

3D non-linear FE analysis of a full scale test to failure of a RC Railway

Bridge strengthened with carbon fibre bars

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Abstract

At a full scale loading test to failure a 50 year old concrete railway trough bridge in Örnsköldsvik, in northern Sweden was tested to failure. The test was a part of the European Research Project "Sustainable Bridges" regarding assessment and strengthening of existing bridges. In the project new calculation methods were developed to capture the behaviour of the bridge during increasing load. The bridge was strengthened in bending with rods of Carbon Fiber Reinforced Polymer (CFRP) before the loading test. Failure was reached for an applied load of 11.7 MN by pulling a steel beam placed in the middle of one of the two spans downwards. The achieved failure was a combination of bond, shear, torsion and bending. The developed model, a 3D -non-linear finite element (FE) model with discrete reinforcement, gave accurate accounts of the response of the bridge. The FE calculations show the effect of the strengthening with CFRP and even the effect of the epoxy when using the Near Surface Mounted Reinforcement (NSMR) strengthening method.

Key words: Bridge, Strengthening, Full scale test, Failure Analysis, Bond, Shear, Near Surface Mounted reinforcement (NSMR), Carbon Fibre Reinforced Polymer CFRP), Ultimate load carrying capacity, 3D Non-linear finite element analysis.

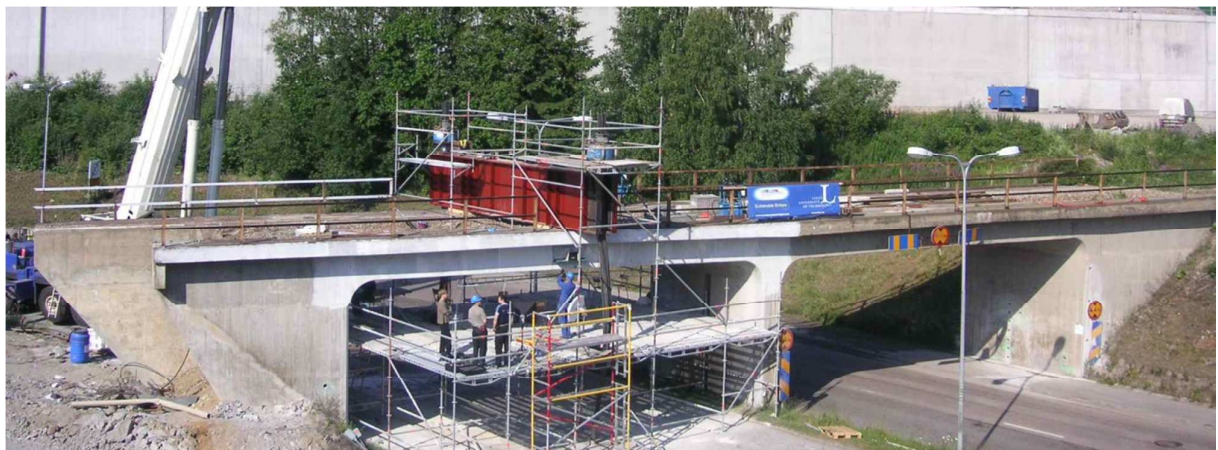


Figure 1. View of bridge in Örnsköldsvik in northern Sweden prior to testing.