ADVANCED NUMERICAL MODELING OF HISTORICAL MONUMENTAL BUILDINGS

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CONSERVATION OF HISTORICAL BUILDINGS

The numerical modeling of historical monumental buildings is a challenging task for contemporary civil engineers. One of the main reasons for this is that, due to the complex geometry of such historic structures, the use of traditional simplified structural schemes is inadequate. Therefore, it is unavoidable to resort to a fully 3D modeling that often is performed using the CAD. In general, CAD based modeling is an expensive and complex process, often manually carried out by the user, which inevitably leads to the introduction of geometric simplifications (defeaturing) or interpretations.

NUMERICAL MODELING: TRADITIONAL APPROACH

A semi-automatic method (CLOUD2FEM) to transform 3D point clouds of complex objects to 3D finite element models has been developed and validated. The procedure constructs a fine discretized geometry with a reduced amount of time and ready to be used with structural analysis: the resulting finite element model accurately capture the whole 3D structure, producing a complex solid made by voxel elements.

A NEW NUMERICAL MODELING STRATEGY

In order to show the potential of the proposed strategy, the application to the case study of the San Felice sul Panaro (Italy) fortress, hit by the Emilia earthquake in 2012, has been performed. This application aims at validating the numerical strategy according to the requirements of the Italian standards and guidelines about monumental historical buildings. Several linear and nonlinear static analyses under vertical and horizontal loads, as well as several nonlinear Response History Analyses (RHA) using natural accelerograms have been performed. Much attention has been paid to the modeling of the connections between adjacent macro-elements of the fortress. A comparison between structural analyses results and the crack pattern experienced by the structure during the Emilia earthquake has been carried out.

A CASE STUDY: THE SAN FELICE SUL PANARO (MO) FORTESS

References