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AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

EVALUATING THE PERFORMANCE OF BRIDGE LEDGE BEAMS CONSIDERING THE CONTRIBUTION OF INNER STIRRUPS TO SUPPORT EXTERNAL LOADS

A Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE IN CIVIL ENGINEERING

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STATEMENT

This thesis is submitted in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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ABSTRACT

Reinforced concrete L-shaped beams are frequently used in the precast concrete industry specially in bridges construction to support a series of deck beams. The spandrel acts as a hanger for the ledge part, hence hanging reinforcement is used in the spandrel for this action. It was supposed that the outer vertical stirrups' branches are the main hanging elements for the ledge part; however, adding internal vertical branches contribute in hanging the ledge part. The perception that the outer vertical stirrups' branches solely are the main hanging elements and the neglection of the effect of inner stirrups' branches in hanging action can become questionable as it leads to using a great amount of outer reinforcement which leads to nesting of this part and increasing the fabrication cost of the beam. Therefore, a need exists to evaluate the contribution of the inner stirrups with the hanging steel reinforcement. This study aims to numerically model the performance of bridge ledge beams taking into consideration distribution and amount of stirrups reinforcement, web width, eccentricity of acting load and ratio of stirrups spacing to web width on the capacity and performance of ledge beam. Numerical models were developed to model the performance of bridge ledge beam. Results of previous experimental studies were used to verify the results of the developed numerical models for different ledge beam configurations. The experimental studies include six simply supported beams with 2700 mm span, 380 mm total height, 250 mm web width and 140 mm ledge height with projection equals 250 mm. The main variables were the internal vertical stirrups distribution and

the eccentricity of the vertical loads. The numerical models have an acceptable accuracy as they showed a good agreement with the experimental results. Concerning the study of the overall behaviour of the hanging action of inner stirrups in bridge ledge beams, a parametric study was carried out on a total of 45 beams with the commonly variables in the ledge beam as the ledge web width, the ledge depth and the eccentricity of the applied loads. All beams are modelled as monolithic beam with span equals 12 m connecting to two columns with height equals 6 m. All beams support five main girders spanning 30 m spaced 3 m each. Hence all beams are subjected to five concentrated loads with spacing equals to 3 m. All beams are designed in which hanging failure in stirrups is the first failure mode.

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