Q642	Q643	Q644	Q645	Q646	Q647	Q648	Q649	Q650	Q651	Q652	Q653	Q654	Q655	Q656	Q657	Q658	Q659	Q660	Q661	Q662	Q663	Q664	Q665	Q666	Q667	Q668	Q669	Q670	Q671	Q672	Q673	Q674	Q675	Q676	Q677	Q678	Q679	Q680	Q681	Q682	Q683	Q684	Q685	Q686	Q687	Q688	Q689	Q690	Q691	Q692	Q693	Q694	Q695	Q696	Q697	Q698	Q699	Q700	Q701	Q702	Q703	Q704	Q705	Q706	Q707	Q708	Q709	Q710	Q711	Q712	Q713	Q714	Q715	Q716	Q717	Q718	Q719	Q720	Q721	Q722	Q723	Q724	Q725	Q726	Q727	Q728	Q729	Q730	Q731	Q732	Q733	Q734	Q735	Q736	Q737	Q738	Q739	Q740	Q741	Q742	Q743	Q744	Q745	Q746	Q747	Q748	Q749	Q750	Q751	Q752	Q753	Q754	Q755	Q756	Q757	Q758	Q759	Q760	Q761	Q762	Q763	Q764	Q765	Q766	Q767	Q768	Q769	Q770	Q771	Q772	Q773	Q774	Q775	Q776	Q777	Q778	Q779	Q780	Q781	Q782	Q783	Q784	Q785	Q786	Q787	Q788	Q789	Q790	Q791	Q792	Q793	Q794	Q795	Q796	Q797	Q798	Q799	Q800	Q801	Q802	Q803	Q804	Q805	Q806	Q807	Q808	Q809	Q810	Q811	Q812	Q813	Q814	Q815	Q816	Q817	Q818	Q819	Q820	Q821	Q822	Q823	Q824	Q825	Q826	Q827	Q828	Q829	Q830	Q831	Q832	Q833	Q834	Q835	Q836	Q837	Q838	Q839	Q840	Q841	Q842	Q843	Q844	Q845	Q846	Q847	Q848	Q849	Q850	Q851	Q852	Q853	Q854	Q855	Q856	Q857	Q858	Q859	Q860	Q861	Q862	Q863	Q864	Q865	Q866	Q867	Q868	Q869	Q870	Q871	Q872	Q873	Q874	Q875	Q876	Q877	Q878	Q879	Q880	Q881	Q882	Q883	Q884	Q885	Q886	Q887	Q888	Q889	Q890	Q891	Q892	Q893	Q894	Q895	Q896	Q897	Q898	Q899	Q900	Q901	Q902	Q903	Q904	Q905	Q906	Q907	Q908	Q909	Q910	Q911	Q912	Q913	Q914	Q915	Q916	Q917	Q918	Q919	Q920	Q921	Q922	Q923	Q924	Q925	Q926	Q927	Q928	Q929	Q930	Q931	Q932	Q933	Q934	Q935	Q936	Q937	Q938	Q939	Q940	Q941	Q942	Q943	Q944	Q945	Q946	Q947	Q948	Q949	Q950	Q951	Q952	Q953	Q954	Q955	Q956	Q957	Q958	Q959	Q960	Q961	Q962	Q963	Q964	Q965	Q966	Q967	Q968	Q969	Q970	Q971	Q972	Q973	Q974	Q975	Q976	Q977	Q978	Q979	Q980	Q981	Q982	Q983	Q984	Q985	Q986	Q987	Q988	Q989	Q990	Q991	Q992	Q993	Q994	Q995	Q996	Q997	Q998	Q999	Q1000	Q1001	Q1002	Q1003	Q1004	Q1005	Q1006	Q1007	Q1008	Q1009	Q1010	Q1011	Q1012	Q1013	Q1014	Q1015	Q1016	Q1017	Q1018	Q1019	Q1020	Q1021	Q1022	Q1023	Q1024	Q1025	Q1026	Q1027	Q1028	Q1029	Q1030	Q1031	Q1032	Q1033	Q1034	Q1035	Q1036	Q1037	Q1038	Q1039	Q1040	Q1041	Q1042	Q1043	Q1044	Q1045	Q1046	Q1047	Q1048	Q1049	Q1050	Q1051	Q1052	Q1053	Q1054	Q1055	Q1056	Q1057	Q1058	Q1059	Q1060	Q1061	Q1062	Q1063	Q1064	Q1065	Q1066	Q1067	Q1068	Q1069	Q1070	Q1071	Q1072	Q1073	Q1074	Q1075	Q1076	Q1077	Q1078	Q1079	Q1080	Q1081	Q1082	Q1083	Q1084	Q1085	Q1086	Q1087	Q1088	Q1089	Q1090	Q1091	Q1092	Q1093	Q1094	Q1095	Q1096	Q1097	Q1098	Q1099	Q1100	Q1101	Q1102	Q1103	Q1104	Q1105	Q1106	Q1107	Q1108	Q1109	Q1110	Q1111	Q1112	Q1113	Q1114	Q1115	Q1116	Q1117	Q1118	Q1119	Q1120	Q1121	Q1122	Q1123	Q1124	Q1125	Q1126	Q1127	Q1128	Q1129	Q1130	Q1131	Q1132	Q1133	Q1134	Q1135	Q1136	Q1137	Q1138	Q1139	Q1140	Q1141	Q1142	Q1143	Q1144	Q1145	Q1146	Q1147	Q1148	Q1149	Q1150	Q1151	Q1152	Q1153	Q1154	Q1155	Q1156	Q1157	Q1158	Q1159	Q1160	Q1161	Q1162	Q1163	Q1164	Q1165	Q1166	Q1167	Q1168	Q1169	Q1170	Q1171	Q1172	Q1173	Q1174	Q1175	Q1176	Q1177	Q1178	Q1179	Q1180	Q1181	Q1182	Q1183	Q1184	Q1185	Q1186	Q11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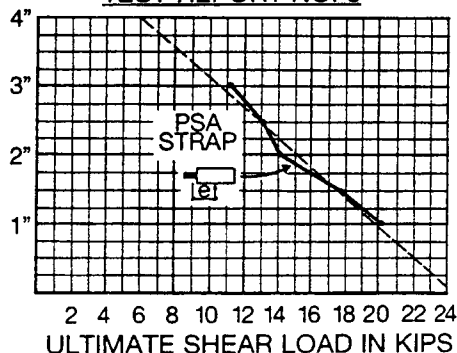
# PSA STRAP ANCHORS

# PSA



**Note:**  
\* Reduce Ultimate Load by 25% if Insert Placed at Top Edge of Panel. (Test Report No. 2)

TEST REPORT NO. 3



## FEATURES:

### • Ultimate Pull-out Capacity

Strap Anchors Develop full Ultimate Capacity of the insert

Insert Type	Depth	Length	Ult. Pull-Out Capacity
4525	2 1/2"	4 1/2"	12,000 lbs
6025		6"	
4535	3 1/2"	4 1/2"	16,000 lbs
6035		6"	
4545	4 1/2"	4 1/2"	20,000 lbs
6045		6"	

Ultimate Pull-Out Capacity Based on Tests Performed in 5,000 psi Normal Weight Concrete (Refer to PSA Test Report No.1)

### • Ultimate Shear Capacity

20,350 lbs. at 1" Eccentricity (See Graph Above)  
Ult. Shear Capacity based on Tests Performed in 6,000 psi Normal Weight Concrete (Refer to PSA Test Report No. 3)

### • Standard Strap Anchor Lengths

6", 8", 10" & 12" Out/Out

• **Available Finishes** – Epoxy or Hot Dipped Galvanized. (Stainless Steel available on Special Order)

• **Material** – High Strength weldable grade HRS Steel

• **Lock Nut** – Ensures Positive Connection in Both Directions

In the U.S.A.

## JVI

In Canada

## PSA

### ACCESSORIES, INC.

7550 North Linder Avenue  
Skokie, Illinois 60077 USA  
705/675-1560 Fax: 708/675-0083

### PATON STEENSON ASSOC. INC.

10 Royal Orchard Blvd. P.O. Box #53009  
Thornhill, Ontario L3T 7R9  
905/889-7357 Fax: 905/889-7648

**DISCLAIMER:** The use of PSA inserts should be approved by a qualified professional engineer or architect.

**TEST REPORT NO. 5**

**MORE PULL-OUT TESTS ON**

**PSA SLOTTED INSERTS**

**At Pre-Con Company Plant**

**MAY, 1994**

**ACKNOWLEDGEMENT**

Special thanks to BOB MILLER AND ROGER WONG of Pre-Con Company for their help and advice in making this test program possible.

**NOTICE**

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May, 1994

**LOAD TESTS ON PSA SLOTTED INSERTS  
TEST REPORT NO.5**

**INTRODUCTION**

The purpose of this test program was, (a) to determine the ultimate pull-out capacity of PSA Slotted Inserts when the load is as applied at one end of the insert, (b) to find out if the ultimate pull-out capacity could be increased by adding reinforcing steel through the holes in the legs of the insert, and (c) to reconfirm the ultimate pull-out capacity of PSA Slotted Inserts as previously tested.

**TEST PANEL**

Two concrete test panels were manufactured at the Pre-Con Plant in Brampton, Ontario on April 22, 1994 as part of a normal day's production. The details of the test panels are shown on Drawing Nos. 1006 & 7, included in Appendix A. Load tests were conducted on May 2nd when the test panels were 10 days old. The average concrete strength, as determined by concrete test cylinders was 5853 psi at the time of the test. The test panels were not prestressed but were reinforced for handling purposes by a nominal layer of welded wire fabric located underneath the inserts. The concrete was cured in a normal manner (not accelerated). Additional reinforcing steel was provided through the legs of specific inserts as shown in detail on the test panel drawings and as noted in the table of test results.

**TEST METHOD**

The test load, in all cases, was applied to the inserts through their normal connection devices using a 20 ton hydraulic ram and hand operated pump. A load cell with a digital readout gauge was used to obtain an accurate direct load measurement. Recent calibration data for the load cell is included in Appendix A.

Figures 1 and 2 illustrate the conventional test arrangement used. A high strength bolt in the load transfer bracket was attached to the heavy duty nut built into the insert. The load was applied with the nut located either in the center of the insert or at one end of the insert as noted on the drawings and in the table of test results. All inserts were tested for ultimate pull-out capacity.

A visual inspection of the pattern of failure cracking was made throughout the tests. The mode of failure was determined, photographed and recorded.

## TEST PROGRAM

Inserts were both 4 1/2" and 6" long and either 2 1/2", 3 1/2" or 4 1/2" deep. Heavy duty square nuts are contained within each insert. The load was applied to the insert using a 3/4" high strength bolt located either at the center or at one end of the insert.

All inserts were positioned away from the edges and corners of the panels, as shown on the drawings, in order to determine the true unreinforced capacity of these inserts.

Additional reinforcing steel was placed through the holes in the legs of specific inserts. This reinforcement consisted of either 2 - 10M (#3) straight bars or one 10 M (#3) hairpin. In all cases, this reinforcement was flat (not stepped).

## TEST RESULTS

A table of test results is given in Appendix A.

## DISCUSSION

1. In all cases the recommended ultimate capacity of these inserts was developed regardless of whether the bolt was located at the center or at the end of the insert. The minor variation between individual tests results is considered to be insignificant.
2. There was no significant increase in ultimate capacity when additional flat reinforcing steel was placed through the inserts. The individual test results in these cases were inconclusive. However the use of such additional reinforcing steel, as required by the UBC Code is highly recommended.
3. The test results compare closely with similar tests done in September, 1993 as reported in Test Report No. 1.

(a) In the case of the 2 1/2" deep inserts (12 kip nominal), the average ultimate capacity was 13013 lbs. compared with 13,475 lbs. previously. In all cases the mode of failure was a typical concrete failure cone extending to the full depth of the insert.

(b) In the case of the 3 1/2" inserts (16 kip nominal), the average ultimate capacity was 17,957 lbs. compared with 18,850 lbs. previously. In all cases (except two) the mode of failure was a typical concrete failure cone extending to the full depth of the insert studs. The other two tests produced a typical mechanical failure of the insert lips at 18,700 lbs. compared with 18,800 lbs. previously. This test confirms the balanced design of this insert. The shoulder studs anchored to the insert legs have increased the concrete capacity of the insert up to its mechanical capacity.

(c) In the case of the 4 1/2" inserts (20 kip nominal), the average ultimate capacity was 22,541 lbs. compared with 21,566 lbs. previously. Two tests were stopped prior to failure at approximately 24,000 lbs. for fear of over loading the load cell. Two other tests were affected by an adjacent crack in the panel caused by a previous test. The mode of failure for the other four tests was a typical concrete failure cone extending to the full depth of the insert studs. These tests confirm the performance of the shoulder studs and represent the highest loads ever achieved with PSA Inserts.

4. Test No. A12 was disregarded because the identification tag for this insert had become embedded in the concrete and caused a smooth shear plane through the concrete failure cone. As a result, the size of the failure cone was reduced to about 2/3 its usual size.
5. Some test results were disregarded because the panel had been cracked near the test insert, by an adjacent test. In future the test inserts should be placed further apart so that one insert failure cannot affect another.

## CONCLUSIONS AND RECOMMENDATIONS

1. The ultimate capacity of these inserts is not dependent on the presence of reinforcing steel in the concrete.
2. The ultimate capacity of these inserts can be developed whether the load is applied at the center or at the end of the insert.
3. The ultimate capacity of these inserts is governed by the strength of the concrete failure cone which in turn is a function of the embedded depth of the insert and/or stud anchors.
4. The ultimate capacity of these inserts is not increased by the use of flat reinforcing bars or hairpins inserted through the holes in the insert legs. However this practice is recommended in order to comply with the UBC Code, particularly in seismic areas.

5. When used in minimum 5000 psi. concrete with appropriate edge distances, the ultimate pull-out capacities of these inserts are as follows:

INSERT TYPE	ANCHORAGE DEPTH	AVERAGE FAILURE (PREVIOUS)	AVERAGE FAILURE (CURRENT)	NOMINAL ULTIMATE CAPACITY
4525	2 1/2"	13,475 lb.	12,716 lb.	12,000 lb.
6025	2 1/2"	13,475 lb.	13,260 lb.	12,000 lb.
4535	3 1/2"	18,850 lb.	17,792 lb.	16,000 lb.
6035	3 1/2"	18,850 lb.	18,162 lb.	16,000 lb.
4545	4 1/2"	21,566 lb.	22,467 lb.	20,000 lb.
6045	4 1/2"	21,566 lb.	22,597 lb.	20,000 lb.

Peto MacCallum Ltd.



A handwritten signature in black ink, appearing to read "Gerry Pacitti".

Gerry Pacitti, P. Eng.

May 15, 1994

## APPENDIX A

1. Table of Test Results (2 Pages).
2. Calibration Report.
3. Photographs - Figs. 1 through 10 incl.
4. Fig. 11 - Test Set Up.
5. Drawing No. 1006 - Test Panel "A".
6. Drawing No. 1007 - Test Panel "B".
7. Data Sheet for PSA Strap Anchors.
8. Data Sheet for PSA Inserts.

INSERT TYPE	TEST NUMBER	INSERT LOCATION	EXTRA REINF.	BOLT LOCATION	FAILURE LOAD (Lbs.)	REMARKS
(12 KIP) 6" x 2 1/2" INSERTS - LOAD APPLIED AT <u>CENTER</u> OF INSERT						
6025	A1	Internal	1 hairpin	Center	13,800	Typ. concrete cone
6025	A11	Internal	None	Center	14,550	Typ. concrete cone
6025	B15	Internal	None	Center	13,100	Lge. concrete cone
(12 KIP) 6" x 2 1/2" INSERTS - LOAD APPLIED AT <u>END</u> OF INSERT						
6025	A3	Internal	2 - #3 Str.	End	13,020	Typ. concrete cone
6025	A9	Internal	None	End	12,120	Typ. concrete cone
6025	B13	Internal	None	End	12,970	Lge. concrete cone
(12 KIP) 1/2" x 2 1/2" INSERTS - LOAD APPLIED AT <u>CENTER</u> OF INSERT						
4525	A4	Internal	1 Hairpin	Center	12,240	Typ. concrete cone
4525	A10	Internal	None	Center	13,120	Typ. concrete cone
4525	B14	Internal	None	Center	13,400	Lge. concrete cone
(12 KIP) 4 1/2" X 2 1/2" INSERTS - LOAD APPLIED AT <u>END</u> OF INSERT						
4525	A2	Internal	2 - #3 Str.	End	13,120	Typ. concrete cone
4525	A12	Internal	None	End	(10,600)**	Tape fouled cone
4525	B16	Internal	None	End	11,700	Lge. concrete cone
(16 KIP) 6" X 3 1/2" INSERTS - LOAD APPLIED AT <u>CENTER</u> OF INSERT						
6035	A7	Internal	2 - #3 Str.	Center	18,700	Insert lips failed
6035	A15	Internal	None	Center	18,150	Lge. concrete cone
6035	B5	Internal	None	Center	17,100	Typ. concrete cone
(16 KIP) 6" X 3 1/2" INSERTS - LOAD APPLIED AT <u>END</u> OF INSERT						
6035	A5	Internal	1 Hairpin	End	(11,8070)*	Cracked before test
6035	A13	Internal	None	End	(15,850)*	Cracked before test
6035	B7	Internal	None	End	18,700	Insert lips failed
Test Results continued on next page						



**TEST RESULTS (CONTINUED)****TEST REPORT NO 5**

May 2, 1994

INSERT TYPE	TEST NUMBER	INSERT LOCATION	EXTRA REINF.	BOLT LOCATION	FAILURE LOAD (Lbs.)	REMARKS
(16 KIP) 4 1/2" X 3 1/2" INSERTS - LOAD APPLIED AT <u>CENTER</u> OF INSERT						
4535	A6	Internal	2 - #3 Str.	Center	18,900	Lge. concrete cone
4535	A14	Internal	None	Center	16,960	Typ. concrete cone
4535	B8	Internal	None	Center	16,700	Lge. concrete cone
(16 KIP) 4 1/2" X 3 1/2" INSERTS - LOAD APPLIED AT <u>END</u> OF INSERT						
4535	A8	Internal	1 Hairpin	End	17,800	Typ. concrete cone
4535	A16	Internal	None	End	(15,100)*	Cracked before test
4535	B6	Internal	None	End	18,600	Typ. concrete cone
(20 KIP) 6" X 4 1/2" INSERTS - LOAD APPLIED AT <u>CENTER</u> OF INSERT						
6045	B11	Internal	None	Center	24,000***	Test stopped early
6045	B1	Internal	1 Hairpin	Center	22,900	Typ. concrete cone
(20 KIP) 6" X 4 1/2" INSERTS - LOAD APPLIED AT <u>END</u> OF INSERT						
6045	B9	Internal	None	End	22,900	Typ. concrete cone
6045	B3	Internal	2 - #3 Str.	End	20,500	Cracked before test
(20 KIP) 4 1/2" X 4 1/2" INSERTS - LOAD APPLIED AT <u>CENTER</u> OF INSERT						
4545	B10	Internal	None	Center	24,200***	Test stopped early
4545	B4	Internal	1 Hairpin	Center	21,900	Typ. concrete cone
(20 KIP) 4 1/2" X 4 1/2" INSERTS - LOAD APPLIED AT <u>END</u> OF INSERT						
4545	B2	Internal	2 - #3 Str.	End	20,470	Cracked before test
4545	B12	Internal	None	End	21,300	Typ. concrete cone

**NOTES**

\* Panel was cracked from adjacent test.

\*\* Insert identification tape was embedded in concrete close to insert.

\*\*\* Test was stopped at 25 kip capacity of the load cell.

