1954

Summary report, Phase I "Tests of several types of corner connections", 1954

G. C. Driscoll Jr.

Project 205C

Welded Continuous Frames and Their Components

CONNECTIONS

Phase I. Tests of Several Types of Corner Connections

SUMMARY REPORT

Report Prepared by G.C. Driscoll, Jr.

March, 1954

Project 205C

Table of Contents

1. Introduction

Tests of several corner connections for welded continuous portal frames were made in Fritz Laboratory.

The program investigated the strength and stiffness of several typical types of corner connections in the elastic and plastic range. All were fabricated using 8 B 13 members thus keeping a common size.

This report includes copies of all quarterly reports to the Welding Research Council and an index to the data sheets, photographs, calculations, reports, and publications.

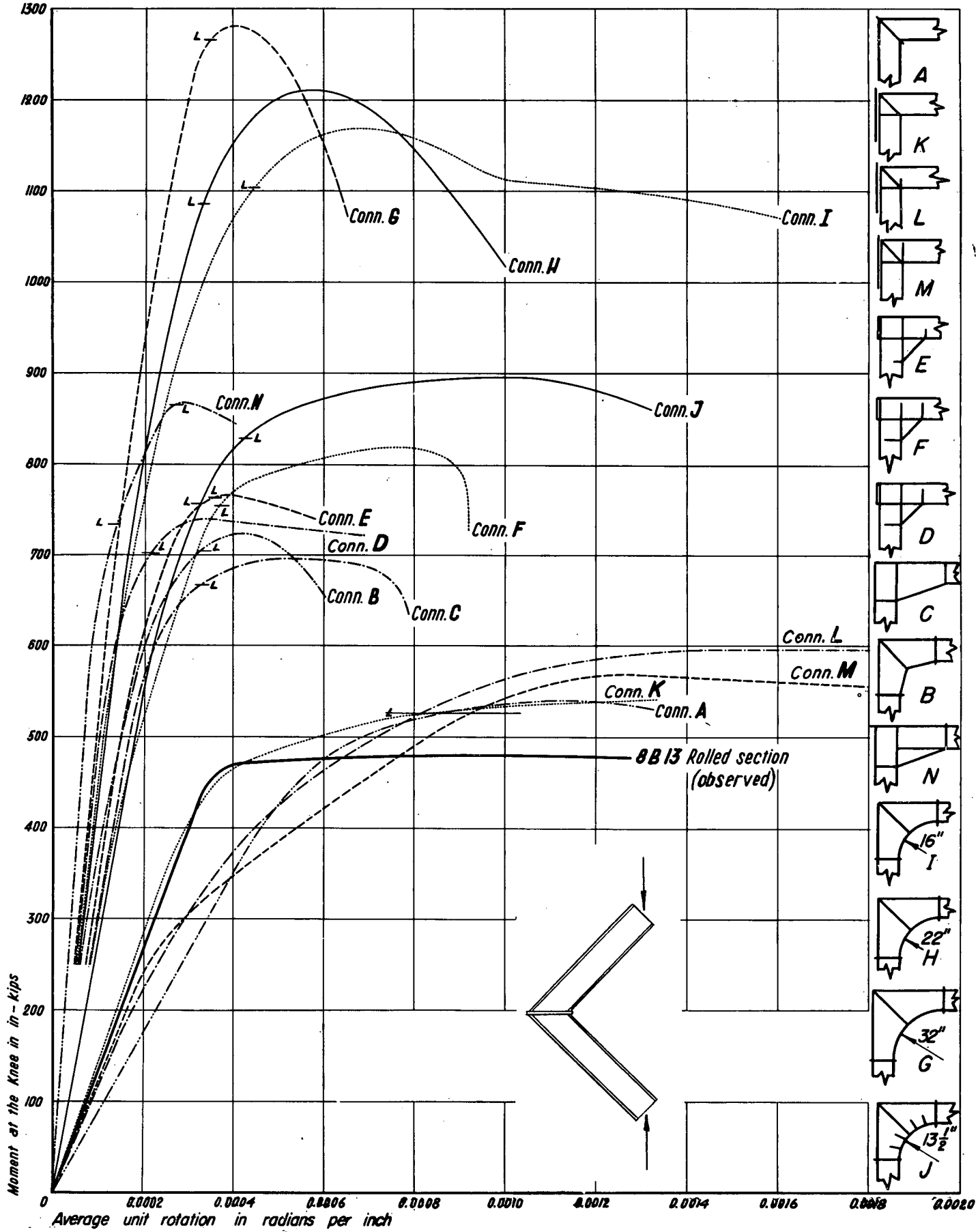


Fig. 52 Connection behavior compared with 8B13 rolled section (Based on moment at the knee).

