

Paper No. 5080.

“The Failure of Girders Under Repeated Stresses.” †

By PROFESSOR FREDERICK CHARLES LEA, O.B.E., D.Sc. (Eng.),
M. Inst. C.E., and JOHN GWYNNE WHITMAN, M. Eng.

Correspondence.

Mr. W. O. Leitch observed that in the tests of girders with rivet-holes, breaks occurred under a range of stress of from 11·1 to 10·25 tons per square inch. Whilst new girders, including impact-allowances, were not designed to bear such high stresses, old girders, before being condemned because of increase of loading after construction, probably bore stresses approaching those figures. It would, therefore, be very interesting to make further tests under bridge-conditions; heavy trains of, say, one hundred axles at intervals of 3 minutes would represent a very busy railway, and consequently one hundred repetitions of stress, followed by a 3-minute rest, and so on, would be nearer actual bridge-conditions. In the floor-system the range might be from nil to, say, 10 tons per square inch, depending on the space between the axles of the trains, but for the main girders the stress, except in short spans, would gradually increase to 10 tons per square inch, would then vary, say, from 7 to 10 tons per square inch with the variation of impact, and would then decrease to nil, a much less severe condition than continuous repetitions of from nil to a stress of 10 tons per square inch.

The Authors, in reply, agreed that stresses comparable to those at which the tested girders broke were possible under working conditions, in very special cases. The fractures in the test-specimens only occurred at those stresses after more than 5×10^6 repetitions, and there was no reason to think that the rate at which axle-loads would be applied would very seriously lower the fatigue-range. The only serious danger would be if, due to some abnormal condition, a very high local stress were produced which started even a very small crack. The application of the slowly-applied axle-loads might then, at less stress than that which produced the first crack, cause a progression of the crack. There seemed to be no danger to riveted girders due to the application of rolling loads, repeated for very many years, provided that the stress did not exceed 10 tons per square inch. If the actual stress produced were less than that there was a real factor of safety greater than unity.

† Journal Inst. C.E., vol. 7 (1937-38), p. 119 (November 1937).