# CALIBRATION CHART

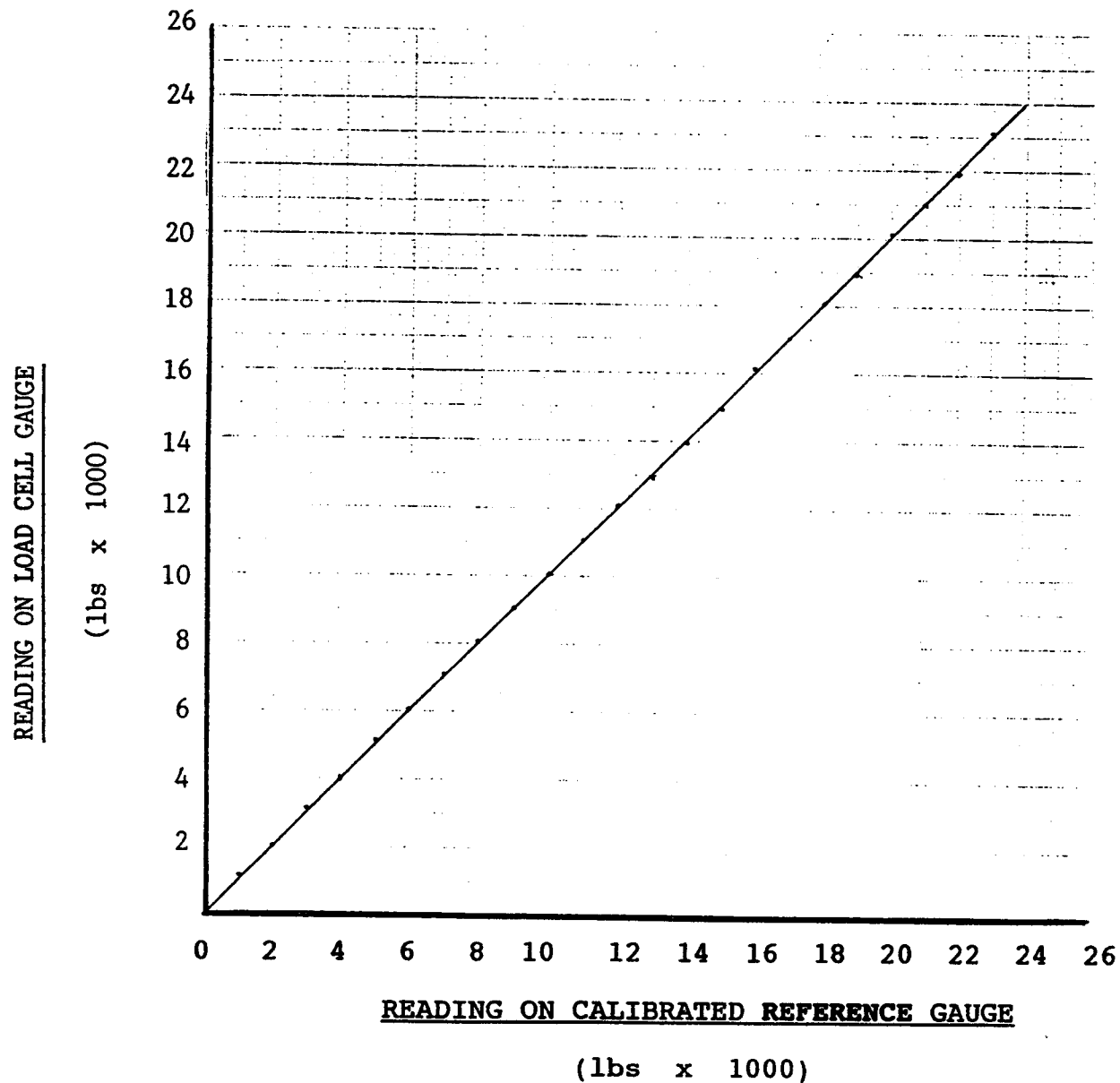
For

- STRAINERT UNIVERSAL FLAT LOAD CELL  
MODEL FL25U(C) S/N 08908-2

Coupled with

- DORIC TRANSDUCER INDICATOR S/N 400236

DATE: September 3, 1993



# PHOTOGRAPHS

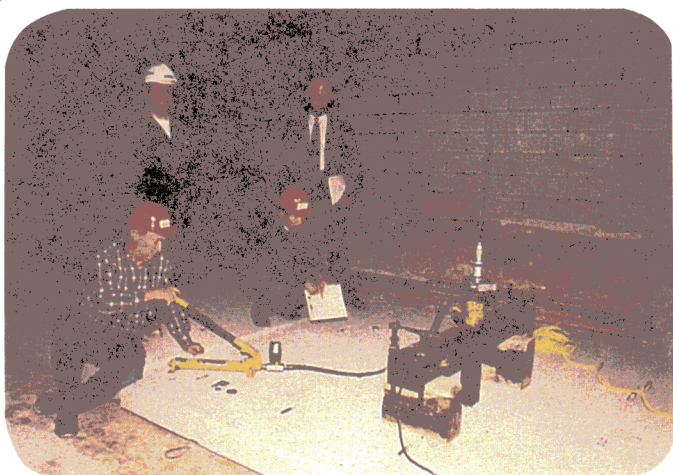


Fig. 1 Test Set-Up  
Pre-Con Engineers

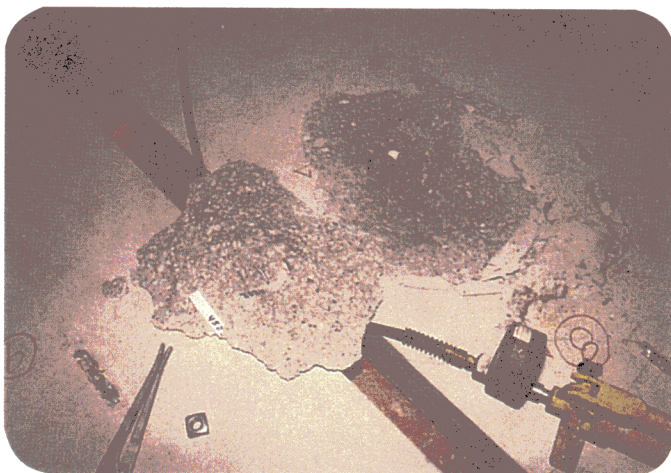


Fig. 2 Identificaion Tape fouled  
concrete cone (Test # A12)

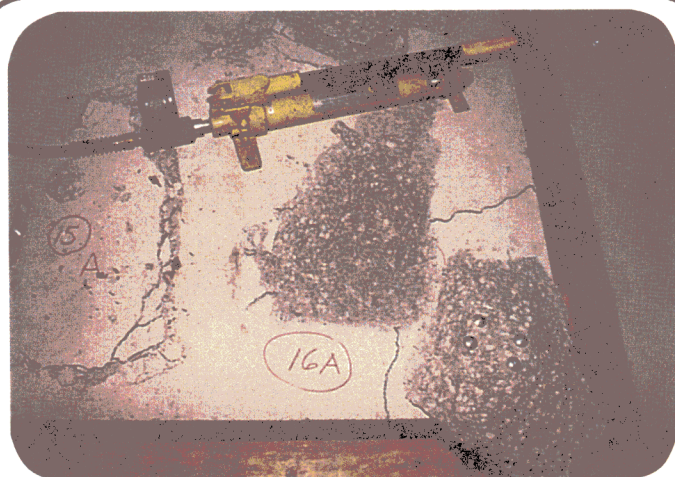


Fig. 3 Crack in panel prevented full  
development of the failure cone.  
Cone extends full depth of studs.

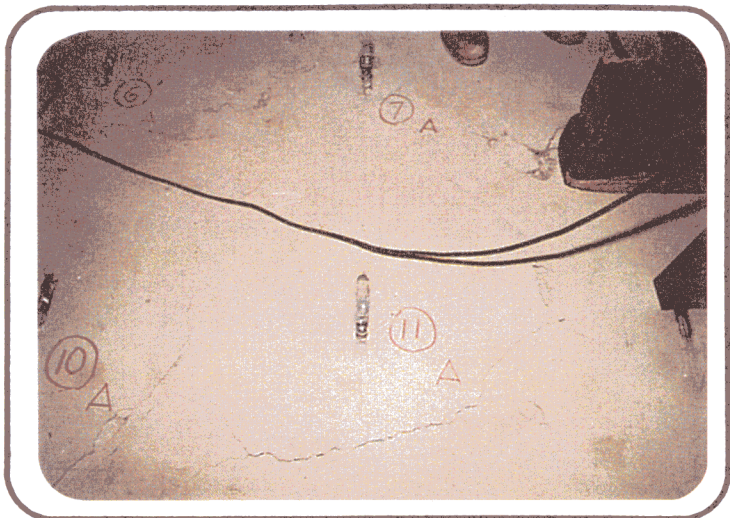


Fig. 4 Typ. 2 1/2" (12 kip) insert (Mk 6025)  
Test # A11 - 14,550 lbs. Load at center.



Fig. 5 Typ. 2 1/2" (12 kip) insert (Mk 6025)  
Test # B13 - 12,970 lbs. Load at end.

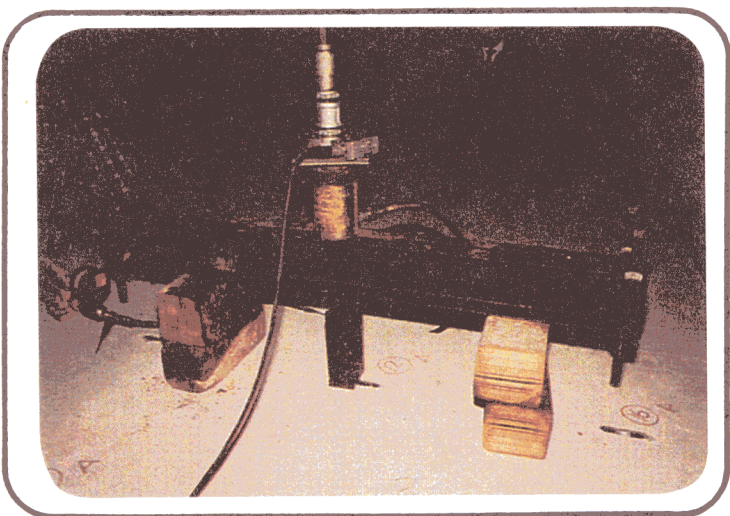


Fig. 6 Test Set-Up showing 20 Ton Jack,  
hand pump and digital load cell.  
Load located at end of insert.



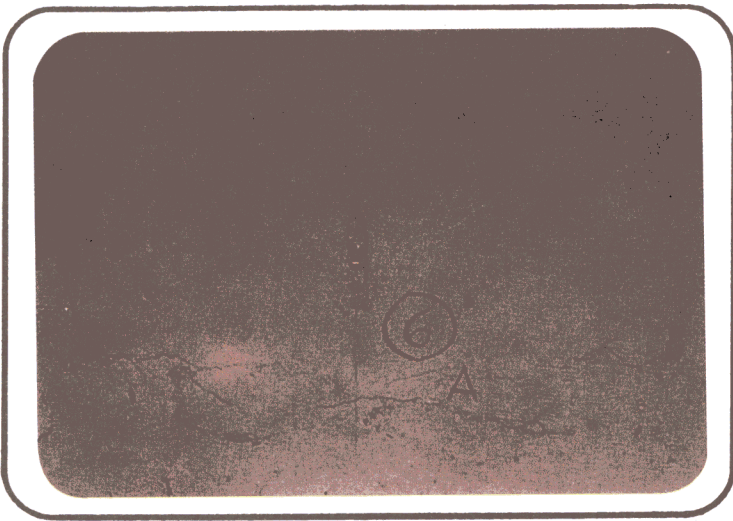


Fig. 7 Typ. 3 1/2" (16 kip) insert (Mk 6035)  
Test # A6 - 18,900 lbs.(2 - #3 Bars str)

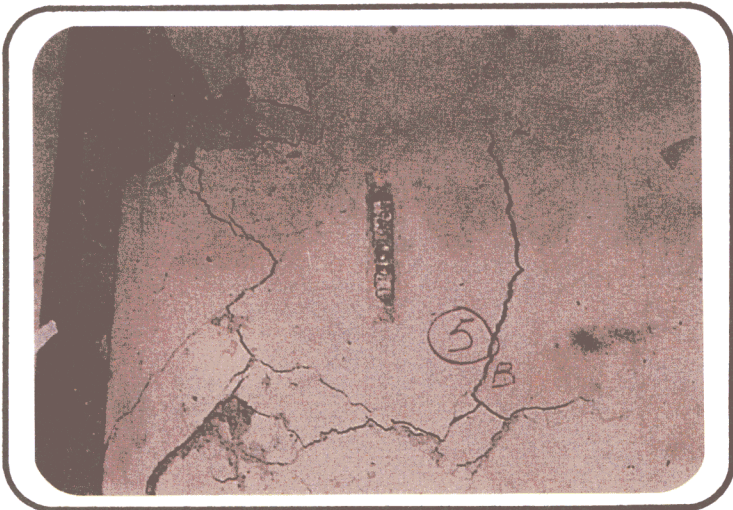


Fig. 8 Typ. 3 1/2" (16 kip) insert (Mk 6035)  
Test # B5 - 17,100 lbs. Load at center.

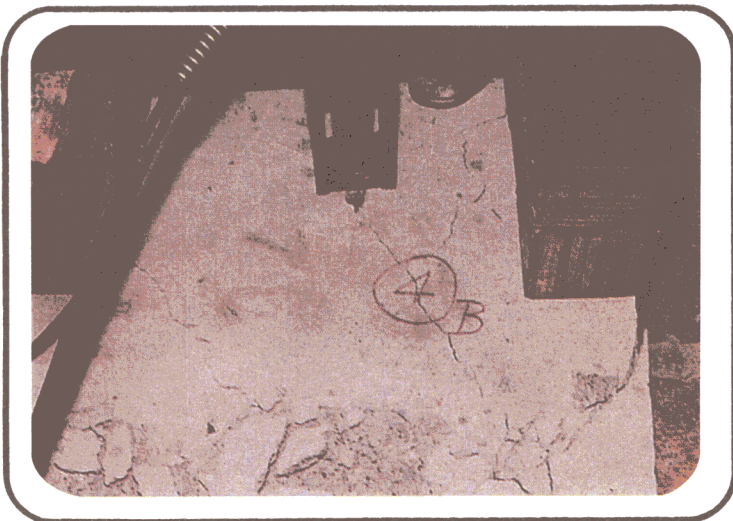
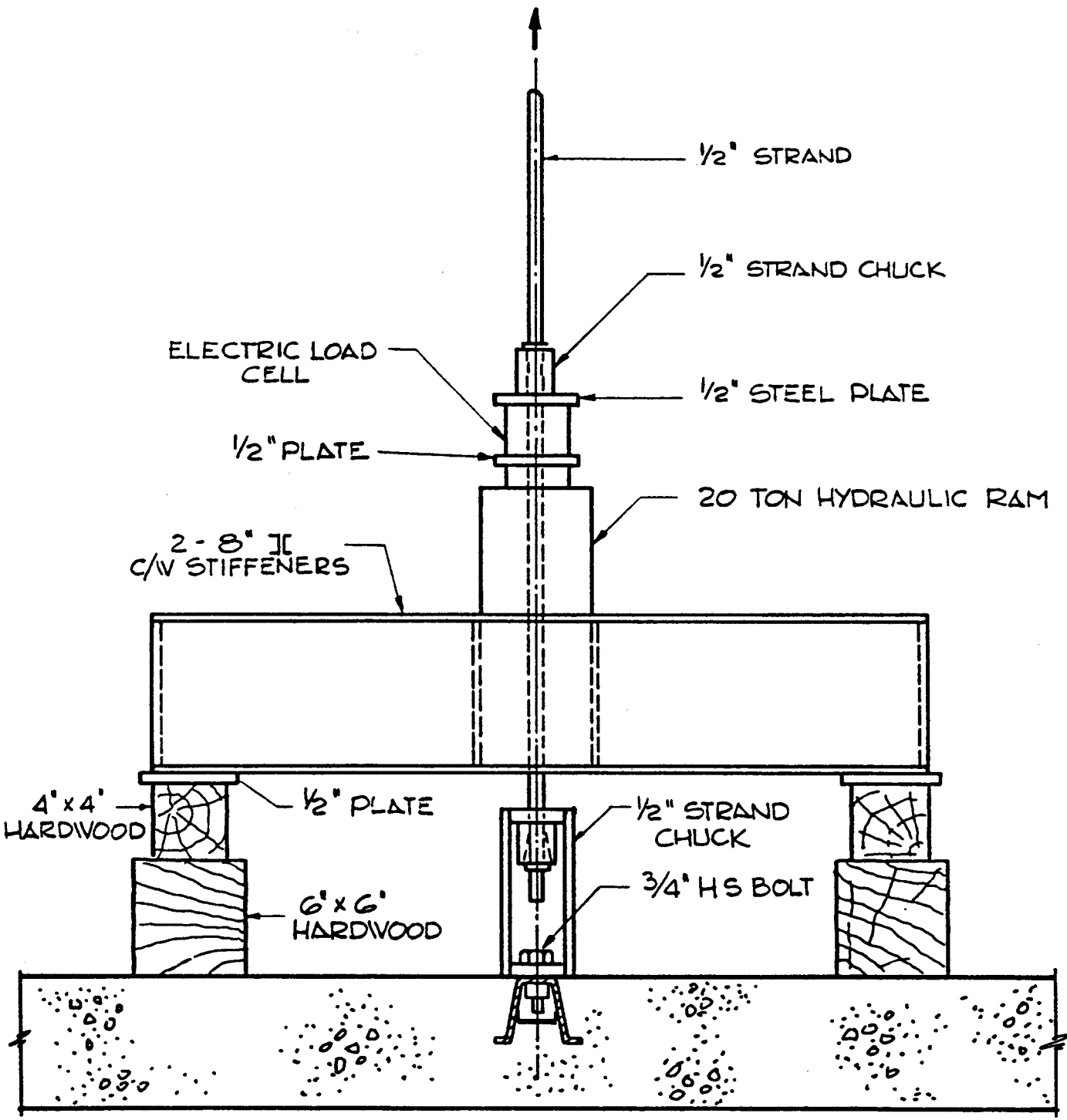


Fig. 9 Typ. 4 1/2" (20 kip) insert (Mk 4525)  
Test # B4 - 21,900 lbs. Load at center.



Fig. 10 Test Set-Up.  
20 Ton Jack.  
Digital Load Cell.  
Load Transfer Bracket.



