

Adopting Wire-And-Arc Additive Manufacturing in Construction Towards a New Generation of Resource-Efficient Structures

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Abstract : The digitalization of the construction sector could potentially produce more efficient structures, reduce material waste and increase work safety. Current strategies for the realization of automated steel constructions see the application of metal Additive Manufacturing processes (and in particular Wire-and-Arc Additive Manufacturing, WAAM) as an opportunity to build a new generation of efficient steel structures with reduced material use. This, though, requires advanced multidisciplinary knowledge in manufacturing, metallurgy, structural engineering and computational design. Recent efforts have been made in order to combine computational design with current digital fabrication procedures to realize resource-efficient steel structures for the future. The present work aims to provide an integrated design approach to develop resource-efficient structural elements combining computational design algorithms with considerations on the WAAM fabrication process, structural considerations and verifications. The idea comes from the preliminary results achieved in terms of new structural optimization theories, fabrication of large-scale elements with WAAM and structural verification of first prototypes. The approach is applied to two classes of structural elements (beam and column). The results aim to increase the application of metal Additive Manufacturing in construction through the development of a new generation of resource-efficient structural members.

Keywords : additive manufacturing, wire-and-arc, steel structures, structural optimization

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