

RESIDUAL STRUCTURAL PERFORMANCE OF A STEEL PLATE GIRDER BRIDGE WITH LOCAL CORROSION

安, 鎮熙

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氏名・(本籍・国籍)	アン ジン ヒ 安 鎮 熙 (韓 国)
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論 文 調 査 委 員	(主 査) 准教授 貝 沼 重 信 (副 査) 教 授 日 野 伸 一 教 授 園 田 佳 巨

論 文 内 容 の 要 旨

There is a growing interest in the maintenance method for the steel bridge as its service periods goes on more than 50 years in Japan, where many steel bridges have been constructed during the past 70 years. Generally, fatigue and corrosion have been considered as a maintenance problem according to the service period of the steel bridge. However, corrosion problem has been relatively recognized as the miner problem related to the painting unlike the fatigue problem. But, corrosion has been occurred on the painted steel surface due to the deterioration of painting film under the various corrosion environments and the various corrosion defects as scratches and thin painting on painted surfaces. Thus, a large number of seriously damaged steel bridges by corrosion problem have been reported such as bridge collapses and cut offs of main structural members. The structural behaviors or residual strengths of corroded steel bridges have not been sufficiently examined and their evaluation method has been also not established. In this dissertation, therefore, structural behaviors and strengths of steel plate girders with local corrosion were numerically examined and compared to evaluate the effect of the corrosion damage on the structural strength and the failure mode related to the structural performance. Thus, residual shear buckling strength of a web panel with local corrosion was quantitatively examined according to boundary conditions of a plate girder, corrosion conditions such as corroded depth and corroded height, and geometrical conditions such as aspect ratio and slenderness. From using residual shear strengths determined by local corrosion and comparing with the residual shear buckling strengths of the plate girder with imperfection, residual shear strength reduction factor equation was proposed to establish the inspection and the evaluation method of a plate girder with local corrosion. Shear buckling failure modes of plate girders with local corrosion were also examined and compared with the typical diagonal tension field of the web panel to examine the effect of the corrosion damage and boundary change developed by corrosion. In addition, residual bearing strength and bearing failure mode of a plate girder with local corrosion were evaluated and compared with design equation values to find the critical corrosion damage for its bearing strength. Thus, this dissertation has been consisted of seven chapters. Outlines of each chapter are explained for this dissertation as shown in followings;

Chapter 1 examined about research background, the objectives and the literature review for structural performance of a plate girder with local corrosion.

Chapter 2 reviews on shear buckling behaviors and strength of a plate girder including the design equation as well as

its bearing behavior and strength. Collapsed and damaged steel plate girder bridges and other cases were shown to explain the corrosion damage of the steel plate girder bridges.

In Chapter 3, shear buckling strength test results were explained for four plate girder specimens with different corrosion damages. These results were compared with FE analysis results of a plate girder with local corrosion to verify the FE analysis model for quantitatively examining the residual shear buckling strength according to corrosion and other conditions.

In Chapter 4, residual shear buckling strengths of a plate girder with local corrosion were examined according to boundary condition, corrosion condition and geometrical condition of the web panel. Then, residual shear buckling strengths reduction equation were proposed for establishing the evaluation method for the shear buckling strength of a plate girder with local corrosion.

In Chapter 5, imperfection effect on the residual shear buckling strengths of a plate girder with local corrosion was examined to consider fabrication defect of a plate girder for the shear buckling behaviors. More conservative residual shear buckling strength reduction equation was proposed.

In Chapter 6, shear buckling failure mode of a plate girder with local corrosion was explained for representative corrosion cases from numerical analysis of shear buckling behaviors of a plate girder according to corrosion damage and boundary condition. Thus, the corrosion damage and web boundary of a plate girder were changed and compared with the typical diagonal tension field of the web panel.

In Chapter 7, residual bearing strength and bearing failure mode of a plate girder with local corrosion were evaluated according to corrosion condition of a plate girder. its residual bearing strength was compared with design equation value to find the critical corrosion damage for bearing strength of a plate girder. In addition, repair method using CFRP was also suggested and examined from the loading test on the plate girder bridge with local corrosion at support.

In Chapter 8, the evaluated results for residual shear and bearing performance of a plate girder with local corrosion were summarized.

論文審査の結果の要旨

本論文は、様々な腐食損傷の形態を有する鋼 I 桁のウェブのせん断強度およびせん断破壊特性を定量的に明らかにするとともに、腐食損傷を有する鋼 I 桁の端部における支圧強度と破壊特性を解明することで、腐食損傷が鋼桁の残存耐荷力に及ぼす影響を定量評価する手法を提案したものであり、橋梁工学、鋼構造工学および維持管理工学上、重要な知見を得たものとして価値ある業績であると認める。

なお、本論文については試験を行った結果、満足な回答を得られたので、試験に合格したものと認める。