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# Progress report on european column tests (CRC - Task Group 11 Meeting, March 1970).

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P. Marek

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EUROPEAN COLUMN STUDIES

PROGRESS REPORT ON  
EUROPEAN COLUMN TESTS  
(CRC - TASK GROUP 11  
MEETING, MARCH 1970)

BY

N. TEBEDGE  
P. MAREK  
L. TALL

FRITZ ENGINEERING LABORATORY HANDOUT No. 351.3

MEETING  
COLUMN RESEARCH COUNCIL  
TASK GROUP 11  
ST. LOUIS, MISSOURI

\* \* \*

PROJECT 351  
EUROPEAN COLUMN STUDIES

\* \* \*

MARCH 23, 1970

Minutes of the CRC Task Group 11 Meeting  
March 23, 1970, St. Louis, Missouri

- I. The meeting was called to order by Mr. D. Sfintesco, Chairman of Task Group 11, at 10:00 a.m., on Monday, March 23, 1970 at Washington University, St. Louis, Missouri.

Members of the Task Group present were:

- D. Sfintesco, CTICM, France, Chairman
- L. S. Beedle, Lehigh University
- W. A. Milek, Jr., AISC
- L. Tall, Lehigh University

Also present were:

- P. Marek, Investigator, Lehigh University
- R. Bjørhovde, CRC, Lehigh University
- N. Tebedge, Investigator, Lehigh University
- D. Hall, Bethlehem Steel
- R. Konyalian, Washington University
- B. T. Yen, Lehigh University

II. INTRODUCTION

Introductory remarks were made by Mr. Sfintesco, who then reviewed the minutes from the last meeting (Sept. 10,

1969, London). Mr. Tall moved for the approval of the minutes, which was seconded by Mr. Beedle.

### III. REPORTS

Mr. Tall presented a summary on the status of the studies. The experimental study on methods of heavy column testing methods was given by Mr. Marek, and Mr. Tebedge presented the test results of the Belgian columns.

#### A. Comparison of Testing Methods of Heavy Columns

Mr. Marek presented the five methods of column testing considered in this study. He recalled that the main purpose of column testing is to obtain the load-deflection curve which will then be used to establish a point on the column curve. The test results showed that the load-deflection curve was influenced significantly by the testing method used. With the use of hand-out sheets distributed during the meeting, included as a supplement to the minutes, he explained the features of each method with respect to the alignment, manner of loading and the time required for testing. Each method was identified using the designation proposed (with slight modifications) during the April, 1969 meeting at Philadelphia. It was pointed out that the method

FL 3 has not been used, as such so far, and is the one suggested by the Lehigh group as the method for future use.

The experimental results from the comparative study based on the seven column tests of U.S.12WF161, all with slenderness ratios of 50, was emphasized as being information of significant importance, especially as it is becoming necessary to have a correlation between past or even future test results. The summary of test results are shown on page 3 of the hand-out supplement.

#### B. Testing of European Columns

Mr. Tebedge gave a brief summary of the test program on the European shapes, such as the sources of specimen, the type of steel, column tests and supplementary tests.

Using color slides, a discussion was given on the instrumentation used to comply with the proposed requirement of testing method. It was pointed out that the use of automatic plotters has been found very effective.

The manner of taking initial measurements of cross-section along the length and out-of-straightness about both axes was described. For the Belgian columns all yield lines of the mill-scale due to cold straightening including the

proper locations were sketched, photographs were also taken in sequence along the length. It was pointed out that it was not possible for the British columns to detect any trace of the yield lines of mill scale since the surfaces of the specimens, as received, were very rusty.

The tests on the Belgian specimens have been completed, except for the full-size tension tests, and the results were presented. The results in a preliminary form are shown in pages 5 through 13 of the supplement. The following remarks were made on the column tests:

- no special difficulty was encountered to satisfy the required method of testing since some experience was gained from the comparative study
- for the Belgian specimens the tension tests and stub column tests showed a slightly lower yield stress level than the specified nominal value. See pages 5 through 9 of the supplement
- Since all columns were exceptionally straight, (page 10-14 supplement) it was found necessary to make a proper identification and location of yield lines due to cold-straightening [For example: column B-1-B-2-4 started bending in the same direction as the apparent out-of-straightness but finally buckled

in the opposite direction - this is probably due to cold-straightening (page 11 of supplement). It was also observed that the maximum deflection for this particular section did not occur at mid-height] - in general, more care should be taken to establish a static point near to the ultimate strength, especially for slender columns. (For example, page 13 of the supplement shows how the static point at the ultimate level was missed).

The British columns have been prepared and are now ready for testing and will be tested as soon as the testing machine is available.

In conclusion, the test results were shown as test points on the latest European Convention Curves - Proposal 3 and were compared to the proposal curves (page 14 and 15 of the supplement).

#### IV. DISCUSSION

##### Test Aspects

Mr. Tall emphasized how important it was to know about the cold-straightening details. The columns received were observed to have yield line patterns at isolated locations even though it was intended originally to test columns with



no cold-straightening. Mr. Sfintesco remarked that it was found impossible to satisfy that requirement due to practical considerations. Mr. Marek inquired if a sketch on yield lines was made prior to the shipment. In reply, Mr. Sfintesco said that it has been asked for but that he does not know how much has been done and when it might arrive. Mr. Milek asked if the yield lines were produced during the process of shipment. Mr. Tall thought that it was very unlikely since the columns were received in a very straight condition.

Mr. Tebedge raised a question regarding full-size tension tests on the European specimen. If the procedure used for light sections is extended to heavy shapes, it may be necessary to test the flange of 12 in. x  $1\frac{1}{2}$  in. under a machine with a capacity of over 1 million pounds. Mr. Sfintesco regarded these tests as necessary. Mr. Sfintesco promised to send some notes on the details and procedure for testing such full-size specimens after his return to France.

Mr. Sfintesco pointed out that the comparison should be made after all tests are completed, and asked when the test program will be completed. He informed that the second shipment of the German and Italian columns has already left France and should arrive any time. Mr. Tall estimated that, if the last shipment should arrive shortly, the results might be available by September, 1970.

Financial Aspects

Mr. Tall gave a brief description on the financial status and emphasized that the project is running out of money due to various reasons, such as, delay of arrival of specimens, extra residual stress measurements, extra instrumentations, extra costs on the preparation of specimens. He noted that almost three years had passed since the initial estimates were made. He estimated that another \$10,000 would be required to complete the study, and said that the NSF, European Convention and WRC would be approached for assistance.

