
Amirkabir Journal of Civil Engineering

Amirkabir J. Civil Eng., 50(3) (2018) 147-148
DOI: 10.22060/ceej.2017.11683.5056

# Structural Improvement of Shear Wall Coupled RC Beam Replaced with HPFRCC

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**ABSTRACT:** Coupling beams made of high performance fiber reinforced cementinous composite (HPFRCC) are capable alternative compared to traditional concrete and resulting to increasing capacity, ductility, energy dissipation and also reducing the congested amount of longitudinal, transverse and diagonal reinforcement. This article investigate the influence of HPFRCC replacement with normal concrete in coupled shear wall with connecting beam. The first specimen of coupling beams designed and made with normal concrete and second specimen of coupling beams designed and made with HPFRCC and tested under cyclic loading. The results indicated that HPFRCC increased tensile capacity of concrete, prevented the increasing the crack widths and increased absorbed energy. also increased rigidity compared to plain concrete specimen and shear-tensile failure was changed to shear-slippage failure. amount of shear strength for HPFRCC coupling beams were 117 percent than normal concrete and the use of fibers increased the energy absorption about 60 percent.

**Review History:**

Received: 29 May 2016
Revised: 18 December 2016
Accepted: 20 February 2017
Available Online: 19 August 2017

**Keywords:**

Coupling Shear Wall
Coupling Beam
Ductility
Energy Absorption
HPFRCC

## 1- Introduction

The use of fiber in concrete and the production of Fiber Reinforced Concrete (FRC) is considered as an effective step in delaying the release of small particles and cracks to compensate for the weakness of concrete tensile strength. The most important characteristic of fiber concrete is its energy absorption, flexibility and resistance to impact. For this reason today, this concrete plays a very serious role in the development of concrete technology and is considered as a new and economical material in construction matters [1].

In Figure 1, the behavioral curve of strong reinforced concrete is shown by direct tensile stress. As shown in Figure 1, these concrete, in contrast to conventional fiber concrete, do not lose their resistance after they leave, and can withstand the deformation and strain and provide strain hardening behavior [2, 3].

In this research, a new type of coupling beam constructed with high-performance fiber-reinforced cement composites (HPFRCCs) was developed to simplify current reinforcement requirements in RC coupling beams. Through an experimental investigation. In addition, the results from this research provide valuable information on the overall behavior of HPFRCC members with low shear span-to-depth ratios when subjected to large displacement reversals, widening the range of structural applications of HPFRCC materials.

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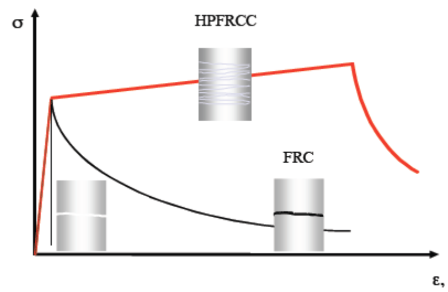


**Figure 1. Tensile stress-strain curves of concrete, FRC, and HPFRCC**

## 2- Experimental Program

Specimens consist of a total of two connectors with a length to height ratio of 2 and concrete walls that are quite similar in dimensions and rebar, but they are different in terms of the type of concrete used.

The first specimen of coupling beams designed and made with normal concrete and second specimen of coupling beams designed and made with HPFRCC

The fiber used in this research is steel fiber made by Zanjan Steel Industries Co., which is being manufactured in Iran. These fibers are hooked and copper coated to protect steel rings against rust. The length to diameter ratio of these fibers is 47.62, the technical specifications of the fibers used in laboratory samples are given in Table 1.

**Table 1. Technical Specifications of Steel Fibers**

| Fiber Type | Length (mm) | Diameter (mm) | L/D |
|---|---|---|---|
| RL-45/50-BN | 50 | 1.05 | 47.62 |

## 3- Test Setup and Instrumentation

The test specimens were rotated and placed into the test setup with one of the walls fixed to the strong floor (Figure 2). In this horizontal position, displacement cycles were applied to the upper wall portion through a horizontal hydraulic actuator with its line of action passing through the midspan of the beam in order to produce an anti-symmetrical moment pattern in the coupling beam. The actuator and the upper portion of the specimen were connected through a steel I-section and the load was transferred to the top RC block by means of direct bearing and un-bonded threaded bars passing through the top wall. The test specimens were braced laterally to prevent out-of-plane movements [4].

