FLEXIBLE SUPPORT TEST PROCEDURE AND RESULTS

C.H. Kurita

D-Zero Engineering Note: 3740.210-EN-112

December 4, 1987

Approved: ______________________

INTRODUCTION

Upon completion of the fabrication process, the four central calorimeter cryostat flexible support assemblies were sent to Construction Technology Laboratories (CTL) in Skokie, Il., where the required tests were performed for Richmond Lox prior to the installation of the stanchions in the cryostat. These tests were to simulate the simultaneous axial and transverse loading experienced by the stanchions when the cryostat undergoes the cool down process.

TEST PROCEDURE

Hydraulic jacks and load cells were used to produce the necessary loads and deflections for the tests. Each stanchion was individually tested using the procedures as stated in DWG.3740.210-MC-222268 Rev. C.

The stanchion was horizontally mounted and the bottom of the assembly fixed so that the plates were positioned normal to the load cell and hydraulic jack combination. A sketch of the test set-up can be found in the appendix. With no axial load applied, the top plate was then deflected 0.25 inches vertically, and the force required to effect this deflection was recorded using a computer operated data acquisition system. The linear potentiometer used to measure the deflection can be seen in figure 1.

After recording the force necessary to produce the 0.25 inch deflection, the vertical load was removed. Figure 2 shows the positioning of the stanchion prior to the second phase of the test procedure. The stanchion was then loaded axially with a 200,000 pound force produced by a second hydraulic jack/load cell combination. The top plate was again deflected 0.25 inches and the required force recorded by the computer. Figure 3 shows the flexible support assembly in the deflected position. The deflection can be observed by noting the slope of the plates as compared to the horizontal tie rod. In the original position, the plates and tie rod were parallel to each other. Figure 4 shows the stanchion returned to its original position.

Upon removing all applied load and dismounting the assembly, the stanchions were visually examined for any permanent damage which may have occurred during the testing.

TEST RESULTS

The measured forces required to effect the 0.25 inch deflection in each of the four stanchions can be found in Table1 of the Appendix.

The resultant forces that were required to produce the same 0.25 inch deflection but with the additional 200,000 pound axial load applied can be found in Table 2 of the Appendix. The calculated value was 33,200 pounds. (See attached calculations done by R. Luther.) The average measured value had a 12.4% deviation from the calculated value.

A residual deflection of zero at zero load for each of the four stanchions after the second test indicates that there was no permanent deformation of the structure. Upon visual inspection, there were no cracks or broken braze joints observed in specimens number 1, 2 and 4. It was noted that there were small cracks at the base of three plates on specimen three. However, these cracks were not in the braze joints but in the welds that had been made as a part of the brazing process and had been present before the testing occurred. They did not seem to be further aggravated by the testing procedure.

CONCLUSION

The testing done by CTL produced satisfactory results as demonstrated by the measured values of required forces and the lack of any permanent deformations to the flexible foot assemblies. After the testing procedures were completed, the stanchions were returned to Richmond Lox where they were then installed in the CC cryostat.

