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그린 뉴딜, 그린 콘크리트

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여수 엑스포컨벤션센터

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5.14(금) 09:00~10:30 (세미나실6)

고성능

좌장: 김형기, 박솔뫼

09:00~09:15 고강도 강섬유의 형상비에 따른 콘크리트 휨 거동 특성
The Effect of High Strength Steel Fiber Aspect Ratio on Flexural Properties of Concrete
왕기 · 김동휘 · 정우진 · 윤현도
Wang, Qi · Kim, Dong Hwi · Jeong, Woojin · Yun, Hyun Do

09:15~09:30 미세공극과 표면 공극의 시너지 효과를 이용한 흡음 모르타르 연구
A Study on the Synergistic Effect of Micro Pores and Surface Holes of SPM on Sound Absorption
알렉스 · 박성우 · 표석훈
Kebede, Alemayehu M. · Park, Sungwoo · Pyo, Sukhoon

09:30~09:45 강섬유와 시멘트 기반 매트릭스 사이의 섬유-매트릭스 영역의 특성
Properties of Fiber-Matrix Zone Between Steel Fiber and Cement Based Matrix
당반피 · 김태욱 · 김동주
Dang, Van Phi · Kim, Tae Uk · Kim, Dong Joo

09:45~10:00 킬레이트 효과를 통해 화학 처리한 강섬유를 혼입한 UHPC의 인장 거동
Tensile Performance of Ultra High Performance Concrete reinforced with Chemical Treated Steel Fiber by Chelate Effect
장윤식 · 오택근 · 류두열
Jang, Yun Sik · Oh, Taek Geun · Yoo, Doo Yeol

10:00~10:15 강섬유의 인장강도에 따른 60MPa급 강섬유보강 콘크리트의 휨 성능 평가
Flexural Performance Evaluation of 60MPa SFRC Steel Fiber Reinforced Concrete according to the Tensile Strength of Steel Fibers
김동휘 · 왕기 · 정우진 · 윤현도
Kim, Dong Hwi · Wang, Qi · Jeong, Woo Jin · Yun, Hyun Do

강섬유와 시멘트 기반 매트릭스 사이의 섬유-매트릭스 영역의 특성

Properties of Fiber-Matrix Zone Between Steel Fiber and Cement Based Matrix

당 반 피* 김 태 욱** 김 동 주***
Dang, Van Phi Kim, Tae Uk Kim, Dong Joo

ABSTRACT

This study investigated the properties of fiber-matrix zone (FMZ) between steel fibers and cement based matrix by conducting nanoindentation tests and energy-dispersive X-ray spectroscopy (EDS). Ultra-high performance concrete (MU) produced the highest hardness of FMZ owing to the highest calcium silicate hydrate (C-S-H) in the FMZ. Besides, MU matrix generated the lowest porosity in the FMZ, whereas the high strength mortar (MH) matrix did the highest one. This is attributed to the effects of water to cement (w/c). The higher w/c ratio generally produced more porous in the microstructure of cementitious materials.

요 약

이 연구는 나노인덴테이션 실험과 에너지 분산형 X-선 분광법 (EDS)를 이용하여 강섬유와 시멘트 기반 매트릭스 사이의 섬유-매트릭스 영역 (FMZ)의 특성을 조사하였다. 초고성능 콘크리트 (MU)는 FMZ 내에서 가장 높은 규산 칼슘 수화물(C-S-H)로 인해 가장 높은 경도를 나타내었다. 또한 MU는 가장 낮은 다공성을 나타낸 반면, 고강도 모르타르 (MH) 매트릭스는 가장 높은 다공성을 나타내었다. 이는 물/시멘트 비의 영향으로 보인다. 높은 w/c비는 일반적으로 시멘트질 재료의 미세구조에서 더 높은 다공성을 나타내었다.

1. INTRODUCTION

There are various approaches available to improve the strength of ITZ: the densification of ITZ (Bentur et al., 2000), and increasing the local stiffness and decreasing porosity at the ITZ by using finer silica sand (Kang, Ahn and Kim, 2012). However, there is little study on the properties of the fiber-matrix zone (FMZ) between steel fibers and cement based matrix by using other matrices. In this study, we investigated the effect of the different matrix compositions on the FMZ properties including hardness (H), Youg's modulus (E), porosity, and the thickness of ITZs.

2. EXPERIMENTAL PARAMETERS INFLUENCING ON TENSILE BEHAVIOR OF TRCCs

An experimental program was designed to investigate the effects of the different matrix

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compositions on the FMZ properties. The three matrices were ultra-high performance concrete (MU), MU with a shrinkage-reducing agent (MS), and high strength mortar (MH). The compressive strength of MU, MS, and MH was 187, 170, and 98 MPa, respectively.

3. RESULT AND DISCUSSION

MU matrix showed the highest average values of both hardness (H) and Youg's modulus (E) of FMZ whereas MH did the lowest one. The H of MU, MS, and MH was 2.20, 2.14, and 1.59 GPa, respectively, while the E corresponding to MU, MS and MH was 42.46, 41.54, and 37.53 GPa, respectively.

The calcium silicate hydrate (C-S-H) microstructure was the main ingredient in all three matrices. The percentage of C-S-H in FMZ of MU, MS, and MH was approximately 70%, 67%, and 63%, respectively. In addition, MU matrix generated the lowest percentage of porosity of FMZ whereas MH did the highest one. The percentage of porosity of FMZ in MU, MS, and MH was 4.31%, 7.86%, and 15%, respectively.

The thickness of ITZ can be completely determined according to the porosity area, hardness, and Young's modulus. The porosity area in ITZ of MU, MS, and MH matrix decreased with the distance from fiber surface within 30 μm, 40 μm, and 50 μm, respectively, then those were almost unchanged. The H and E of the matrices with the distance from fiber surface within 30 μm for MU, 40 μm for MS, and 50 μm for MH were smaller than the rest. The H of MU, MS, and MH was 1.27, 1.12, and 1.06 GPa, respectively, while the E of MU, MS, and MH was 25.33, 22.5, and 21.8 GPa, respectively. This can be attributed to the thickness of ITZ in MU, MS, and MH was about 30 μm, 40 μm, and 50 μm, respectively.

4. CONCLUSIONS

Among three matrices, MU generated the highest hardness (H) and Young's modulus (E) of FMZ due to the highest calcium silicate hydrate (C-S-H) in the FMZ. Besides, MU matrix produced the lowest porosity in the FMZ, whereas MH matrix did the highest one. In addition, the thickness of ITZ in MU (30 μm) was less than those in MS (40 μm) and MH (50 μm).

ACKNOWLEDGEMENT

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