Welded continuous frames and their components. Lehigh project committee meeting - march 1955

L. S. Beedle

Follow this and additional works at: https://preserve.lehigh.edu/engr-civil-environmental-fritz-lab-reports

Recommended Citation
https://preserve.lehigh.edu/engr-civil-environmental-fritz-lab-reports/1278

This Technical Report is brought to you for free and open access by the Civil and Environmental Engineering at Lehigh Preserve. It has been accepted for inclusion in Fritz Laboratory Reports by an authorized administrator of Lehigh Preserve. For more information, please contact preserve@lehigh.edu.
Minutes of the Meeting of the Lehigh Project Subcommittee

March 11, 1955

1. The meeting was called to order at 9:50 with the following members of the committee in attendance: Messrs.: Vasta, MacCutcheon, Howland (representing Newmark), Grover, Higgins, Epstein, Jameson, Weiskopf, Dill, and Beedle. The following were also present: Messrs.: Smith, White, Ketter, Thurlimann, Driscoll, Schutz, and Estes.

2. Reports were presented as shown on the attached Agenda.

3. The status report as of March 11, 1955 was distributed and reviewed. (see attached)

4. The following actions were taken with regard to the topics presented:

Inelastic Instability (205E)

Mr. Vasta expressed an interest in the effective width of a top flange which might be the deck of a ship. This is an item upon which some future studies might be made, particularly in connection with the "built-up members" (248) project.

Procedures of Analysis (205)

Dr. Thurlimann presented a resume of his forthcoming report. It was pointed out that this work differs from previous analytical studies (Brown University, etc.) in that a complete treatment is given for checking the equilibrium condition after the plastic analysis has been carried out. Further a simplification is given for making the mechanism computations for gabled frames (method of instantaneous center).

Connections - Tapered Haunches (205C)

It was agreed that sufficient expression of opinion from the committee had been received and the work on tapered haunch connections -- and curved knees -- could commence. Members of the committee suggested a careful evaluation of the shear stress in haunched connections and also a careful check on the width-thickness ratio of flanges (cross bending). Existing rules should cover these two situations.

Summer Course

The general content and scope of the summer course on plastic design was reviewed and the committee appraised the plans for the September summer school at Lehigh.
Rules of Practice

The committee was advised of the status of expression of opinion by the various committee members. Several specific points on the report were discussed as follows:

1. The committee approved the revised title, "Rules of Practice for Plastic Design in Steel".

2. There was no objection to deleting the word "tentative" from some of the Rules.

3. After a discussion of a figure showing allowable loads according to various specifications and various loading conditions, the committee expressed the opinion that 1.88 should be used as the load factor of safety for bending whenever 1.65 would be used in elastic design. Mr. Weiskopf pointed out that the general philosophy would be to use 1.65 in tension, 1.88 in flexure, and a special factor of safety for compression members (present specifications).

4. For D.L. + L.L. + wind, the factor of safety would be 1.41.

Factor of Safety (205F)

The opinion of the committee was sought with regard to whether or not we should undertake as part of the project a detailed study of the factor of safety. Such a study is not essential to a study of the ultimate strength of structures but is desirable when one is considering the application of plastic analysis to design.

It seemed the consensus of committee opinion was that when the factor of safety was studied it should be done by the group carrying on this work. At least, any other committee (such as ASCE Committee on Factors of Safety) should be completely familiar with the work of the Lehigh Project Subcommittee before undertaking to recommend changes in safety factors. In general, it seems that the committee would go along with substituting a number for the present "1.65" for the time being, but that it might want to undertake a study of the factor of safety in the future.

Special Studies

An outline of the special studies being carried out for course credit without cost to the program was distributed (March 11, 1955).
Column Test Program (205A)

Two proposed changes in the previously-approved program were agreed upon:

(1) Increase the $P/P_y$ ratio for test No. J.

(2) In Series IV (8WF31, weak axis) test Models E, F, and G to be tested under load condition (a) instead of load condition (b).

Reports

It was recommended that abstracts and summaries be included in all project reports (MacCutcheon). With but a few exceptions, this has been done rather consistently.

