AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Structural Engineering Department

BEHAVIOR AND DESIGN OF PRECAST COLUMN/BASE POCKET CONNECTIONS WITH SMOOTH SURFACE INTERFACE FOR RC BRIDGES

A Thesis submitted in partial fulfilment of the requirements for the degree of

Master of Science in Civil Engineering

(Structural Engineering)

by

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Bachelor of Science in Civil Engineering

(Structural Engineering)

Faculty of Engineering, Ain Shams University, year 2013

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STATEMENT

This thesis is submitted to Ain Shams University, Cairo, Egypt, in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering (Structural department).

The work included in this thesis was carried out by the author at the reinforced concrete lab of the faculty of engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or qualification at any other university or institute.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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DEDICATION

To my family

(My Father, My Mother, My Brothers, My Sister and My wife)

I dedicate this thesis to them for their unlimited support and encouragement over the years. I could not be able to complete this work without their support.

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BEHAVIOR AND DESIGN OF PRECAST COLUMN/BASE POCKET CONNECTIONS WITH SMOOTH SURFACE INTERFACE FOR RC BRIDGES

by: Mahmoud Amin Mohamed Abdelrahman Aboukifa

Abstract

Introducing of fast construction techniques to the field of construction of R.C structures has come more and more urgently needed nowadays especially for bridges construction. The vast majority of R.C bridges are constructed above overcrowded roads, so the construction works leads to the aggravation of the traffic congestion, so the more construction time taken the more traffic congestion with its side effects on the national income and public health will be.

Introducing a connection between a precast column and a precast or cast in place foundation that is fast, cheap and easy to construct will be of a great importance nowadays especially for its saving of time which is estimated to be 60% of that taken by cast in place column and this ratio increases as the number of constructed columns increases.

To date, the experimental investigations addressing the pocket connections are very limited and are dedicated to studying of the experimental behavior of the externally embedded pocket connections.
Accordingly, an experimental investigation is made in this research to investigate the behavior of three types of pocket connections (Externally embedded, Partially embedded and Internally embedded pocket connections) with smooth surface interface pocket connections with different embedded depths under vertical and horizontal simultaneous loads. Besides, the existing design models are observed to be very conservative and results in a different reinforcement values. Accordingly, a Strut and Tie design model is proposed and verified according to the experimental results. According to the Strut and Tie design model a design charts are presented in this research to design the externally embedded pocket connections with design recommendations to be used in the partially embedded and fully embedded pocket connections.

The research was carried out over four phases. The first was a review of previous literature related to the focus of the study. This was carried out in order to have a clear and broad understanding of the previous findings in this field.

During the second phase, an experimental investigation was carried out on seven specimens subjected to vertical and horizontal loads applied at the top of the column with medium eccentricities. The seven specimens are distributed as following; one pilot specimen; Two of the specimens were externally embedded; another two specimens were partially embedded; and the final two specimens were fully embedded specimens where every type of specimens consists of two different embedded depths. The experimental results indicated the need to revalue the previous design models for this connection.

During the third phase, a comparison was made between the previous theoretical studies to the experimental results obtained from this research. It was found that the existing design models are very conservative specially when dealing with connections subjected to small and medium eccentricities. Also, the existing design models results in quite different reinforcement values.

The final phase was a proposed Strut and Tie design model which was proposed and verified according to the experimental results obtained from the literature and from the experimental investigation held in this research. Based on the verified Strut and Tie design model, design charts are proposed to design the externally embedded pocket connections with design recommendations to be used in the partially embedded and fully embedded pocket connections which could accurately predict the nonlinear behavior of the structure without the need for a time consuming finite element analysis.

A number of conclusions and recommendations for future work were extracted from this study. The following general conclusions can be drawn: (a) Assuming the fully embedded pocket connections are the case of total fixation as the failure happened in the column itself and nothing happened in the pocket or in the footing, then the partially embedded pockets represented (75% to 90%) of the total fixation case depending on the ratio of the embedded portion of the pocket inside the footing to the whole embedded depth and the externally embedded pockets represented (50%) of the total fixation case; (b) An embedded depth of 1.33h (where h is the bigger dimension of the column) is suitable enough to represent the monolithic specimen in cases of partially embedded and internally embedded specimens; (c) The Partially Embedded pocket connections are the most economic type of the pocket connections to give big flexural capacity; (d) The fully embedded pocket connections are the closest type to represent a monolithic connection where no failure happened in the pocket itself but it is expensive to be used as it requires a big footing depth.

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