TABLE 2: The Yield Strength of Connections**

Type	Connection	Sketch	Comparison of Observed Yield Strength With Initial Yield Moment, $M_{h(i)}$							Deformation Increment at $M_{h(i)}$
			Computed Initial Yield Moment $M_{h(i)}$	Yield Line Moment		Visual Yield Moment		General Yield Moment		
				Observed $M_{h(i)}$	$\frac{M_{h(i)}}{M_{h(i)}}$	Observed $M_{h(2)}$	$\frac{M_{h(2)}}{M_{h(i)}}$	Observed $M_{h(3)}$	$\frac{M_{h(3)}}{M_{h(i)}}$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2	A		454	163	.36	369	.81	476	1.05	.12
2B	B		750	305	.41	380	.51	600	.84	*
15	C		524	402	.77	563	1.07	645	1.23	.13
4	D		597	477	.80	477	.80	640	1.07	.22
	E		597	364	.61	472	.79	680	1.14	.07
	F		597	264	.44	276	.46	640	1.07	.24
5A	G		920	436	.47	654	.71	1125	1.23	.07
	H		840	263	.31	681	.81	1036	1.24	.08
	I		883	526	.60	516	.58	900	1.02	.06
	J		620	300	.48	475	.77	770	1.24	.05
8B	K		454	251	.55	316	.70	444	.98	.19
	L		454	276	.61	176	.39	432	.95	.19
	M		454	226	.50	216	.48	388	.86	.17
16	N		606	402	.66	577	.95	722	1.20	.17
7	(Shear) P		630	311	.49	493	.77	637	1.01	.18
	(Flexure)		1195		.26		.41		.54	*

** See Text and Fig. 74 for more complete description of terminology.

* Connection did not develop $M_{h(i)}$.

SUMMARY OF QUARTERLY REPORTS

CONNECTIONS

April 1, 1948 to June 30, 1948

1. A study of literature has commenced. Mr. Jan Ruzek is the research assistant on both the connection and frame tests.

2. Material for several tests is available.

July 1, 1948 to September 30, 1948

1. A letter has been received from the Office of Naval Research containing recommendations for two specific types of connections, similar in general to type No. 8 of the test program. This will be presented to the committee in the future.

October 1, 1948 to December 31, 1948

1. In the meeting mentioned above, four connection types were approved for future test. Two have corner brackets and two do not. It is probable that during the current program, only one type will be tested. This connection has been designed and working drawing prepared.

2. Design of connection test apparatus is nearing completion. This will involve the fabrication of only a few new parts.

January 1, 1949 to March 31, 1949

1. Under date of February 3, 1949 a working drawing of the first connection test specimen, No. A7, was sent to the Committee for their criticism. Their response indicated general approval and certain specific changes have been made as a report contains a discussion.

2. Preparation of the A7 specimen has been completed and SR4 strain gages are being installed. The test is scheduled in April.

3. A careful time study was made of the fabrication and welding processes involved in preparing the connection. Such a study is to be made on each connection in the program so that information on cost of fabrication may be accumulated. The results obtained from this first time study are shown in Appendix 3. A welding sequence chart was prepared for welding the connection and will be furnished on request.

4. No further connection tests will be made during the next quarter due to lack of funds. The time will be spent in analyses of the result of the first test and preparation of drawings for the remaining approved connection types.

CONNECTIONS (cont'd)

April 1, 1949 to June 30, 1949

1. Tests Completed: Connection type 7

2. Reports Prepared:

   a. Progress Report D, "Test of a Rigid Frame Knee", by Jan Ruzek and A.A. Topractsoglou. (Not for publication) This report describes results of the above test.

   b. Progress Report E, "Working Drawings for Three Tests and Proposal for an additional Test".

3. Future Plans: Proposals are to be prepared embodying the results of discussion at the June 2 meeting of the sub-committee. It is hoped that the experimental investigation may commence in September.

July 1, 1949 to September 30, 1949

7. A revised proposal was circulated under date of September 9, 1949, in accordance with the discussions at the June 2, 1949 meeting of the Subcommittee. Fourteen tests were proposed. This program has been approved by 12 affirmative votes. Answers have not been recieved from four members.

8. Testing fixtures have been designed and a test schedule developed. Testing should commence about October 17, the fourteen tests to be completed in a continuous schedule. This program will form the experimental basis for a thesis by Mr. Topractsoglou.

CONNECTIONS

Jan. 18, 1950

30 September 1949 to 31 December 1949

1. Tests completed (Proposal dated 9 September 1949)

Model	Type
A	2
D	4
E	4
K	8B
M	8B
N	16

The test of model B, type 2B is underway. The fabrication of model C, type 15 has been started.

6. Also during this quarter, tensile tests have been made from coupon material. Test data has been ~~analysed~~ plotted but not ~~plotted.~~ analysed.

CONNECTIONS

April 17, 1950

1. Tests Completed (2). **31 December 1949 to 31 March 1950**

(a) Test 7, Model B, Type 2B, a built-up connection.

(b) Test 8, Model C, Type 15, a built-up connection somewhat similar to Type 7 but provided with a haunch to increase the shear area.

The built-up curved knee sections of Models H, I, and J, Type 5A, were completed.

Numerous coupons were tested in tension, tests being done at a slow rate and data being obtained into the strain hardening region.

2. Results

Test 7 emphasizes the need for lateral support. It has been the most expensive, thus far, from a fabrication cost point of view. Considerable strain hardening was observed in T8 similar to that observed in the Type 8B tests.

3. Further work

Tests of remaining models are to be completed during the next quarter: F, G, H, I, J, and L. Coupon tests will be completed.

A report for publication and presentation at the AWS annual meeting has been commenced and work will continue during the next quarter.

Proposals for further research are to be prepared.

