



# Reconstruction of a Ukrainian road bridge by use of 3D printed minimass beams

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## Abstract

Minimass is an open “truss-type” concrete and steel beam which creates stiffness and strength through axial compression and tension. The new technique of 3d concrete printing unlocks the potential of this design by allowing the fabrication of these beams at a fraction of the cost of traditional means: no formwork, minimal steel reinforcement, low carbon. The rural bridge in Ukraine is located in Kherson Oblast. The original span was destroyed during the war. The new bridge deck is designed with prefabricated minimass beams, lattice slab concrete panels between the beams and a cast in-situ top slab. The combined use of printed and in-situ concrete leaves various technical issues to be studied, for example the construction joints shall be designed to ensure 100 years’ service life. The minimass beam structure is estimated to reduce the material quantities and embodied carbon by 40% in this case.

**Keywords:** minimass™ beam, printed concrete, external posttensioning, composite truss

## 1 Introduction

Road and rail bridges in Ukraine have suffered damage and destruction throughout the period of fighting in the country, as they are a key element of transport logistics. According to the State Agency for Reconstruction and Development of Infrastructure in Ukraine [1], 346 bridges have been destroyed (up to the end of June 2023). 41 bridges were re-built during 2022 and it is expected that 40 locations will be re-built during 2023. In addition, the Reconstruction Agency has implemented temporary crossings at a further 85 of these locations. One of these temporary crossing locations was identified by the State Agency for Roads as being a suitable location for the

construction of a new type of bridge, to act as a pilot which demonstrates the practical application of 3D printed concrete for infrastructure.

The State Agency for Roads has engaged with a local non-profit organisation called Team 4 UA, who have started to introduce 3D printing for concrete to the Ukrainian market. Net Zero Projects (NZP), working with COBOD International and Rambøll, has developed a design for a new bridge, using the principles of minimass beams, described herein.

The bridge is located just north of the village of Starosillya, Figure 1, at km 54+397 of the road T-22-07 / T-04-03 / Vysokopillia – Velyka Oleksandrivka – Beryslav, in the Kherson Oblast.