FIG 1

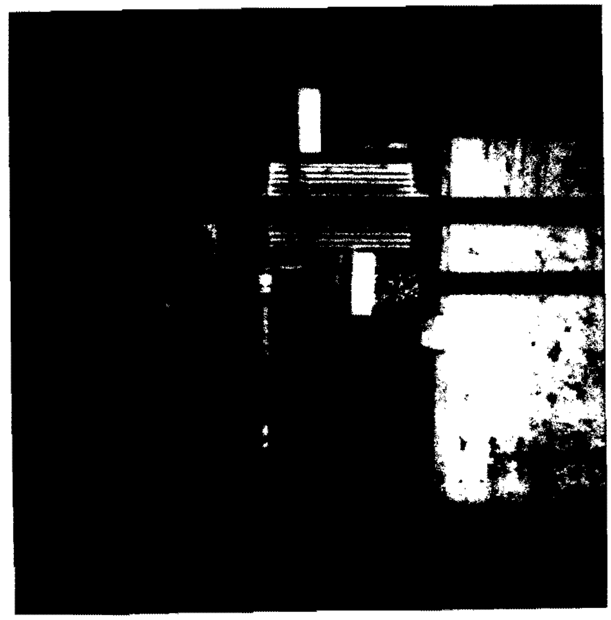


FIG 2

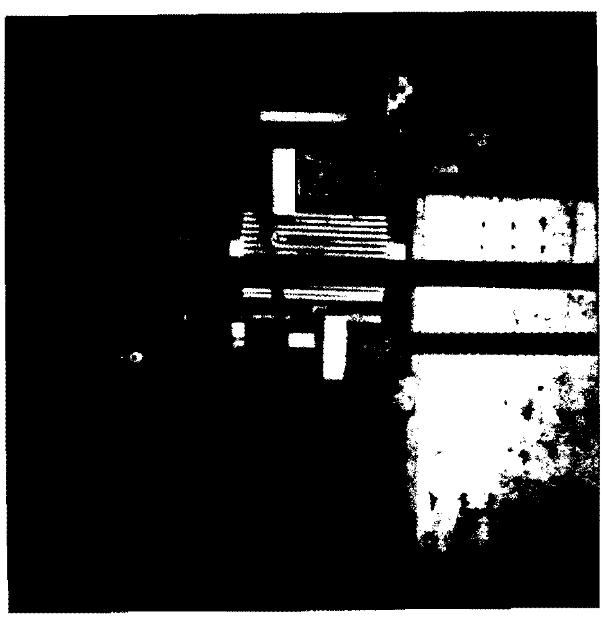


FIG 3

