Numerical Approach to Evaluation of Bond Strength of Headed Bars

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Summary

This paper presents the numerical approach to evaluation of bond strength of headed bars. Bond strength of headed bars reach its maximum before the head fully comes in to play and the bars undergoes significant slip, losing a major portion of its bond, while the head is fully bearing against the concrete. With average bond stress concept, reduced bond strength from splitting failure in that phenomenon cannot be properly described. Therefore local bond stress-slip relationship and numerical approach were used to calculate bond strength of headed bar. After local bond stress-slip model was made with 90 lap splice tests, bond strength of headed bars was calculated using same bond-slip algorithm and different boundary condition. The analytical results show a considerable difference in bond stress of headed bars with experimental results of previous studies. The cause of these results was under discussion in the last chapter.

Keywords: headed bars; bond strength; local bond stress-slip model; numerical analysis

1. Introduction

Anchorage is most important mechanism to use application of reinforced concrete. Hooked bars can be used for this but in many cases, the bend of the hooks will not fit within the dimensions of a member of the hooks create congestion and make an element difficult to construct. To address the problems that arise from the use of conventional anchorages, headed bars were developed for use in the construction of concrete. Like a hooked bar, they can develop within a short distance, but they do not create as much congestion.

Generally, anchorage strength is considered to combination of anchorage by the head and bond along the length of the bar. However, it is evident that the strength of an anchorage comprising a straight portion of bar plus a welded head is less than the sum of the strengths of the two components acting independently. The contribution of the bond along the length of a bar drops to approximately 1/3 of that expected of a straight bar without a head once head bearing area reaches a value of approximately four times the area of the bar. In general, contribution of bond is less than contribution of head. So assuming a linear relationship, many researchers simply calculated bond stress from following equation.

$$f_{s,bond} = \left(\frac{L_a}{L_d}\right) f_y \quad (1)$$

But the diameter and yield strength of rebar more increase, development length and contribution of bond increase so reduced bond strength is more increase. Therefore it is important to calculate reduced bond strength.

This paper presents an evaluation method of bond strength of headed bars. To consider reduced bond strength, using local bond stress-slip relation and numerical procedure, bar stress, which is developed from bond, is calculated.

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