Seventh Colloquium
Unilateral Problems in Structural Analysis
Palmanova, June 17-19, 2010

On the Statics of No-Tension Masonry-like Vaults and Shells

Alessandro Baratta & Ottavia Corbi
Dept. of Structural Engineering, Via Claudio 21, 80125 Napoli, Italia
alessandro.baratta@unina.it; ottavia.corbi@unina.it

Keywords: No-tension material, No-tension structures, Vaults, Shells.

ABSTRACT

In the paper a basic approach for dealing with masonry vault analysis is outlined. Actually the fundamental issue in treating such structural typology is, on one side, to account for suitable identification of the vault geometry, which is, as well known, a pretty complex feature of the problem under the point of view of the analytical description especially for vaults of general shape, and, on the other side, to allow the selection of membrane stress surfaces able to equilibrate the applied load and to respect the admissibility conditions of the masonry material. The paper focuses on both these two features, outlining a general approach for analytically handling the problem.

In details the proposed approach for the treatment of masonry vault analysis is based on the fundamental assumption that the material cannot resist tensile stresses. After reducing the problem to a plane-stress problem, the stress function $\Psi(x,y)$ is introduced, as in the classical Pucher's approach.

For the vault to work as a no-tension structure, it is recognized that it is sufficient that a membrane surface completely included into the thickness of the vault exists, designed in way to resist applied loads by purely compressive membrane forces. It is proved that a possible solution to the problem under purely gravitational loads can be searched for by identifying the stress function with the membrane equation.

In general, the dependence of the stress function on the membrane equation can be postulated in a rather intuitive way, still leading, although in a less immediate manner, to joint equations for equilibrium and admissibility.

The general approach, is at present applied to barrel vaults leading to identify some classes of no-tension membrane equilibrium stress fields.