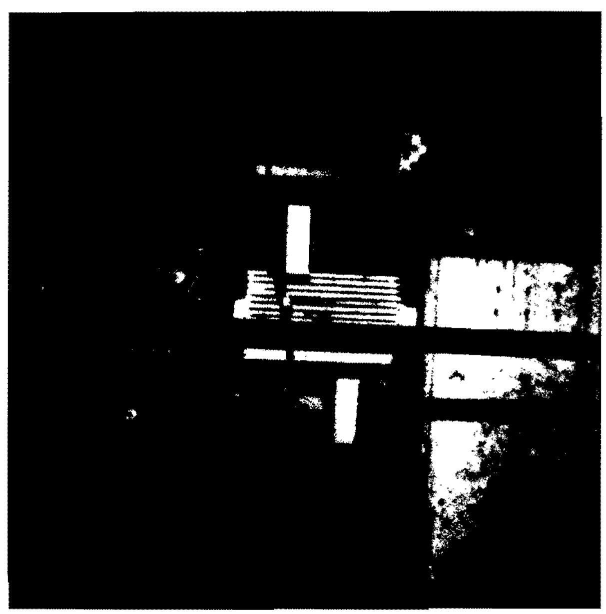
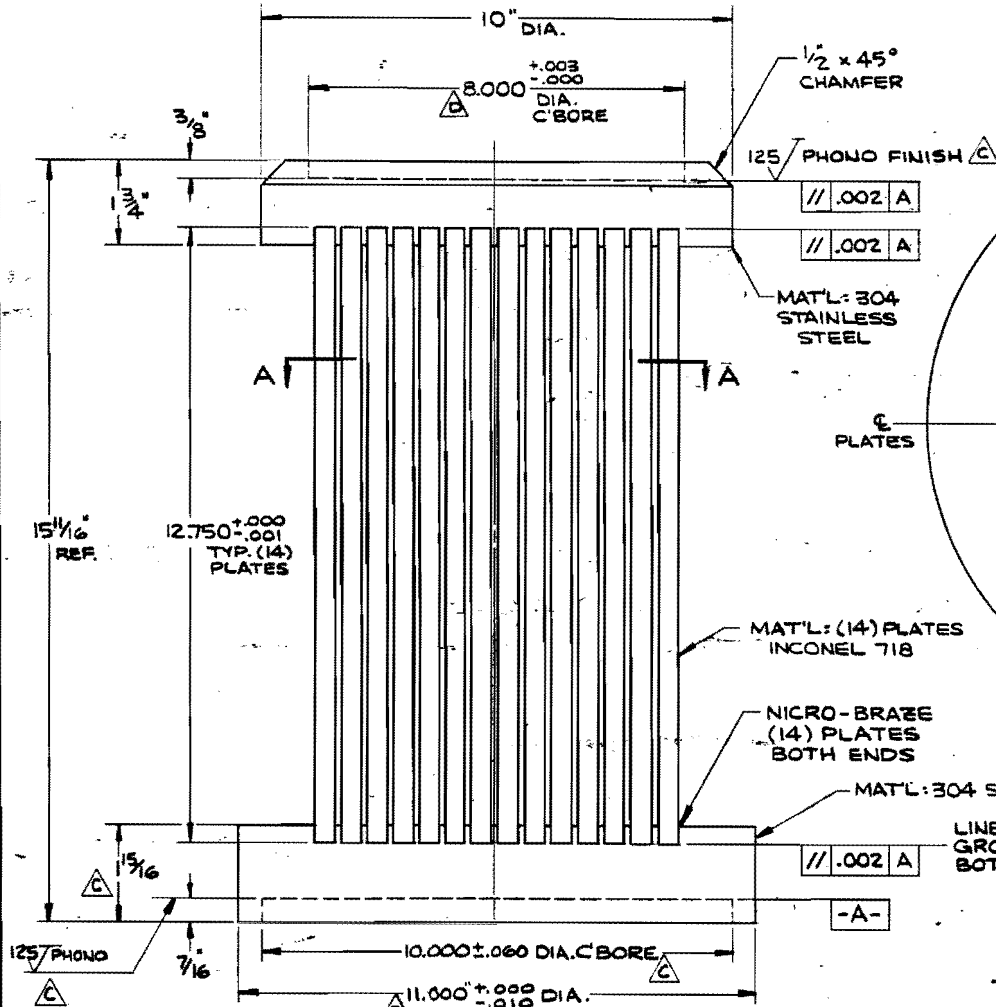
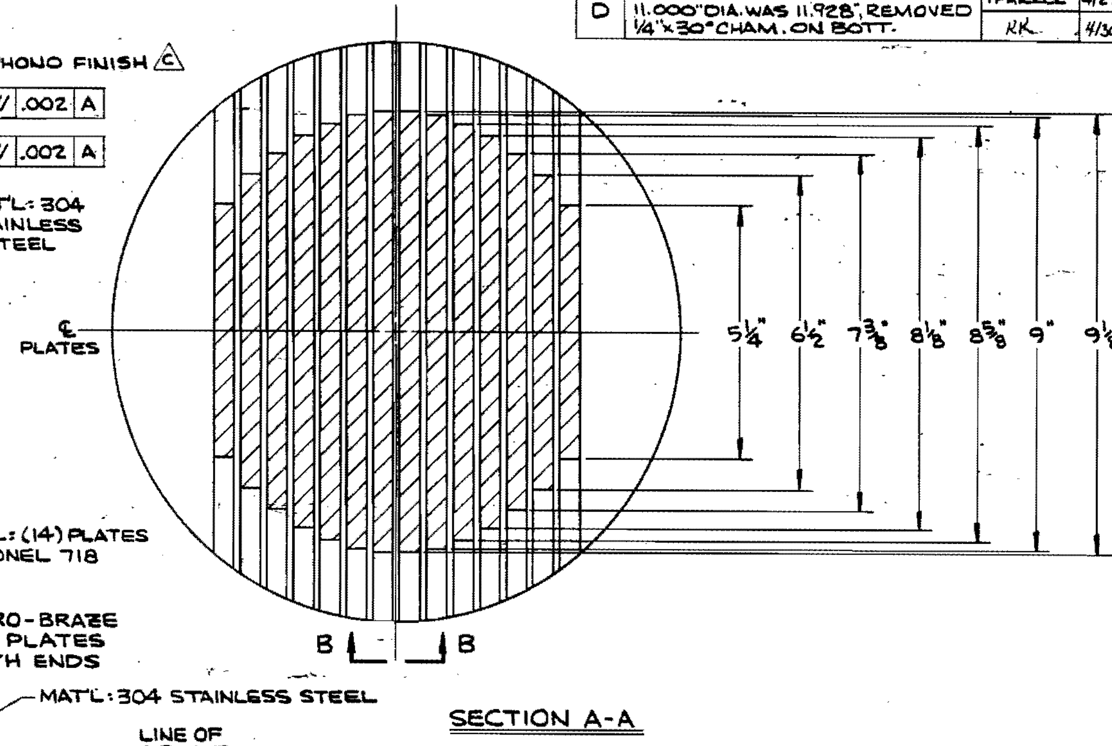


