RCCES Seminar series, 24th November 2016, 5:45pm, room C303

Seismic response of Roman concrete arches and vaults

Martin Williams

Professor of Structural Engineering, University of Oxford

Abstract:

Continuous arches and vaults made of cohesive materials with low but non-zero tensile strength are a common feature in historic and monumental structures, many of them sited in earthquake-prone regions. A striking example of this form of construction is the partially-collapsed Basilica of Maxentius in Rome, comprising barrel and cross-vaults made of Roman concrete. This seminar will describe two elements of our work in this area.

First, it will present the results of a series of surveys and quasi-static analyses of the Basilica of Maxentius. These were aimed at reconstructing the as-built geometry, gaining insights into the partial collapse and assessing the current state of the remains. It will then present experimental research on the seismic behaviour of continuous mortar arches, loosely inspired by the barrel vaults of the Basilica. Significant differences in behaviour between continuous and voussoir arches are highlighted, including: differences in hinge positions; higher accelerations required to generate hinges; inability of hinges, once formed, to close and move to a different location; and the likelihood of sudden collapse once a four-hinge mechanism has formed, whereas voussoir arches can often undergo stable rocking. Limit analysis, whose basis includes an assumption of zero tensile strength, is a suitable analytical tool for voussoir arches, but is shown to be inaccurate, and unsafe, when applied to arches having a modest tensile capacity.

Brief Bio:

Martin Williams received his PhD in structural engineering from Bristol University in 1988 and worked in industry with Atkins before joining the Engineering Science Department at Oxford University in 1990. He is currently Professor of Structural Engineering, and leads research in earthquake engineering and structural dynamics. His interests include development of hybrid testing methods, seismic performance of historic structures, passive and semi-active structural control, and dynamic human-structure interaction.

(Publication portfolio and complete profile available at:

http://www.eng.ox.ac.uk/structdyn/people/professor-martin-williams)