

A Fundamental Study of the Evaluation of Toughness for Fiber Reinforced Concretes

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1991 Fiscal Year Final Research Report Summary

A Fundamental Study of the Evaluation of Toughness for Fiber Reinforced Concretes

Research Project

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02555106

Research Category

Grant-in-Aid for Developmental Scientific Research (B)

Allocation Type

Single-year Grants

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コンクリート工学・土木材料・施工

Research Institution

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Keywords

The Critical Strain Energy Release Rate / Interfacial Zone / Microhardness Measurement / Backscattered Electron Image / Fluorescent Microscopy / Debonding / Frictional Stress / Silica Fume

Research Abstract

The significance of the bond properties between fibers and cement matrix in the toughness of fiber reinforced concretes was investigated. The bond of fiber with the matrix was characterized by the fracture toughness (i. e. the critical strain energy release rate) for the interfacial zone and the frictional shear stress along the debonded interface. Those properties were discussed relating them to the microstructure formed around fibers. The microstructure formed in the vicinity of fibers are elucidated by the microhardness measurements, BEI analysis and fluorescent microscopy. The major results obtained in this study are summarized as follows :

- (1) It was possible to evaluate experimentally the critical strain energy release rate for the interfacial zone from the single fiber pull-out test based on the compliance method.
- (2) The critical strain energy release rate for the interfacial zone between fibers and cementitious matrix appears to sensitively reflect the characteristics of the interfacial zone.
- (3) The addition of silica fume and the reduction of water/cement ratio of the matrix resulted in the dense microstructure of the interfacial zone. However, the dense interfacial zone formed by the addition of silica fume did not lead to the increase in fracture toughness for the interfacial zone.
- (4) Fracture toughness for the interfacial zone is affected by the incorporation of sand grains.
- (5) Observations for the interfacial zone under the fluorescent microscope revealed that the mode of bond failure was not a simple shear failure which has been assumed in the theoretical studies for the single fiber pull-out process.
- (6) Further work is needed to theoretically discuss the complex phenomena of debonding with the fluorescent microscope.

Research Products (13 results)

		All	Other
		All	Publications (13 results)
[Publications]	五十嵐 心一: "ガラス繊維ーセメントペースト界面領域の組織とガラス繊維補強モルタルの力学的特性" 土木学会論文集. 414. 49-58 (1990)		▼
[Publications]	川村 満紀: "鋼繊維ーセメントペーストマトリックス界面領域のエネルギー-解放率による付着特性の評価" コンクリート構造の破壊力学に関するコロキウム論文集. 81-86 (1990)		▼
[Publications]	五十嵐 心一: "鋼繊維ーセメントマトリックス界面領域の破壊靱性に影響を及ぼす2、3の要因" コンクリート工学年次論文報告集. 13. 773-778 (1991)		▼
[Publications]	Igarashi,S.: "Effects of the Addition of Silica Fume and Fine Aggregate on the Fracture Toughness for the Steel Fiber-Matrix Interfacial Zone" Fracture Processes in Concrete,Rock and Ceramics,Proc.Intl.RILEM/ESIS Conf.1. 307-316 (1991)		▼
[Publications]	Kawamura,M.: "Significance of Microstructure of the Glass Fiber-Cement Paste Interfacial Zone in Long Term Durability of GFRC Composites" Proc.2nd CANMET/ACI Intl.Conf.on Durability of Concrete. 2. 799-819 (1991)		▼
[Publications]	Kawamura,M.: "Fracture Toughness for the Steel Fiber-Cement Paste Interfacial Zone" J.Materials in Civil Engineering,ASCE. (1992)		▼
[Publications]	Shin-ichi IGARASGHI: "Formation of Glass Fiber-Cement Paste Interfacial Zone and Its effect of the Mechanical Properties of Glass Fiber Reinforced Mortar" Proceedings of JSCE. 414/V-12. 49-58 (1990)		▼
[Publications]	Mitsunori KAWAMURA: "Evaluation of Bond Properties by the Critical Strain Energy Release Rate for Steel Fiber - Cement Paste Interfacial Zone" Proceedings of JCI Colloquium on Fracture Mechanics of Concrete Structures. JCI-C19. II81-86 (1990)		▼
[Publications]	Shin-ichi IGARASHI: "Effects of the Addition of Silica Fume and Fine Aggregate on the Fracture Toughness of the Steel Fiber-Matrix Interfacial Zone" Proceedings of the International RILEM/ESIS Conference. 1. 307-316 (1991)		▼
[Publications]	Mitsunori KAWAMURA: "Significance of Microstructure of the Glass Fiber-Interfacial Zone in Long Term Durability of GFRC Composites" Proceedings of the 2nd CANMET/ACI International Conference on Durability of Concrete. 2. 799-819 (1991)		▼
[Publications]	Mitsunori KAWAMURA: "Fracture Toughness for the Steel Fiber-Cement Paste Interfacial Zone" Journal of Materials in Civil Engineering, ASCE. (1992)		▼
[Publications]	Shin-ichi IGARASHI: "Durability and Microstructure of Glass Fiber Reinforced Concretes Produced by Premixing" JSCE.		▼
[Publications]	Shin-ichi IGARASHI: "Several Methods to Investigate the Microstructural Features of the Interfacial Zone between a Steel Fiber and Cement Paste Matrix" CAJ Proceedings of Cement & Concrete.		▼

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