Experimental and Analytical Study of Push-out Shear Tests in Ultra Shallow Floor Beams

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Summary

The Ultra Shallow Floor Beam is a new type of composite floor beam fabricated by welding two highly asymmetric cellular tees together along the web and incorporating a concrete slab between the top and bottom flanges. The unique features of this system are circular and elongated web openings that allow tie-bars, building services and ducts passing through the structural depth of the beam. For the composite beam in bending, the longitudinal shear force is transferred by a unique shear mechanism which results from the special configuration of the beam, and shear connectors, if they are present. The work reported in this paper includes a total of 16 full-scale push-out tests aimed at investigating the longitudinal shear behaviour of these beams and the effects of additional shear connectors. A theoretical analysis was also performed to investigate the failure mechanism of the system.

Keywords: shear connectors; web openings; shallow floor beam; push-out test; experimental study; theoretical analysis.

1. Introduction

In recent years, there are increasing demands for composite beam of shallow depth for use in multi-storey building in the urbanized area. For conventional composite floor beams or downstand composite beams, the thickness of the flanges increases with the increase of span of the steel section. Consequently, the steel sections are often heavier than needed [1]. The Ultra Shallow Floor Beam (USFB^{TM}), developed by Westok Limited UK, is a new type of composite floor beam, which is fabricated by welding two highly asymmetric cellular tees together along the web. Precast concrete floor units or profiled steel decking sits on the bottom flange [2], as shown in Figure 1. The top and bottom tees are cut from different parent sections; the top tee is much smaller than the bottom tee. This asymmetric section property reduces the weight of the beam with a smaller top tee and also increases the moment capacity with a bigger bottom tee.

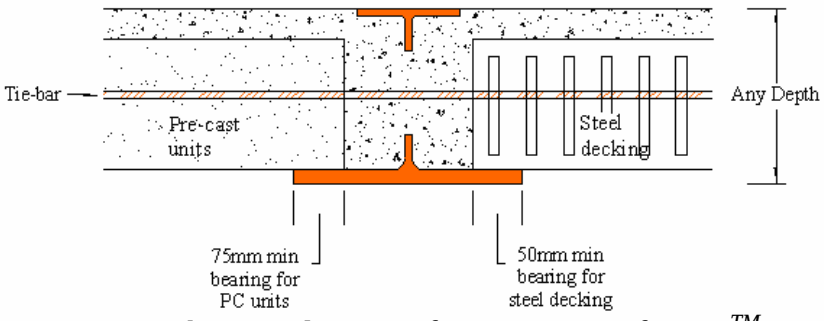

Fig. 1: Schematic drawing of cross-section of USFB^{TM}

Circular and elongated web openings provide a passage for reinforcing tie-bars, building services and ducting through structural depth of the beam, hence minimising the overall floor depth. Full service integration can be achieved when deep profiled steel decking is employed, as pipes or

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