TEST SET-UP

FOR PULLOUT TESTS

FIG.11

INSERT DESCRIPTION		
TEST PANEL A		
INSERT	BOLT	REBAR
1	G025	C
2	4525	E
3	G025	E
4	4525	C
5	G035	E
6	4535	C
7	G035	C
8	4535	E
9	G025	E
10	4525	C
11	G025	C
12	4525	E
13	G035	E
14	4535	C
15	G035	C
16	4535	E

NOTES:

CONCRETE STRENGTH AT TIME  
OF TEST 5894 psi  
TESTED AT PRECON PLANT  
BRAMPTON

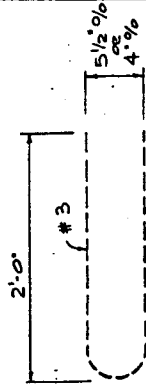
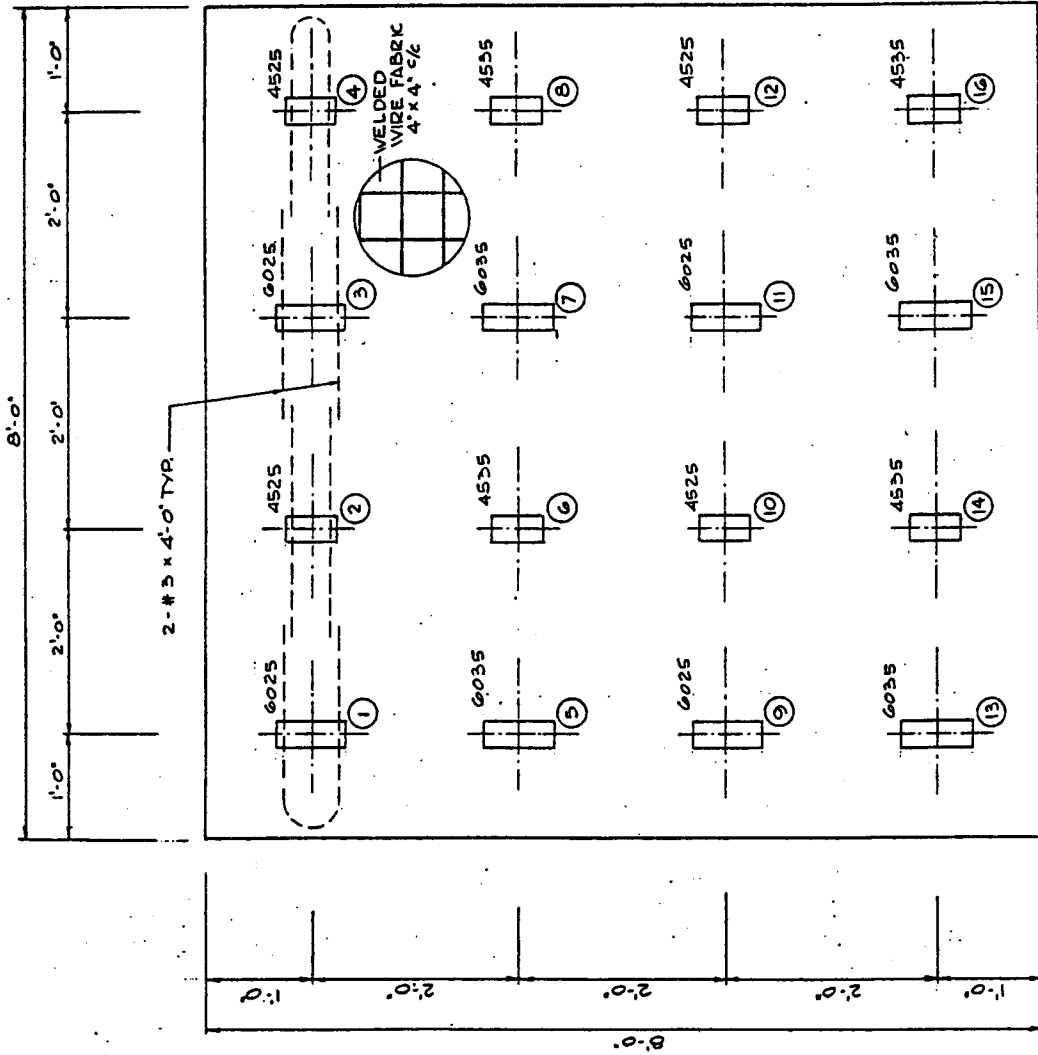
DATE	ISSUE	REV.	DESCRIPTION	CHECK

**PSA** PATON  
STENSON  
ASSOCIATES INC  
10 Royal Oakwood Blvd.  
P.O. Box 15300  
Inverhills, Ont. L3T 7W9

JOB  
TEST REPORT No 5

DETAIL  
PSA TEST PANEL No A

DETAIL No.	DRAWN BY E.E.	DATE MAY /94
DET. REF.	CHECKED BY	REVISION
	DRAWING No.	1006



REBAR

CONCRETE - 5000 PSI MIN.  
(TYP. FLEXWALL CONCRETE)

4 x 4 @ 9/16 WVF



# INSERT DESCRIPTION

## TEST PANEL B

INSERT	BOLT	REBAR
1	G045	C
2	4545	E
3	G045	E
4	4545	C
5	G035	C
6	4535	E
7	G035	E
8	4535	C
9	G045	E
10	4545	C
11	G045	E
12	4545	C
13	G025	E
14	4525	C
15	G025	C
16	4525	E

### NOTES:

CONCRETE STRENGTH AT TIME  
OF TEST 5812 PSI  
TESTED AT PRECON PLANT  
BRAMPTON

DATE	ISSUE	REVISION	DESCRIPTION	CHECK
------	-------	----------	-------------	-------

**PSA** PATON  
STEENSON  
ASSOCIATES INC  
18 BRIMLEY RD.  
P.O. Box 1508  
THORNHILL, ONT. L3T 7W9

JOB

TEST REPORT No 5

DETAIL

PSA TEST PANEL No B

DETAIL NO.

DRAWN BY  
E.E.

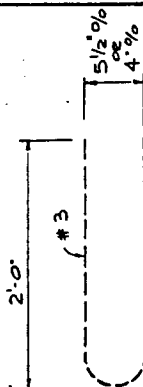
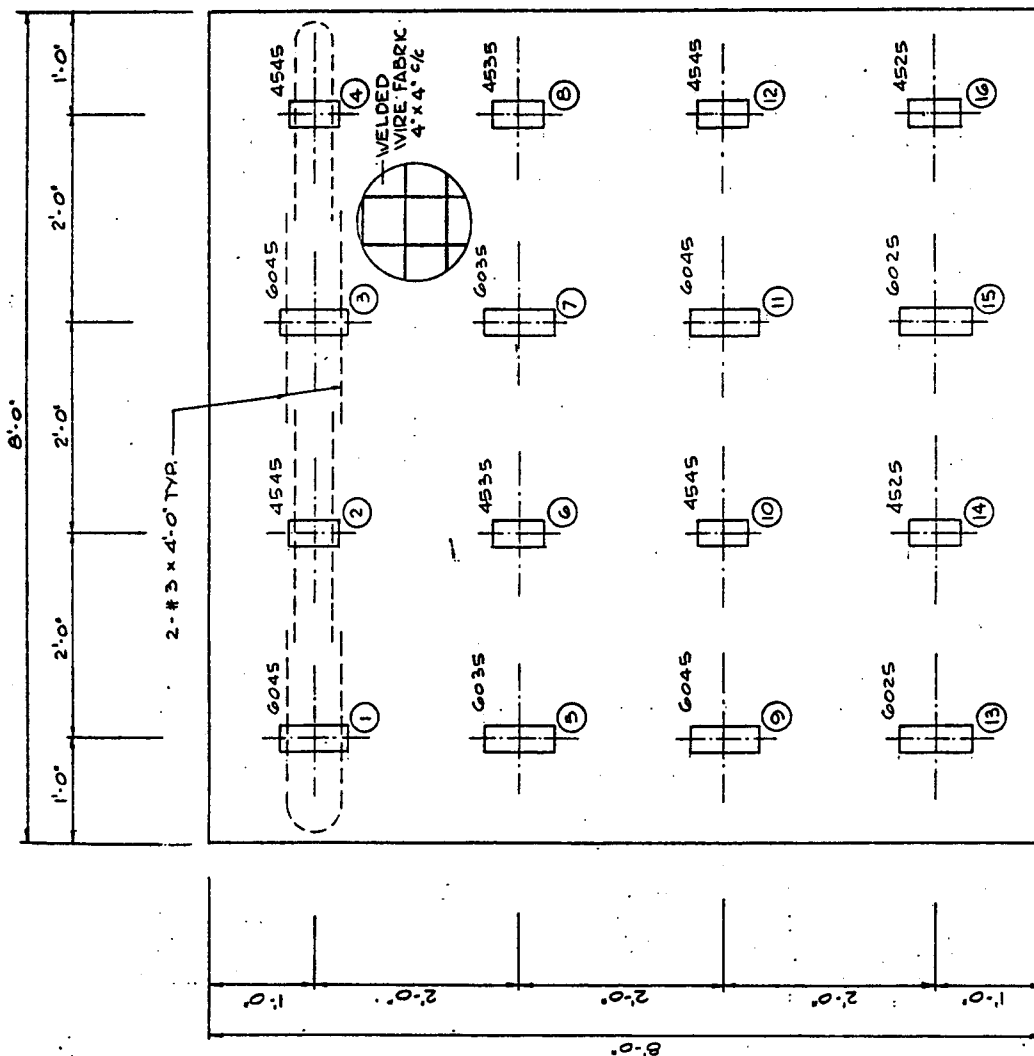
DATE  
MAY /94

CHECKED BY

REVISION

DET. REF.

DRAWING NO. 1007



REBAR

CONCRETE - 5000 PSI MIN.  
(TYP. FLEXWALL CONCRETE)

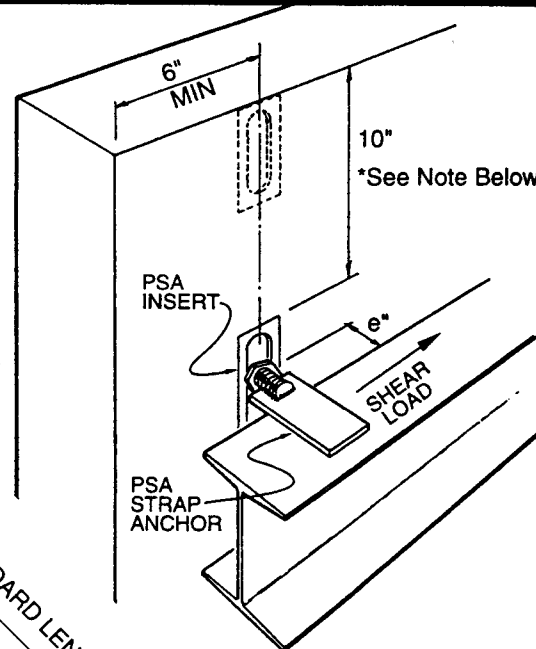
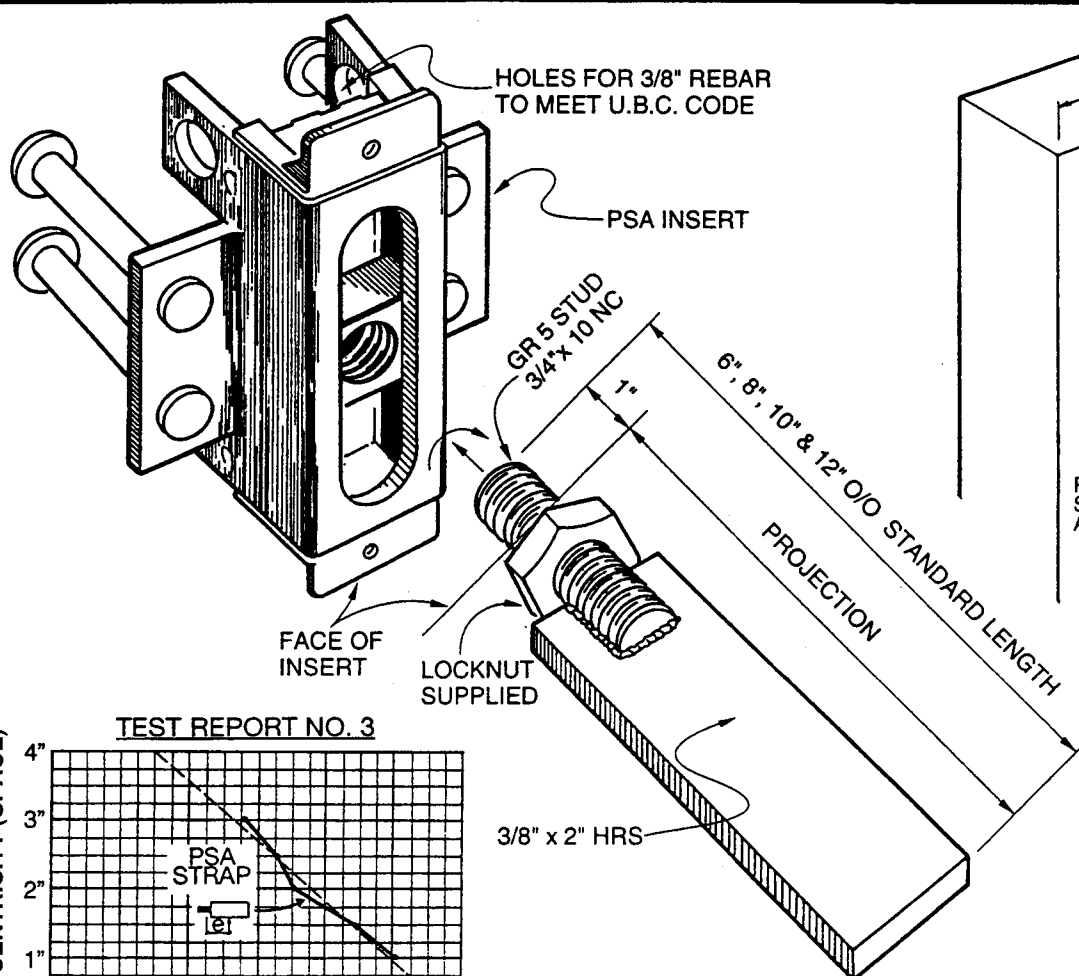
4' x 4' @ 4"





# PSA STRAP ANCHORS

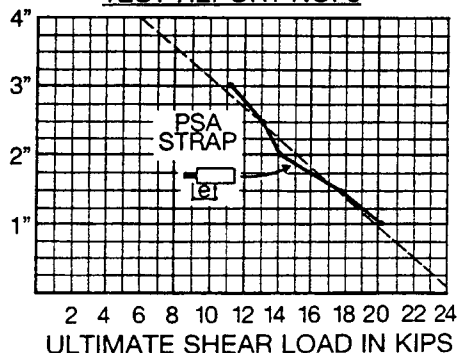
# PSA



## Note:

\* Reduce Ultimate Load by 25% if Insert Placed at Top Edge of Panel. (Test Report No. 2)

TEST REPORT NO. 3



## FEATURES:

### • Ultimate Pull-out Capacity

Strap Anchors Develop full Ultimate Capacity of the insert

Insert Type	Depth	Length	Ult. Pull-Out Capacity
4525	2 1/2"	4 1/2"	12,000 lbs
6025		6"	
4535	3 1/2"	4 1/2"	16,000 lbs
6035		6"	
4545	4 1/2"	4 1/2"	20,000 lbs
6045		6"	

Ultimate Pull-Out Capacity Based on Tests Performed in 5,000 psi Normal Weight Concrete (Refer to PSA Test Report No.1)

### • Ultimate Shear Capacity

20,350 lbs. at 1" Eccentricity (See Graph Above)

Ult. Shear Capacity based on Tests Performed in 6,000 psi Normal Weight Concrete (Refer to PSA Test Report No. 3)

### • Standard Strap Anchor Lengths

6", 8", 10" & 12" Out/Out

• **Available Finishes** – Epoxy or Hot Dipped Galvanized. (Stainless Steel available on Special Order)

• **Material** – High Strength weldable grade HRS Steel

• **Lock Nut** – Ensures Positive Connection in Both Directions

In the U.S.A.

# JVI

In Canada

# PSA

## ACCESSORIES, INC.

7550 North Linder Avenue  
Skokie, Illinois 60077 USA  
705/675-1560 Fax: 708/675-0083

## PATON STEENSON ASSOC. INC.

10 Royal Orchard Blvd. P.O. Box #53009  
Thornhill, Ontario L3T 7R9  
905/889-7357 Fax: 905/889-7648

**DISCLAIMER:** The use of PSA inserts should be approved by a qualified professional engineer or architect.



## Test Report No. 6 UPDATE

The JVI Gold J-Finish has been updated to a Platinum J-Finish per the specifications below.

The Platinum J-Finish is a 3 step process as defined below.

1. Zinc Plate Per ASTM B633 FE/Zn12 TYPE II, SC3 Severe, (minimum thickness 0.0005")
2. Trivalent Clear Chromate (RoHS and ELV compliant)
3. Sealer

The "PLATINUM J-FINISH" shall meet the following specifications.

PLATINUM J-FINISH SPECIFICATIONS		
1.	Coating Thickness	Minimum .00050" on significant surface.
2.	Appearance	There shall be no evidence of blisters, peeling, pinholes, pits or rough surface on parts.
3.	Adhesion Requirements	There shall be no defects such as peeling, blisters or cracking after heating coated parts to $300 \pm 10^{\circ}$ C for $30 \pm 5$ minutes and quenching in water at $15^{\circ}$ C to $25^{\circ}$ C.
4.	Corrosion Resistance ASTM B 117	Part shall show no evidence of white corrosion after 96-hour exposure.  Part shall show no evidence of red rust after 500-hour exposure.

Salt spray testing in accordance with Test Report 6 have been conducted and the results included with this update. The Platinum J-Finish passed all testing the previous gold J-Finish has been subjected to.

The motivation for the change was to have a RoHS/ELV compliant finish, a finish that does not require a hexavalent chromium. While this initiative has been in place since 2003, the trivalent equivalent available until today has not been satisfactory. Recent advances in the trivalent coating have made this a clear change for the better.

Please consider Test Report No. 6 to serve as reference only and consider the latest certificates of compliance to replace Test Report No. 6 for all specification and submittal purposes.

Please contact team JVI with any questions.

[info@jvi-inc.com](mailto:info@jvi-inc.com)

847-675-1560

1-800-742-8127 (toll free)

[www.jvi-inc.com](http://www.jvi-inc.com)



**Coatings 85 Ltd.**

6995 Davand Drive, Mississauga, Ontario L5T 1L5  
Tel: (905) 564-1711 Fax: (905) 564-2819

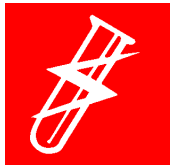
**CERTIFICATE OF COMPLIANCE**

<b>Customer:</b>	<b>A.B.M. Tool &amp; Die Co. Ltd</b>	<b>Processing Location:</b>	Coatings 85 Ltd.
<b>Part Number:</b>	Sample parts	<b>Specification:</b>	<b>ASTM-B633-FE/ZN12 TYPE11+SEAL</b>
<b>Type of Finish:</b>	Electroplated Zinc Clear Trivalent +Seal		
<b>Processing Date</b>	August 24,2015	<b>Prepared Date:</b>	September 25, 15

Actual Parts processed to the above specification have been tested with results as detailed below.

TEST PERFORMED	RESULT	SPECIFICATION
1. <u>Coating Thickness</u> ASTM-B633-FE/ZN12 TYPE11+SEAL Actual parts tested	.00057 .00060 .00059	Minimum .00050 on significant surface.
2. <u>Appearance</u> ASTM-B633-FE/ZN12 TYPE11+SEAL Actual parts tested	No evidence of blisters, peeling, pinholes, pits or rough surface on parts.	There shall be no evidence of blisters, peeling, pinholes, pits or rough surface on parts.
3. <u>Adhesion Requirements</u> ASTM-B633-FE/ZN12 TYPE11+SEAL Actual part tested	No evidence of peeling, blisters or cracking after heating coated parts to 300 ± 10° C for 30 ± 5 minutes and quenching in water at 15° C to 25° C.	There shall be no defects such as peeling, blisters or cracking after heating coated parts to 300 ± 10° C for 30 ± 5 minutes and quenching in water at 15° C to 25° C.
4. <u>Corrosion Resistance – Neutral</u> ASTM-B633-FE/ZN12 TYPE11+SEAL 3 Actual parts tested	<b>Passed</b>  <b>Passed</b>	Part shall show no evidence of white corrosion after 96-hour exposure.  Part shall show no evidence of red rust after 500-hour exposure.

