Abstract

The masonry cross vaults.
From manuals sources to the geometrical and structural analysis

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The goal of the thesis was finding an automatic calculation methodology of masonry cross vaults that could give comparable results with the ones that come from the historical simplified method of manual calculation.

The work was developed with the analysis of the literature and manual sources that contributed to learn an architectonical object that nowadays isn’t built no more. From an excursus on the different typologies of vaulted systems studied in function of their geometry, structural working, material, building weaving and of the constructional phases with an in-depth analysis on timbering and disarmament, it has been reached to the analysis of masonry cross vaults. It has been studied with reference to the literature from who, apart from geometrical, constructive and structural descriptions, it was possible taking back eighteenth and nineteenth-century formulas for the calculation of the intradoxal surface, establishing their precision degree through the comparison of the results that come from their application with the ones that are returned from the measurement of the vaulted surface modelled with the AutoCAD software.

The structural analysis of the cross vaults has been based on, at first, an ideal cross vault on a squared base, that has been modelled with AutoCAD and discretized in three different ways creating as many models: a model subdivided in shell elements (fig. 1), a model in which groins are outlined in a series of arches placed side by side with pins at the base propped on a couple of three-pins diagonal arches (fig. 2) and a model in which groins are divided in a series of three-pins arches placed side by side propped on two diagonal isostatic arches (fig. 3). They have been analyzed using the software GSA and the results of vertical displacements, axial forces and bending moments given by every model of the global vault have been compared with the ones obtained by applying the historical simplified method of manual calculation to establish what was the better methodology, in the point of view of the correspondence between the two types of results, that could be applied on the study case of a real cross vault situated in the Sant'Anna's block in Via Pietro Micca in Turin.

Fig. 1., 2., 3. - GSA’s views of the deformed models of the ideal cross vault
The last part of the work was the application on the real cross vault of the analysis method that was more correct (fig. 4). In terms of values it gave similar results with the ones obtained in the preceding phase highlighting what are the limits of this approach and what are the possible future developments that the thesis presents. Concluding this part, it has been searched the line of thrusts in the section of the diagonal arches by the application, initially, of the eighteenth-century historical method of Mery and, afterwards, the Sixties' method of Heyman.

Fig. 4. - GSA's view of the deformed model of the real cross vault

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