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On the effectiveness of composite layers reinforcements on the static behaviour of damaged civil structures through unified formulation.

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Over the past few years, civil engineering has encountered a sudden growth in the design of constructions that would likely have seemed unimaginable only a few decades ago. For example, long span bridges and skyscrapers have appeared increasingly in modern times. This has been possible thanks to modern structural computer aided tools, which made possible the development of advanced mathematical models and the accurate prediction of particular phenomena which may occur within the structures. The improvement of computational methods, such as Finite Element Method (FEM), has remarkably contributed to expand the knowledge in structure engineering. The present work focusses on the analysis of civil engineering structures that may have suffered deterioration. In fact, due to corrosion or extreme weather conditions, a drop on the mechanical properties may arise within the structures. Repair and rehabilitation of the civil structures needs an enduring repair material. The ideal durable repair material should have low shrinkage, good thermal expansion, substantial modulus of elasticity, high tensile strength, improved fatigue and impact resistance. Reinforcing the civil structures with composite fibers such as polypropylene or fiber glass is one of the possible ways to provide all the criteria of the durable repair material. The main disadvantage of this technique is that it may results to be a costly process, both in terms of fabrication and installation. Then, an accurate design and prediction on their structural behavior results to be be mandatory.

The proposed methodology for the structural analysis of composite reinforcements for damaged civil structures has been built in the framework of the Carrera Unified Formulation (CUF). This methodology, according to which the three-dimensional displacement field can be evaluated as an arbitrary expansion of the unknowns evaluated through FEM, is extremely suitable for this analysis. In fact, every component or layer within the structure can have its

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own kinematic described independently from the others, without the need of any ad-hoc theory implementation. As a matter of fact, one can evaluate the influence of thickness, material properties and fiber direction of reinforcements in a unified manner.
Arch-type structures are analyzed, comparing obtained results with those provided from literature and experimental tests. The results establish and reports graphs showing the effects of the reinforcements on the overall behavior of the components, with the aim of providing a reliable starting point for future design of structure in the civil engineering field.