EXPERIMENTAL AND FINITE ELEMENT INVESTIGATION ON THE LOAD – SLIP BEHAVIOR OF COMPOSITE PUSH OUT SEGMENTS USING VARIOUS SHEAR CONNECTORS

Laith Khalid Al- Hadithy 1 (Ph.D.) , Khalil Ibrahim Aziz 2 (Ph.D.) , Mohammed Raji M. AL-Alusi 3 (M .Sc)

Abstract

The study described herein deals with experimental and finite element modeling of a variety of composite steel-concrete column segments using shear connectors of different shapes and sizes to provide resistance to slip at steel – concrete interfaces . Hence , it represents a qualitative transition in the experimental and analytical investigations on shear connectors effectivity at steel – concrete interfaces , as most studies in the field of shear connectors were devoted to composite beam and slab – systems .

Three types of shear connectors – with four concrete grades for each type – were used in fabricating composite specimens . The twelve composite 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 twelve composite column segments using **ANSYS** computer program (5 th version , 2882) 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 isoparametric brick element with smeared reinforcement (**SOLID** 55) and the eight node isoparametric steel brick element (**SOLID**75) , to model the reinforced concrete medium and the steel section and shear connectors , respectively , considering perfect bond between concrete and steel reinforcing bars . Nonlinear properties including cracking and crushing of concrete , yielding of steel section and reinforcement , and nonlinear bond – slip at interface were also considered. Comparison of the experimental and theoretical results has shown good agreement that verifies the accuracy of the finite element model based on the smeared crack model of concrete. Results have detected the development of the relative movement (slip) be at all ranges of the load-slip relationship at interface even with using effective shear connection and /or high quality concrete.

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