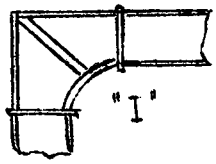
CONNECTIONS

July 19, 1950
4/1/50 - 6/30/50

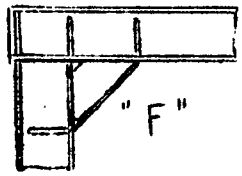
1. Tests Completed — 1 April 1950 to 30 June 1950

The following connections were tested during the quarter, completing the series:

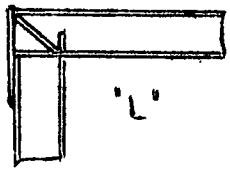
T9 - Connection I, Type 5A



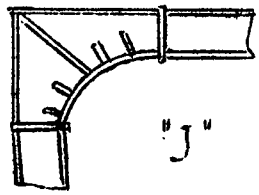
T10 - " F, " 4



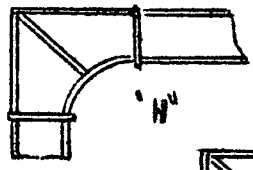
T11 - " L, " 8B



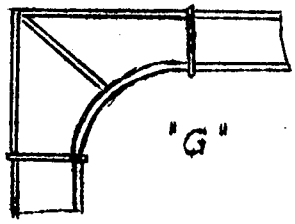
T12 - " J, " 5A



T13 - Connection H, Type 5A



T14 - " G, " 5A



T15 - Control beam test

Five compression specimens

Eleven tensile specimens

2. Results

Connections F and L were tested to find the effect of web stiffeners on the behavior of connections.

Connection J, type 5A, was designed to be comparable in behavior to type 4 connections. Connection G which has the largest radius of inner curved flange is the strongest of all connections but collapses quickly without carrying the ultimate load through large deformations. All of the connections were tested on the 800,000 lb. machine with improved lateral support. The lateral forces necessary to keep the specimen from deflecting laterally were measured with SR-4 gages and Huggenberger tensometers. The forces were found to be small.

Test 15, a 12' span control beam, was tested to obtain the moment-rotation characteristics for the 8B13 rolled section used in all connections.

Two out of the five compression specimens are whole sections of 8B13 (specimens E and F). Specimen E has a height of 1" and F a height of 6". F failed by plastic buckling of both web and flange.

3. Further work

(1) All 14 connections tested in compression are to be tested in tension during the next six weeks.

(2) The data taken is at present under study for a report.

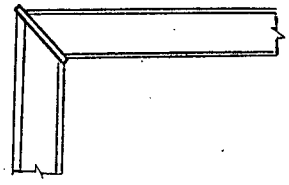
A. A. Topractsoglou
Research Assistant

1 July 1950 to 30 September 1950

CONNECTIONS

1. Mr. Topractsoglou completed his dissertation based on the connection tests completed up to the present time. He will present a paper outlining the results at the Chicago Annual Meeting of the American Welding Society in October.

2. All the connections previously tested in compression were tested in tension. With the exception of madel "A" (see sketch), all knees were stronger and stiffer than when tested in compression.



3. An outline of three connection tests now being carried out by two undergraduate students was circulated to committee members under date of 22 September.

Jan M. Ruzek
Research Assistant

Jan. 23, 1951

CONNECTIONS

1 October 1950 to 31 December 1950

1. Under date of 7 December 1950, Part I of Progress Report No. 4, "Connection for Welded Continuous Portal Frames" was distributed to Members of the Lehigh Subcommittee. Part I contained the test results. Parts II and III, completing the report, are in preparation. On 25 October 1950 an abstract was presented at the Chicago Annual Meeting of the American Welding Society.

2. One of the additional tests on a tapered haunched connection was completed in December, 1950.

10/1/50 – 12/31/50

PROGRESS REPORT J
Final Report to Office of Naval Research
on Contract N3onr--64200 for the period
July 1, 1949 to September 30, 1950

VI SUMMARY OF RESULTS

The detailed results are being presented in separate reports. For the purposes of this FINAL REPORT a resumé has been prepared covering some of the important observations.

Connections (See Table 1)

1. It is possible to design and fabricate with economy simple connections which will carry the full plastic moment. Most of these connections are as rigid or more rigid than an equivalent length of beam and those of the square type will maintain the plastic hinge through relatively large rotations when supported laterally.

Oct. 31, 1950

2. Tests on knees thus far indicate a plastic instability type of failure. The load-deformation curves rise to a maximum and fall off more or less rapidly. The adequacy of the connection will partially be indicated by the amount of rotation necessary to develop full plastic strength at other places in the structure. Lateral support is essential in all connections.

3. In portal frame knees, moment are transmitted around the connection from beam to column primarily by shear. Unless special shear stiffening is provided, by means of diagonal brackets, extra thinkness of web material or by the insertion of a haunch, may typical rolled sections will yield in shear before the yield moment is reached. If the plastic hinge is subsequently attained, it is accompanied by large rotations.

4. The importance of adequate lateral support is not to be minimized. Whenever supports can be provided at points of maximum stress, the lateral buckling which results from local instability may be prevented.

