Connections for welded portal frames tested in tension

Topractsoglou, A. A.
1950
All pictures taken out of this report by AAT.

Negatives are filed at dark room upstairs.

Please make new prints when true available.

Tony
INTRODUCTION

This report has been prepared with the purpose of presenting the results of tests to failure of 14 connections for welded rigid portal frames. The tests are part of the program on "Welded Continuous Frames and Their Components".

The general aim of the tests reported herein is to obtain information on:

a. the behaviour of the knees in the plastic region,

b. their strength and rigidity,

and to compare with results obtained from the compression tests.

SPECIMENS, TEST APPARATUS, AND TESTING PROCEDURE

The specimens used are the connections A to N which have been previously tested in compression. See Fig. 1. All of the connections were tested in the 800,000-lb. machine and were set with the legs at 45° with the horizontal exactly as in the compression tests. A loading fixture was bolted at each end of the specimen with 8 bolts. The loads
were transmitted through a 3" pin welded to the loading fixture and a pair of plate links with a 3-1/4" ø and 6-1/4" ø holes. A 6" ø pin was secured at each tension head of the machine and pulled the specimens through the links.

The specimens were whitewashed to facilitate the observation of yield lines. One deflection gage was only used to measure the amount the two legs are pulled apart under different loads.

While in the plastic range "criterion" readings were not taken. But, the load was applied and readings of deflections were taken only after the balance beam of the machine showed no further reduction in load. This procedure is assumed to be approximately the same as the more precise one used during the compression tests.

The connections tested were not supported laterally. The following are some objections that could be voiced against the test:

1. The specimens have been tested in compression and consequently there is wide variation in the properties of the material.
2. The plastic deformations and the subsequent unloading (compression test) cause severe residual stresses.
3. The specimen has been permanently deformed and distorted. The initial dimensions and shape have been altered.
RESULTS

Tabulated Results

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Discussion of Results

In general the connections sustained higher moments in tension than in compression. Connection A did not develop the compression moment because a crack developed at the re-entrant angle.

Type 8B connection developed high moments in spite of fact that cracking occurred around the maximum moment.

The attached photos show the mode of failure in the various connections. Failure is very similar to the one observed in the compression tests. Ultimate failure occurred, after extensive yielding, by local buckling of the compression flanges.
Since knees of portal frames are very seldom subjected to "tension" loads and since most of the knees developed higher moments, the design of knees for "compression" loadings seems to be ample and satisfactory.

Under "tension", welds in the knee become critical and unless the welding is done with care and by expert welders cracks that may develop will bring about the sudden collapse of the structure. When subjected to "tension" loads the knee area under tension is much smaller (therefore concentration) than the area under tension in compressive loads.
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*Fig. 1*
Sudden opening up of crack

Initial evidence of cracking

Crack developed here and propagated as shown

All weld at right-hand corner opened

Connection - A Type 2

TEST T-16

DEFLECTION (Inches)
Local Buckling in built-up flanges
Visible Lateral Deflections Started

CONNECTION B
Test 1/17

DEFLECTION (Inches)