Clifford Allen  
Q.C. Supervisor



# JAGEMANN PLATING CO.

PH: 920 / 682-6883 • FAX: 682-8003 • 1324 SO. 26th ST. • P.O. BOX 1447 • MANITOWOC, WI 54221-1447

LABORATORY CONTROL • ELECTRO PLATING • METAL FINISHING

ISO 9001:2008 CERTIFIED

## In-House Test

Process Verification: Zinc Trivalent Clear Chromate Plate .0005 Minimum Thickness, With Sealer (Rack Process)

<b>Date:</b>	11/16/2015	<b>Your Ref # :</b>	25DL/Zincroshield
<b>Subject:</b>	Salt Spray Test	<b>Part # :</b>	Sample
		<b>Inspection Date:</b>	10/26/2015 - 11/16/2015
<b>Plating Specification:</b>	Zinc Trivalent Clear Chromate Plate .0005 Minimum Thickness With Sealer 1010 Material Pin		
<b>Actual Plating Thickness:</b>	.00051 - .00062		

## Salt Spray Test Results (ASTM B 117)

Hours Of Exposure	Visual Observations	Test Requirements	Pass/Fail
120	After 120 hours of exposure to the below described test conditions, the parts were removed from the test chamber, rinsed with de-ionized water, dried with filtered dry compressed air and inspected. The surface of the test sample shows no visible white rust products in the concern area. After 500 hours of exposure to the below described test conditions, the parts were removed from the test chamber, rinsed with de-ionized water, dried with filtered dry compressed air and inspected. The surface of the test sample shows visible white rust, no visible red rust products.	We were requested to salt fog test the parts according to American Society for Testing and Materials (ASTM) B 117 for 500 hours.	PASS

Solution	5 % NaCl
Chamber Temperature	95 ± 1 ° F
Specific Gravity @ 95 ° F	1.025 to 1.040
PH Of Collected Solution	6.5 to 7.2
Average Collection Rate	1 – 2 ml/hr./80 cm <sup>2</sup> surf. area

It is our policy to retain samples for a minimum of 10 days from the report date, after which time they may be discarded. The data herein represents only the item(s) testes. This report shall not be reproduced except in full, without prior written permission of Jagemann Plating Company.

*Electronic document*  
*Original Contains Signature*  
**Signed:** \_\_\_\_\_  
John R. Nelesen  
Quality Assurance Manager

## **TEST REPORT NO. 6**

### **CORROSION TESTS ON**

### **PSA STRAP ANCHORS AND INSERTS**

Salt Spray Tests - ASTM B117-94

November, 1994

### **NOTICE**

*This publication is intended for the use of professional personnel, competent to evaluate the significance and limitations of its contents and who will accept responsibility for the application of the material it contains. Paton Steenson Associates Inc. and JVI Accessories, Inc. disclaim any and all responsibility for the application of the stated principles or for the accuracy of the information contained herein.*

## **APPENDIX A**

1. Summary Table of Salt Spray Test Results
2. Individual Salt Spray Test Reports
  - Page 1 J-Type Finish - PSA Strap Anchor
  - Page 2 Zinc Finish - PSA Strap Anchor
  - Page 3 H.D. Galv. Finish - PSA Strap Anchor
  - Page 4 Epoxy Finish - PSA Insert
  - Page 5 H.D. Galv. Finish - PSA Insert
  - Page 6 J-Type Finish - PSA Insert
3. Photographs - Figs. 1 through 6 incl.
4. Fig. 7 - Typical Salt Spray Cabinet
5. Fig 8. - Excerpt from ASTM B117-94 Specification  
"Standard Practice for Salt Spray Testing Apparatus"
6. PSA Data Sheet for Strap Anchor Connections.
7. PSA Insert Brochure

November, 1994

**ACCELERATED CORROSION TESTS**  
**TEST REPORT NO. 6**

**INTRODUCTION**

The purpose of this report is to compare the corrosion resistance of the new J - TYPE automotive coating used on PSA Strap Anchors and Inserts with the traditional zinc, epoxy and hot dip galvanized coatings used in the construction industry.

**TEST SAMPLES**

The following insert and strap anchor samples were tested:

<u>Coating</u>	<u>Sample Tested</u>
J - Type	PSA Strap Anchor - Mk. 675
Zinc	PSA Strap Anchor - Mk. 675
Hot Dip Galvanized	PSA Strap Anchor - Mk. 875
Epoxy	PSA Insert - Mk. 6025
Hot Dip Galvanized	PSA Insert - Mk. 6025
J - Type	PSA Insert - Mk. 6025

**TEST METHOD**

All samples were placed in a commercial Salt Spray Cabinet (Fig. 7) and tested for corrosion resistance in accordance with the ASTM B117-94 Specification "Standard Method of Salt Spray (Fog) Testing" (Fig. 8). A visual inspection was made every 24 hours. The condition of each sample was determined, photographed and recorded.

## TEST RESULTS

Detailed test observations for each sample, together with a summary table of Salt Spray Tests are included in Appendix A. Photographs showing the condition of each sample when the particular test was terminated, are also included in Appendix A (Figs. 1 to 6).

## DISCUSSION

1. The J-Type corrosion resistant finish (guaranteed against red rust for 500 hours), was still intact on both the insert and the strap anchor samples when each test was terminated. There was some white rust but no sign of red rust even after 624 hours (strap anchor) and 648 hours (insert) of test, (see Figs. 2, 4a and 4b in Appendix A). This corrosion resistant finish is being extensively used by the automotive industry for underhood fasteners, brakes and steering parts etc., where salt damage is likely to occur.
2. The zinc finish on the PSA strap anchor was 0.00033" thick in accordance with ASTM specification B633 Type II. After 168 hours when the test was terminated, considerable white and red rust had developed on this sample. (Fig. 2). This finish is not used on any PSA products. The test was made for comparative purposes only.
3. The hot-dip galvanized finish on the PSA strap anchor was 0.0048" thick, (four times as thick as the insert). This sample was covered with white rust after 360 hours when the test was terminated, but no red rust was observed. (Fig. 1).
4. The hot-dip galvanized finish on the PSA insert was completely covered with white rust after 648 hours when the test was terminated. It looked like a Christmas tree. Traces of red rust were observed at termination. (Figs. 5a and 5b)
5. The epoxy finish on the PSA insert performed very well. At 168 hours, red rust started along some sharp edges of the sample. At 648 hours when the test was terminated, significant red rust had occurred along sharp edges primarily on the bottom of the sample. (figs. 6a and 6b). It should be noted that 648 hours of salt spray is an extreme exposure for this type of finish. The epoxy finish out-performed the hot-dip galvanized finish.



## CONCLUSIONS AND RECOMMENDATIONS

1. Corrosion resistance of the J - Type automotive finish is far superior to any other finish tested.
2. The zinc finish performed poorly in comparison with the other finishes tested. This finish is not used on any PSA products.
3. The hot dip galvanized finish, on both the PSA strap anchor and the Insert performed very well and is recommended as an acceptable construction finish for most applications. Stainless steel inserts are recommended for exposed corrosive conditions.
4. The epoxy coating on the PSA insert provides excellent corrosion resistance under normal exposure conditions. Special care must be taken to ensure proper epoxy coverage inside the cavity and at cut edges. The epoxy finish is recommended as an acceptable finish for most building connections.

PATON STEENSON ASSOCIATES INC.

A handwritten signature in black ink, appearing to read "W. D. Paton", written in a cursive style.

W. D. Paton, P. Eng.

November 15, 1994

## SUMMARY OF SALT SPRAY TESTS

HOURS (Av. Thickness)	J-TYPE PSA STRAP ANCHOR (0.00034")	ZINC PSA STRAP ANCHOR (0.00033")	H. D. GALV. PSA STRAP ANCHOR (0.0048")	EPOXY PSA INSERT (0.0023")	H. D. GALV. PSA INSERT (0.00127")	J-TYPE PSA INSERT (0.00037)
24	Nil	Nil	Nil	Nil	Nil	Nil
72	Nil	Nil	Nil	Nil	Nil	Nil
96	Nil	Nil	Nil	Nil	White Started	Nil
168	Nil	White & Red Start Test Terminated	Moderate White	Red Started at Holes & Edges	Moderate White	Nil
336	Nil		Hvy. White-No Red Test Terminated	Same	Moderate White	Nil
432	Slight White			Same	Heavy White	Slight White
648	No Red Test Terminated			Hvy. Red at Edges Test Terminated	Complete White Test Terminated	No Red Test Terminated

**NOTE:**

(1) Detailed test observations and photographs of all test samples are included in Appendix A.

**AUTOTEK ELECTROPLATING INC.**

**SALT SPRAY TEST RESULTS**

**Test Method: ASTM B117-94**

**Customer: Paton Steenson Associates Inc.**

**Part Number: Strap Anchor**

**Revision Code: Hot Dip Galvanized**

**Cast Day: N/A**

**Lot Number: N/A**

**Date Plated:**

**Start Date: 06/13/1994 1300hrs**

**Finish Date: 06/28/1994 1300hrs**

**Exposure Period: 360 hrs (Test Terminated)**

**Coating Thickness in Inches: Reading #1 : 0.0048**  
#2 : 0.0047  
#3 : 0.0050  
#4 : 0.0047

**EVALUATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94**

**Number of Hours( 96 ): No sign of white corrosion products or red rust.**

**Number of Hours(120 ): First sign of white corrosion product .**

**Number of Hours( 360 ): No sign of base metal corrosion (red rust).**

**parts exhibited 100 percent white corrosion. Test terminated.**

**Signature:**

*P. Matheson*

**Date: 06/28/1994**

**AUTOTEK ELECTROPLATING INC.**

**SALT SPRAY TEST RESULTS**

**Test Method: ASTM B117-94**

Customer: Paton Steenson Associates Inc.

Part Number: Strap Anchor

Revision Code: Zinc Finish

Cast Day: N/A

Lot Number: N/A

Date Plated: 05/11/1994

Start Date: 05/12/1994 1130hrs

Finish Date: 05/19/1994 1330hrs

Exposure Period: 168 hrs

Coating Thickness in Inches: Reading #1 : 0.00032  
#2 : 0.00034  
#3 : 0.00032  
#4 : 0.00033

**EVALUATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94**

Number of Hours( 24 ): No sign of white corrosion products or red rust.

Number of Hours( 96 ): No sign of white corrosion products or red rust.

Number of Hours( 168 ): First sign of white corrosion products and red rust  
on threaded portion of part.

Signature:

*P. Matheson*

Date: 05/19/1994

**AUTOTEK ELECTROPLATING INC.**

**SALT SPRAY TEST RESULTS**

**Test Method: ASTM B117-94**

**Customer: Paton Steenson Associates Inc.**

**Part Number: Strap Anchor**

**Revision Code: J-Type Corrosion Finish**

**Cast Day: N/A**

**Lot Number: N/A**

**Date Plated: 05/11/1994**

**Start Date: 06/12/1994 1130hrs**

**Finish Date: 06/07/1994 1300hrs**

**Exposure Period: 624 hrs**

**Coating Thickness in Inches: Reading #1 : 0.00033**

**#2 : 0.00035**

**#3 : 0.00033**

**#4 : 0.00031**

**EVALUATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94**

**Number of Hours( 96 ): No sign of white corrosion products or red rust.**

**Number of Hours(432 ):First sign of white corrosion product .**

**Number of Hours( 624 ): No sign of base metal corrosion (red rust).**

**Test terminated.**

**Signature:**

*P. Matheson*

**Date: 06/07/1994**

**AUTOTEK ELECTROPLATING INC.**

**SALT SPRAY TEST RESULTS**

**Test Method: ASTM B117-94**

Customer: Paton Steenson Associates Inc.

Part Number: Anchor Bracket

Revision Code: Epoxy Coating

Cast Day: N/A

Lot Number: N/A

Date Plated: N/A

Start Date: 09/21/1994 1300hrs

Finish Date: 10/19/1994 1300hrs

Exposure Period: 648 hrs

Coating Thickness in Inches: Not Available

EVALUATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94

Number of Hours( 96 ): No sign of white corrosion products or red rust.

Number of Hours( 168 ): First sign of red rust along sharp edges.

Number of Hours( 648 ): significant red rust corrosion along all sharp edges

Signature: P. Matheson

Date: 10/19/1994

**AUTOTEK ELECTROPLATING INC.**

**SALT SPRAY TEST RESULTS**

**Test Method: ASTM B117-94**

Customer: Paton Steenson Associates Inc.

Part Number: Anchor Bracket

Revision Code: Galvanized zinc

Cast Day: N/A

Lot Number: N/A

Date Plated: N/A

Start Date: 09/21/1994 1300hrs

Finish Date: 10/19/1994 1300hrs

Exposure Period: 648 hrs

Coating Thickness in Inches: Not Available

EVALUATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94

Number of Hours( 96 ): First sign of white corrosion products ,no red rust.

Number of Hours( 168 ): white corrosion 30-35% , no red rust.

Number of Hours( 648 ): 100% white corrosion no red rust.

Signature: T. Matheson

Date: 10/19/1994

**AUTOTEK ELECTROPLATING INC.**

**SALT SPRAY TEST RESULTS**

**Test Method: ASTM B117-94**

Customer: Paton Steenson Associates Inc.

Part Number: Anchor Bracket

Revision Code: J-Type Corrosion Finish

Cast Day: N/A

Lot Number: N/A

Date Plated: 09/27/1994

Start Date: 09/28/1994 1330hrs

Finish Date: 10/25/1994 1300hrs

Exposure Period: 648 hrs

Coating Thickness in Inches: Reading #1 : 0.00038  
#2 : 0.00040  
#3 : 0.00035  
#4 : 0.00034

**EVAULATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94**

Number of Hours( 96 ): No sign of white corrosion products or red rust.

Number of Hours(408 ):First sign of white corrosion product .

Number of Hours( 648 ): No sign of base metal corrosion (red rust).

Test terminated.

Signature:

