PRE-EXISTING DAMAGES AND CHRONOLOGICAL TIME STEP ANALYSES OF HISTORICAL MASONRY BUILDINGS

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ABSTRACT

Old masonry constructions are strongly characterized by their history. Various are the effects of time on such structures:

- long-time material degradation: time progressively reduces the mechanical characteristics of the constituent material (mainly mortar connecting blocks);
- damage derived from historical exceptional actions (earthquakes or winds);
- structure modifications or permanent load variations, caused by changes in use or structural repair interventions; such modification may have produced further damages on the structure.

Moreover, it is worth noting that the structural behaviour of a masonry construction depends on the chronological succession of the building works.

Aim of this paper is the analysis of strategic methodologies for taking in account, in structural analyses, of the effect of historical damages and chronological successions of building works on the behaviour of the masonry structures. The long-time effects, associated to viscous phenomena, are neglected.

As a consequence of its complex history, the main unknowns of an historical construction are: its real resistant structure; its structural age, that is its safety factor with respect to the collapse. In order to identify (recognize) the resistant structure, full-scale continuum models are required. The identification of the structural age and the estimation of the residual life require specific methods. From an experimental point of view, monitoring is the main tool to identify damage evolution; although, it is well recognized the exigency of constitutive laws for evolutive analysis [1-6].

In the first section of the paper, a constitutive model for complex masonry structures, able to predict their behaviour from the linear elastic range, through cracking and degradation until complete loss of strength, is presented. The finite element method is adopted as a framework for the numerical implementation. It will be showed how the formulation of the model allows to introduce in numerical analysis previous damage states, in order to study the structure at the present time.

In the second section, the influence of the succession of the building works on the behaviour of a masonry structure is discussed. In particular, the possibilities furnished by standard finite element programs in activate/deactivate elements are illustrated.