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Experimental study on CFRP - strengthened steel beams

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Abstract

Recently, as a viable alternative to strengthening or repairing steel bridges with welded or bolted plates, bonded CFRP plates have been used. The main goal of the presented study is to compare the flexural behaviour of steel beams strengthened with the CFRP plates. The research has evaluated two strengthening schemes: adhesive-bonded passive plates and adhesive-bonded prestressed or active plates. The ductility and yield/ultimate carrying capacity of steel beams as well as the effectiveness of strengthening have been established in each case. The failure modes of the strengthened beams comprised the CFRP plate debonding or plate rupture, depending on the strengthening system (passive or active) and some system parameters, as the CFRP modulus of elasticity, end plate anchoring and plate prestressing level. The influence of these parameters on the strengthening effectiveness has been also discussed.

Keywords:

A. Carbon fibre; B. Debonding; B. Strength; D. Mechanical testing

1. Introduction

Currently, more than one quarter of railway bridges in Europe are made of steel and about 70% of these bridges are more than 50 years old [1]. Similar situation but to a lesser extent also occurs in the case of steel road bridges. Many of road bridges that are currently in use, were designed and built decades ago and are quickly approaching the end of their fifty-year service life. Rehabilitation of steel bridges is often required due to cross-section losses resulting from corrosion damage. Strengthening may be also required due to increase of traffic volume and weight of the vehicles, which have steadily increased over the years. This increase of axle loads and frequency of loads that occurred since the bridge has been designed and