AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

STRUCTURAL EFFICIENCY OF PRESTRESSING FOR CONCRETE BRIDGES IN ULTIMATE STAGE

BY

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STATEMENT

This thesis is submitted to Ain Shams University, Cairo, Egypt on December 2015 for the Master of science Degree in Civil Engineering (Structural).

The work included in this thesis was carried out by author in the Department of Structural Engineering, 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.

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Abstract of Master of Science Degree Thesis Submitted By

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Title of thesis:-

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ABSTRACT

The main objective of this study is to present the effect of prestressing force and induced prestressing moment on the ultimate moment capacity for the structurally determinate and indeterminate prestressed beams.

An analytical study was carried out for 33 structurally determinate internally bonded prestressed beams and 21 structurally determinate unbonded prestressed beams with different concrete compressive strength and different reinforcement ratios to determine the ultimate moment capacity.

A numerical study included non linear finite element modeling using “Tno-Diana” software was used to solve 5 statically determinate prestressed beams, which were previously tested experimentally. These models were used as a calibration models for the program also 60 statically indeterminate prestressed beams were solved using “Tno-Diana” program and ultimate moment capacity, ultimate deflection, ultimate concrete strain, ultimate prestressing steel strain and load deflection curves were determined.

This study introduces the conceptual design of prestressed beams at ultimate limit state. Proposed calculation method was introduced. Analytical studies were carried out to investigate the ultimate capacity of prestressed beams also non linear finite element models were developed.

The following conclusions can be drawn:-

- An ultimate strength analysis involving equilibrium and strain compatibility equations and prestressing normal force permitted satisfactory prediction of the effects of all important variables on flexural strength compared with experimental results for bonded and unbonded specimens.
- The increase in ultimate moment capacity due to the effect of normal force increases linearly with the reinforcement ratio *(ρ)* and becomes significant for high prestressing ratios > 0.5 %.
- Taking the effect of the normal force in the ultimate limit flexural capacity calculations gave closer results to the experimental capacity values (average and STD).
- The ultimate capacity of the beams increased by a ratio an average ratio 9.2% compared to ACI results by taking the effect of normal force into consideration.
- The use of non linear analysis FEM software to model and analyze the behavior of prestressed concrete beams in the non linear range become useful and efficient design tool to determine the ultimate moment capacity.
- The non linear analysis leads to substantially similar results to the experimental results over a wide range of variations of prestressing ratios and concrete compressive strength.
- From a practical viewpoint, the cost of a more accurate method of analysis may be largely offset by the savings on the amount of steel used.

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