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（博士課程）
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論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	Civil and Environmental Engineering Civil Engineering	系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of (Philosophy)
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

In this study, the assessment model for deteriorated reinforced concrete (RC) beams due to corrosion of reinforcement is proposed. The objectives of the study are (1) to investigate the impacts of reinforcement corrosion and corrosion-induced cracks on the bond between concrete and corroded reinforcement, (2) to determine the effect of localized section loss of steel reinforcement on structural performance of RC beams under arch-tie action, (3) to formulate the assessment model to evaluate the structural performance of RC beams with corroded tensile reinforcement.

Chapter 1 introduces the background and research motivation in this study. The objectives and limitations of the study are clarified. The outline of the dissertation is also described in this chapter.

Chapter 2 provides significant knowledge and literature review. The bond between concrete and reinforcement, corrosion of steel reinforcement in concrete, bond deterioration due to corrosion of steel reinforcement, structural performance of RC beams with corrosion of steel reinforcement, and identification of research gap are described in this chapter.

In Chapter 3, RC members with a single reinforcement (RC ties) were tested under direct tensile force. The effects of reinforcement corrosion and corrosion cracks on the bond between concrete and corroded reinforcement were discussed. The performance of bond between concrete and corroded reinforcement was analyzed through cracking and tension stiffening behaviors. The bond performance was obviously decreased after the appearance of corrosion-induced cracks. The bond reduction model due to the corrosion was proposed in this chapter. Average widths of tensile cracks on the corroded RC members were precisely estimated based on the proposed bond reduction model. Moreover, the constitutive model of concrete including the effects of reinforcement corrosion under tension for finite element (FE) modeling was discussed. The simplified FE analysis was performed to reproduce the average response of the tensile members.

In Chapter 4, damaged RC ties on account of localized section loss of steel reinforcement were tested to investigate the effect of section loss of reinforcement on the tensile performance. To precisely examine the effect of section loss of reinforcement, some areas of the bar including lugs and ribs were removed by a lathe machine before concrete casting. The specimens were varied in lengths and degrees of the section loss of reinforcement. In this chapter, the RC ties with the section loss were precisely modeled by using very fine mesh to capture the local mechanism between concrete and reinforcement. The novel modeling approach for interfacial transition

zone around the tensile reinforcement was introduced in the FE analysis. Based on the experimental and numerical investigations, the localized section loss of tensile reinforcement in RC ties had a relative minor effect on the initial stiffness, cracking strength, and tension stiffening compared to the sound condition. Yield loads of the RC ties were reduced by the degree of section loss. In addition, localized yielding and strain hardening of the reinforcement was significantly pronounced when the crack was located near the section loss.

In Chapter 5, the effects of localized section loss of steel reinforcement on performance of RC beams under arch-tie action through the experimental and numerical approaches were discussed. The performance of RC beams under arch-tie action was investigated by using RC deep beams. The RC deep beams with section loss of tensile reinforcement in shear or flexural span had similar uncracked and cracked stiffnesses; however, the location of the section loss of reinforcement had a notable effect on the critical cracking, yielding and load carrying capacities of the beams. The numerical simulation clearly demonstrated the load-carrying mechanisms of RC deep beams with localized section loss of tensile reinforcement. The load-carrying mechanism was changed from the arch action to combined arch and beam actions when the section loss of reinforcement was in the shear span. Moreover, an extended parametric investigation was carried out to examine the effects of length and degree of section loss of reinforcement on the structural performance of RC deep beams.

In Chapter 6, the simplified assessment model of structural performance of RC beams with corroded tensile reinforcement was formulated. The reference experimental study was selected from the literature to verify the accuracy of the proposed model. Based on the findings in Chapter 3 and statistical analysis, the numerical model was proposed to simulate the structural performance of the corroded RC beams. By considering statistics of non-uniform section loss of corroded reinforcement and modeling the concrete surrounding corroded reinforcement, the proposed numerical model could be suitable for simulating the structural performance of RC beams with non-uniform corrosion of tensile reinforcement. The model could predict both pre-yielding and post-yielding behaviors.

Chapter 7 summarizes the findings in the study. The conclusions obtained in the study and recommendations for further study are given. The study provides the understanding on the effects of corrosion and corrosion-induced cracks and the influence of localized section loss of steel reinforcement on bond performance, tension stiffening, and mechanical performance of corroded RC members. The proposed model shall be helpful to improve the assessment of structural performance of RC beams with corrosion tensile reinforcement.