Statistical Aspects

Mr. Tall mentioned that Mr. Cornell has sent a letter about this study and that he has a student available at the moment who would like to work on this subject for his M.S. Thesis. He would need to know soon of the availability of the European data since Mr. Cornell is leaving for one year. Mr. Tall has sent him the material presently available and asked Mr. Sfintesco if he has some more relevant material to send. It was emphasized that this was an excellent opportunity. Mr. Sfintesco said he would like to contact him before going back to France and will give the necessary

information required for Mr. Cornell's student to perform the study.

#### Membership

Mr. Sfintesco informed the group that he will no longer be the Chairman of the European Convention's Subcommittee 8.1 (but would remain a member) and suggested that the new Chairman, Mr. Carpena of Italy, be made a member of Task Group 11. Mr. Beedle suggested that Mr. Sfintesco propose this to the Executive Committee.

#### Meeting Place

Mr. Sfintesco suggested the next meeting place to be at Madrid, Spain, in September, 1970 simultaneously with the IABSE annual meeting.

#### Conclusion

Finally, the Chairman asked for further questions, and thanked the members for their attendance.

The meeting adjourned at 12:15 p.m.

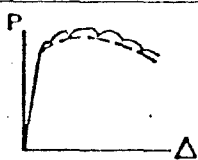
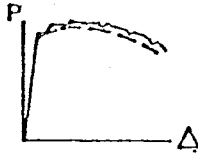
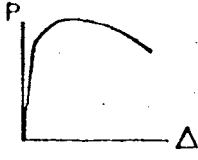
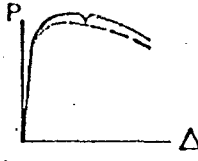
COLUMN TEST METHODS

<u>DESIGNATION</u>	<u>DESCRIPTION</u>
EC 1	EUROPEAN CONVENTION METHOD
EC 2	EC 1 MODIFIED BY L. U.
FL 1	FRITZ LABORATORY METHOD
FL 2	FL 1 WITH GEOMETRIC ALIGN.
FL 3	PROPOSED TESTING PROCEDURE




<u>DESCRIPTION</u>	<u>ALIGNMENT</u>	<u>MANNER OF LOADING</u>
EC 1	CENTER OF WEB	DYNAMIC
EC 2	CENTER OF WEB	INTERRUPTED DYNAMIC
FL 1	"ZERO DEFLECTION"	STATIC
FL 2	CENTER OF WEB	STATIC
FL 3	CENTER OF FLANGES	INTERRUPTED DYNAMIC

SUMMARY OF COMPARISON OF TESTING METHODS

**LOADING**

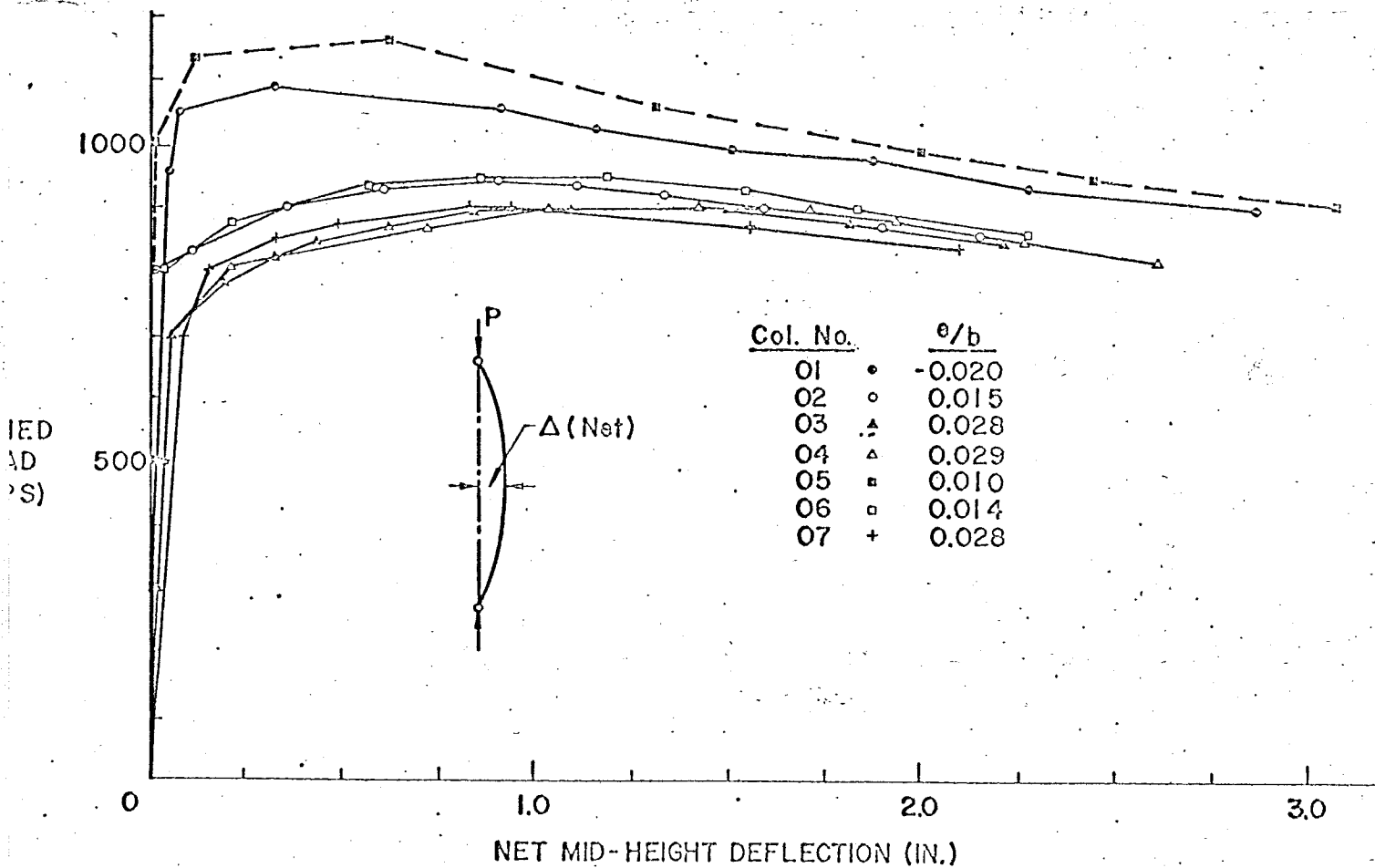
Method	Typical Column Curve	Loading	Testing Time	Accuracy of Static Curve	Remarks
FL 1		Static	4-5 hrs.	0.5 to 1.0% (for hydraulic testing machine)	- Time Consuming - Dynamic Curve not available except $P_{ud}$ .
FL 2		Static	4-6 hrs.	"Horizontal" approach 0.25-0.50% "Vertical" approach 0.5 - 1.0%	- Time Consuming - Dynamic curve not available except $P_{ud}$ - Slightly more accurate Static Curve.
EC 1		Dynamic	15-20 min.	Static Curve not available.	Static Curve not available.
EC 2		Semi-Dynamic	30-40 min.	0.5 - 1.0%	Only the ultimate Static Point available.