*P. Matheson*

Date: 10/25/1994



# PHOTOGRAPHS - 1

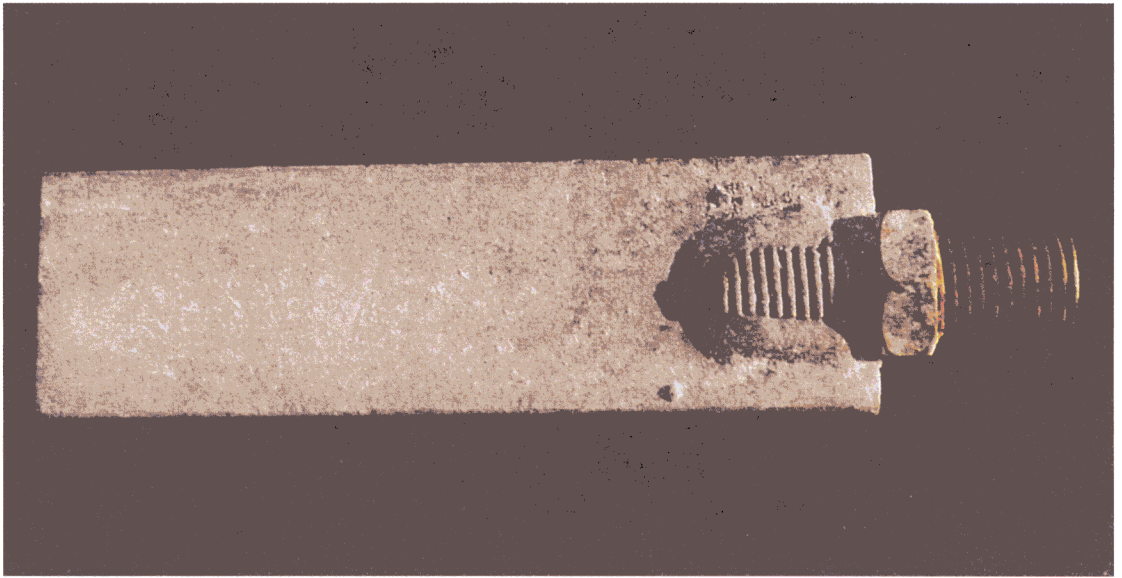


Fig. 1 PSA Strap Anchor Hot Dip Galv. Finish after 360 hours

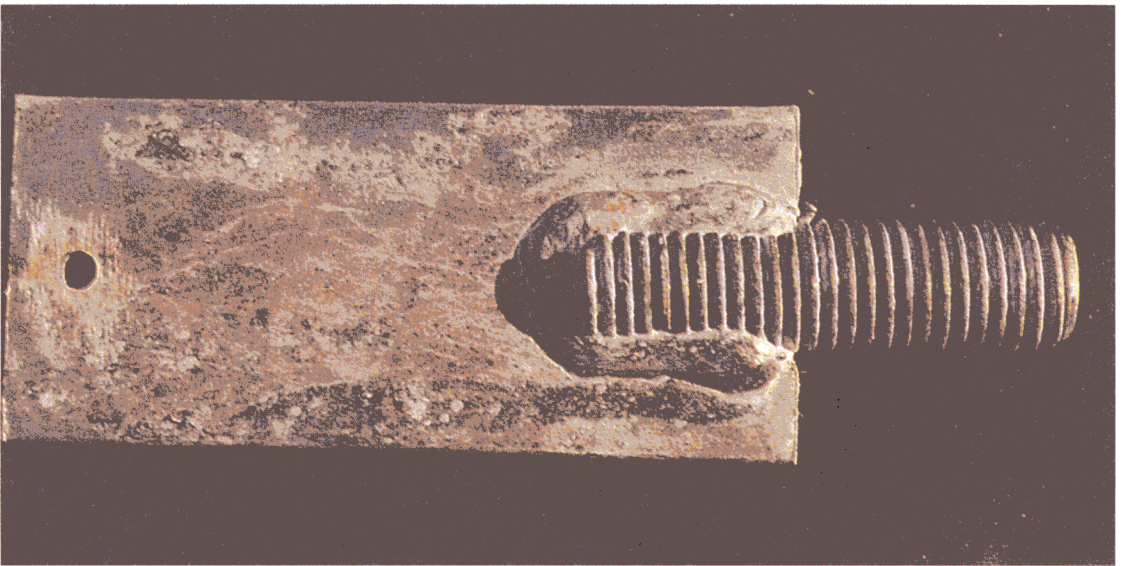


Fig. 2 PSA Strap Anchor J - Type Finish after 624 hours

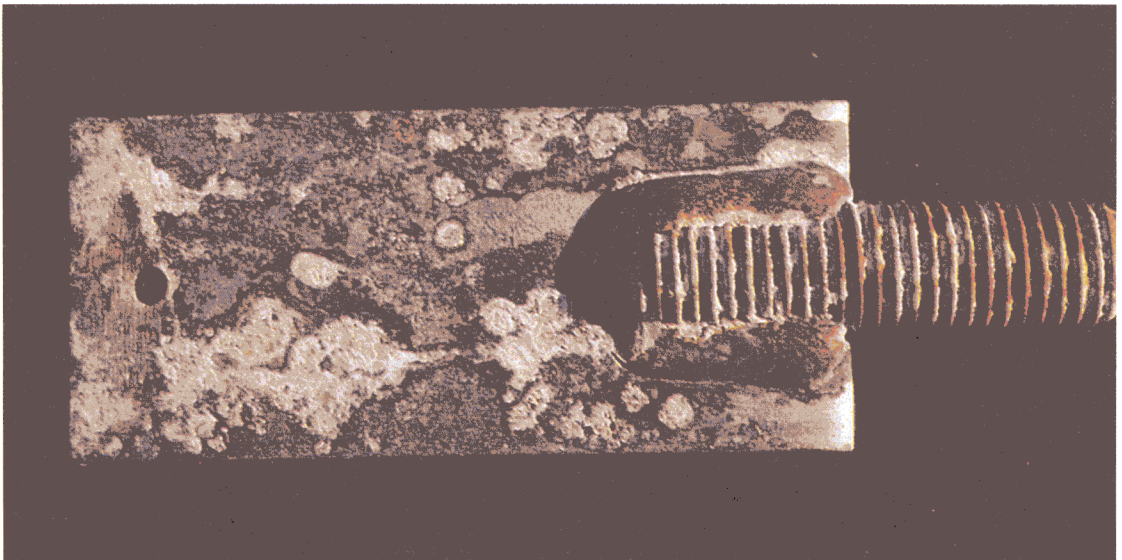


Fig. 3 PSA Strap Anchor Zinc Finish after 168 hours

## PHOTOGRAPHS - 2

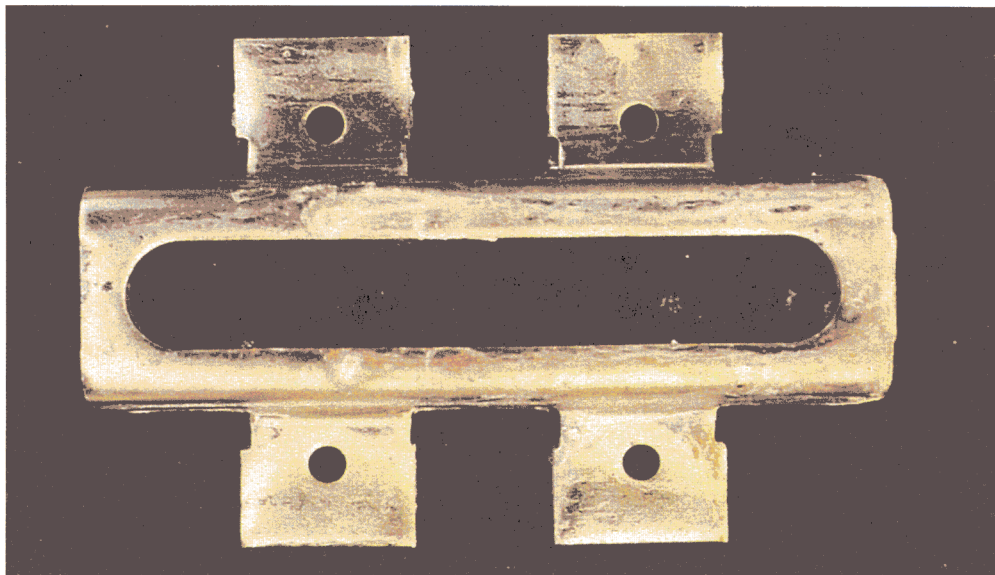


Fig. 4a PSA Insert (Top) J - Type Finish after 648 hours



Fig. 5a PSA Insert (Top) Hot Dip Galv. Finish after 648 hours

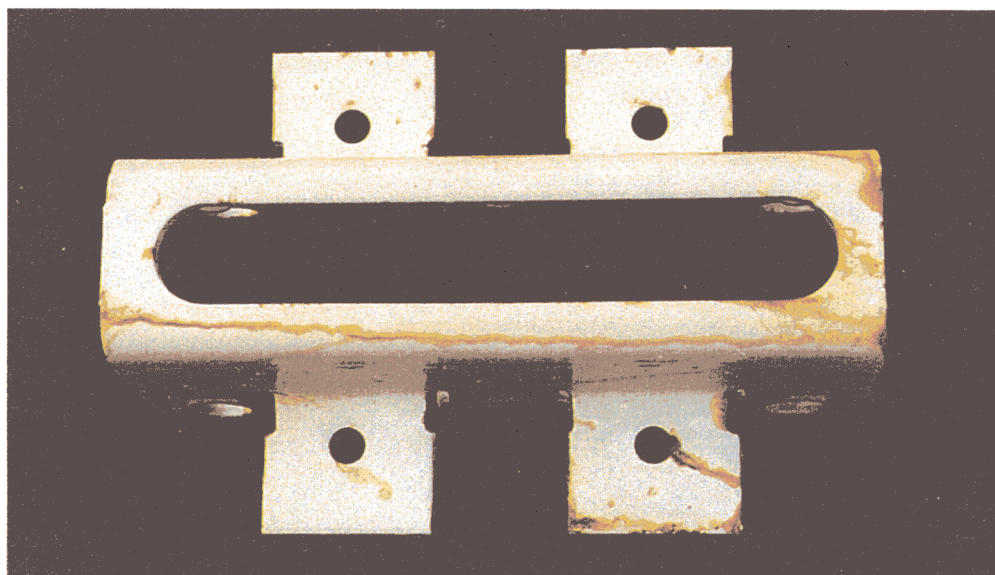


Fig. 6a PSA Insert (Top) Epoxy Finish after 648 hours



### PHOTOGRAPHS -3

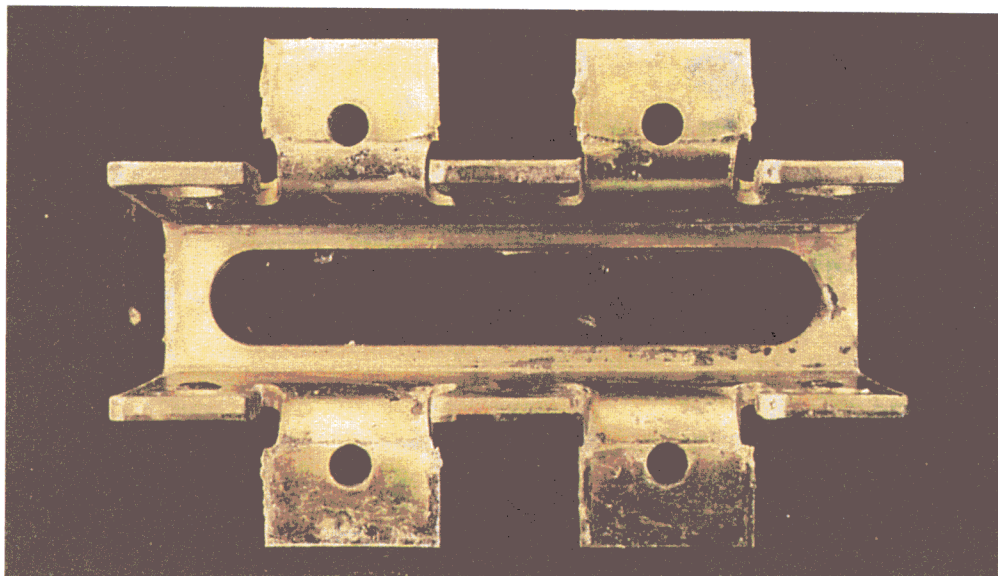


Fig. 4b PSA Insert (Bottom) J - Type Finish after 648 hours



Fig. 5b PSA Insert (Bottom) Hot Dip Galv. Finish after 648 hours

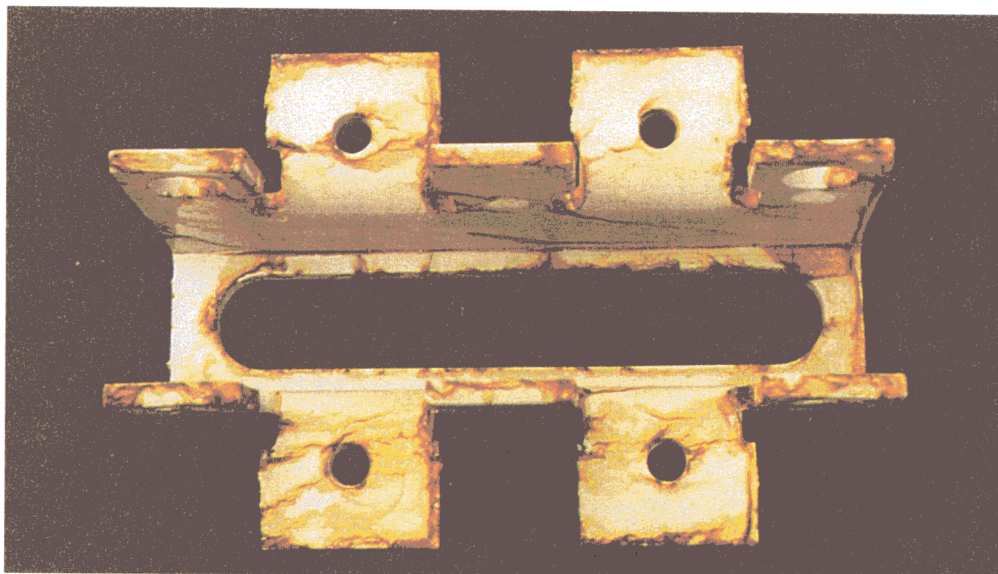
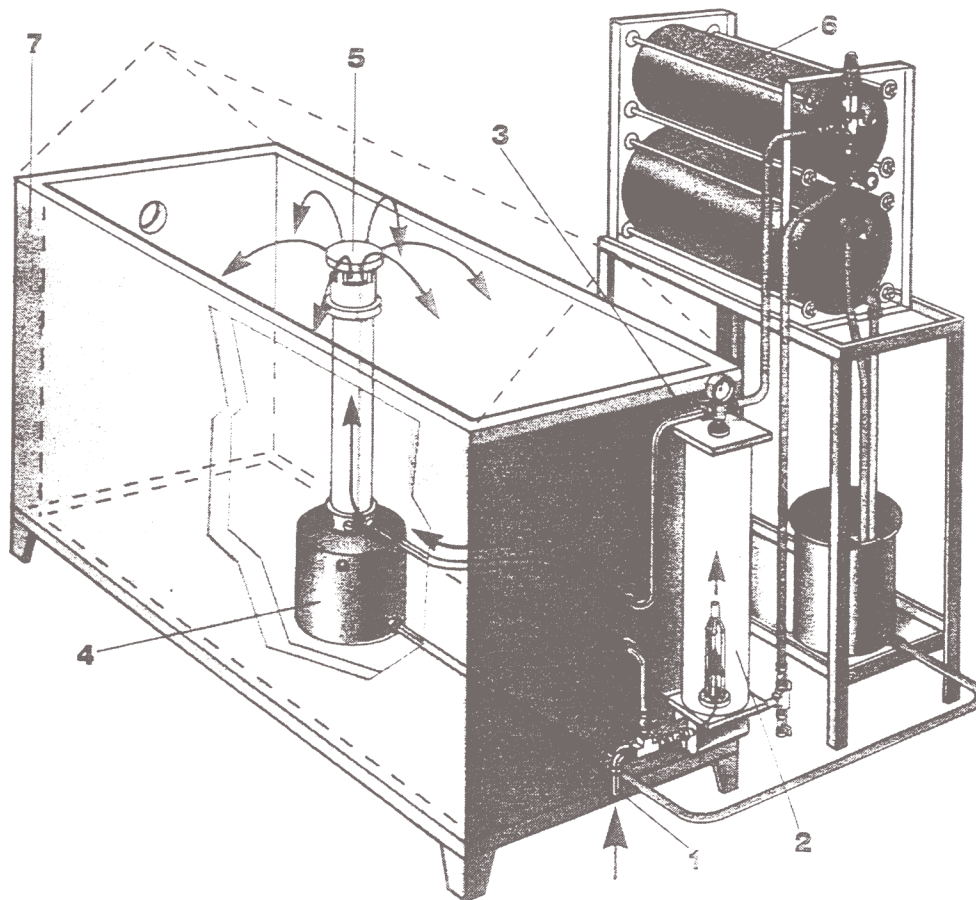


Fig. 6b PSA Insert (Bottom) Epoxy Finish after 648 hours



## How a salt fog chamber works.

**1.** Compressed air enters the humidifying tower via an air line attached to the regulator.

**2.** Air is forced upward through the tower which contains distilled water that is fed from the level control system.

Once the air is in the tower, it reaches a temperature of approximately 118 degrees Fahrenheit.

**3.** The air is forced out of the top through an air line tube that continues into the chamber until it reaches the atomizer nozzle in the dispersion tower.

**4.** Here, the solution of 95 percent distilled water and 5 percent salt is atomized in the tank.

**5.** The atomized solution rises to the top of the dispersion tower where it baffles off the cone into the chamber, providing a consistent salt fog.

**6.** To ensure that the saline solution is readily available at the base of the

dispersion tower, the nearby level control system automatically feeds the solution as needed.

**7.** The chamber is heated to 95 degrees Fahrenheit. This is accomplished by a "water jacket," which surrounds the chamber with water. The temperature of the water is maintained by two heaters.

The entire procedure is virtually a "hands-off" operation.

Fig.7 Typical Salt Spray Cabinet



## Standard Practice for Operating Salt Spray (Fog) Testing Apparatus<sup>1</sup>

This standard is issued under the fixed designation B 117; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense to replace Method 811.1 of Federal Test Method Standard No. 151b. Consult the DoD Index of Specifications and Standards for the specific year of issue that has been adopted by the Department of Defense.*

### 1. Scope

1.1 This practice describes the apparatus, procedure, and conditions required to create and maintain the salt spray (fog) test environment. Suitable apparatus which may be used is described in Appendix X1. This practice does not prescribe the type of test specimen or exposure periods to be used for a specific product, nor the interpretation to be given to the results.

1.2 The values stated in SI units are to be regarded as standard. The inch-pound units in parentheses are provided for information.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- B 368 Method for Copper-Accelerated Acetic Acid-Salt Spray (Fog) Testing (CASS Test)<sup>2</sup>
- D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products<sup>3</sup>
- D 1193 Specification for Reagent Water<sup>4</sup>
- D 1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments<sup>3</sup>
- E 70 Test Method for pH of Aqueous Solutions with the Glass Electrode<sup>5</sup>
- E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method<sup>6</sup>
- G 85 Practice for Modified Salt Spray (Fog) Testing<sup>7</sup>

### 3. Significance and Use

3.1 This practice provides a controlled corrosive environment which has been utilized to produce relative corrosion resistance information for specimens of metals and coated

metals exposed in any particular test chamber.

3.2 Correlation and extrapolation of corrosion performance based on exposure to the test environment provided by this practice are not always predictable. Correlation and extrapolation should be considered only in cases where appropriated corroborating long-term atmospheric exposures have been conducted.

3.3 The reproducibility of results in the salt spray exposure is highly dependent on the type of specimens tested and the evaluation criteria selected, as well as the control of the operating variables. In any testing program, sufficient replicates should be included to establish the variability of the results. Variability has been observed when similar specimens are tested in different fog chambers even though the testing conditions are nominally similar and within the ranges specified in this practice.

### 4. Apparatus

4.1 The apparatus required for salt spray (fog) exposure consists of a fog chamber, a salt solution reservoir, a supply of suitably conditioned compressed air, one or more atomizing nozzles, specimen supports, provision for heating the chamber, and necessary means of control. The size and detailed construction of the apparatus are optional, provided the conditions obtained meet the requirements of this practice.

4.2 Drops of solution which accumulate on the ceiling or cover of the chamber shall not be permitted to fall on the specimens being exposed.

4.3 Drops of solution which fall from the specimens shall not be returned to the solution reservoir for respraying.

4.4 Material of construction shall be such that it will not affect the corrosiveness of the fog.

### 5. Test Specimens

5.1 The type and number of test specimens to be used, as well as the criteria for the evaluation of the test results, shall be defined in the specifications covering the material or product being tested or shall be mutually agreed upon between the purchaser and the seller.

### 6. Preparation of Test Specimens

6.1 Specimens shall be suitably cleaned. The cleaning method shall be optional depending on the nature of the surface and the contaminants. Care shall be taken that

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee G-1 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.05 on Laboratory Corrosion Tests.

Current edition approved Feb. 15, 1994. Published April 1994. Originally published as B 117 - 39 T. Last previous edition B 117 - 90.

<sup>2</sup> Annual Book of ASTM Standards, Vol 02.05.

<sup>3</sup> Annual Book of ASTM Standards, Vol 06.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 11.01.

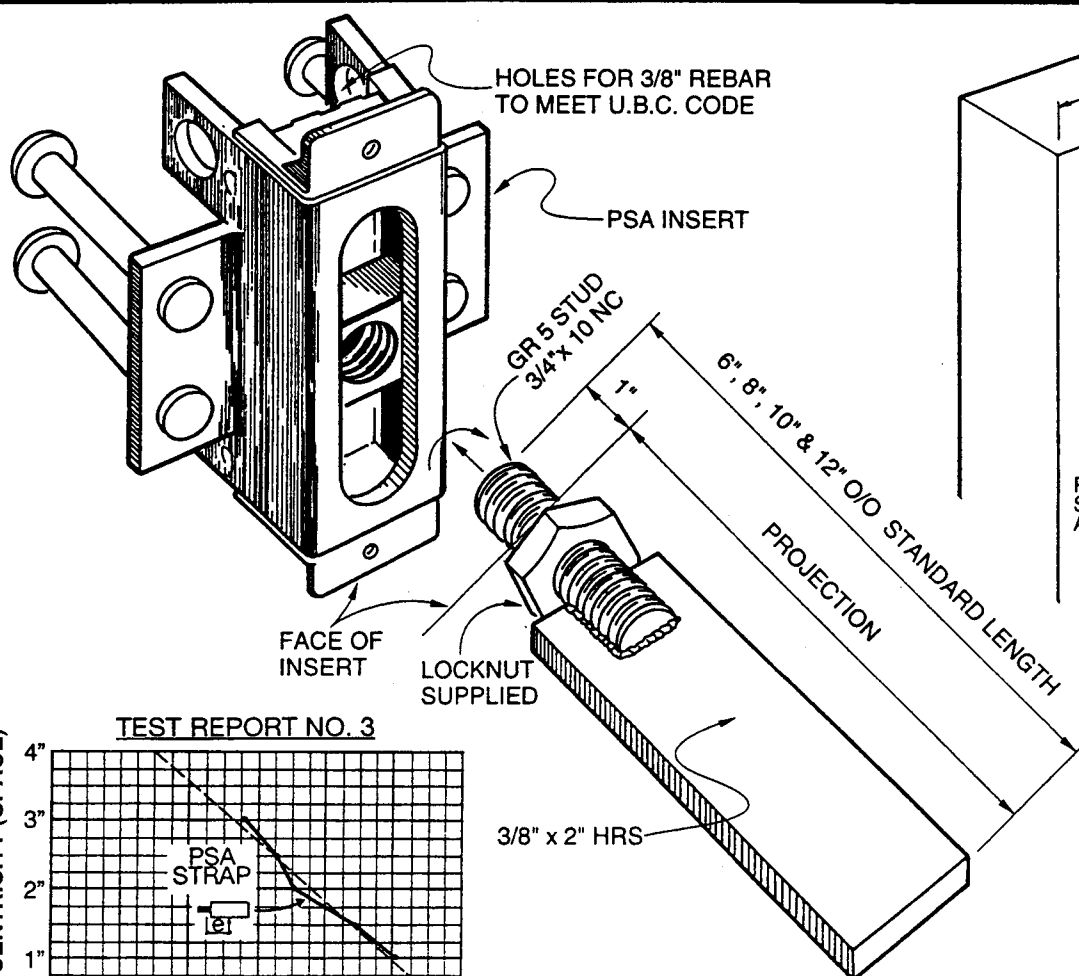
<sup>5</sup> Annual Book of ASTM Standards, Vol 15.05.

<sup>6</sup> Annual Book of ASTM Standards, Vol 14.02.

<sup>7</sup> Annual Book of ASTM Standards, Vol 14.12.

# PSA STRAP ANCHORS

# PSA

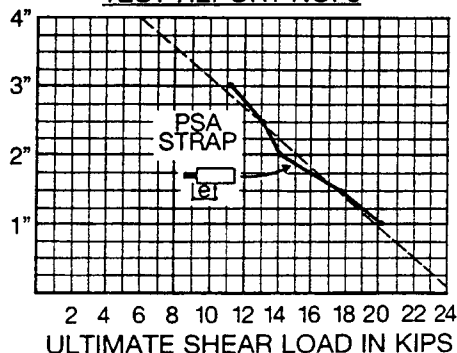


PSA INSERT  
PSA STRAP ANCHOR

## Note:

\* Reduce Ultimate Load by 25% if Insert Placed at Top Edge of Panel. (Test Report No. 2)

TEST REPORT NO. 3



## FEATURES:

### • Ultimate Pull-out Capacity

Strap Anchors Develop full Ultimate Capacity of the insert

Insert Type	Depth	Length	Ult. Pull-Out Capacity
4525	2 1/2"	4 1/2"	12,000 lbs
6025		6"	
4535	3 1/2"	4 1/2"	16,000 lbs
6035		6"	
4545	4 1/2"	4 1/2"	20,000 lbs
6045		6"	

Ultimate Pull-Out Capacity Based on Tests Performed in 5,000 psi Normal Weight Concrete (Refer to PSA Test Report No.1)

### • Ultimate Shear Capacity

20,350 lbs. at 1" Eccentricity (See Graph Above)

Ult. Shear Capacity based on Tests Performed in 6,000 psi Normal Weight Concrete (Refer to PSA Test Report No. 3)

### • Standard Strap Anchor Lengths

6", 8", 10" & 12" Out/Out

• **Available Finishes** – Epoxy or Hot Dipped Galvanized. (Stainless Steel available on Special Order)

• **Material** – High Strength weldable grade HRS Steel

• **Lock Nut** – Ensures Positive Connection in Both Directions

In the U.S.A.