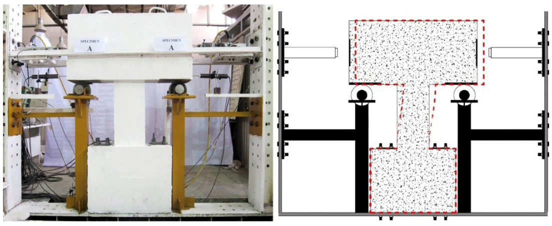

**Figure 2. Coupling beam and test setup**

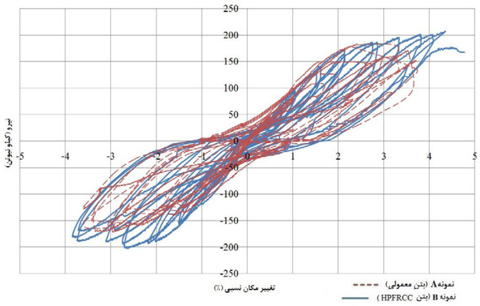

**Figure 3. Hysteresis cycles of specimens A and B**

## 4- Conclusions

The results indicated that HPFRCC increased tensile capacity of concrete, prevented the increasing the crack widths, increased absorbed energy and rigidity compared to plain concrete specimen and shear-tensile failure was changed to shear-slippage failure and that the amount of shear strength for HPFRCC coupling beams were 117 percent than normal concrete and the use of fibers increased the energy absorption about 60 percent. (Figures 3-5)

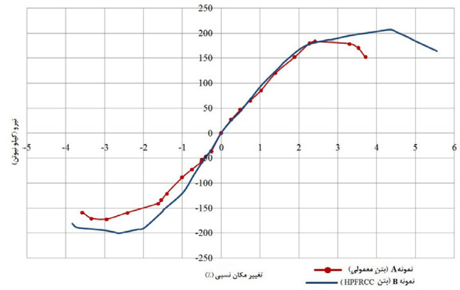

**Figure 4. Force-drift curves of specimens A and B**

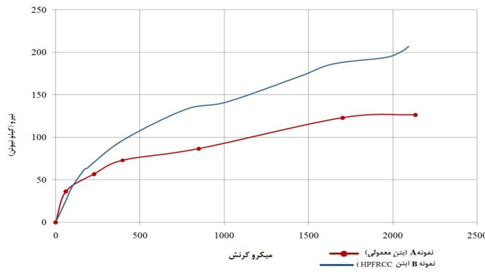

**Figure 5. Force-stress curves of diagonal reinforcement specimens A and B**

## References


[1] Wei-ling, L., Toughness Behavior Of fiber Reinforcement Concrete, Proceeding of the Fourth RILEM International Symposium Sheffield, UK, (1992)

[2] Parra-Montesinos, G.J., High-Performance Fiber-Reinforced Cement Composites An Alternative for Seismic Design of Structures, ACI Structural Journal, 102( 5) (2005) 668-675.

[3] American Concrete Institute (ACI) 544.1R-96, State of The Art Report on The Fiber Reinforced Concrete, Manual of concrete practice, ACI-544. 2R-89 Michigan, USA, (1998)

[4] Canbolat, B. A., Parra-Montesinos, G. J.; and Wight, J. K., Experimental Study on the Seismic Behavior of High-Performance Fiber-Reinforced Cement Composite Coupling Beams, ACI Structural Journal, 102 (1) (2005) 159-166.


Please cite this article using:

A. Kheyroddin, M. Dehghan, M. K. Sharbatdar, Structural Improvement of Shear Wall Coupled RC Beam Replaced with HPFRCC , *Amirkabir J. Civil Eng.*, 50(3) (2018) 471-484.

DOI: 10.22060/ceej.2017.11683.5056