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Proposal for corner connection tests, Phase II Influence of Size of Member

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FRITZ ENGINEERING LABORATORY
Lehigh University

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File 205C

To: Members, Lehigh Project Subcommittee

re: Phase II of Welded Connection Study

Gentlemen:

The attached proposal on further corner connection tests has been promised for some time and is now furnished to you for your criticism and suggestions. Funds are available for these tests and for some additional studies that are being incorporated in a separate proposal not yet completed.

We trust you will be able to give this proposal your attention in advance of the coming Committee meeting in order that we may reach a final decision on the matter at that time.

Sincerely yours,

LSB:aw

L. S. Beedle
Assistant Director

cc: Dr. Jonathan Jones
Mr. F. H. Frankland
Mr. William Spraragen

Welded Continuous Frames and Their Components

A Proposal for

CORNER CONNECTION TESTS

Phase II:

THE INFLUENCE OF SIZE OF MEMBER

December 3, 1952

Background: In previously reported work done at Lehigh University [1] a number of welded knee frames or connections have been tested. These tests investigated as the primary variable the type of connection with most of the knees joining 8 inch deep beams.

A brief survey of additional research considered necessary was presented in Progress Report M [2] and was discussed at the project committee meeting which followed. One of the suggested studies concerned the influence of size of member on strength, stiffness, and rotation capacity. At that time, there was a general agreement among members of the committee that such a study could be carried out.

It is suggested that the type 8B knee (connection "L") be repeated for a range of sizes, maintaining the proportions as nearly constant as possible.

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(1) Progress Report No. 4, "Connections for Welded Continuous Portal Frames" by Topractsoglou, Beedle, and Johnston, Welding Journal, July & August 1951; November 1952.

(2) "Summary Report on Welded Continuous Frames and Their Components", by Project Staff; Progress Report M, Fritz Engineering Laboratory Report No. 205.13, September 17, 1951, pp. 5 - 8.

Object: The object, then, of this second phase of the corner connection study is to examine the effect of size on the strength, stiffness and rotation capacity of Type 8B straight knees.

Program of Tests: A. Sections to be tested.

It is proposed to test 3 geometrically similar sections all using the same Type 8B connection. These sections would be the following:

14 WF 30
18 WF 55
24 WF 94

The properties of these sections are shown in Table 1. A fourth geometrically similar section, 21 WF 73, is also listed in the table and would be included if results of the three tests indicate a need for such an experiment. Also indicated are the average scale factors, λ, the 14 WF 30 member being used as the basis for comparison. The table also shows the properties of the 8 B 13 shape and its scale factor compared with the 14 WF 30 shape. Using the latter shape, it is possible to obtain better geometrical similarity with the larger sections. The length of moment arm shown in Table 1 is the length required to provide a ratio of axial stress to bending stress of about 10% when the connection is loaded as an equal leg 45° frame. The four sections mentioned above, together with the 8 B 13 shape, are sketched in Fig. 1.

Table 1.

Properties:		8B13	14WF30	18WF55	21WF73	24WF94
Scale factor, λ		0.66	1.00	1.37	1.58	1.80
Area, A	(sq.in)	3.83	8.81	16.19	21.46	27.63
Depth, d	(in)	8.00	13.86	18.12	21.24	24.29
Flange width, b	(in)	4.00	6.73	7.53	8.30	9.06
Flange thickness, t	(in)	0.254	0.383	0.630	0.740	0.872
Web thickness, w	(in)	0.230	0.270	0.390	0.455	0.516
Section modulus, S	(in^3)	9.88	41.8	98.2	150.7	220.9
Length of leg, L	(in)	30	55	70	81	92

B. Type of Connection

The connections to be tested will be essentially the same as connection "L" (Type 8B) reported in Progress Report 4. This type was chosen because it exhibited satisfactory strength and rotation characteristics in the previous test program in which an 8 B 13 size of member was used. The connection is shown in Fig. 2.

Each connection would be fabricated with an end plate over the end of the beam and extending down to the column. A diagonal stiffener would be provided equal in width and thickness to the beam flanges, and a half depth vertical stiffener acting as a continuation of the inside vertical flange of the column would be used.

All the sections proposed have been checked against buckling of the flanges in the elastic range, shear buckling of the web in the elastic range, and a theoretical check made also indicates that a reasonable amount of rotation in the plastic range may be expected before plastic buckling of the flange. By use of the equations in Progress Report 4 it has been determined that the diagonal stiffener provided in the above design is sufficient to protect the connection against undesirable shear deformation.

Test Procedure:

A. Loading: Each specimen would be tested in the 800,000 lb. screw-type machine in a manner similar to the test on the original test "L". Lateral support would be provided at the reentrant corners by means of pairs of flexible bars anchored to the testing machine columns. In the case of the largest connection, it might be necessary to attach A-frames or extended beams to the machine columns in order to support the knee laterally. The lateral force

in the flex bars would be measured by means of SR-4 gages. The method of test is sketched in Fig. 3.