**ALIGNMENT**

Method	Aligning Time	Remarks
FL 1 	4-5 hrs.	5% max. deviation from uniform stress at three levels.
EC 1 	30 min.	Center of Web.
FL 2 	30 min.	Center of Flanges.

Col. No.	Method of Testing	Max. Initial Eccentricity (inch)		Rate of Loading (ksi/min)	Ultimate Load, P <sub>u</sub> (kips)	P <sub>ult</sub> / (P <sub>ult</sub> / Y) x 100	Mid-height at P <sub>ult</sub> (inch)	Remarks
		Weak Axis	Strong Axis					
01	FL 1	0.25	0.08	1.42	1154	84.6	0.52	Col. buckled opposite to initial curve.
				static	1084	79.5		
05	EC 1	0.13	0.035	1.42	1170	85.8	0.52	
04	FL 2	0.36	0.08	1.42	940	68.9	1.65	
				static	902	66.1		
02	FL 2	0.19	0.075	2.50*	1000	73.4	1.2	*Four different rates were tried 0.25, 0.50, 1.42, 2.50 ksi/min
				static	950	69.6		
06	FL 2	0.18	0.04	0.5	990	72.6	1.16	
				static	952	69.8	1.04	
07	FL 2	0.35	0.06	1.42	946	69.4	1.34	Load maintained
				static	900	66.0		
03	FL 2	0.35	0.11	1.42	968	71.0	1.54	Deflection maintained
				static	916	67.2	1.85	

SUMMARY OF TEST RESULTS



EXPERIMENT ON EUROPEAN SHAPES

SOURCE: BELGIAN, GERMANY  
GREAT BRITAIN AND ITALY

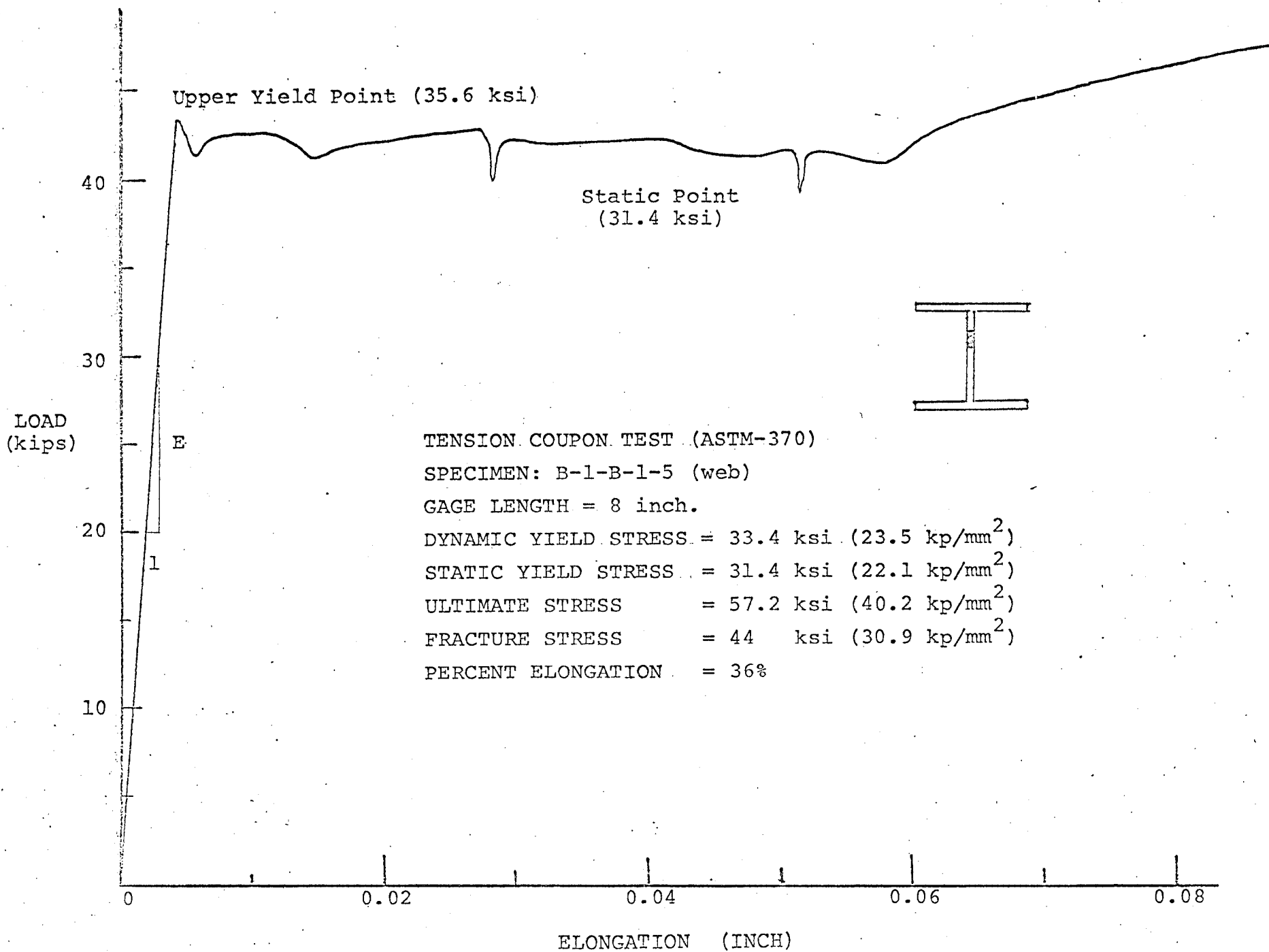
MATERIAL: TYPE - ST 37 (34.1 KSI)  
SHAPE - HEM 340 (EQUIVALENT TO  
U. S. 12 WF 161)