# JVI

In Canada

# PSA

## ACCESSORIES, INC.

7550 North Linder Avenue  
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## PATON STEENSON ASSOC. INC.

10 Royal Orchard Blvd. P.O. Box #53009  
Thornhill, Ontario L3T 7R9  
905/889-7357 Fax: 905/889-7648

**DISCLAIMER:** The use of PSA inserts should be approved by a qualified professional engineer or architect.

**TEST REPORT NO 7**

**30 KIP LOAD TESTS ON**

**PSA SLOTTED INSERTS**

**At Shockey Brothers Plant**

**MARCH, 1995**

**ACKNOWLEDGEMENT**

Special thanks to NED CLELAND And DAVID RAY of Shockey Brothers, Inc. for their help and advice in making this test program possible.

**NOTICE**

*This publication is intended for the use of professional personnel, competent to evaluate the significance and limitations of its contents and who will accept responsibility for the application of the material it contains. Shockey Brothers, Inc., JVI Accessories, Inc. and Paton Steenson Associates Inc. disclaim any and all responsibility for the application of the stated principles or for the accuracy of the information contained herein.*

September, 1995

## **30 KIP LOAD TEST ON PSA SLOTTED INSERTS FOR SHOCKEY BROTHERS**

### **INTRODUCTION**

The purpose of this load test program was, (a) to find out if a special high capacity PSA Slotted Insert could achieve an ultimate pull-out capacity of 30 kips, and (b) to test some special ferrule and coil type insert details often used in parking deck "spandrel to column" connections.

### **TEST PANEL**

Two concrete test panels were manufactured at Shockey Brothers plant in Winchester, Virginia on March 10th and 16th respectively as part of a normal day's production. The details of the test panels are shown on Sketch 1 for panel (1) and Sketch 4 for panel (2), included in Appendix A. Load tests were conducted on March 29th, 1995 when the test panels were 13 and 19 days old respectively. The estimated concrete strength for panel (1) was 7,900 psi and for panel (2), 7,000 psi at the time of the test. These values were interpolated from the actual 7, 14, and 28 day cylinder test results for this batch of concrete as shown in Appendix A of this report. The test panels were reinforced to simulate a typical "parking deck" spandrel panel and the inserts were located at the edges to model a typical "spandrel to column" connection. Extra reinforcing steel was provided around and through the legs of the PSA inserts as shown in detail on the test panel sketches and as noted in the table of test results.

### **TEST METHOD**

The test load, in all cases was applied to the inserts through their normal connection devices using a 20 ton hydraulic ram and hand operated pump. The pressure gauge reading was multiplied by the ram area (4.71 sq. in.) to determine the applied load. Recent calibration data for the pressure gauge is included in Appendix A.

Figures 1 and 10 illustrate the test set-up for interior inserts and figures 7 and 12 show the cantilever method used for testing the corner inserts. In all cases a high strength bolt in the load transfer bracket was attached to the heavy duty nut in the insert. All inserts were tested for ultimate pull-out capacity.

A visual inspection of the pattern of failure cracking was made throughout the tests. The mode of failure was determined, photographed and recorded.



## TEST RESULTS

A table of test results is given in Appendix A

## DISCUSSION

1. Standard PSA - 20 kip (6045) inserts, equipped with special high capacity nuts, were used to achieve the desired 30 kip ultimate capacity. Although the special nuts increased the mechanical capacity of these inserts, it was also necessary to use stepped harpins through the inserts (as shown on the detail sheets in Appendix A), to strengthen the concrete cone and so force a ductile mechanical failure. In Test No. 2, where no extra reinforcement was provided, the concrete failed at 24,400 lbs as expected. The insert simply behaved like a 20 kip insert. In this case the extra mechanical capacity of the insert forced a concrete failure. This test confirmed the need to provide extra concrete reinforcement wherever the insert is located, in order to achieve a 30 kip ultimate capacity.
2. Stepped hairpins were used in all other tests to reinforce the concrete cone areas. Even though these inserts were located near the corners of the panel (to simulate the spandrel panel connection), the hairpins effectively strengthened the concrete cone and so forced a slow ductile mechanical failure of the insert lips at an average capacity of 30 kips.
3. Unfortunately the test bolt failed during Test No. 5 which in turn, damaged the threads of the insert nut. Even so a load of 27,700 lbs was reached. The insert was re-tested using a new bolt but the damaged nut failed at 26,800 lbs.
4. The traditional 1" dia. coil/plate type inserts performed very well. In the special Shockey detail (Tests A and D), one of the four struts is cut short and the threaded coil wrapped with pipe insulation. This detail, P8791PA is included in Appendix A. The insulation is intended to relieve any minor misalignment between the threaded rod and the insert. Tests have shown that the capacity of an insert is substantially reduced if the load is **not** applied perpendicular to the insert. This detail requires very close construction tolerances.

*The use of a slotted insert in the "spandrel-to-column" parking deck connection would provide more construction tolerance, and so ensure that the load is applied perpendicular to the insert.*

5. The other Shockey detail (Tests B & C) using a heavy hex nut welded to a 1/2" plate does not provide any construction tolerance for misalignment. This detail, P8341PB is included in Appendix A. The capacity of this connection detail was adequate without extra reinforcement when located away from an edge (Test C), but requires additional heavy reinforcement when located in the corner (Test B).

## CONCLUSIONS AND RECOMMENDATIONS

1. The PSA 6045 slotted insert when equipped with a special high capacity nut, has a mechanical capacity of approximately 30,000 lbs.
2. This insert has an ultimate pull-out capacity of approximately 30,000 lbs. when reinforced with two stepped hairpins or similar reinforcing steel embedded in 7000 psi concrete, even when the insert is located near the corner of the panel.
3. The ultimate capacity of this insert *without* stepped hairpin type reinforcement is limited to 24,000 lbs. in 7000 psi concrete, when the insert is located well away from the corner or edges of a panel.
4. Straight reinforcing steel around or through the shear cone does not increase the ultimate capacity of the shear cone.
5. Stepped hairpins (#3 weldable grade) or similar reinforcing bars can effectively increase the capacity of the shear cone, *even at the corner of a panel.*
6. The insulated coil/plate type anchorages performed well above the design ultimate capacity of these anchorages.
7. Additional heavy hairpin or stepped hairpin reinforcing steel is needed when these coil/plate type anchorages are located at or near the corner of a panel.

PATON STEENSON ASSOCIATES INC

A handwritten signature in black ink, appearing to read "W. D. Paton". The signature is fluid and cursive, with the first letters of each word being capitalized and prominent.

W. D. Paton, P. Eng

## **APPENDIX - A**

1. Table of Test Results
2. Concrete Strength Graph
3. Calibration Data
4. Photographs - Figs. 1 through 9
5. Fig. 10 - Test Set-Up for Edge Tests
6. Fig. 11 - Test Set-Up for Pull-Out Tests
7. Sketch-1 Test Panel No. 1
8. Sketch-2 Hairpin Reinforcement - 1
9. Sketch-3 Hairpin Reinforcement - 2
10. Sketch-4 Test Panel No. 2
11. Shockey Detail P9603GA - Plate c/w HA Studs
12. Shockey Detail P8341PB - Plate c/w HH Nut
13. Shockey Detail P8791PA - 1" - 4 Strut Coil c/w Insul.
14. Test Block Detail - High Concrete Sleeve

# TEST RESULTS

## March, 1995

INSERT TYPE	TEST NUMBER	INSERT LOCATION	REINFORCEMENT (In addition to normal panel reinforcement)	FAILURE LOAD		TYPE OF FAILURE	COMMENTS
				Gage (psi)	Lbs.		
PSA 6045 HC	2	Interior	None	5,200	24,400	Slow ductile concrete failure	Lack of stepped hairpins forced a concrete failure. Same as a 20 kip insert.
PSA 6045 HC	3	Corner	2 - Stepped hairpins. 1 - #8 Flat hairpin.	6,500	30,600	Slow ductile failure. Concrete cracked, and lips yielded.	Insert deformed - edge concrete cracked which reduced confinement of insert. The nut then caused lips to fail.
PSA 6045 HC	1	Corner	2 - Stepped hairpins only	NIL	NIL	Not Tested	Concrete around sample was damaged by Test No. 2
PSA 6045 HC	4	Corner	2 - Stepped hairpins. 1 - #8 Flat hairpin.	6,250	29,400	Slow ductile failure. Concrete cracked, and lips yielded.	Same as Test No. 3
PSA 6045 HC	5	Corner	2 - Stepped hairpins only	5,900	27,700	Stripped the threads of the test bolt.	Threads of nut weakened by failed bolt. Retested - but nut failed at 26,800 lbs.
Shockey P9603PA	A	Corner	1" dia.coil insert. c/w pipe insulation. 1/2 x 6 x 6 plate 4 - 1/2 x 6 HA Studs 2- #4 & 1-#8 Hairpin	8,000	37,700	No Failure	Test stopped at jack capacity (20 tons). No distress of either concrete or insert.
Shockey P8341 PB	B	Corner	3/4" HH Nut welded to 1/2 x 6 x 6 plate. No pipe insulation. 4 - 1/2 x 5 HA Studs 2 - #3 Hairpins	6,800	32,000	Slow ductile concrete failure.	No pipe insulation to absorb any load misalignment.
Shockey P8341 PB	C	Interior	Same as B (except no hairpins)	8,100	38,500	No Failure	Test stopped capacity (20 tons) at jack
Shockey P8791PA	D	Corner	1" dia coil insert c/w pipe insulation. 1/2 x 6 x 6 plate. 2 - 1/2 x 6 HA Studs. 2- #4 L & 1 #8 H'pin	7,500	35,300	No Failure	Damaged test beam. (Bent bottom flange) Test was stopped. No distress of sample.
Test Blk.	Special	N/A	3 Standard Washers 3/4, 1 1/8, 1 3/8. High Concrete Sleeve	8,000	37,700	Washers yielded (dished)	Washers held load up to 20 kips. Then kept yielding as load was increased.

HOCKEY BROS., INC.

Prestressed Precast Concrete

P.O. Box 2530 Winchester, Virginia

SUBJECT INSERT TEST  
CONC. STRENGTH

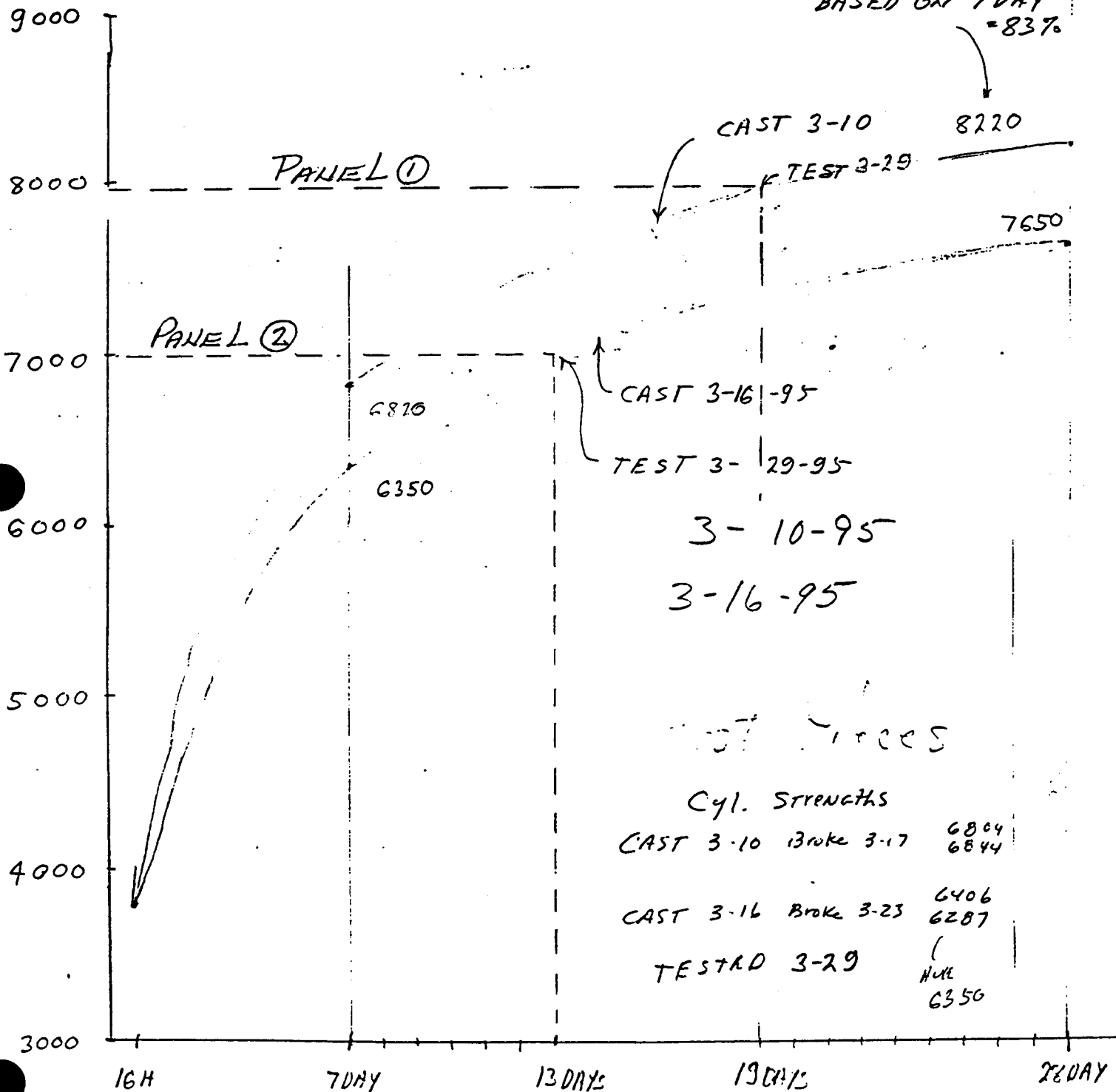
SHEET NO. 1 OF 1

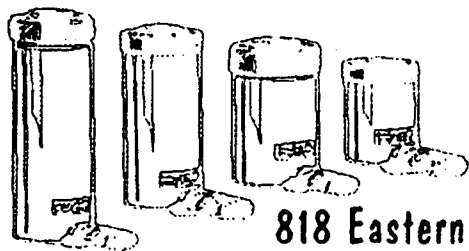
JOB NO. \_\_\_\_\_

BY GH DATE 3-29-95

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

PROJECTED  
BASED ON 7 DAY  
= 83%





# Hydraquip Sales & Service

818 Eastern Avenue, Unit 2, Toronto, ON, M4L 1A1

## Calibration Test Certificate

=====

Customer: Paton Steenson Associates  
Gauge Description: Enerpac Gauge 0-10,000 psi, serial G93-496

=====

Standard Used: Mansfield & Green, Type #R-50  
Dead Weight Serial #: 1315  
Dead Weight Accuracy: 0.1%

=====

**\*\*Note:** Instruments have been tested against a dead weight tester serial # as above, which is traceable to the National Research Council in Ottawa, as per their report # 722.0329, dated August 18, 1989.

Hydraquip Sales & Service Ltd. certifies that the below item(s) have been tested to comply in every way with the requirements of the above purchase order.

=====

Master Test Gauge	Above Gauge
-------------------	-------------

1000 PSI	1000 PSI
3000	3000
5000	5000
7000	7025
9000	9025

Date Tested: Dec 6, 1993  
Technician: Pat Mahon

Phone 416-461-3573 Fax 416-461-2979  
Out of town callers 1-800-463-4168

## PHOTOGRAPHS - 1



Fig. 1 Test Set-Up for Interior Test - (Test No. 2)



Fig. 2 Test No. 2 - (24,400 Lbs.) No stepped hairpins



Fig. 3 Test No. 3 - (30,600 Lbs.) Corner with 2 Hairpins



## PHOTOGRAPHS - 2



Fig. 4 Test No. 5 - Test Bolt Threads stripped at 27,700 Lbs.



Fig. 5 Test No. B - 3/4" Ferrule at Corner - Concrete failed at 32,000 Lbs.

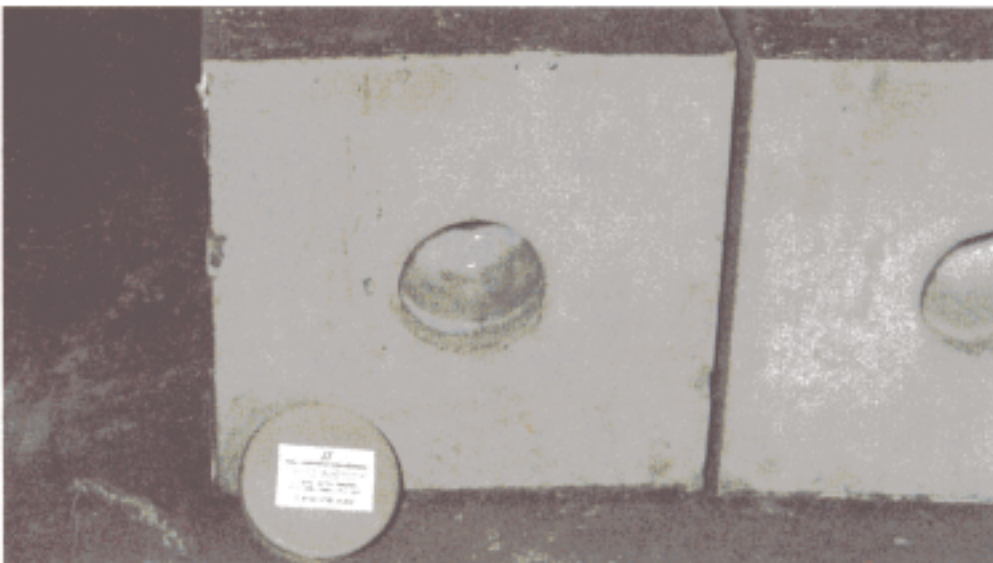


Fig. 6 Test Block with Plastic Connector Sleeve (High Concrete Accessories)



