

ASSESSMENT ON FIGURATION OF TIME-DEPENDENT SURFACE AND STRESS CONCENTRATION IN CORRODED STEEL STRUCTURAL MEMBER UNDER ATMOSPHERIC ENVIRONMENT

鄭, 暎樹

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氏名・(本籍・国籍)	ジョン ヨン ス 鄭 暎 樹 (韓 国)
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学 位 論 文 題 目	ASSESSMENT ON FIGURATION OF TIME-DEPENDENT SURFACE AND STRESS CONCENTRATION IN CORRODED STEEL STRUCTURAL MEMBER UNDER ATMOSPHERIC ENVIRONMENT (大気環境における鋼構造部材の経時腐食表面性状とその応力集中の評価手法に関する研究)
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

Corrosion problem is occurred due to the determination of the infrastructure according to the increase in the service period of steel structures. For the corrosion damage in steel structures, it can generally be reduced their structural performance from the loss of sectional properties generated by corrosion damage, their structural behaviors and the irregularity of the surface generated from corrosion damage can be evaluated from their structural analysis based on the changed sectional properties by corrosion as it is related to structural properties to resist applied load. Thus, the corroded depth of the corroded structure should be evaluated to know their corrosion level. However, it is difficult to examine corrosion level developed by the corroded surface, since corrosion is not environmentally uniform and affected by many corrosion factors as temperature, relative humidity, airborne sea salt, and time of wetness unlike the other corrosion problems of the steel bridges. To identify these phenomena, mechanical behaviors and fracture condition on the corroded

surface should be analyzed considering corrosion environment and the time-dependent configuration of the corroded surface affected by the corrosion environment. Its effect on the real structural behaviors continuously should be examined to explain this corrosion fatigue generated from the corroded surface based on the time-dependent corroded condition. Therefore, the characterized corroded surfaces should be quantitatively identified to know the effect of the corrosion damage and its progress on the steel members and to evaluate their residual strength. However, its prediction and maintenance methods for corrosion damage are not established. Thus, characterized corroded surface conditions were quantitatively identified for the time-dependent corrosion environment from experimental and analytical approach on the corroded steel structures to suggest the fundamental structural information of the corroded steel structure for accrued basic information in the corroded steel structures and assess the possibility of the stress problem in the corroded steel structure.

This dissertation consists of eight chapters as follow:

Chapter 1 examined about research background, the objectives and literature review for atmospheric corrosion analysis and simulation on the corroded surface and corrosion fatigue were also examined.

Chapter 2 reviews on the corrosion mechanism, spatial statistical analysis and corrosion fatigue. The collapse and damage on steel structures affected by corrosion damage introduced.

In Chapter 3, the atmospheric exposure tests were carried out at the 4 test fields depending regional corrosion characteristics to reflect specific factors. This chapter explains the time-dependent configuration of the corroded surface affected by the atmospheric corrosion environment. The time-dependent figuration and corrosion loss on corroded steel plates were quantitatively evaluated to obtain the exposure test.

In Chapter 4, the corroded surfaces achieved from the atmospheric exposure test results were analyzed using typical evaluation method and spatial statistical technique, because it is not evaluated the corroded surface figuration. Their surface figurations of corroded surface were compared depending on their exposure test periods. In addition, they were compared with other test results with different corrosion environment.

In Chapter 5, the time-dependent corroded surface is generated using kriging model based on the spatial statistical value. The real corroded surface and simulated corroded surface were compared with those of spatial statistical value. The verification for proposed spatial statistical analysis, time-dependent corroded surface and thickness change depending regional corrosion environment were expected.

In Chapter 6, the stress concentration effect based on corroded surface in the steel member was examined considering the corrosion condition and the configuration of corroded surface. To evaluate the stress concentration of the corroded surface generated by spatial statistical simulation, it was applicability of stress concentration for corroded surface generated by spatial statistical simulation. The stress concentration factors were proposed based on the stress analysis by correlation analysis between configuration of corroded surface and stress concentration factor.

In Chapter 7, spatial statistical simulation conducted the corroded deck surface of the orthotropic bridge deck. The numerical model developed for corroded surface and FE analysis models were constructed to simulate the stress and displacement distribution of the orthotropic steel bridge deck according to the corrosion level of the deck surface.

Finally, it summarizes the conclusions of the obtained results for the experimental and numerical studies.

論文審査の結果の要旨

本論文は、様々な腐食環境における鋼材の表面性状の経時変化とその応力性状を定量的に明らかにした上で、鋼構造部材の腐食表面性状の経時性とその応力集中係数を評価する手法を提案したものであり、橋梁工学上、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。