J Civil Environ Eng 2015, 5:5
http://dx.doi.org/10.4172/2165-784X.C1.003

OMICS International
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World Congress and Exhibition on
Construction & Steel Structure
November 16-18, 2015 Dubai, UAE

Effect of stiffener configuration on efficiency of SBS for shear deficient steel beams

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Structural engineers are often involved in projects to strengthen deficient structures as a feasible alternative to cost-prohibitive full replacement of the structure. The use of composite materials to strengthen existing concrete structures by externally bonding thin laminates or strips is mature enough that design codes and guidelines are available for flexural, shear, and axial strengthening applications. Researchers have also investigated strengthening steel structures using composite material, however, the field is not as mature as it is for concrete applications. This paper presents a new strengthening technique where pultruded GFRP sections are bonded to shear deficient regions to enhance the local buckling resistance of the thin walled steel structures. The technique, referred to as strengthening-by-stiffening or SBS, was developed at Louisiana State University. An experimental program was designed to study the effect of FRP stiffener configuration on the efficiency of SBS. Different orientations, web slenderness values and aspect ratios were tested monotonically up to failure. The ultimate shear capacities beams were enhanced by a minimum of 30% when one stiffener was used on a beam with a square panel and a maximum of 56%. Post yielding behavior including the transition from a tension field to sway-frame load path will also be discussed.

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Green construction: Reuse of materials in retrofitting of damaged bridges

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Building new bridges generally consumes more resources and time than repairing and retrofitting of damaged bridges. Therefore, the latter can be considered more sustainable. However, proper methods are necessary to assess the level of damages and to verify the fitness of such bridges prior to repair and retrofitting. In the assessment, there are two important criteria to consider. One is the amount of fatigue damage to the bridge due to usual past vehicle loading and hence the remaining fatigue life of the bridge. The other is the magnitude of damage caused to the bridge by the unexpected loading. The case study is about a 34 m long, 5.2 m wide, single spanned, double lattice girded, wrought iron Railway Bridge which was built about 40 years ago and damaged and displaced from its abutments by floods. The bridge was then placed on temporary timber abutments for several years. Then an analysis was done by modeling the bridge and validating the FEM by using results of a field loading test. Both static and dynamic loading tests were carried out. The cost for retrofitting work and constructing new reinforced concrete abutments was much less than that for constructing a new bridge. Therefore it was decided that rehabilitation of the bridge with necessary retrofitting work is more sustainable than demolishing it and constructing a new one. The bridge is now in use after being repaired, retrofitted and placed on new abutments.

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