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Non-linear finite element analyses for reinforcement optimization of concrete structures

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Abstract

Steel Fibre Reinforced Concrete (SFRC) is a widely used and practical material suitable for the construction of both pre-cast and cast-in-site structures; although having been pioneered more than a decade ago, SFRC is now attracting widespread interest.

Compared to conventional reinforced concrete, SFRC generally exhibits improved ductility, toughness, cracking resistance and tensile strength; these improvements in mechanical behaviour of concrete may be exploited to eliminate, partially or totally, the conventional reinforcement and to obtain a significant reduction of costs and labour time. Beside that, the interest in using such an innovative material has progressively increased due to the continuous development of design tools, codes and standards which make the design process easier.

One of the research programmes developed at the University of Brescia, with the collaboration of Bekaert Italia, concerns the numerical study of several types of concrete structures and pre-cast elements in order to study design solutions in which conventional steel reinforcement is partially replaced by steel fibres; the combination of steel fibres and rebars, which leads to the best structural performances both at U.L.S and at the S.L.S, is called "optimized reinforcement".

In the proposed paper, some examples of reinforcement optimization concerning different types of concrete members are shown; the results presented herein are obtained through the non-linear analyses performed with Diana.

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