Failure Load Test of a CFRP Strengthened Railway Bridge in Örnsköldsvik, Sweden

The results obtained when performing a load test to failure of an existing structure are valuable when assessing calculation models, updating finite element models, and investigating the true structural behavior. In this paper a destructive testing and monitoring of a railway bridge in Örnsköldsvik, Sweden is presented. In this particular test the shear capacity of the concrete girders was of primary interest. However, for any reasonable placement of the load (a line load placed transverse to the track direction) a bending failure would occur. This problem was solved by strengthening for flexure using carbon fiber reinforced polymer (CFRP) rectangular rods epoxy bonded in sawed up slots, e.g., near surface mounted reinforcement. The strengthening was very successful and resulted in a desired shear failure when the bridge was loaded to failure. The load-carrying capacity in bending for the unstrengthened and strengthened bridge as well as the shear capacity was predicted with Monte Carlo simulations. The particular calculation presented showed that there was a 25% probability of a bending failure instead of a shear failure. Monitoring showed that the strengthening reduced the strain in the tensile steel reinforcement by approximately 10%, and increased the height of the compressed zone by 100 mm. When the shear failure occurred, the utilization of the compression concrete and CFRP rods were 100 and 87.5%, respectively. This indicates that a bending failure indeed was about to occur, even though the final failure was in shear.

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