FIG 4

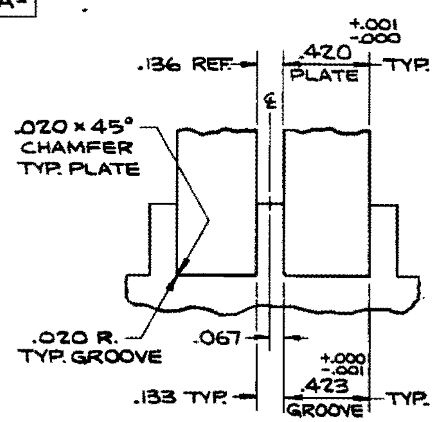
FIG 5

REV.	DESCRIPTION	DRAWN / APPD.	DATE / DATE
A	REDRAWN	C.REID	2-21-86
B	REDRAWN	J.BRANDT	9-16-86
C	125 PHONO FINISHES WERE 63 1 5/16 R. WAS 1 1/2", ADDED 10" C'BORE & 30° CHAMFER, MAX. SURFACE FINISH WAS 32	T.PARKER	11-21-86
D	8.000" C'BORE WAS 7.000", 11.000" DIA. WAS 11.928", REMOVED 1/4" x 30° CHAM. ON BOTT.	TPARKER / KK	4/27/87 / 4/30/87





SECTION A-A



VIEW B-B
2x SIZE

THE FOLLOWING TESTS SHALL BE PERFORMED AND DOCUMENTED FOR EACH FLEXIBLE SUPPORT ASSEMBLY:

1) WITH NO AXIAL LOAD ON THE ASSEMBLY AND WITH THE BOTTOM OF THE ASSEMBLY FIXED, THE TOP PLATE SHALL BE DEFLECTED .25"±.01" HORIZONTALLY IN A DIRECTION NORMAL TO THE VERTICAL PLATES. THE FORCE REQUIRED TO EFFECT THIS DEFLECTION SHALL BE RECORDED.
2) THE ASSEMBLY SHALL THEN BE LOADED AXIALLY WITH A MINIMUM FORCE OF 200,000 LB. AND THE TOP PLATE SHALL AGAIN BE DEFLECTED .25"±.01" AND THE REQUIRED FORCE RECORDED.
3) THE ASSEMBLY SHALL THEN BE VISUALLY EXAMINED FOR CRACKS, PERMANENT DISTORTIONS, AND BROKEN BRAZE JOINTS.

ITEM NO.	PART NO.	DESCRIPTION OR SIZE	QTY. REQ.
		PARTS LIST	

UNLESS OTHERWISE SPECIFIED				
FRACTIONS ± 1/64	DECIMALS ± .005	ANGLES ± 1°	ORIGINATOR	K.KREMPETZ
			DRAWN	C.REID 2-21-86
			CHECKED	R.D. Luther 11-25-86
			APPROVED	[signature] 11/25/86