B. Measurements: The following measurements would be taken and are similar to observations made in the earlier tests.

Deflection would be measured by means of one dial gage referenced to the two ends of the legs.

Change in length of the moment arm would be measured in order to compute the correct moments at each load position.

Lateral and local buckling would be detected at critical points by dial gages as was done in the previous tests.

Relative rotations would be measured by means of rotation indicators developed for the frame tests reported in Progress Report 7 "Welded Portal Frames Tested to Collapse". These measurements would be made just outside the joint between beam and column as previously, and another set of readings would be taken on the girder leg to collect more M - Ø data in the inelastic range.

Strain Measurements would be made at a few locations by means of SR-4 gages as a check on the performance of the tests in the elastic range. It is proposed to use about thirty SR-4 gages on the largest specimen to make measurements in the web of the knee and the knee flanges and stiffeners in order to verify or refute theoretical analyses available for the study of the problem. (1)

Whitewash would be used to reveal flaking of mill scale at the yield point.

In addition to providing a means of investigating the size effect on connections, these tests would also constitute part of a later series for checking the theoretical requirements for additional web stiffening to prevent shear failure. According to the expressions developed in Progress Report 4,[1] all the connections in this first series of tests are well within the safe range insofar as web stiffening is concerned.

GCD:aw

George C. Driscoll, Jr.
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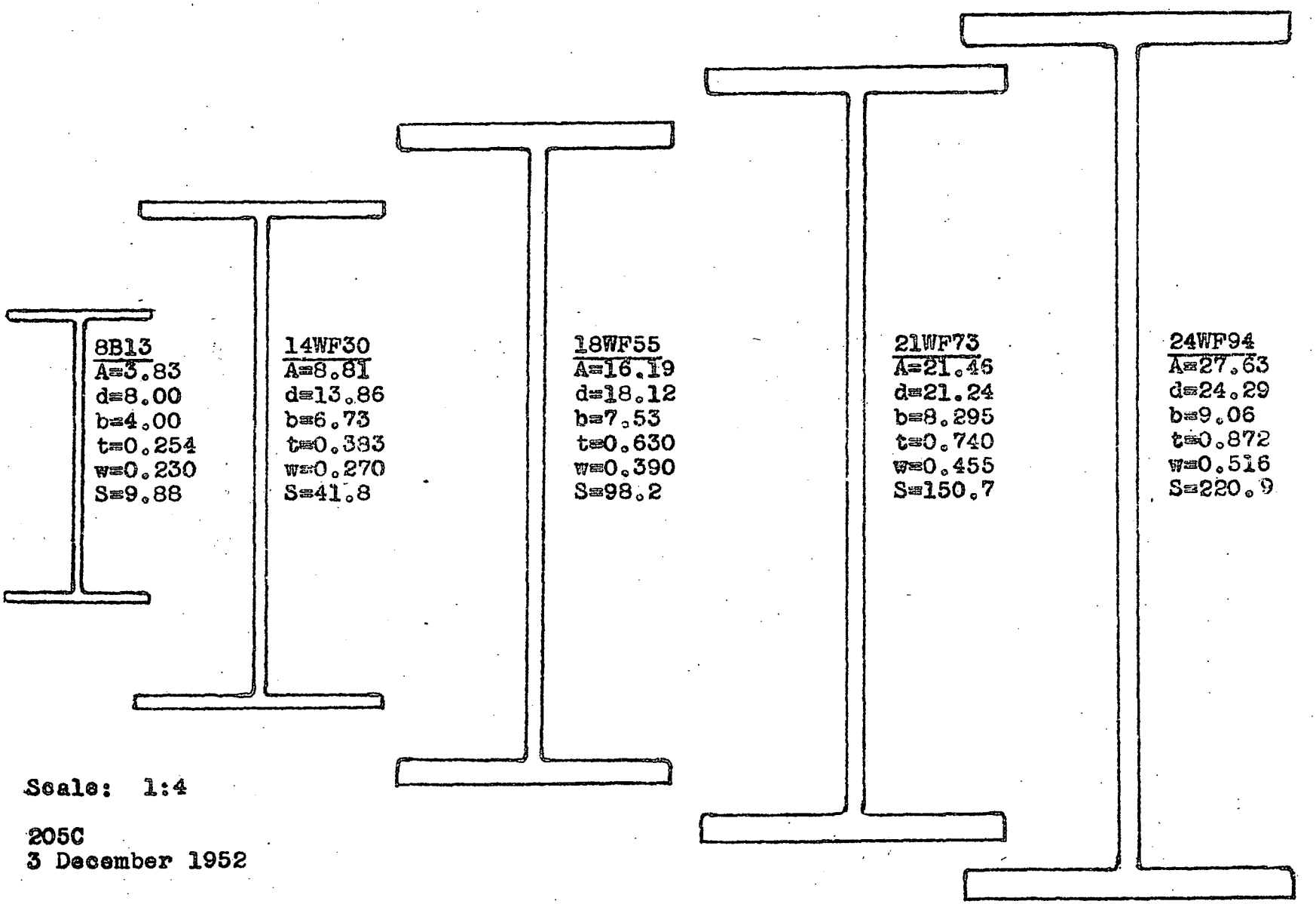
Fig. 1 Scale Drawing of Cross Sections



