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論 文 要 旨
Summary of Dissertation

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専　　攻 Department	都市イノベーション専攻
氏　　名 Name	和　　暢 HE　CHANG
論文題目 Title	Study on Rationalization of Slip Coefficient in High-Strength Bolted Friction Joints for Bridges
和訳または英訳 Translation (J->E, or E->J)	橋梁の高力ボルト摩擦接合継手におけるすべり係数の合理化に関する研究

High-strength bolted friction joints are widely used in steel structures. as time passes, disasters cause destruction and deformation of structures, and mechanical performance decrease of joints deteriorates. Considering repair and reinforcement, it is necessary to verify the residual load capacity after the depletion. It can be said that only the contact surface specifications of the joint have changed compared to the initial state. In order to estimate residual load capacity, it is thought that it can be estimated from the slip coefficients of other joints with similar contact surface specifications.　However, according to lots of experiment results until now, it is known that even if the contact surface has the same specification, the slip coefficient is different due to the influence of various factors. Factors that cause variations in the slip coefficient include not only differences in the finish of the contact surfaces, but also mechanical factors such as residual bolt force, eccentricity, and clearance. Therefore, it is desirable to have another index to evaluate the slip limit instead of the slip coefficient.

A possible solution is to use Weibull stress. The Weibull stress, which applied in fracture mechanics, is a fracture index that considering not only the local stress but also the variability of the material's resistance to fracture and the dimensional effect of the fracture process zone. Since the formulation of the method is based on the weakest link hypothesis, it is known that it can be well applied to the fracture of brittle materials. As for the main slip of bolted joints, after exhibiting the slip resistance, the load capacity is often rapidly reduced due to the occurrence of the main slip, as in brittle materials. Weakest link hypothesis is applied to such behavior, and Weibull stress may be able to integrate the variation of local slip limit and mechanical influence factors of the contact surface. By doing so, it becomes possible to analyze various factors that have been regarded as variations in experiments, and to propose rational slip coefficients for joints used in actual structures, depending on their shapes and other factors.

In this study, basing on the results reported in previous studies, we investigated the sliding limit of bolted joints using a contact surface treated with sandblasting and a contact surface treated with inorganic zinc-rich paint. We evaluated the degree of variation. In addition, assuming a joint of an actual structure within the contact surface subjected to grit blasting, a slip resistance test of a bolted joint was performed using the amount of eccentricity as a parameter, and the number of rows was used as a parameter. We also evaluated the applicability of Weibull stress to the slip limit of bolted joints.

Basing on the slip resistance obtained from experiment and the stress distribution at the contact surface position obtained by finite element analysis, the Weibull stress at the occurrence of the main slip was estimated. It was clarified that the difference in the occurrence limit of main slip according to the specification, manufacturing rod, and joint type can be evaluated by the Weibull parameter and the critical Weibull stress. In addition, although this is a guess based on the study with a limited number of parameters, the relationship between the Weibull stress and the probability of occurrence of the main slip for each joint condition fits the Weibull distribution, and the probability of occurrence of the main slip can be estimated basing on the Weibull stress.

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