1. BREAK ALL SHARP EDGES 1/64 MAX.
2. DO NOT SCALE DWG.
3. DIMENSIONING IN ACCORD WITH ANSI Y14.5 STD's.

125 MAX. ALL MACHINED SURFACES

USED ON: MD-223885, 3740.214-ME-223235

MATERIAL- AS NOTED

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

DØ DETECTOR
CENTRAL CALORIMETER CRYOSTAT
FLEXIBLE SUPPORT ASSEMBLY

SCALE	FILMED	DRAWING NUMBER	REV.
1/2 SIZE		3740.210-MC-222269	D

CTL
construction technology laboratories, inc.
5420 Old Orchard Road, Skokie, Illinois 60077-4321 • Phone 312/965-7500

September 9, 1987

SEP 14 1987
R-L.E. DELPHI

Mr. Lyle D. Holsinger
Richmond-Lox Equipment Company
P. O. Box 198
Delphi, Indiana 46923

Results from Tests on Fermi Flexible Support Assemblies

Dear Lyle:

The purpose of this letter is to document the testing of four (4) DO Detector Central Calorimeter Cryostat Flexible Support Assemblies. The tests were performed by Construction Technology Laboratories, Inc. for Richmond-Lox Equipment Company.

OBJECTIVE

The objective of these tests was to determine the horizontal load required to deflect the support assemblies 0.25 in. Two phases of testing were performed on each of four (4) assemblies. The assemblies were not loaded axially during the first phase of testing. An axial load of 200,000 lb was applied during the second phase of testing.

TEST PROCEDURE

Test procedures detailed on Fermi National Accelerator Laboratory drawing number 3740.210-MC-222269 Rev. C were used. The procedures included:

1. With no axial load on the assembly and with the bottom of the assembly fixed, the top plate shall be deflected 0.25 ± 0.01 in. horizontally in a direction normal to the vertical plates. The force required to achieve this deflection shall be recorded.

2. The assembly shall then be loaded axially with a minimum force of 200,000 lb and the top plate shall again be deflected 0.25 ± 0.01 in. and the required force recorded.

3. The assembly shall then be visually examined for cracks, permanent distortion, and broken braze joints.

Horizontal and axial loads were monitored using load cells accurate to within 1.0%. A linear potentiometer accurate to within 0.001 in. was used to monitor deflection. Load readings were taken at several deflections up to and including 0.25 in. To determine residual deflection, a deflection reading was taken after unloading each support.

RESULTS

Using the procedures described herein, tests were performed on the support assemblies. Table 1 presents results from tests of support assemblies with no axial load. Table 2 contains results from tests with an applied axial load of 200,000 lbs. Load at 0.25 in. and residual deflection are presented in these tables.

VISUAL INSPECTION

Each specimen was visually inspected after the second phase of testing. No visual cracks or broken braze joints were detected on Specimens 1, 2, and 4.

Slight cracking at the base of three plates was detected on Specimen 3. These plates were located at the end with the 10 in. diameter circular plate. Figure 1 shows crack locations, loading direction, and a photograph of the cracks. The cracks were only visible at one end of the plates. No damage to the transverse welds was apparent.

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We were glad to be of service to you. If you have future additional testing needs, contact me at (312) 965-7500.

Sincerely,

Tim R. Overman

Timothy R. Overman
Engineer
Structural Development Section

TRO:cr

Copy to-
H. G. Russell
D. M. Schultz
A. Azizi
Central Files, CR9654/821
2628D

Table 1 - Deflections With No Axial Load

Specimen	Load at 0.25 in. Deflection (lb)	Residual Deflection at Zero Load (in.)
1	22,700	0.02
2	24,200	0.00
3	23,300	0.00
4	25,000	0.02

Table 2 - Deflections With 200,000 lb Axial Load

Specimen	Load at 0.25 in. Deflection (lb)	Residual Deflection at Zero Load (in.)
1	29,400	0.00
2	30,000	0.00
3	29,300	0.00
4	27,600	0.00