### PHOTOGRAPHS -3

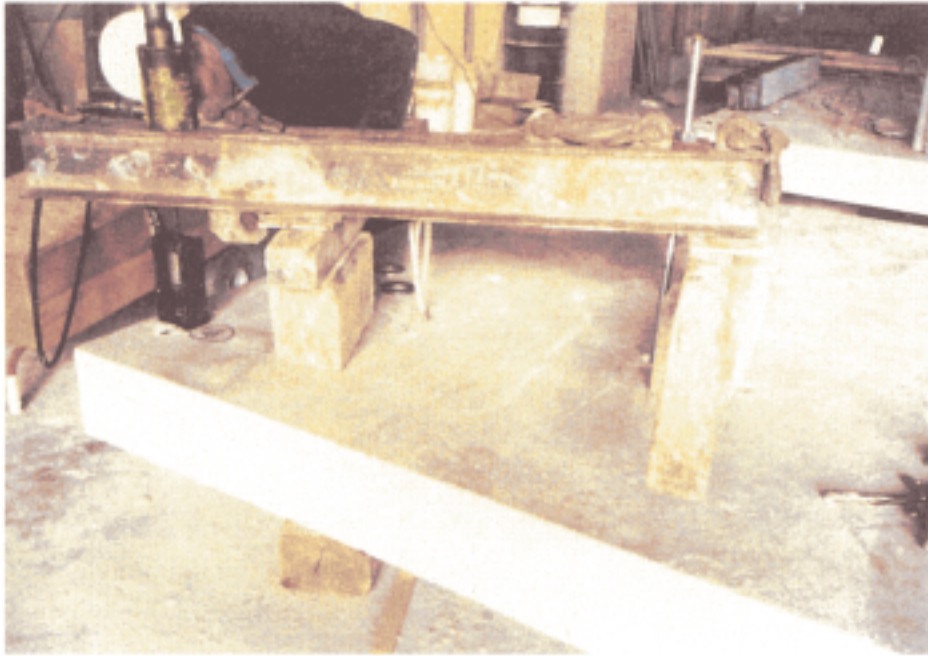


Fig. 7 Test Set-Up for Corner Test



Fig. 8 Test No. 4 - (29,400 Lbs.)  
Corner Test with 2 Hairpins

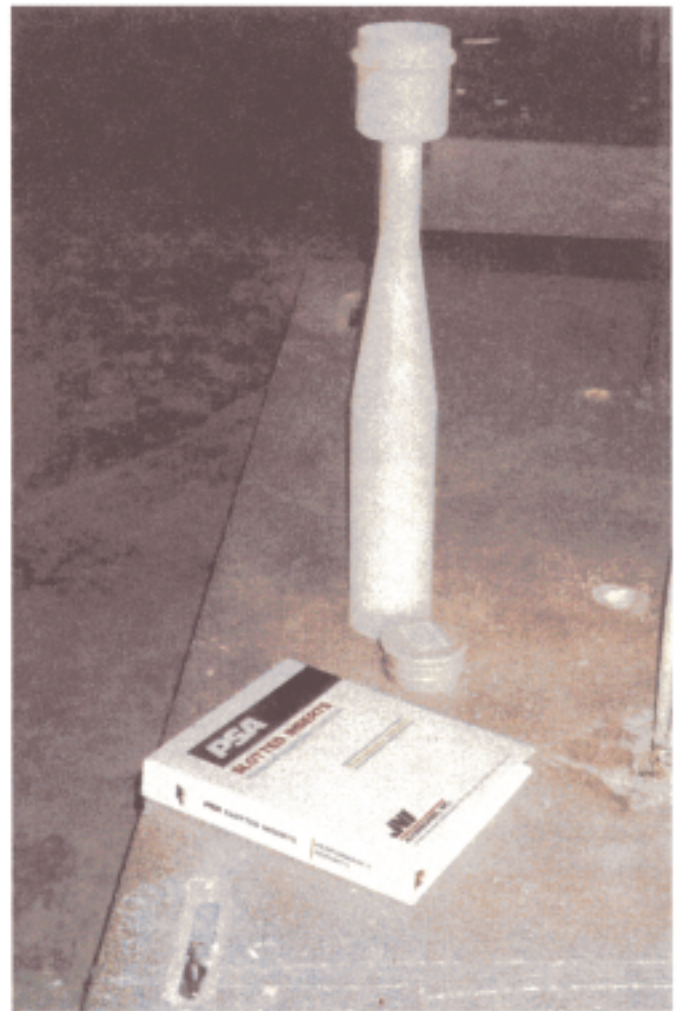
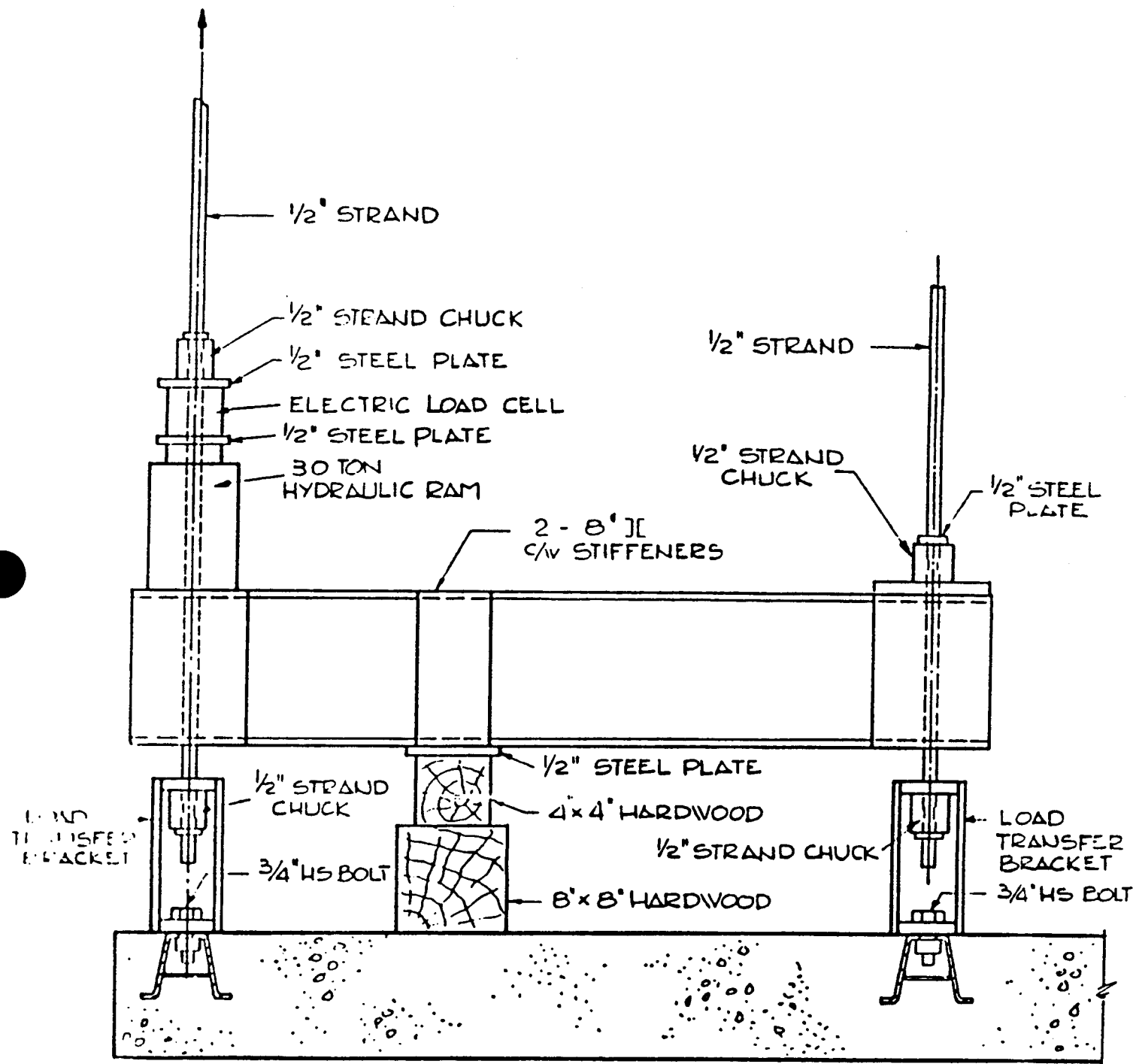


Fig. 9 Connector Sleeve - Column to Spandrel  
(High Concrete Accessories)



TEST SET-UP  
FOR EDGE TESTS

FIG. 10

(2) ① BACK END 5 1/2"

PANEL - 1

SKETCH - 1

HOCKEY BROS., INC.

SUBJECT

BW1

Prestressed Precast Concrete

P.O. Box 2530 Winchester, Virginia

8" TEST PANEL w/  
PSA INSERTS

SHEET NO.

1

OF

JOB NO.

2946

BY

WAR

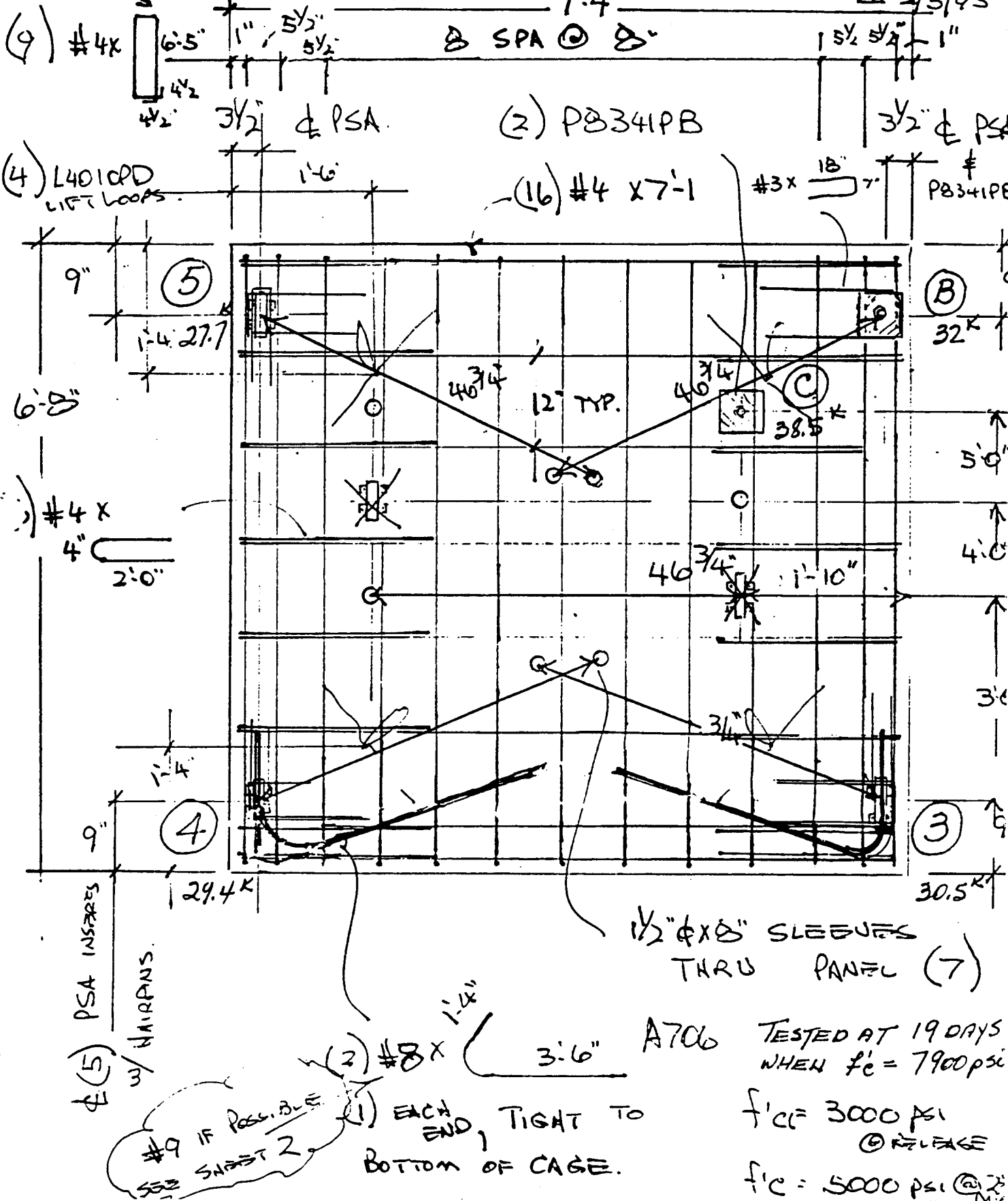
DATE

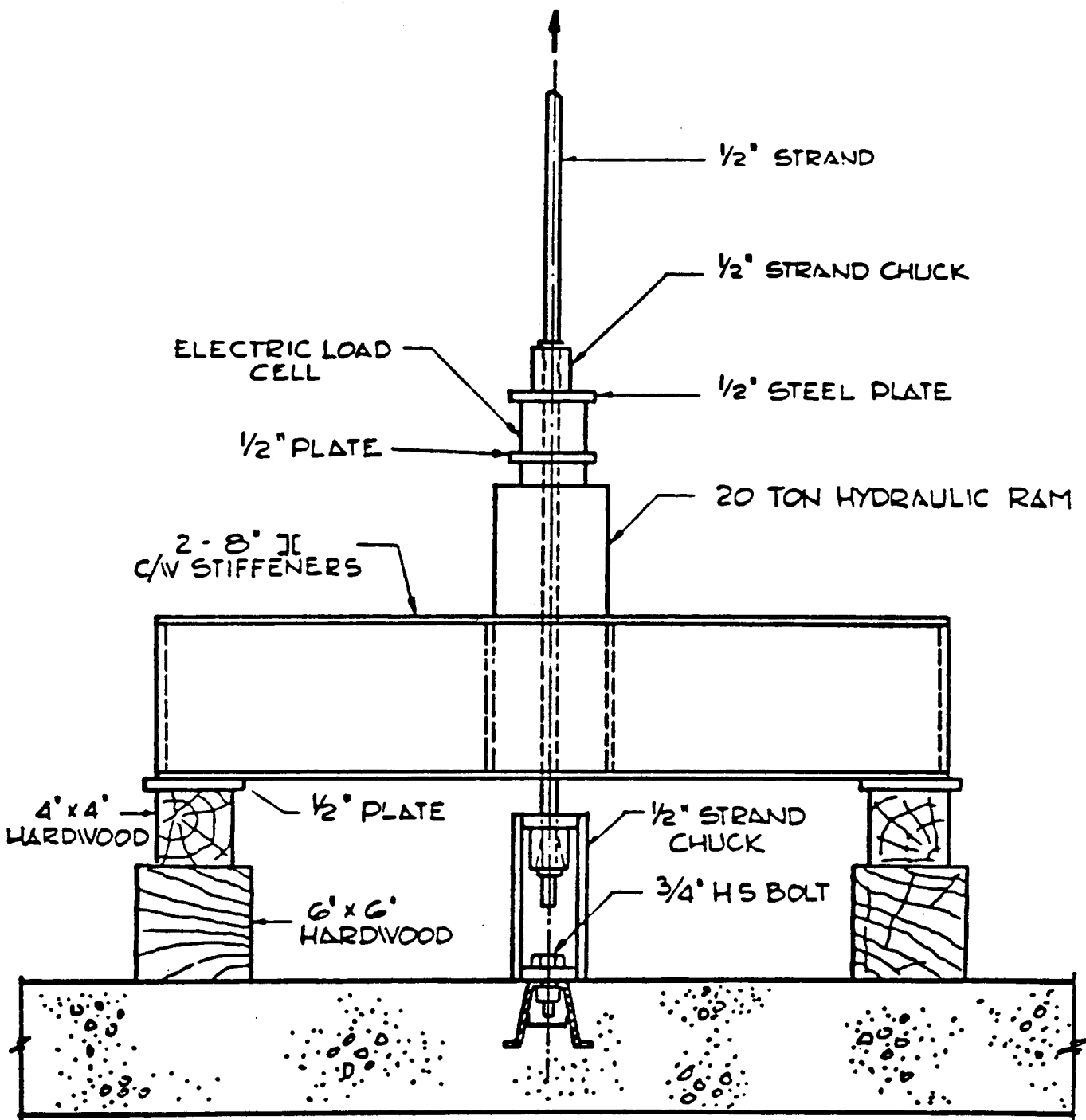
1/30/9

CHKD. BY

DATE

2/3/95





**TEST SET-UP**  
FOR PULLOUT TESTS

FIG. 11

HOCKEY BROS. INC.

Prestressed Precast Concrete

P.O. Box 2530 Winchester, Virginia

SUBJECT REINFORCEMENT

FOR TESTS (3) & (4)

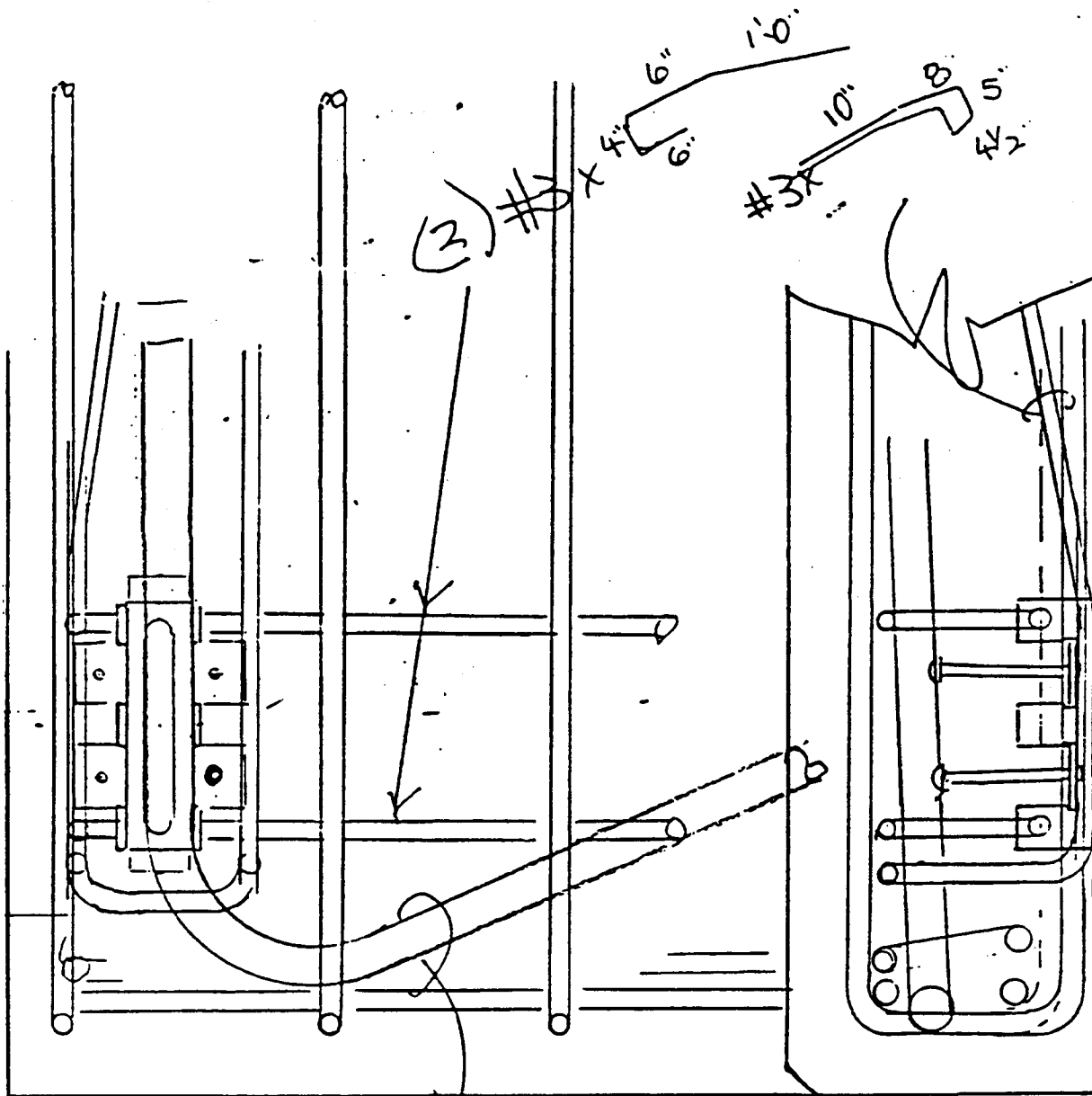
SKETCH - 2

SHEET NO. 2940 OF 1

JOB NO. VAR

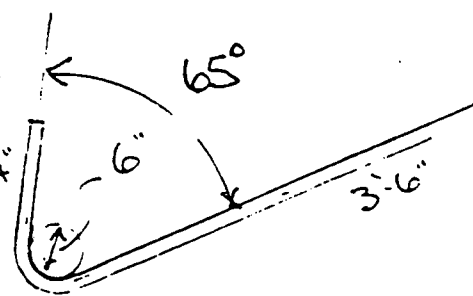
BY VAR DATE 3/11

CHKD. BY VAR DATE 3/11



TEST (3) & (4)