COLUMN TESTS

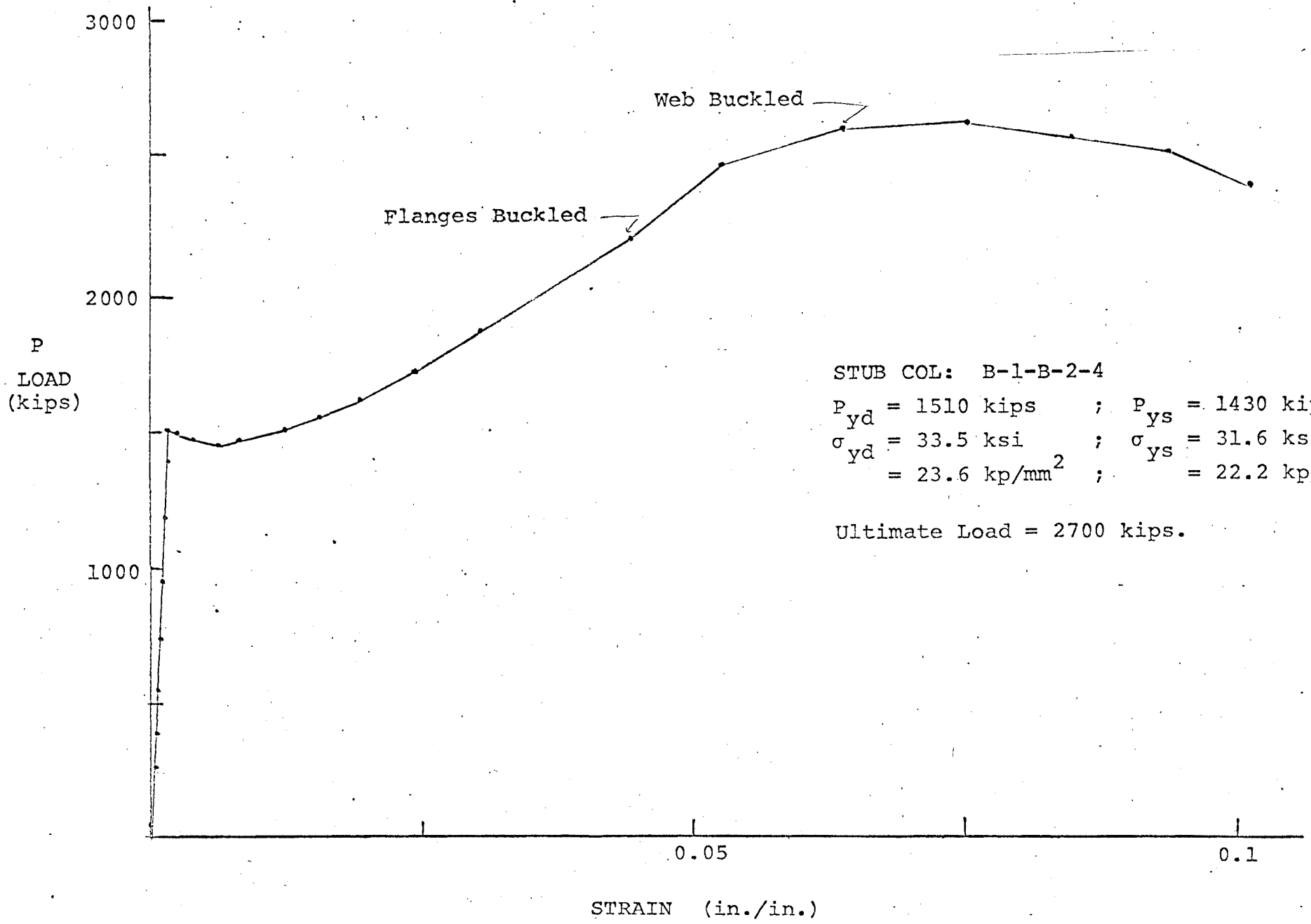
SLENDERNESS RATIO: 50 AND 95  
NUMBER OF COLUMNS: 8 PER SLENDERNESS RATIO  
METHOD OF TESTING: EC 2