Lynn S. Beedle

LSB:plt

Distr: Mr. T. R. Higgins (4)
F.L. Project Personnel
AGENDA
Lehigh Project Subcommittee Meeting
New York, New York
11 March 1955

Morning Session

Preliminary Remarks

Inelastic Instability (205E)

Lateral Buckling -- Review of Recent tests M. W. White
Local Buckling -- Discussion of report B. Thurlimann
Discussion of Further Tests

Procedures of Analysis (205)

Presentation of results of analytical work B. Thurlimann

Frames (205D)

Strength of Frames T3 and T4 F. W. Schutz

Lateral Bracing Requirements (205H)

Survey of measured forces on various tests
Lateral Support Systems J. E. Smith

Connections (205C)

Tapered Haunches J. E. Smith
Final Action on Proposal F. W. Schutz

LUNCH

Afternoon Session

Summer Course and Conference on Plastic Design in Structural Steel L. S. Beedle

Rules of Practice (205)

Reports for Publication

Report of Tension Test of Connections L. S. Beedle
Report on Frames T1 and T2
"Plastic Strength of Steel Frames"

Reports on Special Studies L. S. Beedle

General Status Report and Future Program L. S. Beedle

Use of Models in Plastic Design (205) 3:15

A demonstration R. L. Ketter

Columns (205A)

Lateral Buckling of Columns - results of analytical work
Future Program
Welded Continuous Frames and Their Components

STATUS REPORT
March 11, 1955

This status report is prepared for the semi-annual meeting of the Lehigh Project Subcommittee, Structural Steel Committee, Welding Research Council.

Program Outline

Available to those who wish a copy is a revised PROGRAM OUTLINE, listing the various programs that have been set up as a basis for carrying out the project. The arrangement is according to status of solution ("Current", "Future Planning", "Work Done").

Reports

The following reports have been distributed or published since the last meeting:


The following reports will be distributed to the Committee or published shortly:


Int-26 "RULES OF PRACTICE FOR PLASTIC DESIGN IN STEEL", Beedle, L. S. and Johnston, B. G., (205.20) (Revised).

Int-27 "ANALYSIS OF FRAMES FOR ULTIMATE STRENGTH", Thurlimann, B.
Other reports are in preparation.

Status

Enclosure 1 lists the projects on which work has been in progress since July 1, 1954, or is planned for the remainder of the year. An indication is given of the nature of work yet to be completed.

Future Plans

Enclosure 2 lists work we are considering for the year 1955-56. Some continuations of studies begun this year and included on enclosure 1 are not repeated. Appropriate specific proposals will be submitted.

Lynn S. Beedle
Assistant Director
## 205.4
3/9/55

<table>
<thead>
<tr>
<th><strong>CURRENT WORK '54-55</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Recently Completed</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Report</strong></td>
<td><strong>Analysis Tests, Development</strong></td>
</tr>
</tbody>
</table>

### Practical Applications

- **Evaluation (205-II)**
  - 1.P. R. #14
  - 2. Can Design Be Based on Ultimate Strength

- **Rules of Practice (205-III)**
- **Design Examples (205-V)**
- **Analysis Procedures (205-VI)**
- **Use of Models (205-VII)**

### Frame Studies

- **Portal-Vertical Load (205D-I)**
- **Portals-Combined Load (205D-II)**
- **Arches**

### Studies of Components

**Columns:**

- **Lateral-Torsional Buckling (205A-V)**
- **Framed Columns (205A-IV)**
  - P. R. #13

**Connections:**

- **Size Effect (205C-II)**
- ***Haunched Connections (205C-VI)**
- **"Tension" Behavior (205C-IV)**
- ***Built-Up Members (248)**

### Studies of "Modifications" or "Limitations"

- **Inelastic Instability:**
  - **Local Buckling (205E-III)**
  - P. R. X
  - **Lateral Buckling (205E-V)**

- **Lateral Bracing Requirements:**
  - **Survey of Measured Forces**
  - **Continuous Structure**

