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Enhanced Finite Element Modelling Method and Efficient Maintenance Strategy for Steel Bridge Infrastructures

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Abstract

Bridge safety is of paramount importance in transportation engineering and maintenance management. Corrosion becomes one of the most important causes of deterioration of steel girder bridges which reduce their load carrying capacities and eventually leads to catastrophic collapses. Therefore, regular and detailed inspections are necessary to assess the present condition of the infrastructure and to determine maintenance requirements to assure their safety. Since actual corroded surfaces are different from each other, only experimental approach is not enough to estimate remaining strength of corroded members and to understand their present conditions, critical locations as well as yield/ ultimate behaviors. However in modern practices, FEM analysis method has become the most common, powerful and flexible tool in rational structural analysis, which can be used to replace the time-consuming and expensive experimental work and to comprehend on the lack of knowledge on mechanical behavior, stress distribution, ultimate behavior and so on. Therefore, the numerical analysis method will give important knowledge not only for strength estimation but also for subsequent repair and retrofitting plan.

This study proposes a simple and accurate FEM method developed by considering both stress concentration effect and material loss due to corrosion with CCM parameters which requires only the measurement of maximum corroded depth. The developed model is validated with the results of many tensile coupon tests conducted on corroded specimens obtained from a steel plate girder used for about 100 years with severe corrosion. Furthermore, an efficient maintenance management plan for existing steel bridge structures is developed by combining both experimental and finite element analysis results concerning the cost, time and convenience with reliable accuracy.

Keywords: *Bridge maintenance, Corrosion, FEM analysis, Maximum corroded depth, Remaining strength*

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