

SHEAR REINFORCEMENT OF REINFORCED CONCRETE WITH STEEL FIBERS BEAMS ACORDING TO ACI 318-08 and ACI 318-14

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The code ACI 318 has allowed the replacement of the fences or stirrups as shear reinforcement in concrete beams reinforced with steel fibers (SFRC) when a number of conditions were fulfilled. The edition of the Year 2014, ACI 318-14 [1], has assumed a conceptual change regarding the edition of 2008, ACI 318-08 [2] which is analyzed below.

In both editions the conditions are set at two levels, at the material level and at the structure level.

At the material level, the edition of 2008 specified that in order to be able to admit the SFRC as a shear resisting material, the following three conditions should be fulfilled simultaneously:

1. The dosage of steel fibers must be equal to or greater than 60kg of fibers per cubic metre of concrete
2. The residual resistance obtained in the flexion test performed according to ASTM C1609M when the deflection reaches 1/300 of the length must be greater than or equal to 90% of the first peak of resistance obtained in the test and 90% of the resistance to flexural , f_r , obtained according to the expression $f_r = 0.62\sqrt{f_c}$
3. The residual resistance obtained in the flexion test performed according to ASTM C1609M when the deflection reaches 1/150 of the length must be greater than or equal to 75% of the first peak of resistance obtained in the test and 75% of the resistance to flexural f_r , obtained according to the above expression.

The edition of 2014 maintains the three previous conditions but also requires that the fibers used i) must be corrugated and comply with ASTM A820M, ii) must have a slenderness between 50 and 100 and III) must comply with ASTM C1116M

At the level of structure, the edition of 2008 allowed the total substitution of the stirrups when it was beams with concrete of normal weight reinforced with steel

fibers with a resistance specified to compression no higher than 40MPa, a cross section no greater than 600 mm and in which It complies with the following relation $V_u \leq 0.17\phi\sqrt{f'_c}b_wd$ Being V_u the shear request increased, ϕ the resistance reduction factor, f'_c The specified resistance of the concrete to compression, b_w the width of the beam and d the cross section.

The 2014 edition specifies that the total replacement is possible when $V_u \leq \phi \cdot V_c$ otherwise it is necessary to place a minimum reinforcement area in the form of an reinforcement. In any case, in order to be able to give this total or partial substitution, the structural conditions specified by the edition of 2008 must be fulfilled.

The above criteria are based on experimental results in which it has been found that the beams reinforced with steel fibers with conformed ends and in quantities higher than 60 kg/m³ of concrete reach a shear resistance values Superior to $0.29\sqrt{f'_c}b_wd$ [3]. The criteria of ASTM C1609M are based on the tests of Chen [4] made with SFRC with contents and fibers similar to the tests used in the beams of Parra-Montesinos [3].

The previous analysis makes it possible to conclude that the latest edition of the ACI 318 represents a more conservative turn in the treatment of shear sizing in beams with SFRC, both in the requirements at the material level and at the structure level.

REFERENCES

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