---

* Pending final Committee action.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columns-Biaxial Flexure (205A-III)</td>
<td>Analysis</td>
<td>Tests</td>
</tr>
<tr>
<td>Beams-Influence of Shear (205B-III)</td>
<td>--</td>
<td>Report</td>
</tr>
<tr>
<td>Shear Modulus in the Plastic Range (205E-VI)</td>
<td>--</td>
<td>Report</td>
</tr>
<tr>
<td>Repeated Loading: Deflection Stability (205G-II)</td>
<td>--</td>
<td>Report</td>
</tr>
<tr>
<td>Box Sections in Plastic Design (247)</td>
<td>--</td>
<td>Analysis</td>
</tr>
<tr>
<td>Analysis Tests</td>
<td>--</td>
<td>Report</td>
</tr>
<tr>
<td>Bolted Connections in Plastic Design (245)</td>
<td>--</td>
<td>Analysis</td>
</tr>
<tr>
<td>Aging (238-I)</td>
<td>--</td>
<td>Report</td>
</tr>
</tbody>
</table>
## WELDED CONTINUOUS FRAMES AND THEIR COMPONENTS

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>FRAME</th>
<th>COMPONENT</th>
<th>REPORTS</th>
<th>MMENT PLANNING</th>
<th>WORK DONE</th>
<th>REPORTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>I</td>
<td>I</td>
<td></td>
<td>(1) Initial Studies</td>
<td>3, 205-18</td>
<td>(11) Evaluation</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>III Rules of Practice in Design</td>
<td>IV Tentative Specifications</td>
<td>(20) Tentative Spaces</td>
<td>10, 14</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>V Design Examples</td>
<td>VI Analytical Procedures</td>
<td>VII Use of Models</td>
<td>VIII</td>
<td>(VI) Use of L-Shapes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(VII) Use of single-curvature columns</td>
<td>10, 11</td>
</tr>
<tr>
<td>Columns in Continuous Frames</td>
<td>I</td>
<td>II Simple Columns with M &amp; P</td>
<td>IV Framed Columns</td>
<td>III Design 3,18 (&gt; ) 3,13 (&gt; ) (&gt; ) 2,12,14</td>
<td>(VIII) Use of single-curvature columns</td>
<td>10, 11</td>
</tr>
<tr>
<td></td>
<td>(10A)</td>
<td>III</td>
<td>(11) Ultimate Tensile Strength</td>
<td>(V) Ultimate Shear</td>
<td>(VI) Use of single-curvature columns</td>
<td>(VIII) Use of single-curvature columns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Means: Static Loads</td>
<td>I</td>
<td>II Shear Influence</td>
<td>(1) Simple Beam</td>
<td>(II) Continuous Beams</td>
<td>1.0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>III</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connections</td>
<td>I</td>
<td>II Size Effect</td>
<td>III Rotation Capacity</td>
<td>IV &quot;Sagging&quot; Behavior</td>
<td>V</td>
<td>(V) Web reinforcement</td>
</tr>
<tr>
<td></td>
<td>(242)</td>
<td></td>
<td></td>
<td></td>
<td>VI Recessed Column Connections</td>
<td>(VII) Use of single-curvature columns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deflections &amp; Factor of Safety</td>
<td>I</td>
<td>II P.S. Static Load (for load types)</td>
<td>IV</td>
<td>(III) Industrial Frames</td>
<td>(IV) Tension</td>
<td>(V) Tension</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected Loading</td>
<td>I</td>
<td>II Preliminary Studies of Deflection Stability</td>
<td>(II) Preliminary Load</td>
<td>(IV) P.S. Repeated Load</td>
<td>(V) Studies of Loading</td>
<td>(VII) Use of single-curvature columns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td>I</td>
<td>II Column Connections</td>
<td>III Girders and Beams</td>
<td>IV</td>
<td>(III) Beams</td>
<td>(IV) Beams</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Sections in Plastic Design (240)</td>
<td>I</td>
<td>II Girders and Beams</td>
<td>(II) Beams</td>
<td>(IV) Beams</td>
<td>(VI) Beams</td>
<td>(VII) Beams</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact</td>
<td>I</td>
<td>II Girders and Beams</td>
<td>(II) Beams</td>
<td>(IV) Beams</td>
<td>(VI) Beams</td>
<td>(VII) Beams</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Built-Up Members (346)</td>
<td>I</td>
<td>II Girders and Beams</td>
<td>(II) Beams</td>
<td>(IV) Beams</td>
<td>(VI) Beams</td>
<td>(VII) Beams</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arch</td>
<td>I</td>
<td>II</td>
<td>(I) Model Studies</td>
<td>(II) Model Studies</td>
<td>(III) Model Studies</td>
<td>(IV) Model Studies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolted Connections in Plastic Design (340)</td>
<td>I</td>
<td>II Girders and Beams</td>
<td>(II) Beams</td>
<td>(IV) Beams</td>
<td>(VI) Beams</td>
<td>(VII) Beams</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Properties (344)</td>
<td>I</td>
<td>II</td>
<td>(II) Mean in Exterior Column</td>
<td>(II) Mean Continuous over Column</td>
<td>(II) Mean on girders</td>
<td>(I) Means</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Connections II</td>
<td>I</td>
<td>II</td>
<td>(II) Mean in Exterior Column</td>
<td>(II) Mean Continuous over Column</td>
<td>(II) Mean on girders</td>
<td>(I) Means</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| * Formerly, phases X000 - VII and VIII
* Rowhea in parentheses are Interim Reports, all others are Progress Reports
\[ f_1 \leq \frac{T_{ri, max}}{\alpha} \]

