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Design considerations for cold formed lipped channel steel sections in composite slab systems

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ABSTRACT

The use of lipped channel members as the reinforcing for composite beams in rib and block type slab systems is advantageous due to its lightweight nature which facilitates efficiently in construction. The main consideration in the design if such composite members is the integrity of the shear bond at the concrete/ steel interface. Premature de-bonding of the concrete from the steel results in an overall loss of structural strength of the composite member. Certain guidelines are to be established to facilitate in the design of such systems.

In this research project the shear bond strength of composite members using lipped channel members is investigated by interrogating the results from three independent research experiments. Design formulas from first principles are developed to more easily benchmark the behaviour of such members. Complex and simple equations are developed and the results obtained are compared to similar shear bond stresses obtained from literature. A reasonably acceptable correlation is achieved.

A comparative study was also carried out between the various experimental beams regarding vertical shear, flexural strength and short-term deflections. The purpose was to ascertain what effect early shear bond failure has on these structural properties. The formulas used to benchmark the results were the well known formulas used for the design and evaluation of reinforced concrete members. The results were tabulated showing the difference between the calculated and experimental results.

As a result of the investigation the following conclusions seem justified :

- The simple equations as developed for horizontal shear failure give acceptable results which are within the range as given by more complex equations.
- The composite beam has a certain amount of reserve shear strength even after the initial onset of horizontal shear failure.

- The reinforcing ratio, the concrete strength and the slenderness ratio of the composite beam all have an influence on the level of horizontal stress failure.
- The composite beams tend to fail at levels higher than that predicted by the homogeneous shear equations but lower than the predicted flexural equations. The parameters which influence this are again the reinforcing ratio, the concrete strength and the slenderness ratio.
- Once a composite beam has experienced shear bond failure the deflection integrity of the beam is completely compromised.

The above conclusions show the designer that caution must be exercised when using lipped channel members in rib and block slab systems.