شبكة المعلومات الجامعية

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بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

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Behavior of Deep Beams using Different Concrete Grades

Thesis

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Master of Science
in
Civil Engineering (Structures)

by

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Behavior of Deep Beam using Different Concrete Grades

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Date: Oct. 2021

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, Reinforced Concrete Laboratory, 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 small shear span depth ratio. Because of the geometry of deep beams, their behavior is different from slender beams. 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.

The current research program presents both experimental and numerical studies to investigate the behavior of simply supported deep beams having layers of concrete of different grades (25 MPa and 50 MPa) subjected to vertical loads such as (Cracking-deflection-ultimate loads). All deep beams were exposed to vertical concentrated load at mid-span up to failure. All specimens were fabricated and tested in the Laboratory of Reinforcement Concrete of Faculty of Engineering, Ain Shams University. An experimental program is carried out using five simply supported deep beams with the same dimensions; specimens with an effective span of 1100 mm, width of 200 mm and a height of 1000 mm, specimens also share same top, bottom, vertical, and horizontal reinforcement. Five numerical models were developed using a non linear finite-element analysis software (ABAQUS 2017), all models were verified against the experimental results and showed good agreement with the test data. The finite element analysis was extended to investigate another parameters:

Effect of load locations (at mid span and quarter span) and type of loads (concentrated and uniform).

Both the experimental and numerical studies showed that failure of tested deep beams was mainly due to diagonal cracks. Changing compressive

strength of concrete from 25 MPa to 50 MPa results in less deflection, higher value of cracking load and a higher to failure load. Casting concrete on different layers causes the first cracks appear at earlier load than in beam with one grade of concrete. . It was also found that the best flexural behavior of deep beams is obtained when the bottom layer is casted using high concrete compressive strength and gives results (deflection, and failure load) close to results of deep beam casted with high compressive strength. Also it was observed that the position of the applied vertical load at quarter span compared at mid span leads to decreases in the ultimate capacity of deep beam and finally the deep beam which is subjected to a distributed vertical load has a higher ultimate vertical load capacity compared to the deep beam which is subjected to concentrated vertical load.

Keywords: Deep beams, Cracking pattern, Deflection, Experimental study, High compressive strength (HCS), Normal compressive strength (NCS).

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