CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Three types of shear connections were tested with concrete grade 20, 30, 45 and covers 20, 25, 30mm. To design composite trusses with CFSTs in top chords, following experimental evidences were obtained.

The shear carrying capacity of configuration 1 and 3 increase with concrete top cover, but with configuration 2 shear carrying capacity is not dependent on concrete top cover. The shear carrying capacity of configuration 1 and 2 is considerably higher than configuration 3 and configuration 2 has highest capacity. With configuration 1, 16%- 45% of increase in shear carrying capacity was achieved by increasing concrete top cover from 20mm to 30mm. With configuration 3, 23%- 29% of increase in shear carrying capacity was achieved by increasing concrete top cover from 20mm to 30mm.

The shear carrying capacity of configuration 1 and 3 increase with concrete cube strength, but with configuration 2 shear carrying capacity is not dependent on concrete cube strength. The shear carrying capacity of configuration 1 and 2 is considerably higher than configuration 3. With configuration 1, 16%- 21% of increase in shear carrying capacity was achieved by increasing concrete cube strength from grade 20 to grade 45. With configuration 3, 20%- 53% of increase in shear carrying capacity was achieved by increasing concrete cube strength from grade 20 to grade 45. All together, the shear carrying capacity of Configuration 1 and 2 are 131% - 385% higher than configuration 3. It is with configuration 2 nearly 41% higher than configuration 1.

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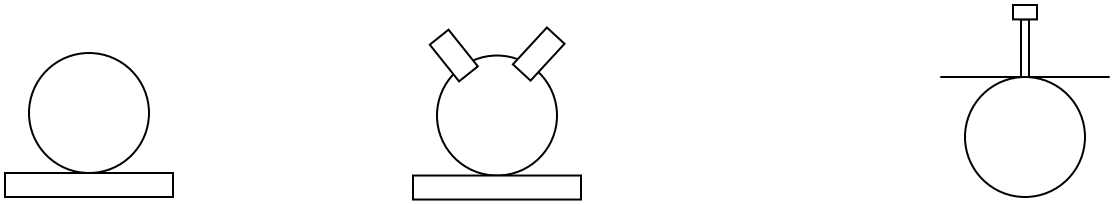
Configuration 1 Configuration 2 Configuration 3



The patterns of shear failure planes for each of new deck slab configurations were found. The shear failure cracks propagated at minimum top cover at configuration 1 and 2. One longitudinal crack was seen at top of the steel tube in configuration 1, two longitudinal cracks were seen at top of the steel strips welded to steel tube in configuration 2, and shear cone failure was seen with configuration 3 as expected.

The connector type for configuration 1 and 2 is non-ductile and it is ductile with configuration 3, according to Eurocode 4.But as an average the ratio of load at first crack (serviceability load) to ultimate load is 0.83 for both configurations 1 and 2 (ratio as a range 0.54-1.00 for configuration 1, and 0.71- 0.95 for configuration2) and 0.58 (as a range 0.34-1.00) for configuration 3.

The effect of position of shear stud was found with configuration 3. The shear carrying capacity of strong position was slightly higher (14%-19%) than stud weak position. The effect of status (filled/empty) of steel tube was not predictable, but specimens with filled steel tube have higher (14%- 34%) shear carrying capacity than specimens with empty steel tube.

The relevance of existing design methods (including shear capacity prediction equation) given in Eurocode 4 was checked for configuration 3 and safety margin for stud weld through steel deck is more than 22%. But stud shear connection resistance increases with concrete top cover but Eurocode 4 prediction equation does not include the effect of cover in their design methods.

For shear carrying capacity prediction equation for configuration 1 and 2, Hawkins and Mitchell (1984) prediction formula was modified. The modified prediction equation (as given below) permits both concrete top cover and concrete grade and accurate prediction also possible.

$$Q_K = k\,\beta\,[A_c\, f_{cu}^{(c/100)}]^{0.685}$$

Where, k = constant = 0.053
β = constant = 1 for both configuration 1 and 2, 0.32 for configuration 3
c = cover (20, 25, 30mm)

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This research was done with Portland limestone cement and C20, C30, C45 concrete. With more tests with different concrete types and grades suitable for Sri Lankan conditions, this modified shear prediction equation can be improved. Further analysis for this study also can be done with different steel deck profiles available in the industry (this study was done with SDP 51 type steel decking), and different steel tube diameters (during this study only 114mm diameter steel pipe was used) for different slab thicknesses.

The limited experimental evidences suggest that configuration 1 and 2 give a greater shear carrying capacity with little warning of failure, but configuration 3 behaves in a ductile fashion but its shear carrying capacity is only about 30% of that of configurations 1 and 2. The highest shear carrying capacity was obtained with configuration 2, cover of 25 mm and grade 30 concrete.