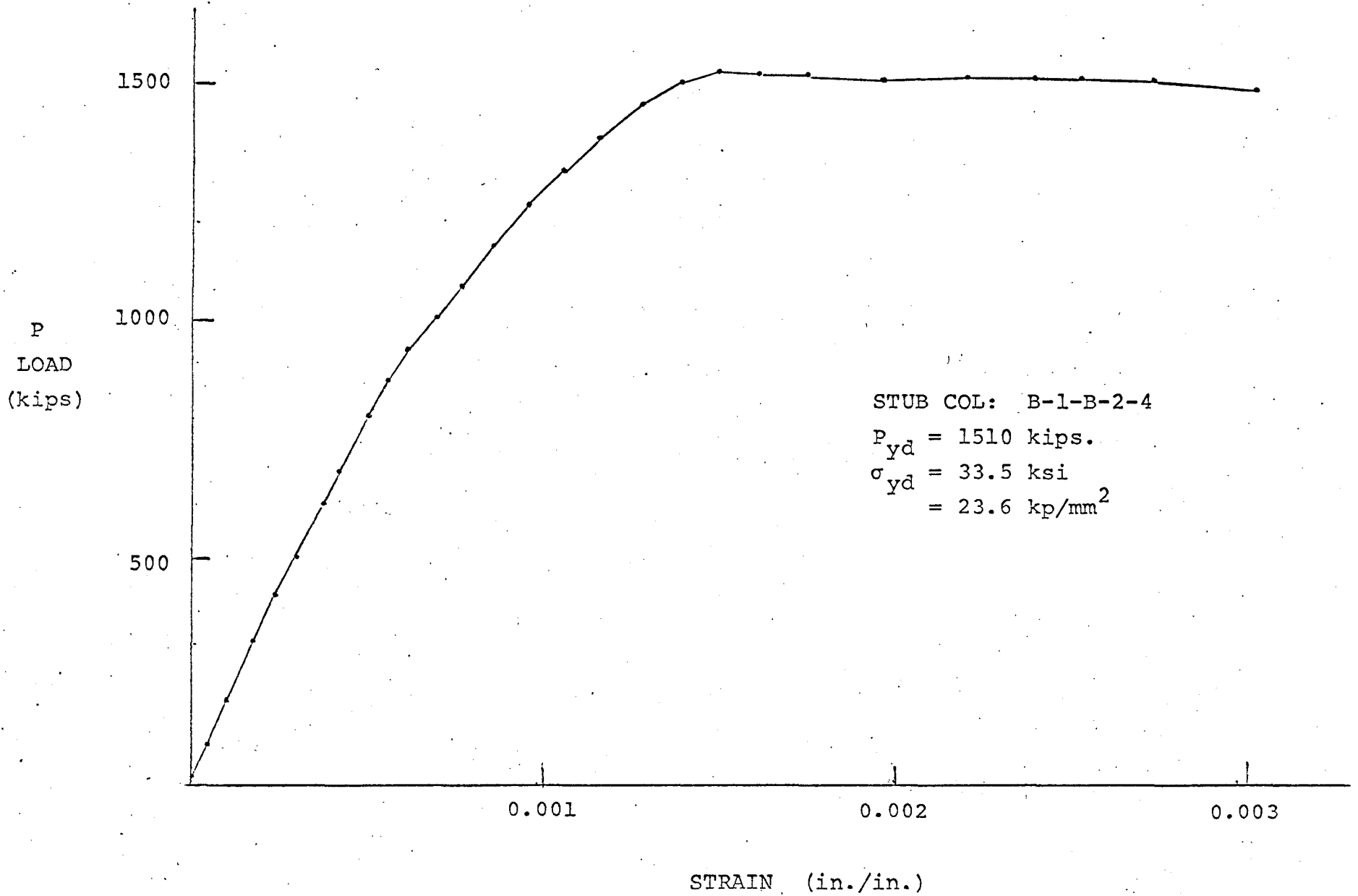
SUPPLEMENTARY TESTS

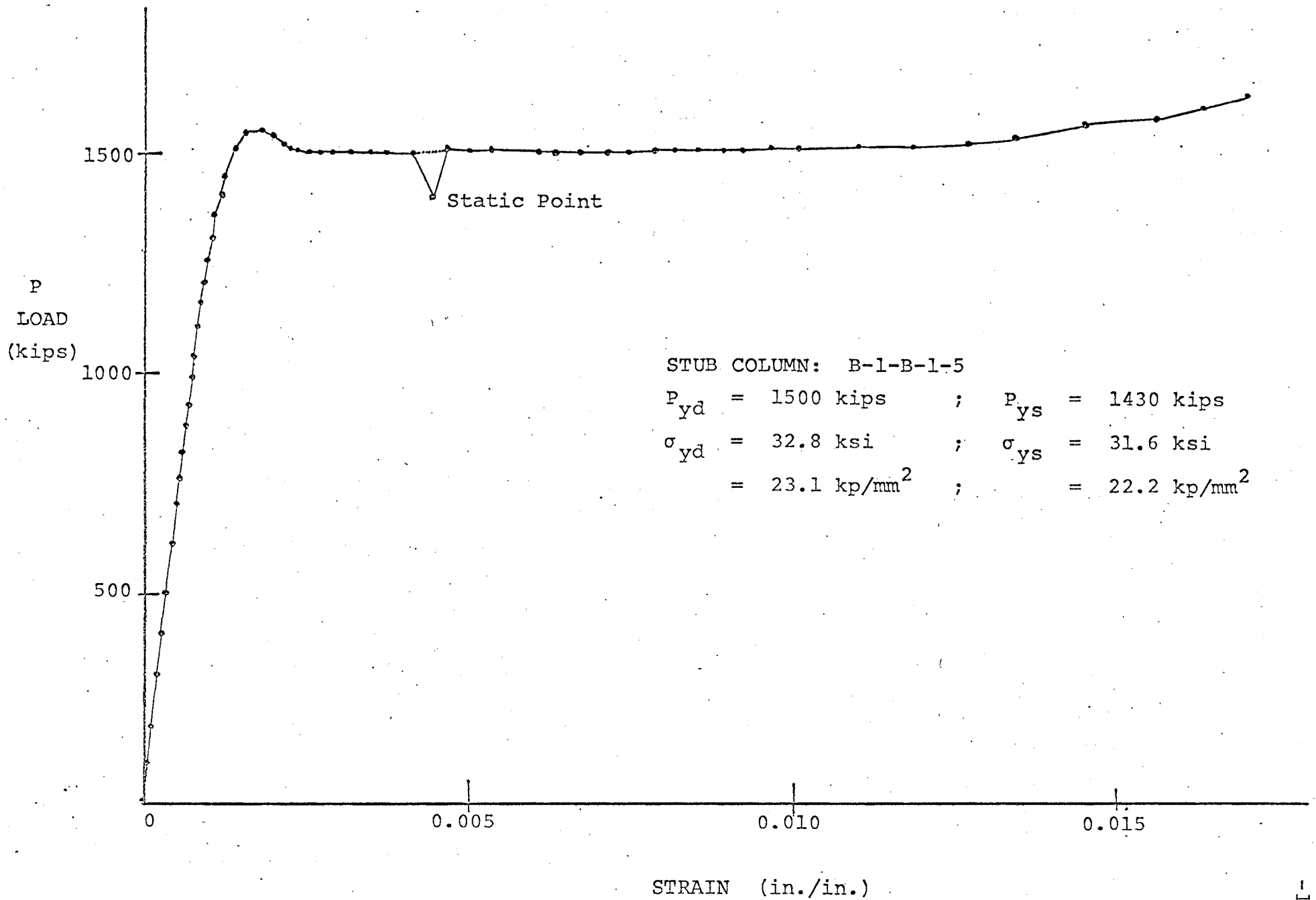
STUB COLUMN TEST  
RESIDUAL STRESS MEASUREMENT  
TENSION TESTS: ASTM - 370 AND FULL-THICKNESS

