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ALLOWABLE INTERFACE SLIP OF COMPOSITE SLAB TO ACHIEVE FULL INTERACTION BEHAVIOUR

ROHIZAT ARIFFIN

A project report submitted in partial fulfillment of the
requirement for the award of the degree of
Master of Engineering (Civil – Structure)

Faculty of Civil Engineering
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April, 2010

I declare that this project report entitled "Allowable Interface Slip of Composite slab to Achieve Full Interaction Behaviour" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any degree.

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Specially dedicated to my beloved wife and families

ACKNOWLEDGEMENT

Firstly, I wish to express my sincere appreciation to my supervisor, Dr. Izni Syahrizal bin Ibrahim, for his guidance and advise throughout the completion of this experimental study.

Secondly, huge thanks to Mr. Ng Kok Peng, Mr. Tang Lai Peng, Ir. Chu Kiun Heng and En. Mohd Zainuddin of Eastern Pretech Sdn Bhd for their assistance in providing the test specimens for the experimental study. I would also like to thanks to Dr. Zuhairi, En Naim, En Termidzi and all the technicians of Construction Research Institute of Malaysia (CREAM) for providing the necessary experimental facilities and assistance during the test.

Lastly, deep appreciation to my wife and families who provided logistic and emotional support, as well as tolerated my absences from the family activities during completion of this experimental study.

ABSTRACT

This thesis presents the experimental study to determine allowable interface slip of composite slab to achieve full interaction behaviour. For a composite member to act monolithically, a good connection between the two components is essential. The monolithic behaviour is possible only if the horizontal shear is effectively transferred and no horizontal slip occurs along the contact surface of the components. This could be obtained by providing shear stirrups to resist horizontal movement between the components. However, when in-situ concrete is cast on a precast unit there is usually no mechanical key in the form of reinforcement provided between the two types of concrete. Reliance has to be made on the bond and shear strength between the contact surfaces. Tests usually show that interface slip does occur when they are bent in flexure, thus act as a partially composite member. To extend the data regarding interface slip of composite slab available in the literature, the combined bending and shear test were carried-out on precast prestressed hollowcore unit (HCU) with in-situ concrete topping. Seven HCU with various surface roughness (smooth as-cast, longitudinal and transverse roughened) including one unit with shear keys for a control slab were cast with 45 mm and 75 mm thick in-situ concrete toppings. The test results clearly showed the significant effect of surface roughness and concrete topping on ultimate shear capacity and interface slip of the composite slabs. Averagely, the ultimate shear capacity of 75 mm thick concrete topping specimen was 22% to 32% higher than the 45 mm thick concrete topping specimen. The smooth as-cast surface for both 45 mm and 75 mm thick concrete topping specimens experienced the largest slip as compared to the other specimens. By comparing the design interface slip proposed by Cholewicki to the experimental interface slip, the study suggested 0.10 mm and 0.18 mm as the allowable interface slip for the 75 mm and 45 mm thick concrete topping, respectively to achieve full composite interaction behaviour.

ABSTRAK

Tesis ini membincangkan kajian terhadap had gelangsar permukaan di antara komponen di dalam papak rencam untuk memastikan sifat rencam penuh dicapai. Untuk memastikan sifat rencam dicapai, keadaan permukaan sambungan yang baik di antara komponen di dalam papak rencam adalah perlu. Ianya boleh dicapai sekiranya daya ricih mengufuk dapat diagih dengan berkesan di antara komponen yang bersentuh dan tiada gelangsar berlaku. Tetulang ricih kebiasaannya disediakan di antara komponen untuk mengelakkan gelangsar daripada berlaku. Walaubagaimanapun, apabila konkrit tuang di-situ digunakan ke atas konkrit pra-tuang, tetulang ricih kebiasaannya tidak disediakan. Had gelangsar adalah bergantung kepada kekuatan sambungan dan daya ricih mengufuk di antara komponen itu sendiri. Ujikaji terdahulu menunjukkan bahawa gelangsar di antara komponen di dalam papak rencam sentiasa berlaku apabila menerima daya lenturan. Bagi menambah data daripada ujikaji-ujikaji terdahulu, ujian gabungan lentur dan ricih dijalankan terhadap konkrit pra-tuang berongga bersama konkrit tuang di-situ. Tujuh unit papak konkrit pra-tuang berongga dengan kekasaran permukaan yang berbeza (licin, kekasaran memanjang dan melintang) termasuk satu unit bersama tetulang ricih sebagai papak rujukan dikonkrit bersama konkrit tuang di-situ dengan ketebalan 45 mm dan 75 mm. Keputusan ujian jelas menunjukkan kesan kekasaran permukaan dan ketebalan konkrit tuang di-situ terhadap kekuatan daya ricih muktamad papak rencam dan gelangsar di antara komponen di dalamnya. Secara purata, papak rencam bersama ketebalan 75 mm konkrit tuang di-situ menunjukkan kekuatan daya ricih uktamad 36 % lebih tinggi berbanding papak rencam bersama ketebalan 45 mm konkrit tuang di-situ. Dengan membandingkan gelangsar permukaan rekabentuk kaedah Cholewicki [11,12] terhadap gelangsar ujikaji, gelangsar permukaan maksimun 0.1 mm dan 0.18 mm di antara komponen di dalam papak rencam adalah dicadangkan untuk memastikan sifat rencam penuh dicapai.

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V_{ult}	Ultimate shear capacity
V_{calc}	Design ultimate shear capacity of a uncracked flexure section
I	Second moment area
A	Area of concrete
b_w	Width of the HCU
y'	Distance from the centroid of the section to the centroid of the area above the plane considered
f_{cu}	Cube compressive strength of concrete
f_t	Concrete splitting tensile strength
f_{ck}	Cylinder compressive strength of concrete = $0.8f_{cu}$
f_{cp}	Concrete compressive stress at the centroidal axis due to prestressing
K_s	Shear stiffness
l_i	Interface length
ω	Restraint constant
E_c	Modulus of elasticity of concrete (HCU)
E_c'	Modulus of elasticity of concrete (topping)
a_n	Distance from the centroidal axis of HCU to centroidal axis of concrete topping
L	Effective span length