

論文 / 著書情報
Article / Book Information

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Title(English)	EVALUATION METHOD FOR SHEAR CAPACITY OF FIBER REINFORCED CONCRETE BEAMS BASED ON TENSION SOFTENING CURVES
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種別(和文)	論文要旨
Type(English)	Summary

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論文要旨

THESIS SUMMARY

専攻： Department of	Civil Engineering	専攻	申請学位 (専攻分野)： Academic Degree Requested	博士 (Philosophy) Doctor of
学籍番号： Student ID Number			指導教員 (主)： Academic Advisor(main)	Prof. Junichiro NIWA
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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

In this study, the evaluation method for the shear capacity of fiber reinforced concrete (FRC) beams based on tension softening curves was proposed. The objectives of the study are a) to investigate the effects of fiber volume fractions, stirrup ratios, fiber types and sizes of specimens on the shear capacity of fiber reinforced concrete beams, b) to evaluate the shear carried by fibers of FRC beams using the crack surface displacement, diagonal crack length and the tension softening curves and c) to propose the predictive equation for shear capacity of FRC beams.

Chapter one includes the background of FRC members and the research motivation. The objectives and scope of the study are clarified.

In Chapter two, the existing design equations for steel fiber reinforced concrete in the design guidelines and the equations proposed by other investigators are summarized. Based on the literature, the factors affecting shear strength of FRC beams are listed. Four significant factors that are fiber volume fractions, stirrup ratios, fiber types and effective depths were determined as the experimental parameters.

In Chapter three, the tension softening curve, which is significant for explaining the post-cracking behavior of FRC, is described. The curves were analyzed from the results of notched beam tests. The tension softening curves and the fracture energy of eight fiber types and two fiber volume fractions were investigated. The results show that steel fibers transfer more stress than synthetic fibers. With the increase in fiber volume fraction, the fracture energy increases and the tension softening curves show better post peak behavior.

In Chapter four, the experimental program of FRC beams is explained. Seventeen FRC beams were tested. The specimens were varied in fiber volume fractions (0.5 and 1.0%), stirrup ratios (0.0, 0.12, 0.18, 0.24 and 0.30%), types and combinations of fibers (30-mm steel fibers, 60-mm steel fibers, polypropylene fibers, polyvinyl alcohol fibers, PET fibers, hybrids fibers between 30-mm steel and polypropylene, 60-mm steel and polypropylene and 30-mm steel and 60-mm steel) and effective depths (187.5, 250 and 375 mm).

Chapter five presents the experimental results of the 17 FRC beams. The shear capacity of FRC beams increases with the increase in fiber volume fraction from 0.5% to 1.0%. Nevertheless, the shear capacity does not monotonically increase with the increase in stirrup ratio. The addition of fibers is more beneficial for specimens with less stirrup ratio. In addition, steel, synthetic and hybrid fibers

significantly enhance the shear capacity of FRC beams. Among all fiber types, the steel fibers with 60 mm length are the best to improve the shear capacity since the fibers have long length resulting in better bonding between fibers and matrix. There is no size effect on shear strength of FRC beams within the range of study. Moreover, the diagonal cracking behavior was studied. Crack surface displacement was measured using the image analysis. The length and angle of diagonal crack were also measured. The length and angle of diagonal crack are affected by fracture energy, stirrup ratio and the effective depth. The increase in fracture energy or stirrup ratio increases the angle of diagonal crack but reduces the diagonal crack length. With the increase in specimen size, the diagonal crack length and the angle of diagonal crack increase.

Chapter six is the evaluation method for shear carried by fibers of FRC beams using tension softening curves. The stress transferred across the diagonal crack at the peak load was investigated using the crack surface displacements and the tension softening curves. The increase in fracture energy or stirrup ratio enhances the value of stress transferred across the diagonal crack. However, the stress decreases with the increase in the effective depth. The shear force carried by fibers was calculated by multiplying tensile stress with the area of crack surface. The calculated shear carried by fibers was verified with the experimental results of 17 FRC beams. Although fiber volume fractions, stirrup ratios, types and combinations of fibers and effective depths are varied, the evaluation of shear carried by fibers based on tension softening curves shows a good correlation with the experimental results.

In Chapter seven, the simplified predictive equation for the shear carried by fibers was formulated based on the investigation in this study. Moreover, the predictive equation for shear capacity of FRC beams was proposed. The equation was validated with 43 specimens from the author and other researchers. The proposed equation accurately predicts the shear capacity of FRC beams and provides the best mean ratio among the existing equations. The equation can be applied in not only steel but also synthetic and hybrid fiber reinforced concrete beams both with and without stirrups.

In Chapter eight, the conclusions obtained in this study and the recommendations for further study are given. The finding in this research provides the understanding of the shear behavior of FRC beams with stirrups and shall help to improve the rational procedure for predicting the shear capacity of FRC members.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 2 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 2 copies of 800 Words (English)