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A SHELL-BASED COMPUTATIONAL FRAMEWORK FOR THE STATIC LIMIT ANALYSIS OF MASONRY DOMES UNDER HORIZONTAL FORCES

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Masonry domes are fascinating structural elements, often covering large spans with small thicknesses. Limit analysis is here considered for their structural capacity assessment [1].

In the last decades, several computational approaches have been developed to investigate the limit behavior of masonry domes under their self-weight, clarifying the interplay between the compressive-only masonry response and the double-curved dome geometry [2]. By contrast, the problem of masonry domes subject to horizontal forces, such as those mimicking pseudo-static seismic loadings, has received less attention.

In the present work, an original computational framework is proposed for the static limit analysis of masonry domes under horizontal forces. Its distinctive feature is the representation of the stress state within the dome in terms of the classical shell stress resultants on its mid-surface. Differential or integral equilibrium equations of shells can be resorted to for imposing the equilibrium of the dome, complemented by Heyman's assumptions [1] to enforce the stress state admissibility. Alternative discretization strategies can be envisaged, such as finite differences [3] or finite volumes [4]. Either the case, the discrete static limit analysis problem results in a second-order cone programming problem, to be effectively solved by available convex optimization software. Numerical simulations prove the predicting capabilities of the proposed approach, providing an accurate and safe estimate of the collapse capacity of masonry domes under horizontal forces.

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