Abstract

Today's Architecture-Engineering-Construction (AEC) industry is based on four types of strength system: 1. Vector-active, such as trusses, which is characterized by a triangulated assemblage of straight-line members and its mechanism rests upon the concerted action of individual tensile and compressive members. 2. Form-active, such as cables, which redirect external forces by simple normal stresses and its bearing mechanism rests essentially on the material form. 3. Bulk-active, such as concrete and steel beams or column, has its bearing mechanism consists of the combined action of compressive and tensile stresses within the beam section in conjunction with shear stresses. 4. Surface-active, such as shell structure, which is composed to form mechanisms that redirect forces. Among these, the current AEC industry practice is dominated by a bulk-active structure system, mainly rectangular beams, and columns. This paper explores the possibility of applying origami and folded patterns to the short column design, which is traditionally bulk-active system, to explore the benefits of utilizing surface active system combined with the bulk active system. In order to do so, the experiments on applied folded patterns and origami patterns in column designs are performed.

This thesis explores the ability of origami and folded patterns to provide extra strength in a column. Through experimentation, where 3-D printed columns with different applied folded patterns are tested under axial load, it was found that columns with folded and origami patterns are indeed stronger than regular circular and rectangular columns. A column with a folded pattern (octagonal twisted column), infilled with 11% material, demonstrated the most efficient design with the highest strength per weight ratio. The octagonal twisted column exhibited 50% more efficiency in strength per weight than the traditional rectangular column did, and 10% more efficiency than circular column did.