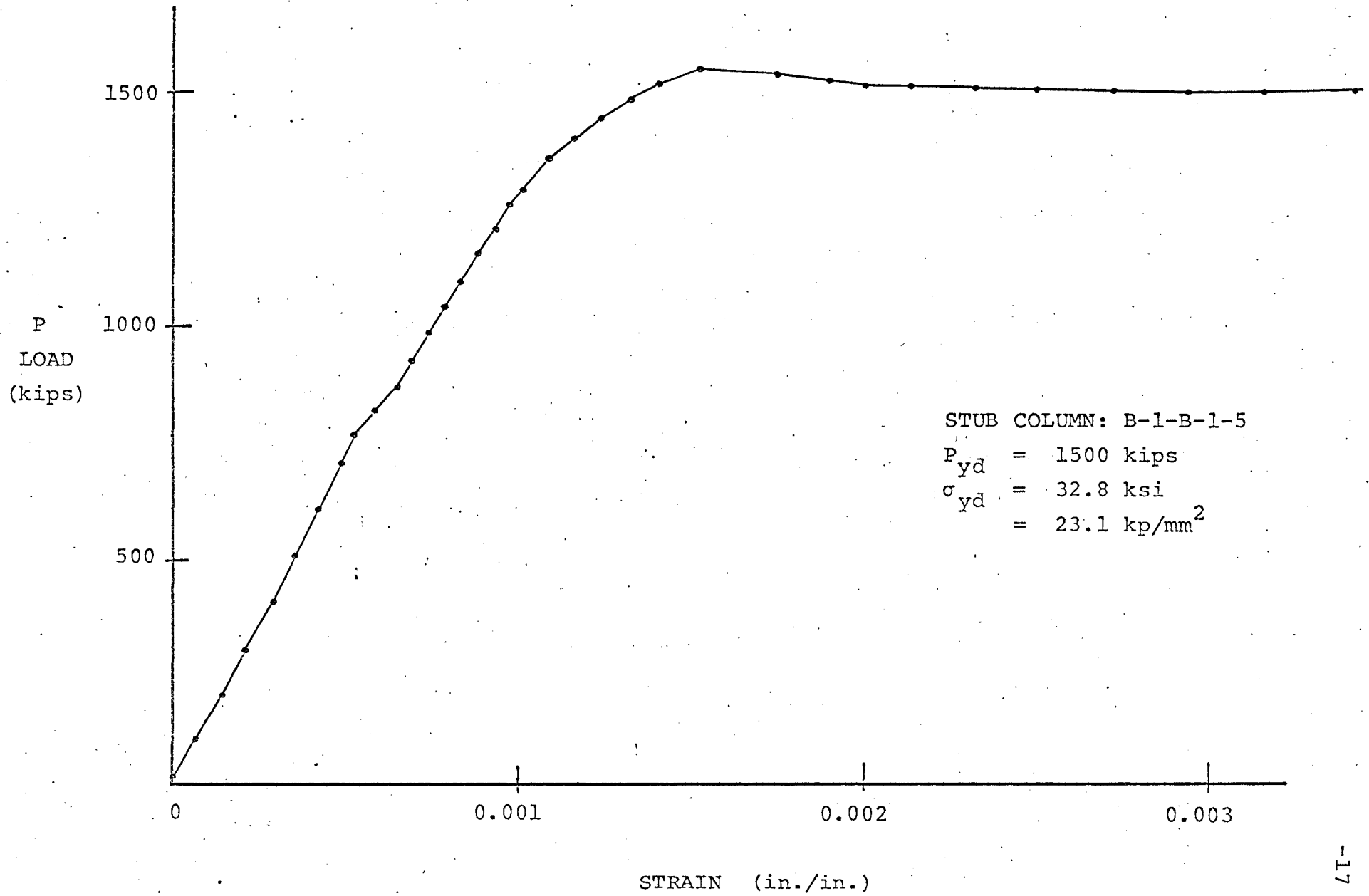


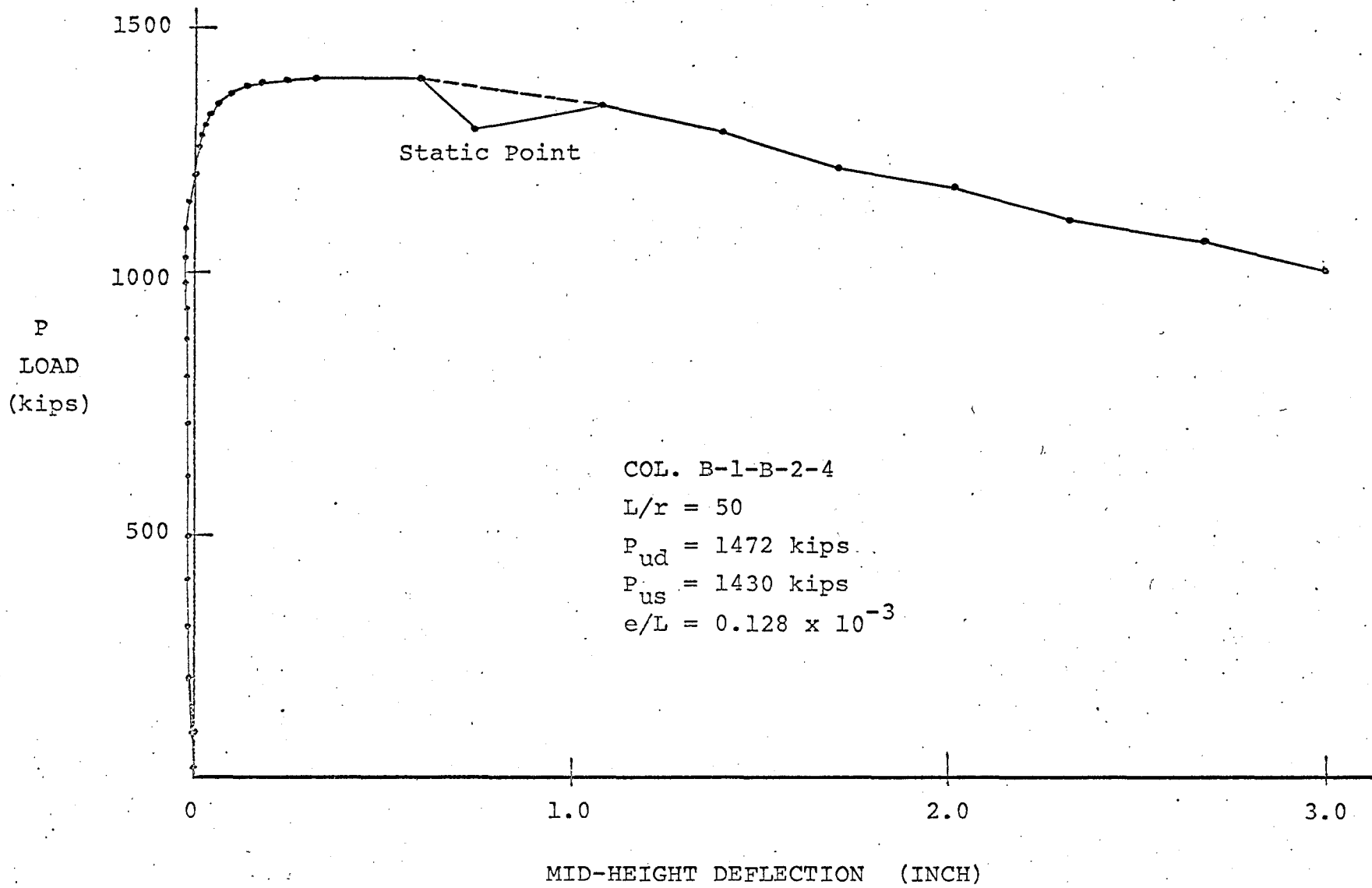


