Ain Shams University

Faculty of Engineering

Structural Department

Behavior of Post-tensioned Simply Supported Deep Beams

By

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B.Sc. (2009), Structural Division

Civil Engineering Department

Faculty of Engineering, Ain Shams University

A Thesis

Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Civil Engineering (Structural Dept.)

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Date: Des. 2019

STATEMENT

This thesis is submitted to Ain Shams University, Cairo, Egypt, as a partial fulfillment of the requirements for the degree of Master of Science (M.Sc.) in Civil Engineering (Structural), Faculty of Engineering, Ain shams University.
The experimental and numerical works included in this thesis was carried out by the Author at Ain Shams University, Facility of Engineering lab, Cairo, Egypt
No part of this thesis has been submitted for a degree or qualification at any other University or Institute.

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ABSTRACT

The deep beam is a beam having a large depth/thickness ratio and shear span depth ratio. Because the geometry of deep beams, their behavior is different from the slender beam. Deep beams have many applications for both residential and commercial building structures such as transfer girders, transfer caps of high-rise buildings and as part of a lateral load resisting system (Outriggers)…etc. The use of deep beams has increased rapidly because of their convenience and economic efficiency. Using post-tensioning (PT) in deep beams offers many advantages like significant reduction of reinforcement, high durability, greater stiffness, and hence better cracking and deflection behavior.

The prime objective of the thesis is to study the contribution of post-tensioned cables to the main reinforcement of the deep beam and the optimum ratio of (vertical stirrups to side bars) from the required shear reinforcement of the deep beams.

An experimental program is carried out for five simply supported post-tensioned deep beams with 1200 mm clear span, height of 500 mm and a width of 220 mm were fabricated and tested in the laboratory of Faculty of Engineering, Ain Shams University. A linear finite-element analysis software (ADAPT PT-RC 2015) were used to investigate the behavior of post-tensioned concrete simply supported beams under gravity load with the same parameter of tested specimens. The failure was occurred due to the ultimate flexural load of each specimen. Change in post-tensioned system (bonded or unbonded) and a different ratio of vertical stirrups to side bars varying from 0% to 100% from the required shear reinforcement of the deep beams is also studied. All post-tensioned deep beams were exposed to gravity concentrated load at mid-span up to failure for each combination of parameters. The load was increased gradually till failure. The design of post-tensioned and the design of deep beams was carried out according

to the Egyptian Code of Practice ECP203-2018. The experimental results show that using post tensioning cables (applying early compression load) to the deep beams enhances the capacity of the beams. Besides, greater stiffness and hence better cracking and deflection behavior were found. Also, experiment show that in the present of post-tensioned cables the horizontal web reinforcement is less effective in providing shear strength than the vertical web reinforcement. So it is found that decreasing the distance between stirrups (Increase vertical shear reinforcement) tends to increase cracking load value, which is because the shear ductility of reinforced concrete deep beams increases due to the contribution of the stirrups. Also experiment show that for all specimens with the bonded post-tensioned system, flexure capacity is larger compared to specimens with an unbonded post-tensioned system.

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