Optimization of grid pattern of single-layer latticed dome

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Abstract

Shape optimization of latticed shell structure have been presented by many researcher, where various types of geometrical and mechanical objective function and constraints were proposed. The optimization problem with the combination of objective functions and constraints was performed to compensate for their disadvantages [1]. The combination produced the mechanically effective optimized shape while its validity was not revealed quantitatively. Moreover, the external form of the optimized shell structure was changed from the initial shape in reducing the volume of its internal space, which is unfavorable to designer's preference.

The purpose of this study is to examine the properties of optimized shape of single layer latticed dome of minimizing objective functions and constraints, then propose the appropriate combination of them. In the optimization problem, the nodal coordinates was defined as design variables while their movement was constrained on the surface of the dome to remain the external form of dome. The initial shape of the latticed dome was assigned by formex algebra and the sequential quadratic programming method was employed as the optimization algorithm. As shown in Fig. 1, six types of objective functions, which were standard deviation of member length, total member length, total strain energy, maximum compressive axial force, the linear buckling load factor and knockdown factor provided by reduced stiffness method, were selected on the optimization. Moreover, the relationship between values of objective function was investigated on the optimized latticed dome shape as shown in Fig.2.

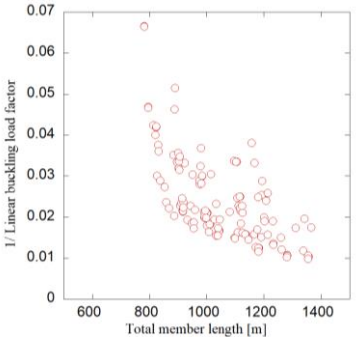

Fig. 2 Relationship between linear buckling load factor and total member length.

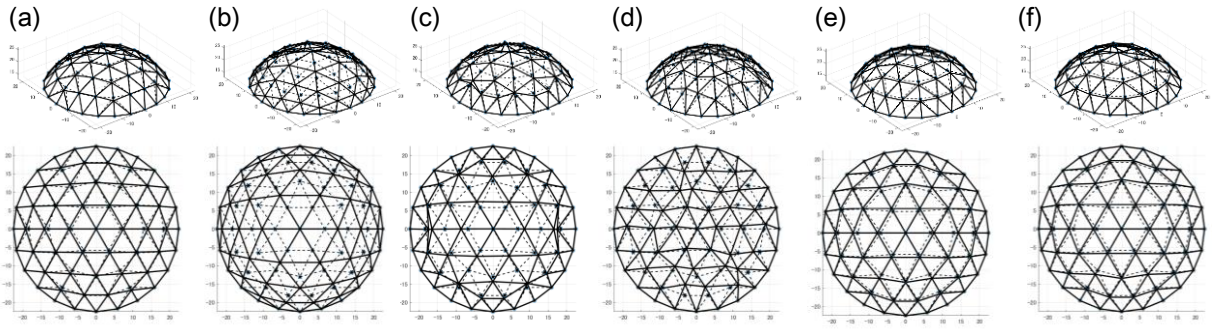

Fig. 1 Optimized dome shape for (a) standard deviation of member length, (b) total member length, (c) total strain energy , (d) maximum compressive axial force, (e) linear buckling load factor and (f) knockdown factor. Solid line and dotted line represent optimized and initial shape respectively.

References

[1] S. Fujita, M. Ohsaki, "Shape optimization of latticed shell defined by parametric surface for uniform member length and maximum stiffness"*: J. Struct. Constr. