COMPARISON OF DIFFERENT MODELS OF CALCULATION TO EVALUATE THE RESISTANCE TO COMPRESSION OF THE CONCRETE CONFINED WITH CARBON FIBER TISSUES

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The resistance of concrete to compression can be increased very importantly by its confinement. The confinement of the concrete by means of the external gluing of high resistance fiber fabrics is a technique that has been known for decades and is increasingly used in reinforcement works of structural elements subjected to compression. Carbon fiber fabrics are commonly used, due to their high strength and high modulus of elasticity. The break of the elements occurs when the tensile fiber fails (figure 1).

Fig. 1: Break shape of confined concrete.

There are different models to predict the compressive strength of concrete confined with this type of fabric. In America, the model proposed by the ACI [1] is usually used, while in Europe, the one proposed by the FIB is used [2].

In both models, the strength of the confined concrete is obtained from the geometry and strength of the unconfined concrete and the geometric and mechanical characteristics of the fabric that confines the concrete. However, the expressions used are conceptually different. Table 1 shows the expressions contributed by both associations for circular section elements.

Table 1: Expressions used by ACI and FIB for confined concrete

ACI440-17	FIB
$f_{cc} = f_c + \varphi_f \cdot 3{,}3 \cdot f_l$	$f_{cc} = f_c \left(2{,}254 \sqrt{1 + 7{,}94 \frac{f_l}{f_c}} - 2 \frac{f_l}{f_c} - 1{,}254 \right)$
$f_l = \frac{2E_f \cdot n \cdot t_f \cdot \varepsilon_{fl}}{D}$	$f_l = \frac{2E_f \cdot n \cdot t_f \cdot \varepsilon_{fu}}{D}$
$\varepsilon_{fl} = k_e \cdot \varepsilon_{fu} = 0{,}55 \cdot \varepsilon_{fu}$	
$\varphi_f = 0{,}95$	
$0{,}55\varepsilon_{fu}$	ε_{fu}

Where f_{cc} is the strength of the confined concrete; f_c is the strength of the unconfined concrete; φ_f is a coefficient of value 0,95; f_l is the confinement stress; E_f is the modulus of elasticity of the confinement material; n is the number of layers of the fabric; t_f is the thickness of the fabric; ε_{fl} is the unitary longitudinal deformation that the fabric can reach when it confines the concrete; D is the diameter of the piece to be reinforced; k_e is a coefficient of value0,55; ε_{fu} is the ultimate deformation of the fabric tested under tension.

The comparison between the two expressions reveals two fundamental differences.

First, for ACI the increased strength of the confined concrete is independent of the strength of the unconfined concrete.

Secondly, ACI decreases the maximum deformation at which the fabric can work (and therefore its resistance) to a value close to half of the ultimate deformation of the fabric tested to pure traction, as a result of multiplying by the coefficients φ_f y k_e, while FIB does not specify this point clearly.

REFERENCES

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