Behavior of Tension Lap Splices Confined by Transverse Reinforcement on Different Types of Reinforced Concrete Beams

BY

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Summary:

The primary objective of this research is to evaluate the effect of using transverse reinforcement within the splice region on the bond strength of tension lap splices anchored in different types of reinforced concrete beams. All beams are of 1800 mm clear span and 150 × 250 mm cross-section. The main studied variables are: number, diameter, distribution and shape of transverse reinforcement provided for the different concrete types. During testing; ultimate capacity, deflection, crack pattern, mode of failure and strain distribution on the main steel and stirrups were recorded. The data obtained showed that transverse reinforcement has an important effect on the improvement of the bond strength within the tension lap splice. Using self-compacting concrete gave the best results. The beams tested were all modeled using three-dimensional nonlinear finite element static analysis of the concrete using the well-known finite element method (FEM) software ABAQUS. The analytical and experimental results were compared and reasonable agreement was obtained.

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CHAPTER 2: LITERATURE REVIEW

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ABSTRACT

In the recent years, many research efforts have been carried out on the effect of different parameters on modifying bond strength of tension lap spliced reinforcing bars in beams such as lap splice length. Comparatively, Limited attention has been directed towards the effect of using transverse reinforcement along the splice length. An experimental program consists of sixteen reinforced concrete beams was conducted in the concrete research laboratory of Cairo university to investigate the effect of providing transverse reinforcement within the splice region and splice bond strength. The parameters covered are number, diameter and shape of transverse reinforcement provided for different concrete types. The used concrete types on the research are normal strength concrete, high strength concrete and self - compacting concrete. The research involved tests on simply supported beams of 1800mm span and 150*250 mm cross section where tensile steel was spliced in the constant moment zone. Load - deflection relationship, steel strain and crack propagation are recorded during loading from which we can judge the effect of each parameter on the ductility and mode of failure of each beam.

CHAPTER 1

INTRODUCTION

1.1 General

It is usually possible from the practical point of view to produce reinforcement bars with lengths that can fit the different details of structural members with full length continuous bars. Many reasons make it impossible to have continuous reinforcement bar such as; steel fabrication, transportation limitations and steel workshop detailing that usually set targets to reduce the waste of the standard fabricated bar with 12 meters length as much as possible as a result, it is necessary to splice bars in the field.

Lap splicing, which is often achieved by the overlapping of two parallel bars with enough length that allow stress transfer from one bar to another through the concrete surrounding both bars, has long been considered as an effective and economical splicing method. The efficiency of the lap splice can be measured by how much it gives performance similar to continuous bars embedded in concrete. Good bond strength of lap splice with surrounding concrete reduce the probability of bar slippage or splitting failure before the yielding of reinforcing steel bars.

Stress distribution of reinforcing bars in concrete basically depends on bond strength between steel and concrete. That bond is based on concrete characteristics as a kind of material proprieties. On the other hand, modern codes present other factors that affect the bond strength namely; lap length, concrete cover, reinforcement bar diameter, reinforcement ratio, bar relative rib area and transverse reinforcement provided within the lap zone.

As mentioned above, concrete mechanical properties significantly affect the bond characteristics. As a result, each type of concrete could be a worthy parameter in the evaluation of splice bond strength. Construction using concrete is spreading widely and there is a need for concrete types that satisfy special requirement such as Self-Compacting Concrete (SCC) and High Strength Concrete (HSC). SCC is known for its excellent deformability, high resistance to segregation, without applying vibration flow under its own weight and completely fills the formwork of shape, even with congested reinforcement. HSC has higher strength than the usual normal strength concrete (NSC) that has been produced for almost a century with a compressive strength in the range of 20-40 MPa. HSC has higher compressive strength than the usual normal-strength concrete so naturally; it has higher tensile strength as well.

1.2 Research Objectives

The main objective of this research mainly was to investigate the effect of using transverse reinforcement on the behavior of the beams with tension lap splices and the following parameters were studied:

1- Increasing amount of transverse reinforcement within splice zone for different concrete types; NSC, HSC and SCC.