\[ \alpha = 0.1^\circ (5.7^\circ) \]

\[ \alpha = 0.4^\circ (22.9^\circ) \]

\[ \alpha = 0.1^\circ (5.7^\circ) \]

\[ f_3 \leq \frac{T_{ri, max}}{\alpha} \]

\[ \alpha = 0.4^\circ (22.9^\circ) \]

\[ \alpha = 0.1^\circ (5.7^\circ) \]

\[ Af = \text{Area of one flange} \]

\[ \text{Area of one-half web} \]

\[ f = \text{Stress by simplified method (Olander)} \]

\[ \sigma = \text{Stress by more rational method (Osgood)} \]
$P_2$

$\alpha = 0.1 \circ (5.7\%)$

$\frac{f_2}{\sigma_{T_2, \text{max.}}} = 0.9$

$\alpha = 0.4 \circ (22.9\%)$

$\alpha = 0.4 \circ (22.9\%)$

$\frac{Af}{Af + \text{tra}}$

$Af$ = Area of one flange

$\text{tra}$ = Area of one half web

$f$ = Stress by simplified method (Olander)

$\sigma$ = Stress by more rational method (Osgood)
\[ \frac{A_f}{A_f + tra} = 0.358 \]
\[ \frac{A_f}{A_f + t r_{\alpha}} = 0.492 \]
**Indeterminate Structure**

**Beam**

**British Procedure**

**Tension**

- **Deflection**
  - $F_1: \frac{P_4}{P_W} = 1.75, \frac{P_U}{P_W} = 0.57$
  - $F_2: \frac{P_4}{P_W} = 1.88, \frac{P_U}{P_W} = 1.65$
  - $\frac{P_U}{P_W} = 0.53$

- **Load**
  - $F_1: \frac{P_4}{P_W} = 1.75, \frac{P_U}{P_W} = 1.53$

- **T**
  - $F_3: \frac{P_4}{P_W} = 1.65, \frac{P_U}{P_W} = 0.61$
SPECIAL STUDIES

The following special studies are being carried out for course credit by graduate students at the Fritz Laboratory:

Influence of Shear on the Plastic Moment (205B)

To correlate with analysis, a series of tests was performed on WF beams on the influence of shear stresses on the plastic moment. Previous tests tended to confirm the theoretical findings, but a program controlled to study the particular variable was considered desirable. The tests have been completed and a report is being prepared.

Preliminary Study of Deflection Stability (205G)

Little is known about the plastic behavior of structures under variable loading conditions. Certain theoretical considerations indicate that progressive collapse by increasing deflection may occur under a limited number of load applications. Tests on WF beams have been made. The rough draft of the final report is ready for editing.

