INTRODUCTION
The main cause of failure of masonry bridges is flooding, which results to scour. After the Somerset floods of 2015, it is important that the effects of scour are studied. The Computational Structural Mechanics Group has developed an accurate mesoscale representation combined with a hierarchical partitioning approach for modelling masonry. This study uses this approach as a starting point to complete the following:

1. Define scour simulation methodology
2. Define modelling strategies for applying the methodology
3. Identify most efficient modelling strategy
4. Use the best strategy to evaluate the effect of scour on multi-span masonry arch bridges

SCOUR METHODOLOGY
Definition: Scour is a natural phenomenon caused by erosion or removal of streambed or bank material from bridge foundations due to flowing water.

Bed removal occurs due to the wake vortices around the vertical axis and results to the formation of a horseshoe vortex about the horizontal axis.

Scour leads to hole around bridge pier → Use equations to define hole geometry

\[ d = \max(0, x \tan \frac{\alpha}{2} + y \tan \theta) \]

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MODELLING STRATEGIES FOR EVALUATING THE EFFECTS OF PIER SCOUR ON MULTI-SPAN MASONRY ARCH BRIDGES
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MODELLING STRATEGIES
STRUCTURE SIMPLIFICATION
Model structure components as beam elements instead of bricks. These elements are connected with the hierarchically partitioned components using mixed-dimensional coupling.

SOIL SIMPLIFICATION
Instead of soil elements, interfaces are used for modelling the behaviour of the soil surrounding the bridge foundations. The characteristic parameter of these interfaces is the stiffness that corresponds to the soil stiffness. The stiffness varies based on orientation and depth.

Vertical Orientation:
Horizontal Orientation:

MODEL DEFINITION
Model 1: Beam-element arches
Brick pier
Solid soil

Model 2: Beam-element arches
Brick pier
Solid interfaces

Model 3: Beam-element arches
Beam-element pier
Solid soil

Model 4: Beam-element arches
Beam-element pier
Solid interfaces

CONSIDER 3 SCOUR DEPTHS
With time scour depth increases → Considering different scour depths, scour evolution is simulated

With increasing scour depth:
• Initial displacement increases
• Response stiffness reduces
• Ultimate load reduces by 26%

CONSIDER GREATEST SCOUR DEPTH
• Greatest stress: arch edges
• Asymmetric stress distribution in arches
due to scour hole asymmetry
• Pier displacement indicates that the pier will rotate

REFERENCES