SHEAR TRANSFER IN COMPOSITE CONCRETE-CONCRETE T-SECTION

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LIST OF SYMPOLS

Symbol Description

A_s"Area of steel tics across the plane.

P' Percentage of steel ties across the shear plane.

F_yYield stress of steel ties.

F_c' Concrete compressive strength.

V_uUltimate shear force.

V Ultimate shear strength.

ΔV_bShear resistance by intrinsic bond.

ΔV_fShear resistance by friction.

ΔV_iShear resistance by aggregate Interlock.

ΔV_dShear resistance by dowel action.

C_o Apparent cohesion.

K_1Ratio of bonded area to total area.

μ' Apparent coefficient of friction.

I Reinforcement parameter P" F_y.

C' Apparent cohesion.

C_kTotal area or the shear key cross sections along the composite Interface.

V_mUltimate shear strength of the shear key consider as monolithic.

A_{sh}Area of the contact surface between two concretes.

q_cUltimate shear stress carried by the interface due to cohesion forces.

νpoisson ratio.

G Shear modules

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ABSTRACT

The problem of shear transfer between different types of concrete surface cast at different ages has been discussed in many researches. Different types of surface treatments and shear connectors were studied experimentally to test their efficiency in what is called the (composite action) which could be formed between a precast beams and cast in place slabs. In this research 11 composite concrete-concrete T-section with dimensions (beams 120*400*2000mms and slabs 500*100*2000mms) were tested under static concentrated load in the middle of the span, one of them was reference monolithic T-section and the others were with different types of surface treatment like epoxy and roughening, Also shear connectors with different lengths, and increasing concrete strength were studied to obtain the best way to transfer the shear between concrete layer

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CHAPTER (1)

INTRODUCTION

1.1 General

The composite concrete structures have been always a topic of major importance in the field of construction. The use of concrete in composite structures may be with steel sections in the form of steel-concrete composite sections, or with concrete cast at different times to form what is called concrete-concrete composite sections which are used in buildings and bridge constructions. Economic considerations indicate the desirability of composite action between the precast and the cast in place elements. Composite behaviour, with the slab serving as the flange of T-beam results in horizontal shearing stress at the construction joints. The stresses at this region are very complicated and several trials to represent the behaviour in this region have been made.

The rapid population growth in Egypt is increasing the need for housing projects, multistory garages and also for bridges rapidly constructed. Precast concrete with casts in place slab has this advantage. There is an urgent need for further investigations, laboratory tests, numerical analysis and theoretical studies to find an acceptable method for solving the problem of shear transfer along the interface between precast concrete and cast-in-place concrete to simplify dealing with such structures as the need for them is becoming urgent.

1.2 Advantages and disadvantages of composite concrete section

In concrete-concrete composite structures the precast beam acts as a form for the cast in place slab. According to some economic considerations for the application of such structures some of the advantages and the problems of this type of construction are summarized as following:

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1.2.1 ADVANTAGES

1) Quality control on precast beams can be easily made as they are manufactured in proper conditions. The concrete can be made denser, more resistant to corrosion, less permeable, stronger and of more uniform quality than the concrete cast-in-place in thefield .improved quality of concrete should result in lower maintenance and repair cost and longer service life for the structures.

2) Using precast beams as a form for cast-in-place concrete reduces cost as it eliminates the need for forming which represents in some cases a high percentages of the cost.

3) The precast concrete could be designed as a form to support the weight of all the wet concrete above, thus form to support scaffolding can be eliminated and this could solve lots of traffic problems in Egypt during bridges construction.

4) The time required for construction can be reduced by the use of precast concrete integrated formwork as stated, and this also could help solving lots of construction time in Egypt.

1.2.2 DISADVANTAGES

1) Problems with precast beams construction, as extra reinforcement is needed to withstand handling stresses and the problem of storing precast units to provide mass production.

2) Handling and transportation of the precast units may require special details as well as special precast form units.

3) Special propping may be needed to support the precast beam during casting. In addition to, the problem of differential shrinkage between the precast element and the cast in place concrete should be taken into account.

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4) Treatment of joints along the interface before and after pouring the cast-in-place concrete is the main problem that could face such structures. Problems of composite action of the beam and slab together, impermeability of joints and good appearance of concrete face finish.

The least stated problem made many researchers investigate this subject to ensure full composite action at the interface for both precast beams and cast-in-place slabs, these researchers concerned mainly with the problem of shear transfer along the interface . The shear force must be transmitted across the interface between the two layers in the same manner and with the same deformations as if the entire section was casting monolithically.

Roughness, intermediate roughness, steel dowels, shear keys, steel angles, epoxy binding.....etc., may be used to improve the shear transfer.

1.3 Objective

The main objectives of this research can be summarized as follows:-

- Studying the shear transfer across interface in composite concrete-concrete T-section.
- Get the best way of treatment the interface to achieve maximum load transfer, minimum deflection, minimum slip and minimum crack width
- Studying the actual behaviour of simply supported T-section beam under concentrated loads.

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1.4 Format of thesis

The present thesis consists of five chapters:-

Chapter (1):-

Presents a general idea about the development of using precast concrete with casting in place concrete to form the composite concrete-concrete section. It also contains the advantages and disadvantages of this type of constructions according to some economic considerations. The chapter also includes the objectives and format of the thesis.

Chapter (2):-

Presents a review of available pervious work concerning composite action of composite beams, precast beams with casting in place slabs. Also, different types of shear connectors and factors affecting their strength are reviewed. It also presents method of shear transfer across an interface.

Chapter (3):-

Presents the experimental work and test program which consist of testing for 11 reinforced composite concrete-concrete T- section, one of them was reference monolithic T-section and the others ten were composite precast beams and cast in place slabs under the effect of concentrated load at the mid span of the beam using different types of interface connections. The behavior of those sections studied under the effect of the following parameters:-

- Using to shear connectors with different lengths.
- Roughening the interface to a higher degree of roughness.
- Using bending materials (Epoxy).
- Using different concrete strength.