Biaxially-Loaded Steel Columns (205A)

A set of end fixtures for testing model columns (3/4-in square and under) have been fabricated to permit an exploratory program of tests to be carried out on concentrically or eccentrically loaded columns. The end conditions will be controlled so that bending about either or both principal axes will be possible. Actual testing will begin shortly.

Bolted Connections in Structures Proportioned by Plastic Methods

In order to explore the possibilities of shop welding and field bolting for appreciable moment resistance, a theoretical study will be made and several alternate designs of bolted connections will be tested to determine dependable "hinge moments".

Shearing Modulus in the Plastic Range (241)

Theories of local buckling depend to a large extent on the plastic shearing modulus. Tests to obtain this data were conducted on steel tubes under combined compression and twist. A report is being prepared.

Aging and the Strength of Steel Beams (239)

Tests have been completed in which the specimens were loaded into the plastic region, unloaded, and after aging were deformed to maximum load. Different strain rates and aging times were used to study the influence of these variables on the M-ζ relationship. A report has been prepared and will be available shortly. Under condition of "uniform moment" strain aging has been shown to have such a small effect that it may be neglected.

Welded Corner Connections in Tension (242)

The corner connections from Portal Frame #3 (12WF36) were removed from the frame and tested with a tensile load across the knee so that the moments developed were opposite those normally experienced in a portal knee. One knee had been subjected to very high moments and rotation during the frame test while the other had not been subjected to moments as high as its
yield moment. No fractures occurred during these tension tests. The testing and analysis of results has been completed. A report shall be completed soon.

Box Sections in Plastic Design (247)

The problem of providing lateral support to rolled beams which are to be used in plastic design has been shown to be real and difficult. The Lateral buckling tendency of a section is directly related to its torsional rigidity. It is expected therefore that closed box sections should be vastly superior to rolled sections as far as lateral buckling is concerned. The pilot program now under way as a graduate student research project involves the testing of a box beam (14" deep) subjected to a pure plastic moment over a length of 150 inches. The equivalent rolled WF section (14 WF 30) would buckle at strains equal to the yield strain whereas the box section is expected to reach at least strain hardening.
Practical Applications

Rules of Practice - Supplement
Analysis (Tier Buildings)
Design Examples
Use of Models

Frame Studies

Portal Frame (Gabled roof, combined loading)
Tier Building Frame
Simulated Building Structure (double frame)
Arches

Studies of Components

Connections: Rotation Capacity
Framed Columns
*Haunched Connection
*Built-Up Members

Studies of "Modification" and Special Topics

Inelastic Instability: Stiffening
Repeated Loading (as part of a frame test)
Lateral Bracing
Deflections

* Pending final Committee action.
List of Reports

I. Progress Reports, Published or for Publication


- Beedle, L. S. RESEARCH ON RIGID FRAMES Proceedings, AISC National Engineering Conference, p. 21, F.L. #205.18 Apr. 1952

   May 1953

    PLASTIC DEFORMATION OF WF BEAM COLUMNS ASCE Proceedings, Separate 79(330), F.L. #205A.12, Reprint No. 91.
    Oct. 1953

11. Ketter, R. L.
    A VIRTUAL DISPLACEMENT METHOD FOR DETERMINING THE STABILITY OF BEAM COLUMNS ABOVE THE ELASTIC LIMIT, Submitted for publication as an ASCE Separate, F.L. #205A.14.
    1954

12. Beedle, L. S.
    Apr. 1954

    Discussion of "STRENGTH OF COLUMNS ELASTICALLY RESTRAINED AND ECCENTRICALLY LOADED", by Fisher, Bijlaard, and Winter, ASCE Proceedings Separate. 80(532) F.L. #205A.15, Reprint No. 98.
    Oct. 1954

14. Beedle, L. S.
    Oct. 1954
II. Progress Reports, Not for Publication

A. Beedle, L.S., Ruzek, J., and Johnston B. G. 
   PLANS FOR CONNECTION AND COLUMN TESTS 
   F. L. #205.A. 
   November 1948