Connections

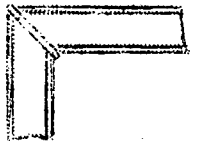
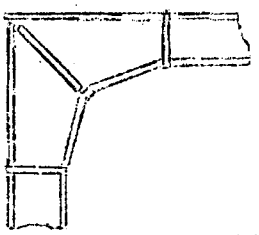
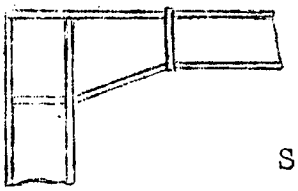
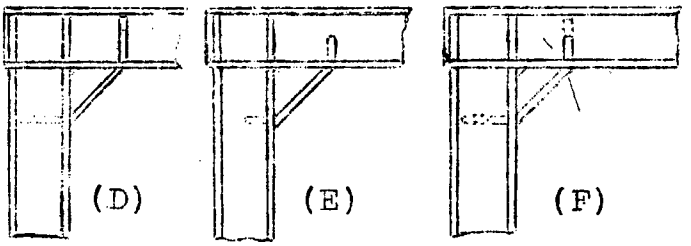
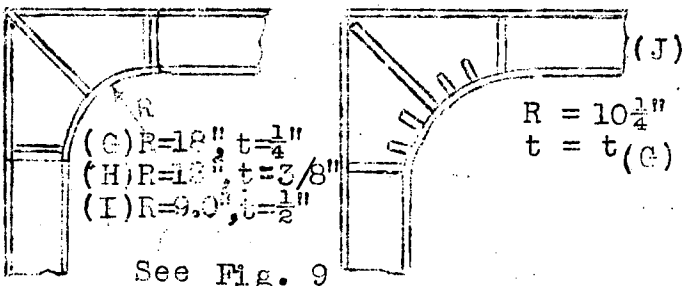
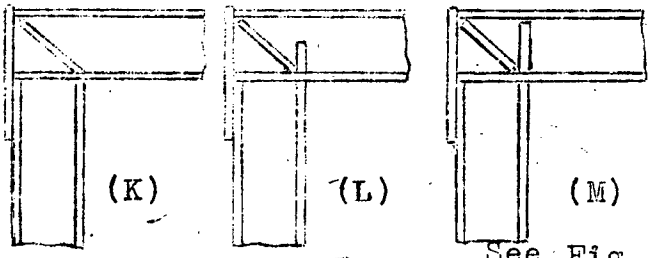
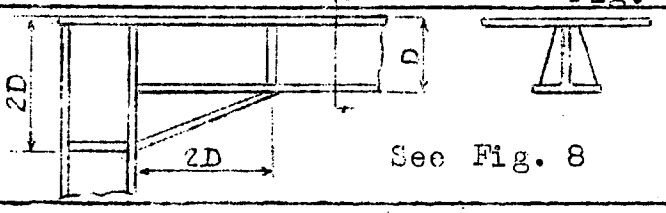
Model	Type*	Initial Moment Arm	
A	2 (S)**	25.1"	
B	2B (H)	38.1	
C	15 (H)	30.9	
D	4 (H)	25.1	Length and form of stiffeners varied
E	4 (H)	25.1	
F	4 (H)	25.1	
G	5A (C)	43.6	Radius and thickness of inner flange varied
H	5A (C)	30.9	
I	5A (C)	23.9	Number, position, and length of stiffeners varied
J	5A (C)	25.0	
K	8B (S)	25.1	
L	8B (S)	25.1	Length and form of stiffeners varied
M	8B (S)	25.1	
N	16 (H)	33.8	

* See Table 1.
**Designators are S: square knee, H: haunched knee, and C: curved knee.

Oct. 31, 1950

TABLE II

Corner Connection Tests

Test Model	Type of Conn.	Number of Specimens	Sketch
A	2	1	 See Fig. 3
B	2B	1	 See Fig. 4.
C	15	1	 See Fig. 7.
D E F	4	3	 (D) (E) (F) See Fig. 5
G H I J	5A	4	 (G) R=18", t=1/4" (H) R=12", t=3/8" (I) R=9.0", t=1/2" (J) R = 10 1/4" t = t(G) See Fig. 9
K L M	8B	3	 (K) (L) (M) See Fig. 6
N	16	1	 2D 2D See Fig. 8

CONNECTIONS

1 January 1951 to 31 March 1951

1. An additional test of a tapered haunched connection (type 2B) was completed. With the improved lateral support provided at the end of the haunch and with the 7-foot beam extensions, the connection developed the full plastic strength at the break between the haunch and rolled section. Further tests with shorter beam lengths are planned.

2. Part II of Progress Report No. 4, "Connections for Welded Continuous Portal Frames" has been completed. Part II containes the theoretical analysis of straight (or square) knee-type connections. It includes analyses of elastic stress distribution and of elastic and plastic rotations and deflections. In the elastic range both shear and flexure are considered. The comparison between experimental and theoretical results is gratifying.

3. Part III of the above report discussing test results should be completed during the next month.

CONNECTIONS

July 12, 1951

4/1/51 - 6/30/51

1 April 1951 to 30 June 1951

1. Tests - None

2. Reports - The Status of Progress Report 4, "Connections for Welded Continuous Portal Frames" is as follows:

   Part I:* (Test Results and Requirements for Connections)
   After a final review with the Lehigh Project Subcommittee Chairman, Mr. Higgins, this paper was submitted to the Welding Journal. It is scheduled for the July, 1951 issue.

   Part II:** (Theoretical Analysis of Straight Knees)
   This report, after circulation to committee members, was submitted to the Welding Journal and is scheduled for publication in the August issue.

   Part III: (Discussion of Results and Conclusions)
   Work is continuing on this paper and a draft copy is to be submitted to committee members.

