

Study of Tile Layer Contribution of a Thin-Tile Masonry Dome

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Abstract:

Recently an article was published in this journal by the authors that discussed the component (thin dome webbing and side arches) interactions of a unique masonry structure type known as Guastavino or thin-tile domes. That paper studied a model of a Guastavino dome constructed in the Nebraska State Capitol building. However, the model studied was comprised of only one layer of tiles in the thin dome webbing. This study builds upon that paper by investigating the contribution that additional dome webbing layers of thin tile make to the system's static and modal behavior. A physical model was constructed with three layers of tiles in the thin dome webbing with experimental modal analysis performed on the structure after the completion of each tile layer. The results were used to validate finite element models which were then used to determine each layer's contribution. The constructed physical model was also tested quasi-statically to determine its stiffness at the dome webbing crown. From both the testing and the finite element analysis it was shown that the increase in the thickness of the dome webbing by incorporating additional thin tile layers increased proportionally the mass and stiffness of the structure while preserving the natural frequency of the system. Each additional layer of tiles also increases the vertical stiffness at the crown of the dome of the structure by approximately fifty percent per layer.

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