#8 x 1 1/4"  
G260



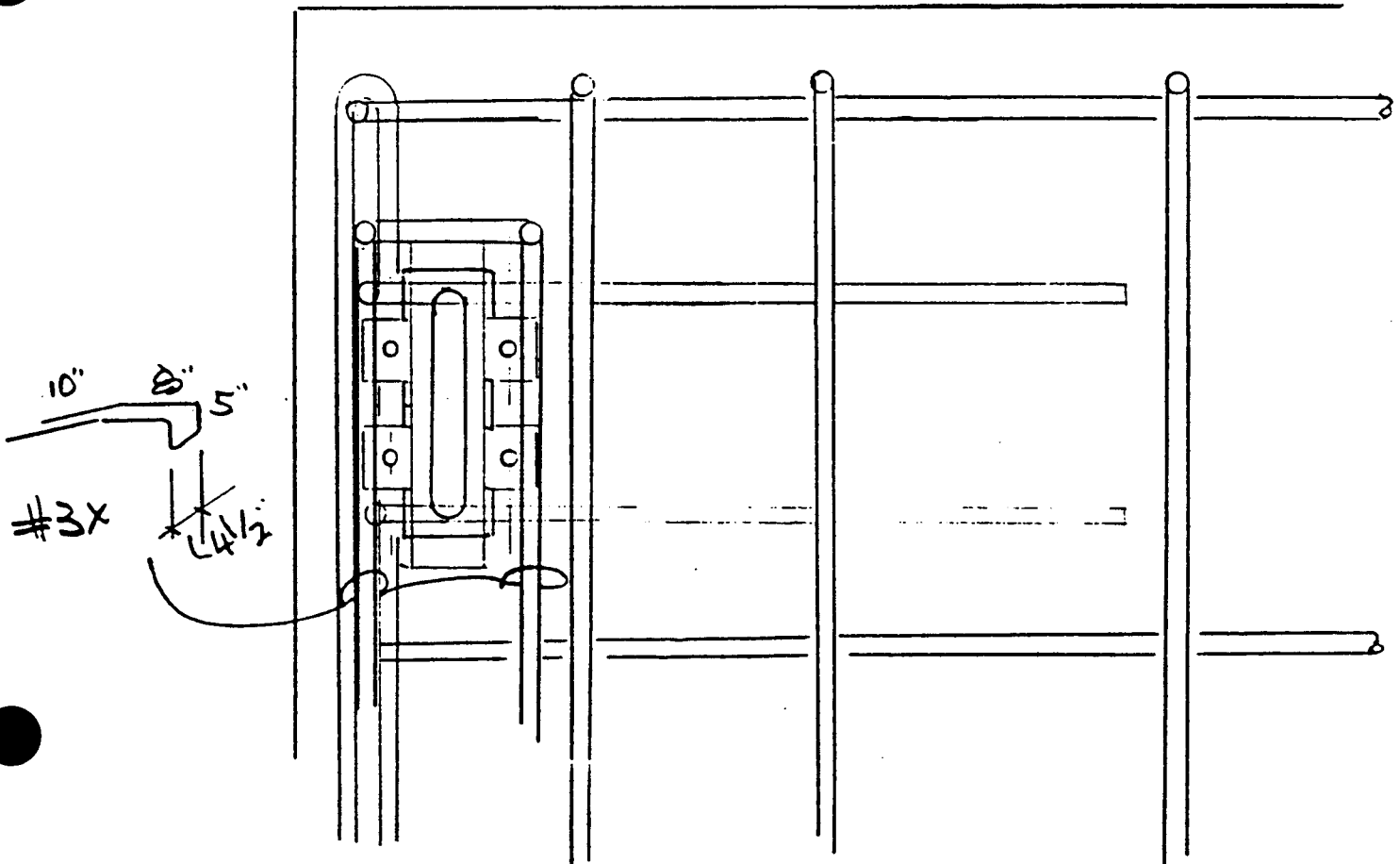
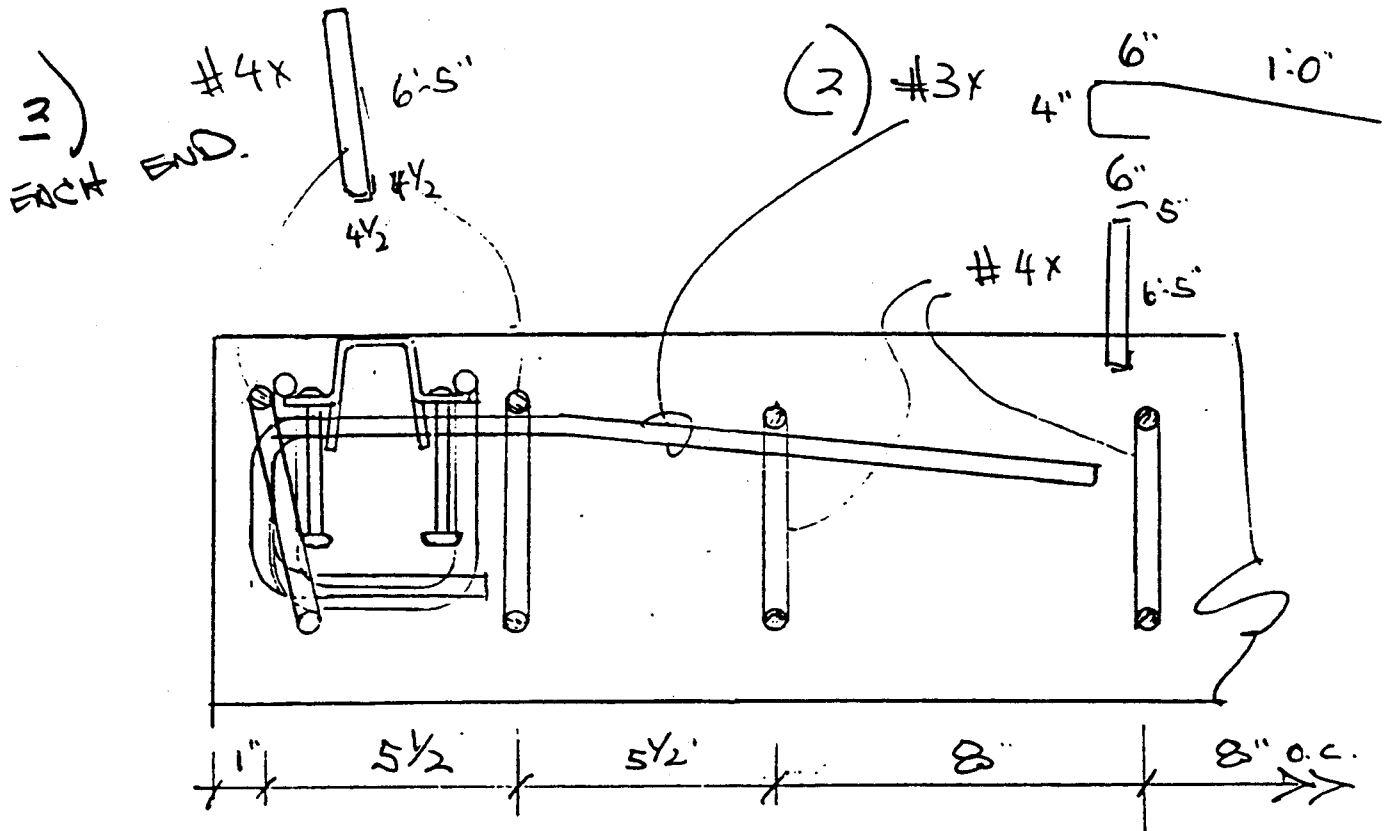
Jim  
Nesselrod

(#9 IF BEND & CAN BE HELD)  
A700

2530 Winchester, Virginia

FOR TESTS (1) & (5)

SHEET NO. 2946 OF 311/95  
JOB NO. WAR  
BY WAR DATE 3/11/95  
CHKD. BY WAR DATE 3/11/95



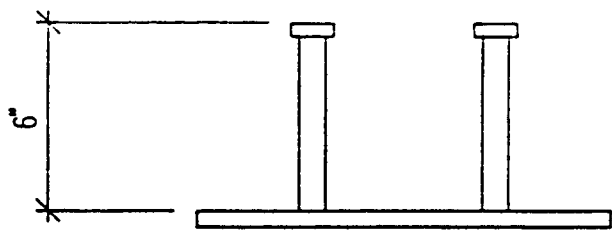
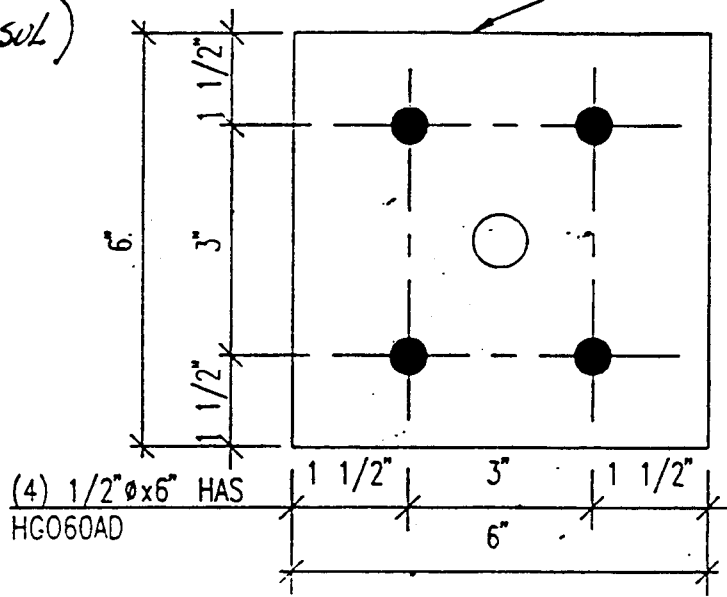


TEST (A) & (D)

w/8791 PA

(1"φ COIL + INSUL)

PL 1/2"x6"x 0'-6" (A36)  
w/(1) 1 1/8"φ HOLE CENTERED



NOTES:

THESE DOCUMENTS--SHOP DRAWINGS, PLANS, SPECIFICATIONS ARE THE PROPERTY OF SHOCKEY BROS., INC. AND MAY NOT BE USED, REPRODUCED OR UTILIZED WITHOUT THE EXPRESS WRITTEN CONSENT OF SHOCKEY BROS., INC.

NUMBER REQ'D.

390

JOB NO. 2938-1245

P9603GA

DRAWN BY JBS

APPROVED BY GH 8-12-94

SHOCKEY BROS., INC.

P.O. BOX 2530 703-667-7700  
WINCHESTER, VA.  
22604



A Hard Hat to Top!

WHERE USED RFA & PFA PANELS  
REVISED

CHECKED BY GH

DATE 12 8/4/94

CIRCLE ONE A S



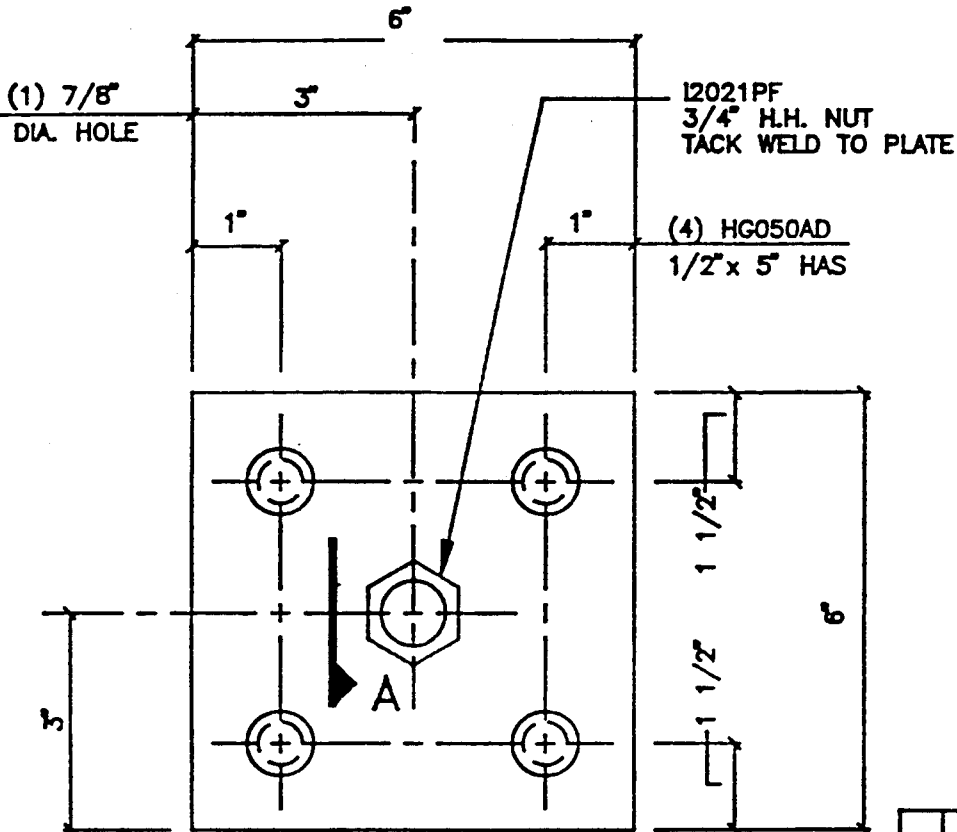
# RETRIEVAL DESCRIP.

# NOTE

P8341PB

THIS ITEM USED :  
SPANDREL TO COLUMN CONNECTION

TESTS (B) & (C)



## SECTION A

1	I2021PF
1	HB030AF
4	HG050AD
1	P8340PA
QTY.	CAT. NO.
BILL OF MATERIAL	

STANDARD MATERIAL DETAIL :

PL 1/2" x 6" x 0' - 6"  
w/ 3/4" NUT SPAN'L TO COL

P8341PB

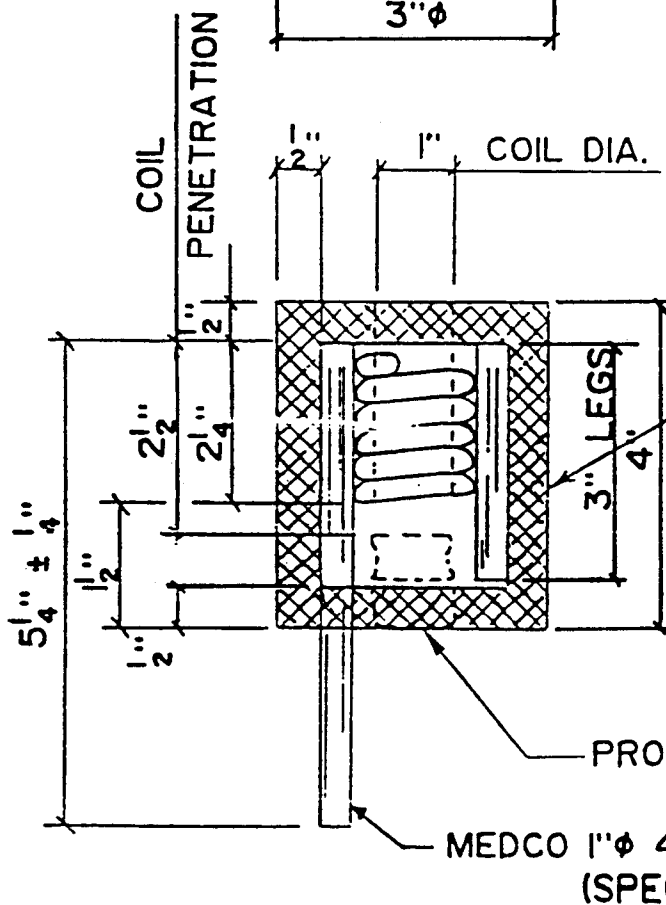
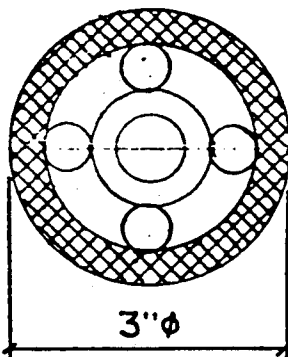
# RETRIEVAL DESCRIPT.

# NOTE

P879IPA  
1"φ 4 STRUT COIL  
INSERT

SERVICE LOADING, TMAX=25.0 K  
ERECTION LOADING, TMAX=37.5 K

USED IN  
TESTS (A) & (D)



TAPPE 1 5/8"  
PIPE INSULATION  
ALL AROUND  
HP040PM

DETAIL: 1"φ 4 STRUT COIL INSERT

P879IPA

HOCKEY BROS. INC.

SUBJECT

BW1

Prestressed Precast Concrete

P.O. Box 2530 Winchester, Virginia

SHEET NO.

OF

JOB NO.

2946

BY

WJR

DATE

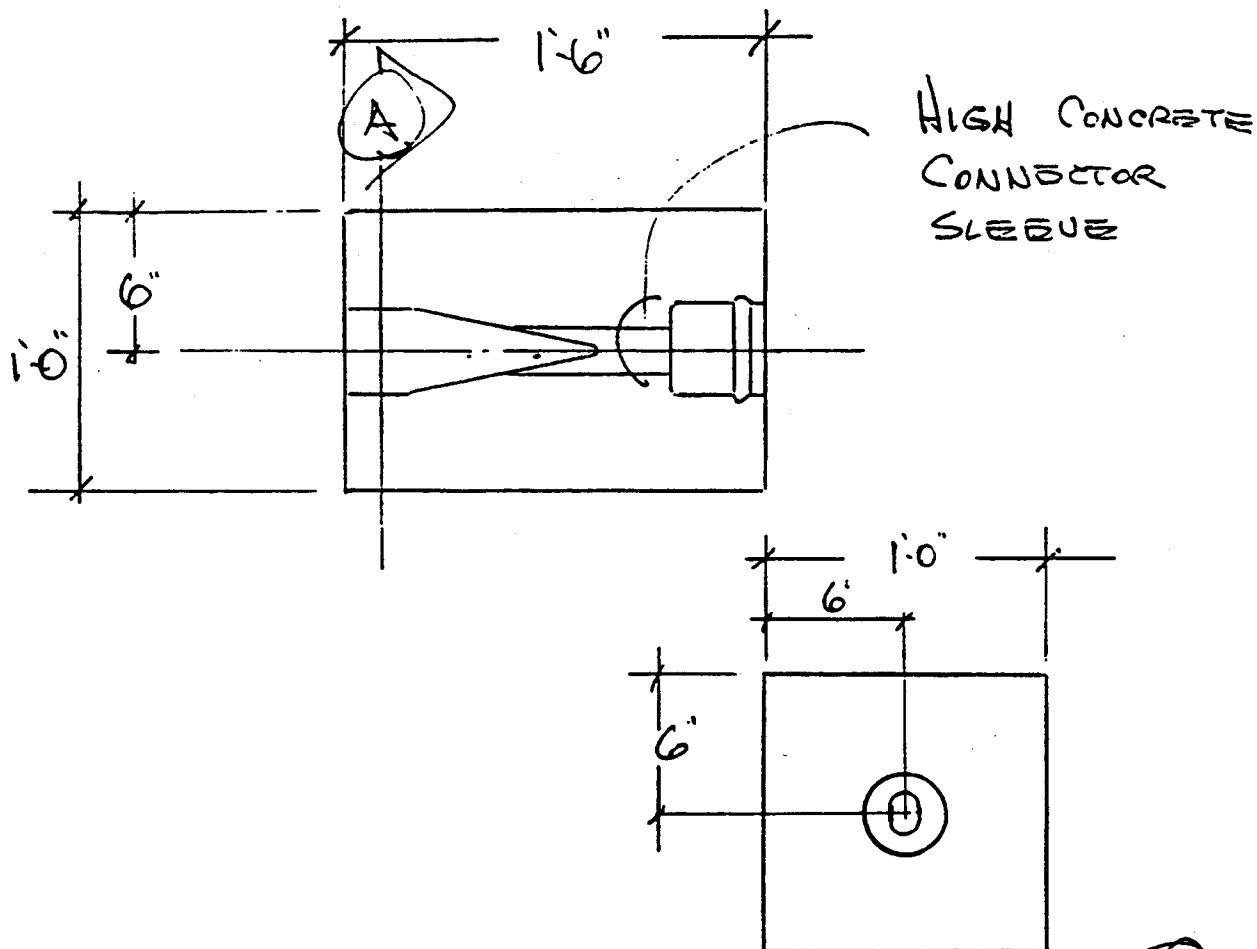
1/30/95

CHKD. BY

DATE

LOAD TEST MOCKUP UNITS

COLUMN SLEEVE ANCHORAGE LOAD TEST.



A