   Work is continuing on the preparation of progress reports on the "tension" tests and on the analysis of elastic strain distributions measured on the straight, curved, and tapered haunch corner connections.

3. Proposals and Plans for further work - A tentative program of further connection research has been prepared and will be disbtributed when in final form.

** ONR Technical Report No. 3
* ONR Technical Report No. 1

As part of a course project, Mr. A. Huber is making further analysis of tests of built-up connections (curved and bracketed).

Under date of April 24, 1951, a proposal was submitted by Professor C. D. Jenson to Welding Research Council for the establishment of a research fellowship on the subject, "The Development of Welded Interior Beam-Column Connections". This was circulated to the Structural Steel Committee under date of May 9, 1951.

Lynn S. Beedle
Assistant to the Director

TESTS OF WELDED RIGID CONNECTIONS
University of Texas

Note:- This report is included since committee members will probably be interested in the work at the

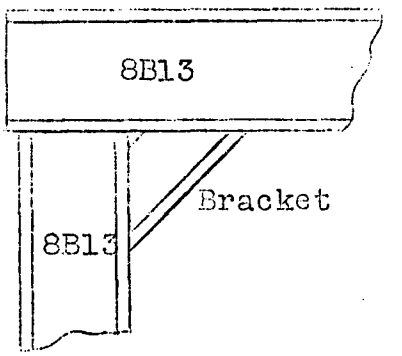
University of Texas being done be Dr. Topractsoglou. The program was distributed on November 24, 1950.

During the months of April and May two type 4 connections (Conn. S and T) and one Type 1 (Conn. R) have been tested. The specimens were fabricated at the University shops using an 8B13 rolled section. For the purpose of comparison the lengths of rolled sections in each specimen were made equal to the lengths used in the specimens tested at Lehigh University last year.

All specimens were tested in a 400,000 lb. screw type machine and were laterally supported with two pairs of flexible bars. Rotations, deflections, and strains were measured.

Connection S

This connection with no stiffeners (except the bracket) proved to be unsatisfactory. Although it showed good rigidity it failed to develop the strengths of similar types of connection tested at Lehigh. Failure took place by local buckling of the compression flanges after considerable yielding. This tests proved that stiffeners are definitely needed to reinforce both web and flanges.

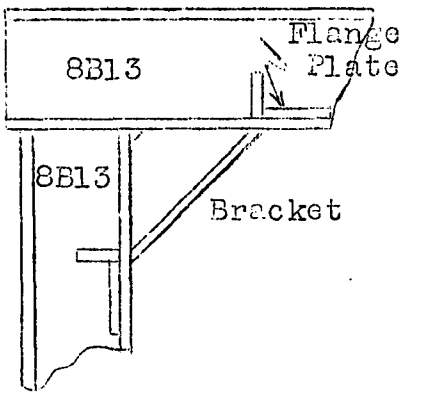


Twenty-two A-1 and seven AR-1 SR-4 gages were used on this specimen to study the strain distribution and compare with calculated values. This specimen was tested to furnish experimental data for a Master's thesis.

Connection T

This connection has a half stiffener at the rolled section where the bracket begins. In order to reinforce the flanges against buckling 1 3/8" x 1/4" x 0'-8" plates were welded to the flanges as shown.

Connection T carried moment equal to those of specimen F tested at Lehigh University. It failed in

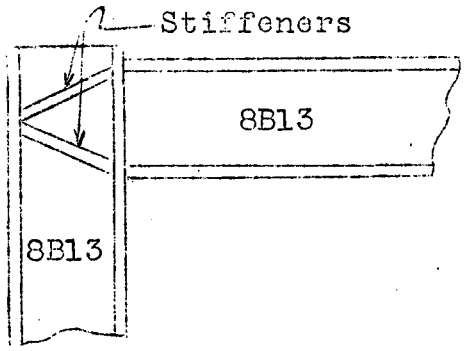


a similar way by local buckling after considerable yielding at the compression flanges. The plate reinforcement at the flanges forced the local buckling to take place away from the bracket.

Connection R

Designed to avoid shear yielding in the knee web, this connection showed a behavior comparable to Type 2 and 8B specimens tested at Lehigh.

The 8B13 rolled section used was contributed by Austin Brothers of Dallas, Texas. The fabrication and instrumentation expenses were paid for by the University of Texas, Civil Engineering Department.



A. A. Topractsoglou
Assistant Professor of C. E.
University of Texas

CONNECTIONS

Oct. 15, 1951

1 July 1951 to 30 September 1951 7/1/51 - 9/30/51

1. Tests - None.

2. Reports -

   (a) During the period Parts I and II of the paper "Connections for Welded Continuous Portal Frames" by Topractsoglou, Beedle, and Johnston were published in the WELDING RESEARCH SUPPLEMENT (July and August issues).

---

* Proposals are in preparation to Column Research Council whose Research Committee A is directly concerned with the residual stress problem.

7/1/51 - 9/30/51

(b) Criticism of the first draft of Part III of the above paper has been received from the other two co-authors. It is expected that a manuscript will be submitted to Lehigh Project Committee during the next quarter.

(c) Work is continuing on the progress report of connections tested in "tension".

(d) As part of a course project, Mr. Alfons Huber has analyzed the tapered-haunch connection for elastic deflection and rotation.

