

論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
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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 Doctor of	(Philosophy)
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)

This dissertation, entitled Predictive Equation Applicable to High Strength Concrete for Diagonal Compressive Capacity of RC Beams, consists of six chapters as the following.

Chapter 1, introduction introduces general background of diagonal compressive capacity of RC beams and research motivation. The utilization of high strength concrete (HSC) in construction practice can be one of the approaches used to reduce CO₂ emission due to construction activities and to achieve sustainable communities. To fully utilize the advantage of high strength properties, the combination of thin web HSC beams and high strength stirrups is introduced. However, this combination will lead to diagonal compression failure, that is, an uncommon type of shear failure caused by the crushing of web concrete prior to stirrup yielding. The research on the mechanism of diagonal compression failure is insufficient since it is usually avoided in design. The Standard Specifications for Concrete Structures of Japan Society of Civil Engineers (JSCE) for the diagonal compressive capacity provides inadequate accuracy, only considers f'_c as an influential factor and limits the applicability to concrete with f'_c up to 50 N/mm², resulting in extravagant and inefficient designs of RC beams. Therefore, this research aims to investigate the effect of various parameters on the diagonal compressive capacity of HSC beams and develop an accurate and simple predictive equation applicable to high strength concrete for the diagonal compressive capacity of RC beams.

In Chapter 2, literature reviews, the mechanical model of diagonal compressive capacity is explained. The features of existing equations for evaluating diagonal compressive capacity of RC beams by Placas et al., JSCE Standard, ACI building Code, Eurocode 2, and *fib* Model Code 2010 are reviewed. Also, the summary of the study by Kobayashi is also included.

Chapter 3, experimental program, presents the outline of experiments for investigating the diagonal compressive capacity. Twelve thin web HSC beams ($f'_c = 100-135$ N/mm²) with stirrup were tested by three point bending. The experimental cases can be classified into four series: the effect stirrup ratio ($r_w = 0.9-3.5\%$) and spacing ($s = 90-370$ mm), the effect of compressive strength with different stirrup, the effect of flange width to web width ratio ($b_f/b_w = 3.75, 6.25$ and 12.5) and size effect ($d = 220-319$ mm). All specimens were designed to fail in diagonal compression

failure and prevent yielding of both tensile bars and stirrups by providing high strength reinforcing bars ($f_y > 930 \text{ N/mm}^2$). Specimen fabrication and measurement items are also described in this chapter.

In Chapter 4, experimental results, the effect of stirrup, compressive strength of concrete, flange width to web width ratio and effective depth on diagonal compressive capacity, as well as, angle of diagonal cracks and principal strain are discussed. As a result, the diagonal compressive capacity linearly decreased with wider stirrup spacing regardless of its diameters and configuration when stirrup spacing was narrower than 140 mm; however, the effect of stirrup spacing became negligible when stirrup spacing was wider than 140 mm. With insufficient confinement effects provided by stirrups, the localization of compressive stress in struts occurred. Thus, stirrup spacing is prominent, not stirrup ratio, for evaluating the diagonal compressive capacity of RC beams. However, even when wide stirrup spacing was used, diagonal compressive stress did not concentrate in local area of the specimens and a sufficient confinement effect was achieved by providing two-legged stirrups, and the localization of compressive stress in struts was prevented. Furthermore, the effect of stirrup spacing became more significant with higher compressive strength of concrete. Thus, the effect of compressive strength and stirrup spacing was interrelated. On the other hand, there were slight effects of flange width to web width and effective depth on the diagonal compressive capacity RC beams. Furthermore, there is no clear relationship between the average diagonal crack angle in B-region and compressive strength, stirrup ratio, stirrup spacing, and shear span to effective depth ratio. The angle of principal strain in B-region had no tendency with stirrup ratio, spacing, diameters and configuration.

In Chapter 5, proposal of predictive equation, a new predictive equation considering compressive strength for evaluating diagonal compressive capacity of HSC beams is proposed on the basis of the experimental findings. The existing equations reviewed in Chapter 2 should be improved in both accuracy and appropriateness on the prediction of the diagonal compressive capacity of RC beams. The proposed predictive equation covers the application to concrete with compressive strength up to 165 N/mm^2 and practical stirrup spacing. It provides the sufficient simplicity and precise prediction of the diagonal compressive capacity of RC beams ($Avg. = 0.99$) with low variation ($C.V. = 10.5\%$).

Finally, conclusions and recommendations for further study are given in Chapter 6. This research will enable the wider use of high strength materials for the sustainability and the development of rational designs for the diagonal compressive capacity.

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).