Young's Modulus Variability: Influence on Masonry Vault Behavior

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Abstract : This paper presents a methodology for probabilistic assessment of bearing capacity and prediction of failure mechanism of masonry vaults at the ultimate state with consideration of the natural variability of Young's modulus of stones. First, the computation model is explained. The failure mode is the most reported mode, i.e. the four-hinge mechanism. Based on this assumption, the study of a vault composed of 16 segments is presented. The Young's modulus of the segments is considered as random variable defined by a mean value and a coefficient of variation CV. A relationship linking the vault bearing capacity to the modulus variation of voussoirs is proposed. The failure mechanisms, in addition to that observed in the deterministic case, are identified for each CV value as well as their probability of occurrence. The results show that the mechanism observed in the deterministic case has decreasing probability of occurrence in terms of CV, while the number of other mechanisms and their probability of occurrence increase with the coefficient of variation of Young's modulus. This means that if a significant change in the Young modulus of the segments is proven, taken it into account in computations becomes mandatory, both for determining the vault bearing capacity and for predicting its failure mechanism.

Keywords : masonry, mechanism, probability, variability, vault
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