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## **A COMPARISON OF BRITTLE VERSUS DUCTILE VASCULAR NETWORKS: WHY DUCTILE NETWORKS ARE PREFERABLE FOR SCALING UP**

**Y. Shields, C. De Nardi, V. G. Cappellesso, T. Jefferson, N. De Belie, K. Van Tittelboom**

Most vascular networks studied in literature for self-healing concrete purposes have brittle properties, allowing them to break upon crack formation within concrete and thus be able to release a healing agent into the damaged matrix. However, brittle networks are difficult to fabricate and scale up for industrial use as they become too fragile for on-site handling. This study highlights the challenges with producing brittle networks via fused deposition modelling (FDM), a type of additive manufacturing (AM) technique, and introduces a novel vascular network methodology for self-healing concrete that is ductile, rather than brittle, which relies on releasing a healing agent through pores without damaging the network itself. Both types of network release mechanisms were embedded in concrete prisms and subjected to multiple loading tests, with ductile channels outperforming brittle channels. Recommendations for printing layer heights, wall thicknesses, printing orientation, and healing agent supply methods are given, as well as considerations for scaling up for practical use.