論文 / 著書情報
Article / Book Information

題目(和文)	腐食した鉄筋コンクリート部材のひび割れ挙動と付着劣化
Title(English)	Cracking Behavior and Bond Splitting Degradation of Corroded Reinforced Concrete Members
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出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第9512号, 授与年月日:2014年3月26日, 学位の種別:課程博士, 審査員:篠原　保二,坂田　弘安,河野　進,山田　哲,三上　貴正
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第9512号, Conferred date:2014/3/26, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	環境理工学創造	専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	(Engineering)
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This thesis is entitled "Cracking Behavior and Bond Splitting Degradation of Corroded Reinforced Concrete Members". It consists of six chapters with an emphasis to study the influence of material degradation as a result of corrosion reinforcement and corrosion cracking upon the structural performance of reinforced concrete members. As known, nowadays, corrosion of reinforcement becomes a main issue as an increasing number of deteriorated structures due to corrosion and the demand on service-life and safety prediction of corroded structure.

In the "Introduction" of Chapter 1, the current conditions and problems on the research of materials degradation of concrete structures induced by corrosion are briefly overviewed. The research objectives included the necessity to evaluate the effect of corrosion not only in a single reinforcement specimen but also in a concrete member specimen having bar arrangements. Moreover, the outline of this paper is described in this chapter.

In Chapter 2, "Evaluation of Crack Behaviors Induced by Corrosion-product Expansion", the accelerated corrosion experiment by impressed current was conducted using reinforced concrete beam type specimens having different amount of transverse bars (p_w=0, 0.15, 0.30%), diameter of reinforcement (4-D19, 3-D22), and concrete strength (Fc24, Fc48) with 6% of target corrosion weight loss of longitudinal reinforcement. The actual measured corrosion weight loss greatly varied among steel reinforcements due to different bar position, diffusion direction of chloride ion, and concrete casting directions. The corrosion loss variation is around 30-70 % of the mean value of corrosion loss for Fc24 specimens which have higher concrete porosity. Although the effect of transverse bars on the crack behavior did not appear significantly by the presence of taping for gauge protection, the effect of concrete strength became remarkable caused by the difference in a pore structure. The observed crack widths of Fc48 which had less porosity increased greatly about three times of the crack widths of Fc24 and the strain of transverse bar for Fc48 also increased up to 800 micrometer. Furthermore, in order to predict the amount of corrosion reinforcement from the crack width using the finite element analysis, the volume increase ratio of corrosion expansion product can be set around 2 for Fc24 and around 2.5-3 for Fc48 due to small amount of corrosion products that can penetrate into concrete pores.

Evaluation of "Bond Characteristics between Corroded Steel and Concrete through Tension Test" is covered in Chapter 3. Both accelerated corrosion and tension test were performed using the cylinder concrete specimen with a single bar in order to evaluate the bond behavior between corroded reinforcement and concrete. An increase of maximum bond stress up to 1% of corrosion weight loss was observed from the test then bond was gradually decreased and it decreased sharply at 3 to 4% when corrosion crack appeared in concrete surface. It was also observed from transverse crack spacing that the bond degradation is combined with the deterioration of the tensile strength of concrete. Moreover, to examine the bond stiffness of corroded reinforcement, the axisymmetric analysis was conducted and the tri-linear bond-slip relationship was proposed having first and second bond stiffness

of ascending curve which reasonably could reproduce the tension stiffening response and the crack pattern of experimental result.

In Chapter 4 "Bond Splitting Behavior of Corroded RC Member through Pullout Test", the bond splitting test was conducted using the beam specimen used in Chapter 2. Higher bond stiffness was shown up to 2N/mm^2 of bond stress like the proposed model in Chapter 3, where slip is hardly to develop caused by adhesion between reinforcement and concrete for both healthy and corroded reinforcement. After that, for healthy reinforcement the bond stress increased up to 1 mm of slip or more, however, for corroded reinforcement, the maximum bond stress reached in less than 1 mm of slip and the bond stress declines rapidly after that. The simple bond-slip model reflecting the bond splitting behavior of the tested beam member was proposed.

In Chapter 5, the "Evaluation of Structural Performance of Corroded Reinforced Concrete Members" was performed to estimate the structural performance of concrete beam and column members having corrosion of reinforcement. Finite element analysis was conducted using the materials degradation model based on the analysis of experimental results described in Chapter 2 to Chapter 4. The analysis also showed that some members designed to have flexural failure mode shifted to shear failure mode corresponding to corrosion deterioration as result of loss shear strength due to cross-sectional reduction of transverse bars and the stress increase resulting from corrosion crack, and also bond degradation.

Finally, Chapter 6 "Conclusions" summarizes the main results stated in each chapter and the conclusions obtained from this research.

As mentioned above, the research work in this thesis builds in the relationship between corrosion crack width and amount of reinforcement corrosion and the bond behavior of corroded reinforcement which is required in assessing the structural performance of reinforced concrete member subject to the aged deterioration based on the experiment and the analysis. This research contributes to development of evaluation of the structural performance of deteriorated members from the easily measurable corrosion crack width on the cover of concrete member and the model developed here can serve as useful tool in engineering and industrial practice. To improve the accuracy of model further experimental or analytical research is required.