Stochastic Bayesian Calibration of Finite Element Models of Masonry Vaults

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Abstract:

Historic unreinforced masonry buildings, both in the US and in other locations, include features such as load bearing unreinforced masonry vaults, and their supporting framework of piers, fill, buttresses, and walls. The assessment of these features and the prediction of their behavior under load require careful development of an analytical model and, eventually, some procedure to determine whether the behavior predicted by the model is similar to that of the structure being assessed. In this paper, experimental modal analysis is applied to the calibration of an analytical model of a masonry vault. The dynamic response characteristics measured on the vault are compared to the predictions of the analytical model. An automated, Bayesian statistics- based procedure is developed for affecting these comparisons, using posterior distributions of expected parameters of the analytical model. In this procedure, expected values of important parameters, such as modulus of elasticity of the vault material and support spring constants of the vaults are determined, based on the results of the experiments. The procedure is applied to the determination of elastic constants for the choir vaults of the National Cathedral, Washington, DC.

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