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Structural Optimization for Hybrid Structure with Cable and Strut Member: Analysis Using Finite Element Technique with Coordinates Assumption

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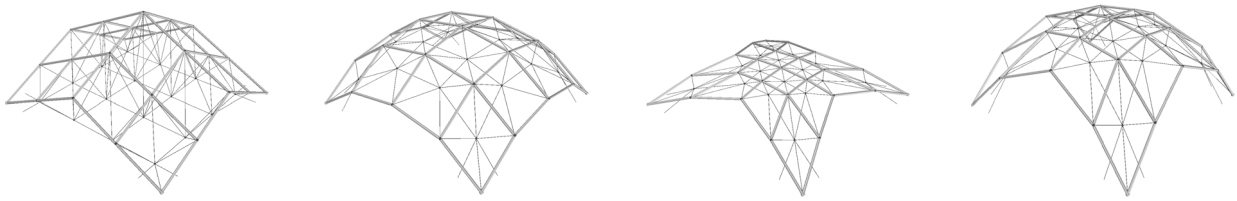
Abstract

In general, the hybrid structures with cable and strut member is constituted with unstable and isolated compression members. Our proposal structural model has the characteristic of tensegrity structures and cable-dome structures, and is a system with simple constructability to stabilize by only tension introduction into the cable members [1]. The structural optimization can be commonly applied to the architectural design as a design process in recent year. The form-finding methods for the hybrid structure that constitutes the self-equilibrated state with cable and strut member has a lot of researches. However, there are relatively few combined researches of the structural optimization and the form-finding analysis for hybrid structures. It is suggested that computational cost is large in this problem. Therefore, an efficient numerical analysis procedure is demanded to the structural optimization technique of this structural model.

FEM using the coordinate value on a deformed body [2] is one of the efficient form-finding analysis for cable and membrane structures. In order to apply this analysis to the hybrid structure with cable and strut member, we formulated the model with constraint conditions of specified length of compression members. The self-equilibrated state can be found by using this method as shown in figure.1.b-d. The standard genetic algorithm (SGA) is applied to the structural optimization. The design variable is length of compression members, and optimization problems are minimization of the total strain energy or the maximum displacement. In this paper, we confirm solution forms and solution spaces which are given by different objective functions.



a. Initial form b. Form-0 c. Form-1 d. Form-2

Figure.1 Structural form of hybrid structure constituting self-equilibrated state with cable and strut

References

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