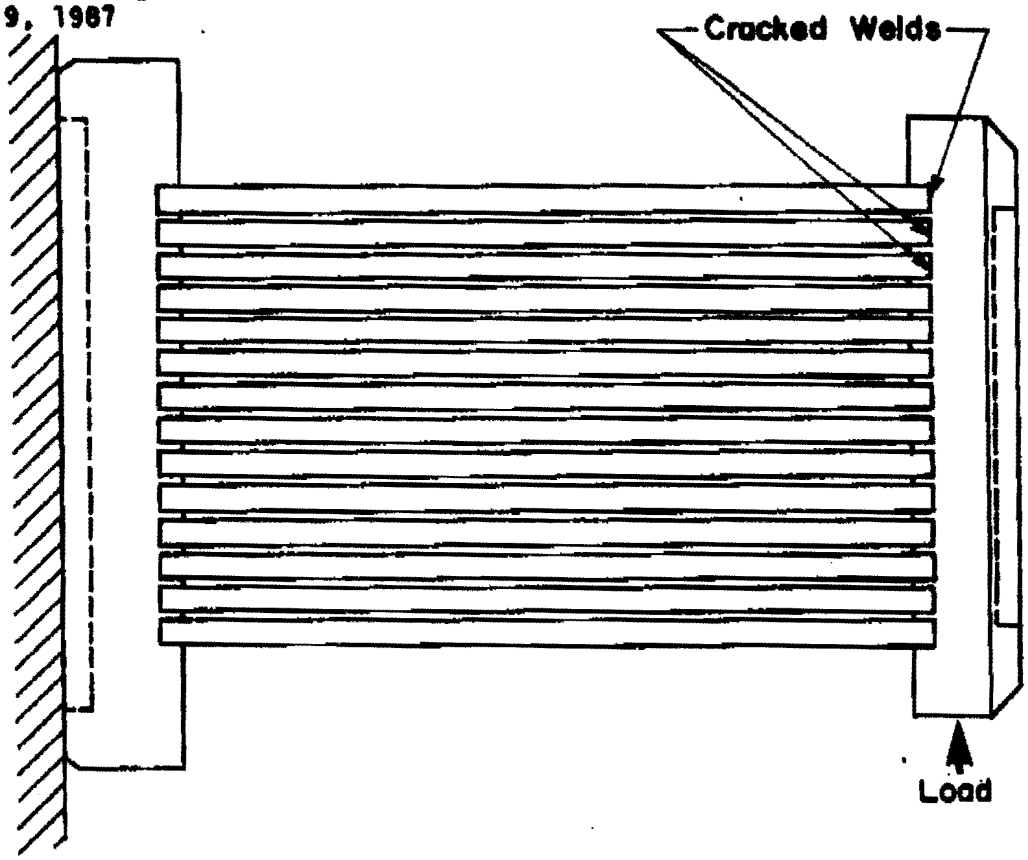

Figure 1 Crack Locations

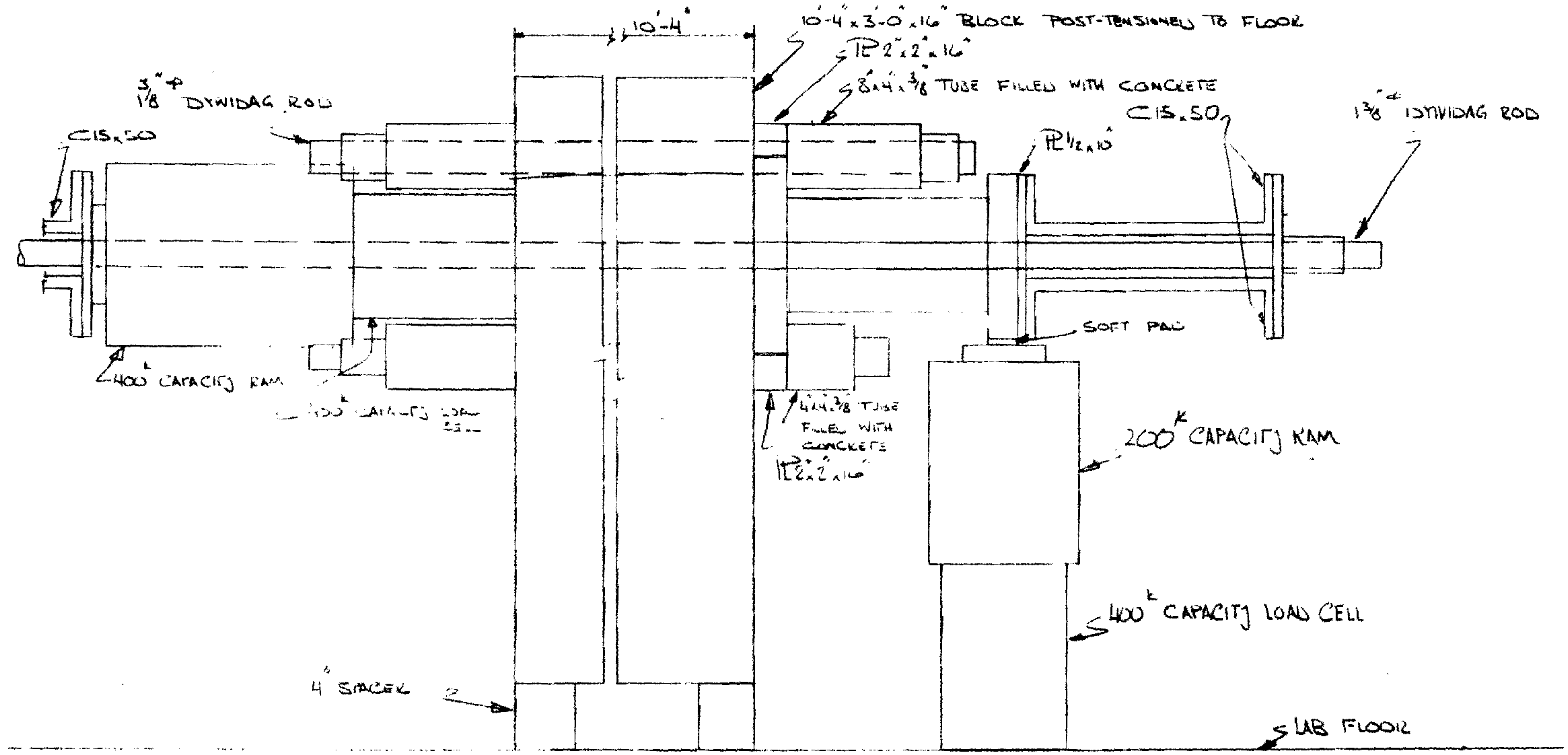

FIG. 1 LOADING HARDWARE

RDL

STANCHION STIFFNESS - CC

$E = 30 \times 10^6$; For Wide Plates $E = \frac{30}{1-\nu^2} = 33 \times 10^6$

$l = 12"$; $\delta = 0.25"$

USE ROARKE & YOUNG, TABLE 10, CASE 1b

No Actual Load $F_{LIT} = 22500\#$

200" Av $= 31000$

Perfect alignment:

$I = 0.667\ in^4$

$k = \left(\frac{P}{EI}\right)^{\frac{1}{2}} = \left[\frac{200000}{33 \times 10^6 (.667)}\right]^{\frac{1}{2}} = .0953$

$kl = .0953(12) = 1.1439$

$\tan \frac{kl}{2} = .6437$

$y = -.25 = -\frac{W}{kP}\left(2 \tan \frac{kl}{2} - kl\right)$

$W = \frac{.25(.0953)(200000)}{2(.6437) - 1.1439}$

$W = 33200\#$

$K = 33200 \times 4 = \underline{132800\ \#/in}$ for 0° MISALIGNMENT.

1° MISALIGNMENT:

$I = 0.743\ in^4$ $\quad k = \left[\frac{200^k}{33 \times 10^6 (.743)}\right]^{\frac{1}{2}} = .0903$; $kl = 1.084$; $\tan \frac{kl}{2} = .602$

$W = \frac{.25(.0903)(200^k)}{2(.602) - 1.084} = 37620\#$

$K = 37620 \times 4 = \underline{150500\ \#/in}$ for 1° MISALIGNMENT