In-plane behaviour of an iron-framed masonry façade: comparison between different modelling strategies

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ABSTRACT

'Baraccato' system[1] is one of the typical constructions with genius earthquake resilient features used for the reconstruction of the historical city centres of the South of Italy after the catastrophic events occurred in the 19th-20th centuries. A very interesting example of such a building typology is represented by the Church of Santa Maria Maddalena[2] located in the municipality of Casamicciola Terme of the Ischia Island, which was hit by an earthquake with M_w=4.2 on 21st August 2017. The Santa Maria Maddalena church was built in 1896, after the catastrophic earthquake of 1883, with a mixed 'baraccato' system mainly made of yellow tuff block masonry walls strengthened by iron profiles or wooden elements. The 'baraccato' system made of wooden element is more traditional and diffusely used in the Ischia Island and all over the world, i.e. the 'Pombalino system' in Portugal[3] , while the other, very rare and innovative for that time, is made of masonry walls encaged in slender iron frames. The latter system is the main part of the church, while the former one is only present in the back part of the church, including the apse. The reduced damage suffered by the church after the seismic event of 21st August 2017 has evidenced the good behavior of such a mixed structural system, especially into avoiding out-of-plane mechanisms.

The presence of the iron-framed system is even more challenging in the definition of the modelling strategies for the structural analysis. Thus, the choice of an appropriate finite element type to be used for the frame (beam elements, truss elements, embedded elements, etc.) should be properly investigated as well as the interaction/connection of the frames with the elements representing the masonry walls. As a first step of the structural analysis of this church, this paper is aimed to perform numerical analyses of the behaviour of the main façade of the Church of Santa Maria Maddalena in order to evaluate the efficacy of different modelling and analysis strategies. In particular, the study will consider different non-linear models according to finite and discrete element strategies available within DIANA FEA[4] and 3D MACRO[5] softwares and will perform nonlinear static analyses[6]

in the in-plane direction and with different load pattern distributions. The obtained results will be compared, discussed and applied for the following study of the behavior of the whole church.

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