EXPERIMENTAL AND FINITE ELEMENT INVESTIGATION ON THE STRUCTURAL BEHAVIOR OF DIFFERENT SHEAR CONNECTORS WITHIN DIFFERENT TYPES OF CONCRETE

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Abstract

The complex sections are characterized with some features in design , achievement and cost besides the possibility of their use in the buildings and bridges due to their high ability in carrying the forces , therefore , they can be used in covering the wide gaps .

The compound joining between the components of the constructional compound parts (mostly are steel , concrete , and wood) can be considered available only theoretically since the practical researches proved that the slip between the components of the compound bridges happens even when large numbers of shear connectors are available . Some of these connectors are solid and others are more flexible since a limited slip takes place (horizontal displacement) and this problem becomes more complicated when using shear connectors which are less than the number necessary to ensure complete joining between the components of compound beams .

The study described herein deals with experimental testing and finite element modeling of a variety of composite steel-concrete column segments which employ shear connectors of different shapes and size to provide resistance to slip at steel – concrete interfaces . Hence , it represents a qualitive transition in the experimental

and analytical investigations on shear connectors affectivity at steel – concrete interfaces , as most studies in the field of shear connectors were being devested to composite beams and slab – systems .

Three types of shear connectors – with four types of concrete for each – were used in fabricating the loaded and tested composite column segments . The twelve composite column prototypes were subjected to push – out test individually to examine their behavior by measuring the slip values for each load incremental till failure , thus determining the resistance extent of each connectors type and specifying the failure mode at interface .

A nonlinear three – dimensional finite element analysis have been carried out on the twelve composite column segments using ANSYS computer program (5 th version , 2002) to investigate their behavior and predict their load – slip relationships , equivalent stress distributions and concrete cracking patterns . The defined numerical modeling included using the eight node is isoparametric brick element with smeared reinforcement (SOLID 65), the eight node isoparametric steel brick element (SOLID45) and the five node interface element CONTAC , to model the reinforce concrete medium , the steel section , and the shear connectors , respectively , considering perfect bond between concrete and steel reinforcing bars . Non linear properties including cracking and crushing of concrete , yield of steel section and reinforcement , and nonlinear bond – slip at interface were also considered .

Comparison of experimental and theoretical results has shown good agreement that verifying the accuracy of the finite element model based on the smeared crack model of concrete .Results has proved the existence of relative movement (slip) at interface even with using effective shear connection .

The headed studs has revealed the highest slip resistance and ultimate load over the channel and the L-shaped studs . The reactive powder cement concrete has also revealed the same superiority over the other three tested types of concrete .