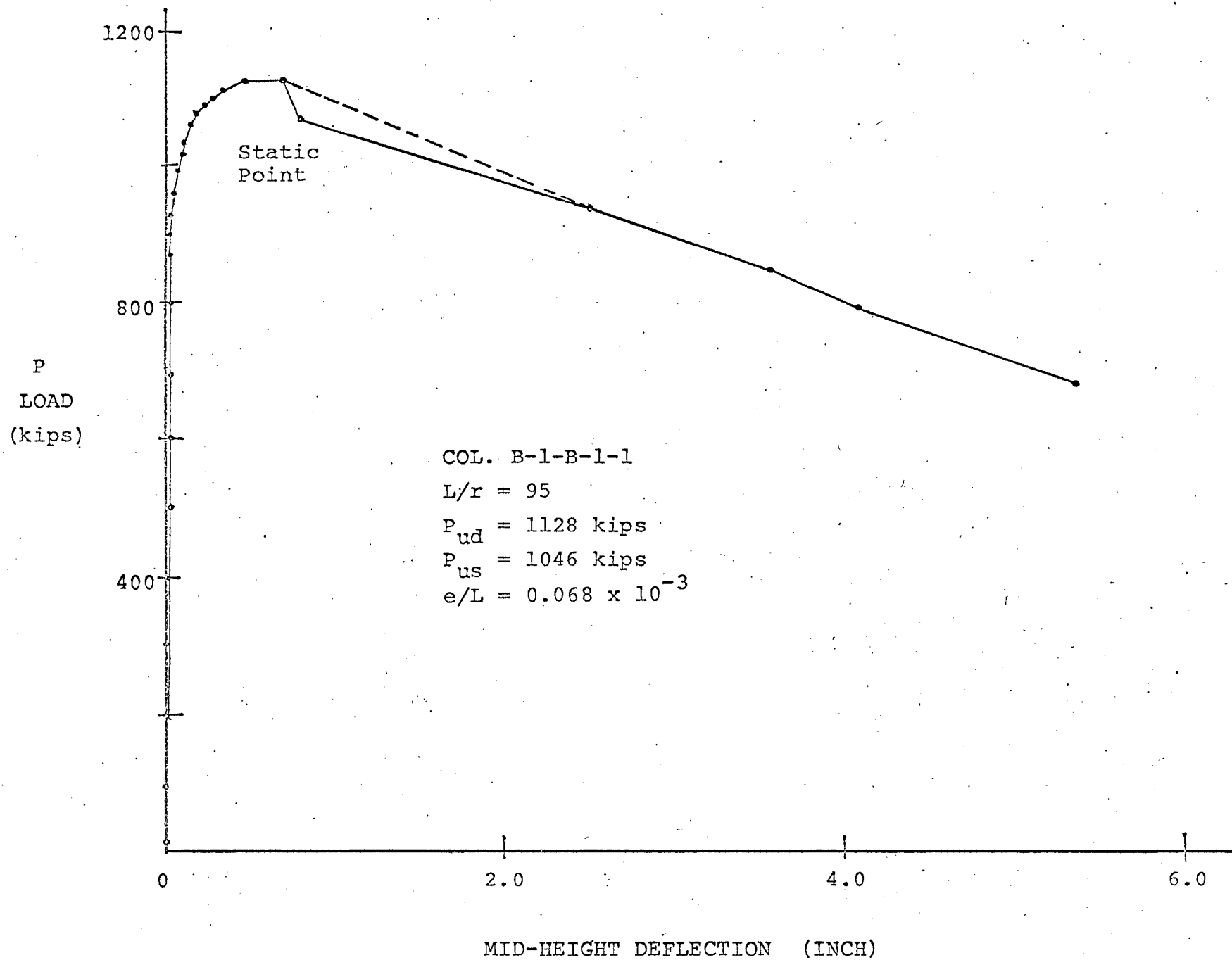


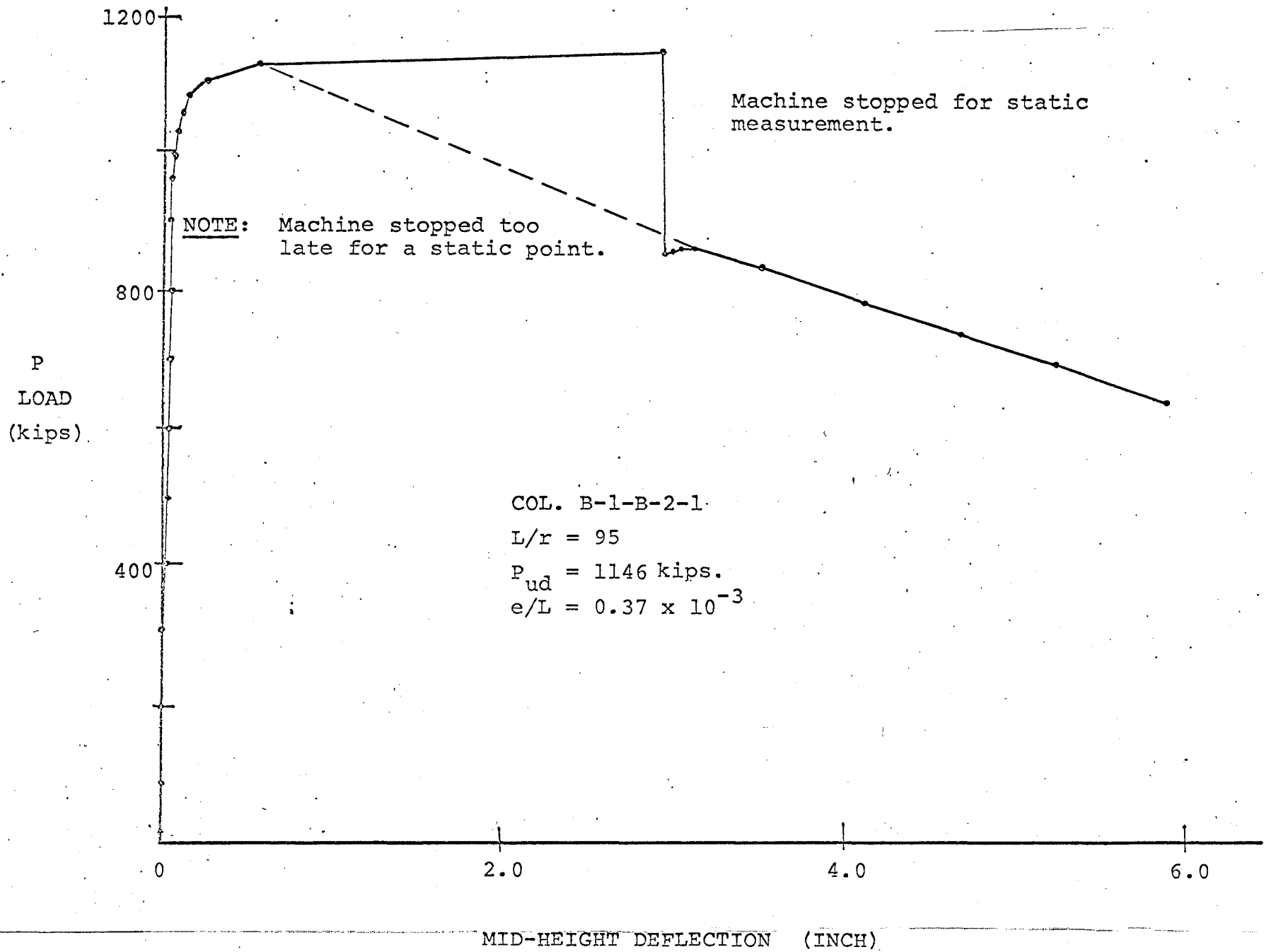




