

COMPLETED RESEARCH PROGRAM

CRANE GIRDER RESEARCH

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The test program consisted broadly of two types of tests to obtain information on five different topics. The program consisted of tests on full sized cranes in the mills and fabricating shops; and tests on model girders in the laboratory. The topics studied were impact, acceleration and braking stresses, allowable compression stresses in the girders, torsional stiffness of riveted girders, diaphragms, and lateral loads.

1. Full Size Crane Tests.

a. Shop Tests.

Lateral load tests have been made on four cranes in the fabricating shop. The load was applied on the top flange and the stresses and lateral deflection were measured.

The following is a brief description of the cranes.

- (1) No. 4683, a 10-ton riveted crane of uniform section and of 88 ft. 4 in. span.
- (2) No. 8441, a 30-ton welded crane of uniform section and of 104 ft. span.
- (3) No. 5886, a 60-ton riveted fish-belly crane of 120 ft. span.
- (4) No. 5879, a 175 long-ton trussed I-beam crane of 100 ft. 11 in. span.

b. Mill Tests.

Tests on three cranes in a steel mill, and on the crane in the laboratory were made to measure impact stresses and lateral stresses due to acceleration and braking. The stress readings were measured by scratch strain gages. The lateral tests were made with maximum acceleration and with maximum braking applied to the crane. The accelerations and decelerations were also measured.

The lateral forces were measured with various loads and with the load hung high and low. The impact was measured when the crane was run over wedges to simulate bad joints. It was also measured for rough handling and on a skullcracker crane.

The cranes tested were:

- (1) No. 10097, a 10-ton riveted fish-belly crane of 47 ft. span.
- (2) Bethlehem No. 430, a 10-ton riveted fish-belly crane of 69 ft. span.
- (3) Bethlehem No. 410, a 5-ton hand-operated I-beam crane of 37 ft. 4 in. span.
- (4) Bethlehem No. 4, a 30-ton riveted fish-belly crane of 75 ft. span used as a skullcracker.

## 2. Laboratory Tests.

Tests were made on twenty-six box girders in the laboratory to determine the allowable stresses in box girders.

### a. First Series.

This series investigated the length-width ratios of the girder. Welded girders G-1, G-2, G-3, and G-4 with the following  $l/b$  ratios 80, 60, 40, and 30 respectively, were tested. The following riveted girders were also tested; G-15 with  $l/b$  of 58.2 and G-16 with  $l/b$  of 29.1. These girders were tested under vertical loads on the girder placed at distances five feet from the ends. The  $l/b$  ratios given above are the ratios for the spans between the load points. The total overall span-width ratios were 110, 90, 70, and 60 for the welded girders and 78 and 61 for the riveted girders.

A hi-tensile steel girder G-17 was also included in the above series. This girder is a duplicate of G-4.

Retests were made on four of the above girders which could be restraightened. These girders were tested with a ten per cent lateral load in addition to the vertical load. The retests were made on G-4a, G-3a, G-2a, and G-17a, and correspond to the girders mentioned above.

b. Second Series.

This series investigated the spacing of the webs, and the width-thickness ratio of the cover plate. These girders were eighteen feet long and loaded at the third-points. They are specified by the following terminology; G-5, G-6, G-7, G-8, G-9, and have the following width-thickness ratios on the cover plate, 32, 48, 64, 80, and 96. Girder G-9 had a longitudinal stiffener on the cover plate.

Retests were made on G-5a, G-6a, G-7a, and G-8a. These girders were loaded through an I-beam to simulate a rail, and with the loads placed half-way between the diaphragms.

A hi-tensile steel girder G-18 was also tested. This was a duplicate of G-7.

c. Third Series.

This series varied the height-thickness ratio of the web. Girders G-10, G-11, G-12, G-13, and G-14, with web-thickness ratios of 320, 192, 176, 160, and 144 were tested in this series. The girder with the web-thickness ratio of 320 had a longitudinal stiffener. These girders were tested under vertical load at the third-points.

The stresses in the diaphragms were also measured in the above tests.

d. Fourth Series.

This series investigated the torsional strength of built-up girders. Three riveted box girders were tested with various diaphragm spacings. Two riveted I-beams and two duplicate I-beams with intermittent welds instead of rivets were also tested.

Summary.

The above program on the whole provides the answers to most of the questions brought up in the analysis of the specifications. However, there seems to be insufficient data from the impact tests to make any definite conclusions and further tests are recommended. Secondly, the effectiveness of longitudinal stiffeners was so great that further investigation in this topic might be advisable.