

RESILIENCE OF MASONRY ARCH BRIDGES ACCOUNTING FOR AGEING AND FLOOD EFFECTS

ABSTRACT Masonry arch bridges (MABs) form a critical part of transportation infrastructure in the UK and globally, with over 50,000 such structures in service in the UK alone, many spanning rivers and watercourses. As heritage structures, they are subject to long-term ageing effects, including material degradation and loss of structural integrity, which increase their vulnerability to flood-induced actions. Climate change has intensified the frequency and severity of flood events, causing significant damage and, in some cases, collapse of UK MABs, including Braithwaite Bridge (2009), Linton Bridge (2015), Tadcaster Bridge (2015), and Llanerch Bridge (2021). The current masonry design standard, Eurocode 6 [1], and bridge assessment code, CS 469 [2], do not consider ageing effects or the direct impact of floods on the superstructure of a MAB, highlighting the need to understand the combined influence of ageing and flood-induced loads on this type of historic yet prevalent structure.

Masonry progressively deteriorates under certain environmental effects, with temperature fluctuations and moisture ingress among the most influential factors. This study experimentally investigates these effects on fired clay brick masonry using environmental chambers at the University of Liverpool. Specimens prepared with locally manufactured clay bricks and lime-based mortar, replicating traditional historic construction, are subjected to repeated heating-cooling cycles between sub-zero and elevated temperatures. Key mechanical and physical properties, including compressive strength, flexural strength, and crack propagation, are monitored to track deterioration.

Building on these findings, the combined effects of ageing and flood loading will be investigated using finite element modelling, enabling an understanding of the corresponding MAB behaviour. The results highlight that environmental ageing significantly affects the structural integrity of existing MABs and must be considered in assessments, particularly under increasing flood-induced out-of-plane loads.