B. Yang, C. H. 
   PLASTIC BEHAVIOR OF CONTINUOUS BEAMS 
   F. L. #205.B. 
   May 1949

C. Chen 
   STRENGTH OF COLUMNS UNDER COMBINED BENDING AND COMPRESSION 
   F. L. #205.C. 
   May 1949

D. Ruzek, J. and Topractsoglou, A. A. 
   TEST OF A RIGID FRAME KNEE 
   F. L. #205.D. 
   June 1949

E. Topractsoglou, A. A., Ruzek, J., and Beedle, L. S. 
   WORKING DRAWINGS FOR THREE CONNECTION TESTS. PROPOSAL FOR ADDITIONAL TESTS 
   F. L. #205.E. 
   June 1949

F. Beedle, L. S. 
   GENERAL SUMMARY REPORT 
   F. L. #205.F. 
   July 1949

G. Beedle, L. S. 
   STRUCTURAL RESEARCH AT CAMBRIDGE UNIVERSITY 
   F. L. #205.G. 
   January 1950

H. Beedle, L. S. and Yang, C. H. 
   DISCUSSION OF FLEXURE OF I-SECTIONS ABOVE PLASTIC RANGE 
   F. L. #205.H. 
   February 1950

I. 205 Staff 
   SPECIAL SEMI-ANNUAL REPORT TO SUBCOMMITTEE 
   F. L. #205.I. 
   March 1950

J. 205 Staff 
   ANNUAL REPORT 
   F. L. #205.J. 
   January 1951

K. Ketter, R. L. and Beedle, L. S. 
   SOME RESULTS OF COLUMN TESTS. PROPOSED PROGRAM 
   F. L. #205A.1. 
   November 1950

L. Ketter, R. L. and Beedle, L. S. 
   INTERACTION CURVES FOR COLUMNS 
   F. L. #205A.4. 
   April 1951

M. 205 Staff 
   SUMMARY REPORT 
   F. L. #205.13. 
   September 1951
N. Knudsen, K. E.
Abstract Translation of Maier-Leibnitz
CONTRIBUTION TO THE PROBLEM OF ULTIMATE CARRYING
CAPACITY OF SIMPLE AND CONTINUOUS BEAMS OF STRUCTURAL STEEL AND TIMBER
F. L. #205.15.

P. Ketter, R. L. and Beedle, L. S.
THE MOMENT-CURVATURE RELATION FOR WIDE FLANGE
COLUMNS
F. L. #205A.10.

Q. Yang, C. H. and Beedle, L. S.
INELASTIC LOCAL BUCKLING OF WIDE-FLANGE SECTIONS
F. L. #205E.1.

R. Ketter, R. L. and Beedle, L. S.
MOMENT ROTATION CHARACTERISTICS OF BEAM-COLUMNS
F. L. #205A.11.

S. Haaijer, G.
COMPRESSION TESTS ON SHORT STEEL COLUMNS OF
RECTANGULAR CROSS-SECTION
F. L. #205E.3.

T. Thurlimann, B. and Haaijer, G.
BUCKLING OF STEEL ANGLES IN THE PLASTIC RANGE
F. L. #205E.2.

U. Schutz, F. W., Schilling, C., and Beedle, L. S.
COLLAPSE STRENGTH OF A WELDED SINGLE BAY FRAME
F. L. #205D.5.

V. Ketter, R. L.
A VIRTUAL DISPLACEMENT METHOD FOR DETERMINING THE
STABILITY OF BEAM COLUMNS ABOVE THE ELASTIC LIMIT
F. L. #205A.14.

X. Haaijer, G. and Thurlimann, B.
LOCAL BUCKLING OF WIDE-FLANGE SHAPES
F. L. #205E.5.

Y. Driscoll, G. C.
CONNECTION BEHAVIOR AS INFLUENCED BY SIZE OF MEMBER
In preparation.

Z. 205 Staff
SUMMARY REPORT
F. L. #205.25.
File No. 205

INTERIM REPORTS

26. Beedle, L. S. and Johnston B. G.
RULES OF PRACTICE IN PLASTIC DESIGN
F. L. #205.20.

August 1954