THE STRUCTURAL BEHAVIOUR OF COMPOSITE STUB-GIRDER FLOOR SYSTEMS

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Abstract

In this dissertation, the overall structural behaviour of composite stub-girder floor systems is examined.

An analytical method for analysing the stub-girder system based on partial-interaction concept is presented. The method treats the stub-girder as a beam with three distinct layers. The top and bottom layers behave according to the normal beam bending theory, while the middle layer is a shear layer without any bending stiffness. At the interface between the steel and the concrete elements, the headed stud shear connectors are modelled as linear elastic built in cantilevers. The theory therefore smears the effects of all the contributing elements, and as such is reliable in predicting the overall response of the assembly. Comparisons of the analytical method proposed with experimental and Vierendeel frame computer model results show good agreements.

The second part of the work carried out deals with full-scale experimental work. The main test assembly was designed according to British Standards BS5950 and BS8110, for the steel and concrete components respectively. The experiments were carried out in two stages, namely the construction and the composite stages.

In the construction stage, 1.60mm steel decking was used as the top chord. The assembly was successful in carrying the construction and wet concrete load. The failure mechanisms observed were due to local buckling of the decking at the mid-span. Only the two decking panels adjacent to the main girder longitudinal axis were found to be effective in carrying the load. Tearing of the decking vertical webs was also observed, and this was believed to have been caused by the reduction of the plate strength due to the cold-forming indentation process.

In the composite stage, simple welded mesh reinforcement was used throughout. This was done to achieve a simple fabrication. Detail strain measurements were taken throughout the test specimens, and critical sections were identified. Within the concrete deck-slab, it was found that slippages between the decking and the concrete slab occurred at quite an early load level. Slippages were generally more significant at the mid-spans of the decking between two secondary beams, slightly away from the main girder longitudinal axis.

The longitudinal shear strength of stub-girder system was also considered. A series of strain gauges were used to monitor the strains at the outer stub region. The results indicated that the highest values of transverse strains occurred in front of the outer stubs, and they decreased rapidly towards the outer end of these stubs. Assuming that the full length of the stub is effective in contributing to the longitudinal shear strength of the stub-girder system in practice would therefore overestimate the true capacity.

The successful testing of the main assembly demonstrated that a simple prop-less construction could be achieved without the need for special top chords during the construction stage, or of special reinforcement arrangements during the composite stage.