Experimental and numerical in- vestigation of the behavior of LWFC L-girders under combined torsion

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Abstract

In most of the internationally recognized design codes, the design provisions for Light weight concrete (LWC) elements was developed based on modifying normal weight concrete (NWC) ones. With the many impressive advances in manufacturing of LWC including but not limited to adding fibers to the mix. And LWC structures are spread worldwide in various applications. Thus, design codes need a revisit based on actual testing of LWC beams. Since, experimental testing is essential to establish base for the verification of numerical models and updating the current design codes, this paper focused on investigating the behavior of lightweight Foamed concrete (LWFC) L-beams under combined loading. An experimental program was conducted, which included testing five L-beams. A numerical model was developed, which was implemented to model seventeen LWFC L-beams. The effect of the moment to shear-depth ratio (M/Vd), the torsion to shear-depth ratio (T/Vd), the flange width to web width ratio (B/b), and the transversal reinforcement ratio (ɟw) was examined. For LWFC L-beams under combined loading with large moment-to-shear-depth ratio (M/Vd > 2), the following was observed: 1) The strength increased with the decrease of moment-to-shear-depth ratio, 2) Increasing torsion to shear-depth ratio by 67% was not effective, as the failure mode was governed by flexure. On the other hand, for the ones with small moment-to-shear-depth ratio (M/Vd Ò 2), the following was observed: 1) increasing torsion to shear-depth ratio by 67%, decreased the failure load by 28% and changed failure mode from flexure failure to combined shear, and torsion failure; 2) the Concrete contributed significantly to the strength of beams. In addition, for LWFC L-beams under combined loading, the following remarks were observed : 1) Increasing the flange width 1.7 times lead to an increase in the failure load by 24%, which is insignificant, and 2) Using transversal reinforcement ratio above 1.2% changed the failure mode from ductile to brittle. The selected design code was found to be overly conservative, in particular cases of significant torsion and shear.

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