Estimation of Seismic Behaviour of Corroded Steel Bridge Plates

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Summary

The maintenance and safety of existing bridges is an important concern of all highway and railroads. Corrosion is one of the most important causes of deterioration of steel girder bridges which affects their long term mechanical performance, usability and durability. Furthermore, some recent earthquakes demonstrated the potential seismic vulnerability of some types of steel bridges, and hence, it would be very important to understand the behavior of existing steel bridges which are corroding for decades in future severe seismic events. Therefore, the prediction of residual ultimate strength capacities of steel bridge members with different corrosion conditions is investigated under different earthquake loadings and a methodology to assess the seismic demand of existing steel bridge members with different corrosion conditions is discussed.

Keywords: Bridge maintenance, Corrosion, Earthquakes, Seismic resistance

1. Introduction

The consequences of corrosion are many and varied and effects of these on safe, reliable and efficient operation of structures are often considered than simply loosing of volume of metal. Various kinds of failures and need of expensive replacements may occur even though the amount of metal destroyed is quite small. One of the major harmful effects of corrosion is the reduction of metal thickness leading to loss of mechanical strength and structural failure, causing severe disasters and hazardous injuries to people. In Japan, there are more than 50,000 steel railway bridges, where more than half of them have been used over 60 years and some bridges are aged over 100 years [1]. With aging, Corrosion becomes one of the major causes of deterioration of steel bridges, and its' damages seriously affect on the durability of steel bridges [2 and 3]. It is known that the corrosion wastage and stress concentration caused by the surface irregularity of the corroded steel plates influence the remaining strength of corroded steel plates [4]. In the future, it is evident that serious social problems will arise when the number of damaged bridges increases, as it is very difficult to retrofit or rebuild those aged bridges at the same time. Therefore, it is important to evaluate the remaining strength capacities of those bridges, in order to keep them in-service until they required necessary retrofit or rebuild in appropriate time.

Benefits of regular and proper inspections of older bridges cannot be overlooked. They not only help in planning the necessary work but also help in discovering and monitoring any problems, thereby reducing expensive maintenance, reducing operating hazards, preventing structural failures and averting emergencies. Therefore, no laxness in inspections should be permitted as they form the essential source of information to carry out a comprehensive evaluation of its current capacity. Several experimental studies of corroded surfaces were done by some researchers during past few decades, in order to introduce methods of estimating the remaining strength capacities of corroded steel plates [5-8]. But, to develop a more reliable strength estimation technique, only experimental approach is not enough as actual corroded surfaces are different from each other. Further, due to economic constraints, it is not possible to conduct tests for each and every aged bridge structure within their bridge budgets. Therefore, nowadays, use of numerical analysis method could be considered to have a reliable estimation in bridge infrastructure maintenance industry [9].

https://doi.org/10.2749/222137912805111735