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# 主論文の要旨

論文題目　**EFFECT OF CORROSION SURFACE ROUGHNESS ON TENSILE DUCTILITY OF STRUCTURAL STEEL (腐食による表面粗さが引張を受ける構造用鋼材の変形性能に与える影響)**

氏　　名　**GATHIMBA　Naftary Kimenju**

## 論文内容の要旨

Corrosion results in a reduction in thickness and a change in surface geometry due to differential corrosion rates on the surface of a steel member. The surface unevenness may have a significant effect on the deformation capacity than on strength, due to the expected high-stress concentration phenomena. Limited studies investigating the effect of corrosion surface morphology are available, and the significance of the surface configuration on the deformation behavior remains unclarified. This study investigated the effect of corrosion surface roughness on the tensile deformation capacity of corroded structural steels. The aim is to clarify the mechanism of ductility decrease due to the roughness of the corroded surface, as well as proposing ways of estimating residual deformation capacity based on the corrosion surface characteristics. Deformation capacity was studied in terms of tensile ductility.

Corroded steel pipes were employed in studying the surface roughness characteristics. Characteristics of the corroded surfaces were quantified using geometrical and statistical parameters. A series of fundamental experimental tests and finite element (FE) analyses on corroded coupon specimens subjected to tensile loading were conducted in order to clarify the influence of surface roughness on the ductility. Corroded steel members having different grades of steel and corroded in different environments were employed in this study.

Results from the surface roughness analysis showed that parameters that capture an aspect of surface heights have a correlation with the degree of corrosion degradation.

Empirical equations for estimating some surface roughness parameters based on thickness reduction were proposed. From the tensile testing, corrosion was found to cause a reduction in not only load-bearing capacity but ductility as well. About 87% reduction in the load-carrying capacity and up to 84% and 92% reductions in uniform and total elongations were recorded for severely corroded specimens. The trend of the tensile ductility was found to be similar for steels with different material properties. Tensile ductility was found to decrease at a decreasing rate with increasing surface roughness parameter. Empirical equations for estimating the ductility based on the surface roughness parameters were proposed. The mechanism of ductility reduction was clarified as follows. Under tensile loading, corrosion surface roughness causes stress concentration and uneven yielding. Strain localization followed yielding, translating to an early necking initiation and ultimately a reduction in the tensile ductility of corroded specimens.

Finally, on the FE analysis studies, the capability of numerical models, created using measured thickness data, to simulating the behavior of corroded specimens up to failure was confirmed. Prediction of the ductile failure location for the corroded coupon specimens employing the stress modified critical strain failure criterion could be achieved with high accuracy especially for specimens with mind corrosion.

The results from this fundamental study, which involved material test and finite element analysis of corroded steel specimens to investigate the mechanism of ductility reduction due to corrosion surface roughness, can be used as a basis in studying the behavior of a corroded structural member experiencing tensile loads such as a steel girder under bending. Furthermore, results from this research form a basis for future research on the effects of surface roughness on the ductility of corroded steel members under cyclic loading.