INTEGRATED PLAIN AND SLURRY INFILTRATED FIBRE CONCRETE (IP-SIFCON) COMPOSITE BEAMS

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Summary. Composite beams (IP-SIFCON) were composed of two layers; a bottom SIFCON layer and an upper layer manufactured of plain cement paste. Beams made totally with SIFCON were also investigated for comparison. The effects of the SIFCON layer thickness on the flexural strength and energy absorption of composite beams were reported. The IP-SIFCON beams exhibited a distinctive deflection hardening behaviour and performed comparatively with total SIFCON beams. The studies indicate that, compared with normal concrete beams, the IP-SIFCON composite beams have significantly improved flexural strength and energy absorption capacity.

1 INTRODUCTION

Plain concrete is a brittle material, whose tensile strength is generally around 10% of its compressive strength [1]. In conventional concrete structures, steel reinforcement is used to sustain tensile loading and prevent sudden failure. Herein, a novel type of beam is designed by using plain high-strength concrete in the compressive zone and slurry-infiltrated fibre concrete (SIFCON) in the tensile zone.

SIFCON is a high performance cementitious composite, which exhibits outstanding strength and ductility. It is manufactured by first placing fibres in formwork moulds and then infiltrating the fibre network with cement-based slurry. The infiltration is generally achieved by gravity flow assisted by external vibration, or by pressure grouting. Due to this procedure, much higher fibre volume fraction can be achieved in SIFCON. SIFCON exhibits up to ten times higher tensile strength and a thousand times larger toughness than normal unreinforced concrete [2]. However, SIFCON is more expensive due to its high fibre content and intensive labour requirement.

In the present research, we aimed to fully utilize the high compressive strength from plain high strength concrete and the high tensile strength performance from SIFCON in a flexural member, such as a beam. On the one hand, this composite beam has higher strength and ductility compared with plain concrete beam; and on the other hand, it may cost much less than pure SIFCON beam while having comparable strength and ductility.
2 EXPERIMENTAL PROGRAM

Beam specimens were manufactured and tested under third-point loading. At least, three specimens were tested for each case. The height of the SIFCON layer was 0.2 or 0.5 of the total height of the beam.

3 RESULTS AND DISCUSSION

As shown in Figure 1a, the load carrying capacity of plain cementitious paste beams collapses suddenly when reaching the linear limit. However, IP-SIFCON beams (Figure 1b) still show increasing load carrying capacity beyond the linear limit. That is, these beams show a deflection-hardening process, followed by a softening branch with a moderate slope. The average maximum load for the IP-SIFCON beams is 45.8 kN, in contrast with 24.3 kN for plain cementitious paste beams. When the depth of the SIFCON layer was increased to 0.5 of the total depth, the beam exhibited strength and ductility comparable to the totally SIFCON composite.

![Figure 1](image)

(a) (b)

Figure 1. Load-deflection curves of beams of plain cementitious paste (a), and IP-SIFCON where the depth of the SIFCON layer was 0.2 of the total depth (b)

4 CONCLUSIONS

Hybrid composite beams with SIFCON layer constituting only 0.2 of the beam’s depth have presented deflection-hardening behaviour, and shown much higher flexural strength and ductility than plain concrete beams. Increasing the height of the SIFCON layer to about half the depth of the beam, resulted in strength and ductility comparable with totally SIFCON beams.

REFERENCES