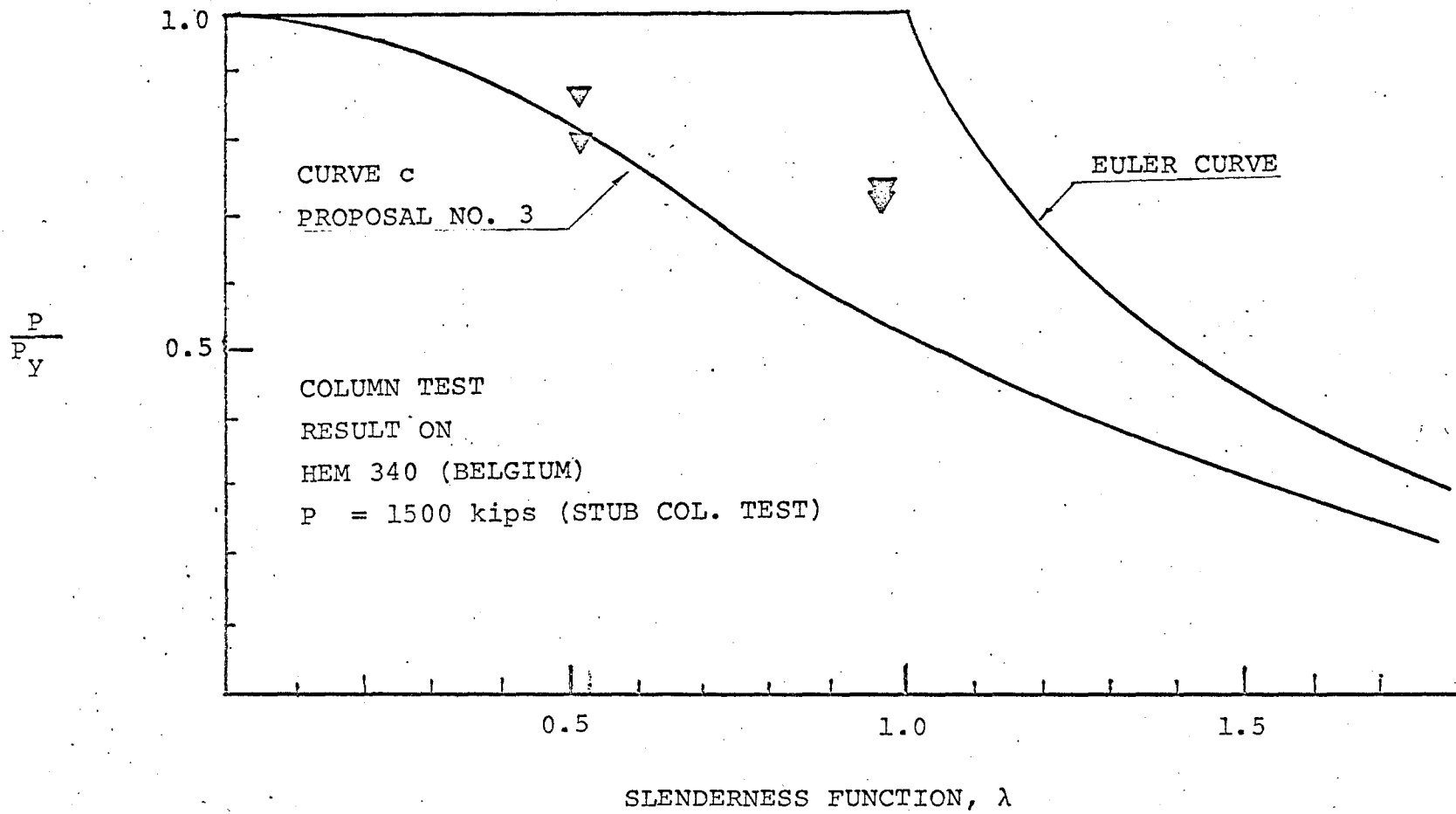








EUROPEAN CONVENTION





EUROPEAN CONVENTION: PROPOSAL 3

