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File No. 205DC

Members, Lehigh Project Subcommittee
Structural Steel Committee
Welding Research Council

Gentlemen:

We are enclosing for your information a description of a test program which two students are going to perform this fall as part of their undergraduate studies.

The program will investigate the effect of the position of the load line on knee characteristics. Information as to the purpose, procedure, and elements to be tested is given in the enclosure.

We anticipate only incidental costs to the project. Any suggestions you have will be welcomed.

Sincerely yours,

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Special Problems CE 113

Suggested Project

The testing and analysis of one or more structural knees in order to ascertain the effect on their characteristics of the position of the load line.

Background

During the past year extensive tests have been performed on structural knees. These tests were part of a larger investigation being conducted at Fritz Engineering Laboratory on the "Ultimate Strength of Welded Continuous Frames and their Components".

In these tests the knees were tested as shown in Figure 1. A loading arm (member BC) was welded to each knee and the load applied at C. In all cases the knees were loaded until complete failure occurred.

Purpose of Project

In the above tests each knee was tested under a single position of the load (i.e., a single length of loading arm). For the built-up knees this was selected at the "worst loading condition". It is now proposed that a knee be tested under several load positions as shown in Figure 2.

The reason for these tests is shown in Figure 3, where the plastic hinge capacity of each section of the knee is plotted against the distance from A. The bending moment diagrams at maximum load are also drawn for load position 1 and 3.

The moment diagram for loading 3 intersects the capacity curve at point A; thus a hinge should develop at A. Likewise the moment diagram for loading 1 intersects the capacity curve at point B and should develop a hinge at B. Thus if the strength of the knee be defined as the maximum moment occurring at point A, it is seen that the position of the load has an effect on the strength. It is the purpose of these tests to investigate this effect. An analytical investigation of this problem should also be made in an attempt to correlate the position of the load line and the characteristics of the knee.

Procedure

A typical welded haunched knee (Type 2B) will be fabricated. To this, loading arms (8B13) will be welded. This knee has been tested previously. The loading arm for the first test will be made long enough to assure that a plastic hinge develops in the loading arm at point B.

After loading this combination to failure the loading arm will be replaced by a shorter member and the test repeated. This procedure will be repeated until the hinge is developed inside the knee.

General

In addition to the above test program it is planned to test two additional knees. One knee will be encased in concrete in accordance with standard fireproofing techniques; the purpose of this test is to furnish an indication of the buckling restraint afforded by standard encasement. The second additional test will repeat a knee test performed last year in which the lateral support was insufficient.

This project will require one semester to complete and can carry three credit hours.

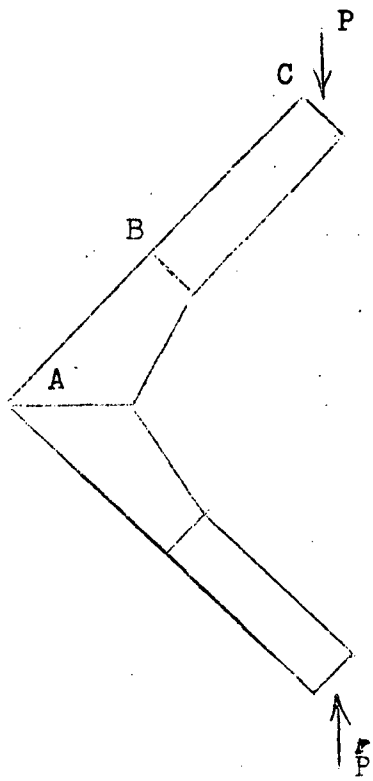

Figure 1

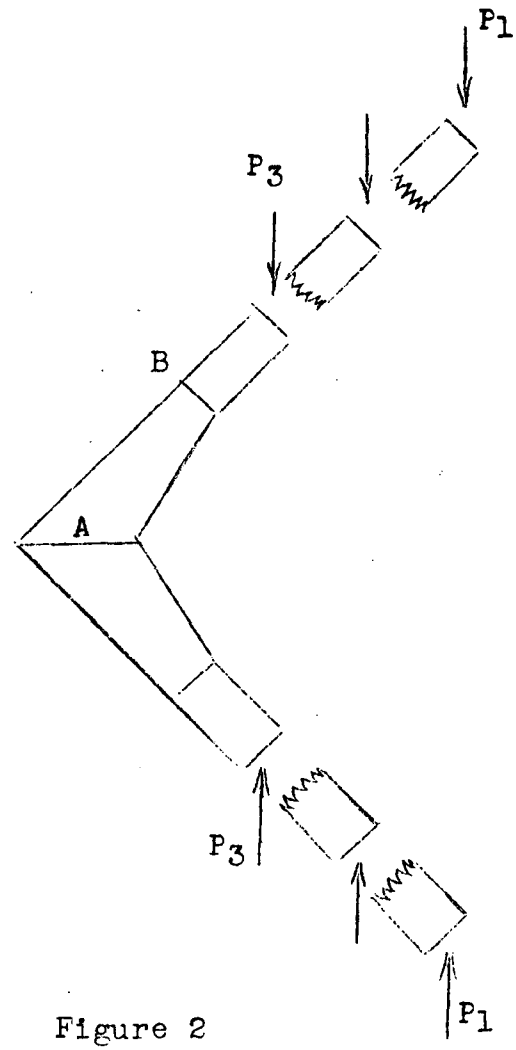

Figure 2

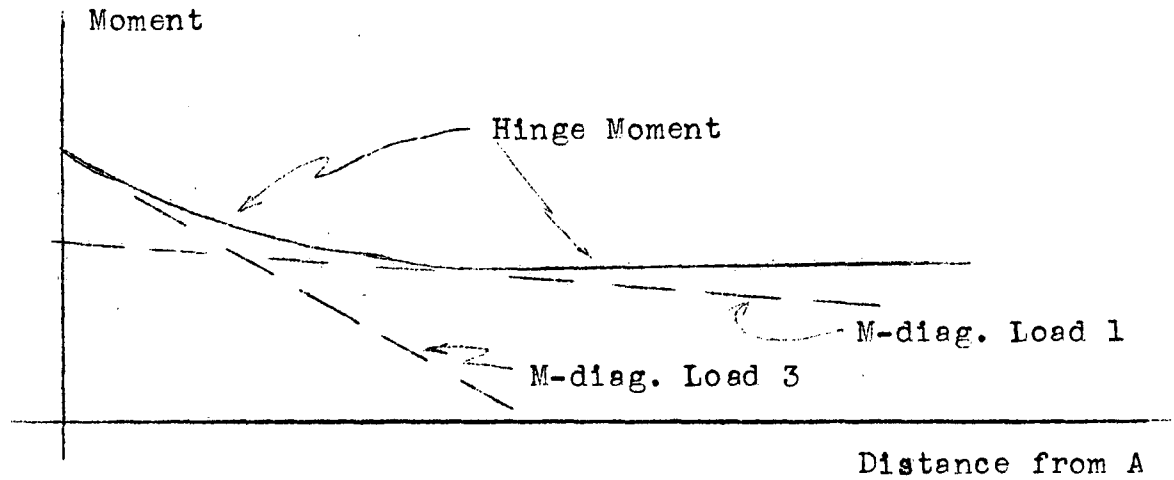

Figure 3