Scale: 1:4

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Figure 2. Details of Connection

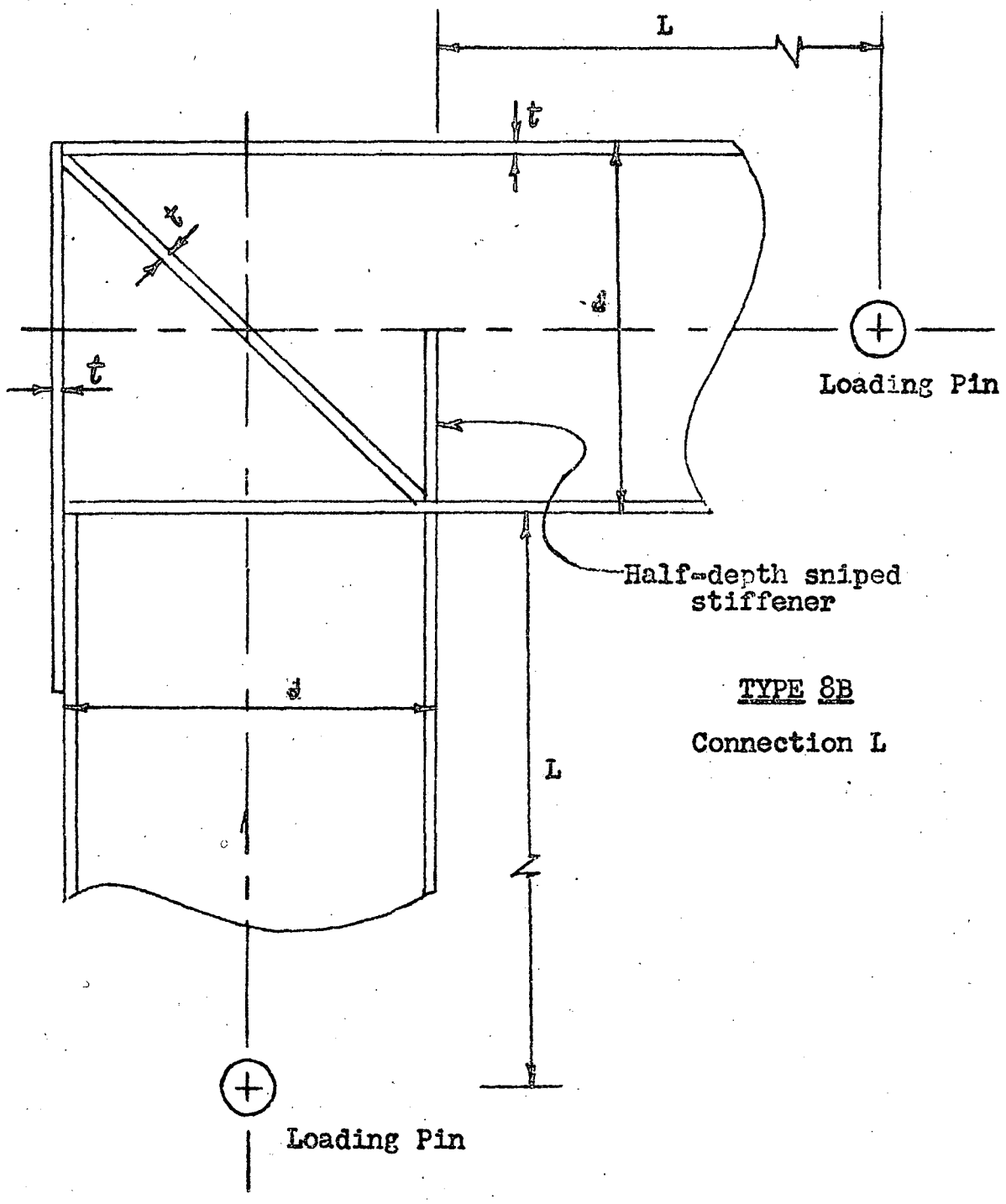

Figure 3

Sketch of Test Setup