3. Further work - At the recent meeting of the Lehigh Project Subcommittee an outline of further corner connection research was discussed. On the basis of suggestions received a detailed proposal is to be prepared.

Among the suggestions and comments made were:

(a) The influence of size and shape of section used in straight knees should be studied.
(b) In ship structures the tendency has always been to use additional bracket stiffening due to the presence of side forces.
(c) Experimentation on connections using American Standard I-sections would only be done if over-all frame economy could be shown in advance.
(d) Additional analysis and tests of tapered haunch knees are desirable.
(e) Completely built-up column and haunch assemblies should be studied.
(f) Further curved knees should be tested using a channel as curved inner flange. The same device should be studied for tapered haunch knees.
(g) Tests of channel corner connections should be made.

Lynn S. Beedle
Assistant to the Director

CONNECTIONS

1 October 1951 to 31 December 1951

1. Work on Part III of the paper, "Connections for Welded Continuous Portal Frames" (Beedle, Topractsoglou, and Johnston) was continued.

Lynn S. Beedle

CONNECTIONS (cont'd)

1 January 1952 to 31 March 1952

1. Reports

Part III of the paper "Connections for Welded Continuous Frames", containing discussion of test results and conclusions, has been completed and is being prepared for distribution.

2. Results

a) Approximate expressions have been developed for determining the average unit rotation of haunched connections as compared with straight knees. This is of value in computing the distribution of moment in frame members. Expressions have also been developed for the required thickness of the web of simple straight connections to prevent premature web yielding due to shear force. According to this conservative relationship, it appears that WF shapes do not have adequate web thickness without some form of additional stiffening; only the heaviest in each series of the American Standard I-beams have adequate web thickness to prevent premature shear yielding. It is possible to correct this deficiency without undue expense by the use of diagonal stiffness.

b) So far as plastic strength is concerned, effective lateral support of connections is more important than variations in fabrication details. This lateral support should be provided at points of maximum stress; when this is done, the seriousness of local instability is markedly reduced. In practice, compression flange support should be provided at the center of built-up haunches and at the splice points between haunch and beam.

c) Properly detailed straight connections will exhibit considerable plastic rotation at constant moment in the plastic range.

s/ Lynn S. Beedle
Project Director

4/1/52 - 6/30/52

CONNECTIONS

1 April 1952 to 30 June 1952

1. Part III of the paper CONNECTIONS FOR WELDED CONTINUOUS FRAMES was completed and distributed to members of the Lehigh Project Subcommittee and others under the date of April 10, 1952. The paper was outlined to the project committee at its May 6, 1952 meeting and suggestions received. Subsequently the report was approved for publication. During the next quarter it will be submitted to the Welding Journal.

2. A discussion was prepared of the paper A METHOD FOR CALCULATING STRESSES IN RIGID FRAME CORNERS by Harvey C. Olandor. This discussion was presented by letter at the ASCE Meeting in Denver, May 1952.

S/Lynn S. Beedle
Project Director

Oct. 13, 1952

7/1/52 - 9/30/52

CONNECTIONS

1 July 1952 to 30 September 1952

Reports

Part III of the paper CONNECTIONS FOR WELDED CONTINUOUS PORTAL FRAMES was submitted to the Welding Journal for publication, tentatively scheduled for the November issue of the RESEARCH SUPPLEMENT.

Future Work

A detailed proposal is to be prepared for the criticism of members of the Lehigh Project Subcommittee.

Lynn S. Beedle

3. List of Specimens Tested

Test No.	Spec.	Type Test	Date
T-0	P	Compression Test of Knee (Pilot)	4-25-49
T-1	A	Compression Test of Knee	11-3-49
T-2	K	" " " "	11-17-49
T-3	M	" " " "	11-19-49
T-4	D	" " " "	11-27-49
T-5	E	" " " "	11-30-49
T-6	N	" " " "	12-3-49
T-7	B	" " " "	2-8-50
T-8	C	" " " "	2-22-50
T-9	I	" " " "	4-6-50
T-10	F	" " " "	4-27-50
T-11	L	" " " "	4-29-50
T-12	J	" " " "	5-3-50
T-13	H	" " " "	5-6-50
T-14	G	" " " "	5-10-50
T-15	8B13	Bending Test of Control Beam	4-13-50
T-16	A	Tension Test of Knee	7-18-50
T-17	B	" " " "	7-21-50
T-18	C	" " " "	7-20-50
T-19	D	" " " "	7-27-50
T-20	E	" " " "	7-26-50
T-21	F	" " " "	7-24-50
T-22	G	" " " "	
T-23	H	" " " "	
T-24	I	" " " "	7-25-50
T-25	J	" " " "	7-25-50
T-26-	K	" " " "	
T-27	L	" " " "	7-19-50
T-28	M	" " " "	7-20-50
T-29	N	" " " "	7-27-50

Coupons:

A1-1	Tensile Coupon Web 8 B 13	Spring 1950
A1-2	" " " "	
A2-1	" " " "	
A2-2	" " " "	
A1-3	Tensile Coupon Flange 8 B 13	
A1-4	" " " "	
A2-3	" " " "	
A2-4	" " " "	
B-1	" " " "	
B-2	" " " "	
B-3	" " " "	
C-1	Tensile Coupon 3/8 inch. Plate	
C-2	" " " "	
D-1	Tensile Coupon 1/2 inch. Plate	
D-2	" " " "	

