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Effects of stirrup, steel fiber, and beam size on shear behavior of high-strength concrete beams

Doo-Yeol Yoo[a] and Jun-Mo Yang[b*]

ABSTRACT

This study investigates the effectiveness of steel fibers and minimum amount of stirrups on the shear response of various sized reinforced high-strength concrete (HSC) beams. For this, six large reinforced HSC beams with a shear span-to-depth ratio (a/d) of 3.2 were manufactured. Three of them contained 0.75% (by volume) steel fibers without stirrups as per ACI Committee 318, while the rest were reinforced with the minimum amount of stirrups without fibers. Test results indicate that, with increasing beam size, significantly lower shear strength was obtained for steel fiber-reinforced high-strength concrete (SFR-HSC) beams without stirrups, than for the plain HSC beams with stirrups. The inclusion of steel fibers effectively limited crack propagation, produced more diffused initial flexural cracks, and led to higher post-cracking stiffness, compared to plain HSC. On the other hand, the use of minimum stirrups gave better shear cracking behaviors than that of steel fibers, and effectively mitigated the size effect on shear strength. Therefore, a large decrease in shear strength, with an increase in the beam size, was only observed for the SFR-HSC beams without stirrups. A shear strength decrease of 129% was obtained by increasing the effective depth from 181 mm to 887 mm. The shear strengths of reinforced steel fiber-reinforced concrete beams were not accurately predicted by most previous prediction models. Therefore, a new shear strength formula, based on a larger dataset, that considers the size effect, is required.

Keywords: *High-strength concrete; hooked steel fiber; minimum shear reinforcement; shear; size effect*

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