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A Case Study on the Selection of Optimum Loop Units for the Deployable Arc Structures Exposed to Lateral and Non-Uniform Gravity Loads

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ABSTRACT

Radially deployable arches may be created by using various types of units. However, for any deployable structure to be constructed in real life, it should satisfy the structural regulations and codes. Despite various advantages from architectural perspective, deployable structures are weak to satisfy the operational code limits when compared to trusses with similar height and span. Therefore, weight minimization is very important to reduce the dead loads of structure which in return help to facilitate the code-conformance of structure. The optimization of deployable structures requires an initial selection of the loop unit types to define the structure parametrically. An initial selection strategy depending on the loads on the structure is important to increase efficiency of optimization process. Under uniform gravity loads optimum arrangement for each unit type converges to a similar point. However, in real world, the loads on the arches are not always uniform and the structure is exposed to non-uniform loadings such as point loads or lateral loads. This work focuses on the performance of various arches with different unit types under lateral and non-uniform vertical loads. Different lateral load and non-uniform gravity loading scenarios are created. For each scenario, arches with different units are analyzed. In all cases the clear span and clear height kept the same. Performance of an arch with a specific unit type for a given load is measured with a score that includes the deformations and the weight of the structure. All the members are assumed to be circular hollow sections with variable diameter and thickness to have a meaningful weight comparison between structures. This work intends to define an initial selection guide for deployable arches under typical non-uniform and lateral loading conditions.