3. List of Specimens Tested

Coupons:

Spec. No.	Type Test	Date
P1-1	Tensile Coupons 1/4 in. Plate	Spring 1950
P1-2	" " " "	
P1-3	" " " "	
P1-4	" " " "	
P2-2	" " " "	
P2-3	" " " "	
P2-4	" " " "	
P3-1	" " " "	
P3-2	" " " "	
A	Compression Blocks 1" x 1/4"	May 1950
B	" " "	
C	" " "	
D	" " "	
E	Compression of Short Block of 8B13	
F	Compression of Short Block of 8B13	

Project 205C

Connections

Summary Report

4. List of Reports & Publications.

205C.1	"Elastic Analysis of Rigid Frame Knees" by Schneider	
205C.2	"Tests in Tension" by Topractsoglou	
205C.3	"Stress & Strain Distribution and Rotations in very short-span Beams of Wide-Flange Sections" by Topractsoglou	7/2/50
205C.4	"Literature Search on Rigid Connections - Chart of Types" by Ruzek, Beedle.	
205C.5	"Connections for Welded Rigid Portal Frames" Vol. I & II (Dissertation) by Topractsoglou	
205C.6	"Connections for Welded Rigid Frames" Progress Report 4. (Part I) by Toprac, Beedle, Johnston.	12/7/50
205C.6A	"Connections for Welded Continuous Portal Frames" (Part III), L.S. Beedle, A.A. Topractsoglou, B.G. Johnston	4/17/51
205C.6B	"Connections for Welded Continuous Portal Frames" (Part II), Theoretical Analysis of Straight Knees", by A. Topractsoglou, L.S. Beedle, B.G. Johnston	1/17/51
205C.6C	"Connection for Welded Continuous Portal Frames" Report 4, by Johnston, Topractsoglou, Beedle.	
205C.7	"Connections for Welded Rigid Frames" by Toprac, Beedle, Johnston	
205C.8	"Special Problems CE113" by E.R. Johnston & L.S. Beedle.	9/22/50
205C.9	"Proposal for Connection Tests (Texas)	11/29/50
205C.10	"Proposal for Connection Tests (Students)	9/22/50
205C.11	Test No. 29, "Investigation of Plastic Hinge in Rigid Knees" by A.B.	1951

205C.12	"Connections for Welded Continuous Portal Frames Theoretical Analysis of Haunched Knees" A.W. Huber	8/20/51
205C.13	Olander Discuss by Beedle	
205C.14	Beedle Dissertation	
205C.15	"Further Tests (Tension) of Welded Corner Connections" by Toprac & Beedle	
205C.16	"Rotation Capacity" Driscoll	
205C.17	Proposal for Corner Connection Tests - Phase II, "The Influence of Size of Member" - G.C. Driscoll & F.W. Schutz	

Published Progress Report

Progress Report 4 Parts I, II, and III.
(Welding Journal)

Progress Reports not for Publication

Progress Report "A"

"Plans for Connection and Column Tests"
by, Jan Ruzek, Lynn Beedle, Bruce Johnston
November 26, 1948

Progress Report "D"

"Test of a Rigid Frame Knee"
"Ultimate Strength of Welded Continuous Frames and their Components"
by, Jan Ruzek and A. A. Topractsoglou
June 1, 1941

Progress Report "E"

"Working Drawings for Three Connection Tests, Proposal for Additional Tests
by, A. A. Topractsoglou, Jan Ruzek, Lynn Beedle

Summary Report "M"

"Connections for Welded Continuous Portal Frames"
by, A. A. Topractsoglou, Lynn S. Beedle, Bruce G. Johnston

Part I---Test Results and Requirements for Connections
Part II--Theoretical Analysis of Straight Knees
Part III-Discussion of Test Results and Conclusions

Project 205C

Connections

Summary Report

5. List of Test Data X-File

Accopress Binders:

1. Fabr. Time Study Costs
2. Drafts of Thesis (Toprac)
3. General Analysis
   Design of Fixtures
   Material Properties
   Test of Control Beam T-15 M-Ø
   Tensile Tests
4. Curves T-0 Connection P
5. Test of Connection P 205C-1
6. Test Data T - 1 - 4 A-K-M-D
7. Test Data T - 5 - 9 E-N-B-C-I
8. Test Data T - 10 - 14 F-L-J-H-G

Manila Folder

9. Some of Data Sheets for Tension Tests
   T-16 - T 29
10. Extra Copies of Item 9.

X File

Rough Drafts and Ozalid Masters
(See report list for subject covered)

X205C.3	"Stress and Strain Distribution and Rotations in very Short-Span Beams of Wide Flange Sections" A. A. Topractsoglou
X205C.6	Four folders of Rough Drafts of Progress Report 4.
X205C.6A	Three folders of Rough Drafts.
X205C.6B	Four folders of Rough Drafts.
X205C.6C	Four folders of Rough Drafts.
X205C.12	Three folders - Report (Ozalid) Rough Draft Calculations
X205C.13	One folder - Original and Data
X205C.14	One folder - Original Tracings (Ozalid)
X205C.15	One folder - Tracings
X205C.17	One folder - Ditto master (Proposal)
X205C	Extra copies of Progress Report "D"

Project 205C

Connections

Summary Report

6. List of Computations Folders (X - File)

Calculations

1. Two Folders by AAT

   Analysis of Type 7 Connection

2. 205C.6 Computations (LSB)

   Calculations Made for Progress Report 4.

