

A Long-life Maintenance Strategy for Existing Steel Railway Structures in Japan

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Abstract

Since Japan's first rail line between Shinbashi and Yokohama opened on 14 October 1872, Japanese National Railways (JNR) has been expanding the railway network using many short span railway bridges. As a result, some of existing railway bridges become old nowadays. With aging, deterioration resulting from fatigue and corrosion becomes a severe problem and seriously affects the serviceability and durability of bridges. Therefore, appropriate preventive maintenance or strengthening should be performed on aged steel railway structures to ensure their reliability and safety in service condition. On this background, a maintenance method for existing steel railway bridges using rubber-latex mortar, Glass Fiber Reinforced Polymer (GFRP) plates, lightweight rapid hardening concrete, and reinforcement, was reported in this study. Both field tests and numerical analyses were performed to confirm the actual effectiveness of this strengthening method. According to the results obtained from this study, the present renovation method can greatly enhance the rigidity and reduce the stress levels of old steel railway bridges, resulting in the extension of their residual service lives.

Keywords: Maintenance, steel structures, rubber-latex mortar, GFRP plates, lightweight concrete.

1 Introduction

Since Japan's first rail line between Shinbashi and Yokohama opened in 1872, Japanese National Railways (JNR) has been expanding the railway network using many short span railway bridges. After several years' services, many of them become old nowadays and need to be strengthened appropriately or replaced by new bridge structures. Due to the traffic disturbance and impact on local environment in building new structures, rehabilitation or strengthening on existing

structures to extend their residual service lives is generally the priority option.

In recent years, many researchers have put efforts on this topic. In Europe, the Project entitled "Sustainable Bridges - Assessment for Future Traffic Demands and Longer Lives" funded by the European Commission was carried out, and the guidelines for strengthening of railway bridges was proposed [1]. In 2014, Ghannam et al. performed site investigation and finite element (FE) analysis to strengthen an existing steel box girder bridge by using post tensioned cables [2]. The bridge crosses the river Nile in Sherbeen city near Mansoura,