7. List of Plans & Drawings

   X205C.6 - Six Folders of drawings and tracings for P.R.4

   Large Drawings & Tracings File

   Pigeonholes 41 and 48

LSB

LIST OF 205C,6 CALCULATIONS (LSB)

(FILED IN SPECIAL FOLDER WITH THIS TITLE)

REFERRED TO AND FILED BY DATE

DATE	GEN'L SUBJECT	
10-10-50	DEFLECTIONS	Theo. Load - deflection curve [slide 3A]
10-10-50	ROTATIONS	Analysis of F_j S1. Rotations in Haunched Knees
10-12-50	SEMI-RIGID CONN	Influence of Semi-Rigidity on Frame deflection
10-10-50	M-ϕ	Analysis of F_j S2
10-17-50	M-ϕ	Rotation Capacity, - straight knees
1-11-51	STRESS	Straight knees - Shear - A check of Griffith's Rule 9
2-1-51	"	" " " (re-check)
1-12-51	FRAME DESIGN	Design of single-open rigid frame
2-13-51	ROTATION	Square knees with diagonal stiffeners
2-14-51	"	" " " " and vertical stiffeners
2-15-51	"	" " Analysis on the basis of minimum requirements

NOTE: Other additional computations were made in the body of the report, do not appear elsewhere, and may be found in the original (and supplementary) drafts.

2-16-51	DEFLECTION	Moment - deflection curve, 8I13 square knees
2-10-51	DIMENSIONS	8WF31
2-10-51	"	14WF30
2-26-51	INITIAL YIELD	MODELS A-P: Initial Yield by M-ϕ & Struct. Methods
2-27-51	M-ϕ	Central beam M ϕ curve
2-28-51	" (str. H)	Theoretical Strain-Hardening M-ϕ curves
3-3-51	M-ϕ STRESSES	Connection L
3-11-51	WORST LOADING	Connection B
9-50	P-M	Conversion of load to Moment
3-31-51	Shear stress	Non-uniform distribution of shear. -
4-3-51	Rotation	Elastic Rotation, $d_1 \neq d_2$, "Equiv. length"
4-15-51	LOCAL BUCKLING	Tabulation of observed local buckling loads
3-26-51	Rotation	Straight Knees - elastic rotations Type 2, 2B, 7
2-5-51	Material Properties	Dimensions & properties 8I13, 8WF31, 14WF30, 1/4" plate
7-9-51	Yield due to Shear or Moment (Huber)	
1-13-52	DIAGONAL STIFFENER DESIGN	
1-13-52	Web Thickness Reqt's	
1-16-52	Yield Strength Determination Increment	
1-19-52	(2) Theoretical Yield	
1-28-52	Calculated Initial Yield	
1-28-52	Mat'l Properties Variation	

DIST.
GCD
LSB
205C Calc
205C Summary

205C Calculation list (cont'd)

Date	Gen'l Subj	Notes
2/4/52	Haunched Knees	Hinges at the ends
4-2-52	STRAIGHT KNEES	Further study of some expressions for Web thickness
4-3-52	HAUNCHED KNEES	Use of in plastic design
4-29	CONN. P	Web thickness Req't
7-30	STRAIGHT CONN.	Web thickness Req't
8-7	HAUNCHES - PORTALS	Savings in frames using two design conditions
8-12	STRAIGHT CONN.	Shear Stress
8-16	" "	Deformation - M-θ
8-17	" "	Diag. stiffener requirement
8-18	" "	" " design
8-17	" "	Shear rotation in 8WF31
8-25	" "	Rotation of Type 8B
8-26	" "	Stresses in Type 8B

Project 205C

Connections

Summary Report

8. List of Photographs.

Photographs are listed against each specimen in it's section of the data book. It is Recommended that you look up the test data to get negarive numbers and a sample print.

9. List of Special Equipment

1. Loading Fixture for 8 B 13 Knees.
2. Four Flat Tension Plates

Project 205C

Connections

Summary Report

10. Budget & Expenditures

Expenditures 1 July 1948 - 30 June 1949 (Acct. 607B)
(Both Frames & Connections)

Wages & Salaries	$ 893.96
Overhead	156.88
Expanses	1942.84
Total	$2993.68

Expenditures 1 July 1949 - 30 June 1950 (Acct. 607B)

Wages & Salaries	$3132.88
Overhead	759.67
Expenses	1095.23
Total	$4987.78

Expenditures 1 July 1950 - 30 June 1951 (Acct. 525-2)

Wages & Salaries	$1654.50
Overhead	551.50
Expenses	588.25
Total	$2794.25
Budget	$2420.00

Expenditures 1 July 1951 - 30 June 1952 (Acct. 525-2)
A.A.T.

Wages & Salary	$160.65
Overhead	53.56
Expenses	121.35
Total	$235.56
Budget - None	

(Acct. 526-3)
L.S.B.

Wages & Sarary	$656.96
Overhead	164.23
Expenses	113.71
Total	$934.90
Budget	$5600.00

Total Cost $11,946.17

Further charges up to about November 1952 are carried in cost of Phase II.

11. List of Personnel

Project Directors:

B. G. Johnston

L. S. Beedle

Research Workers

J. M. Ruzek

A. A. Topractsoglou

A. W. Huber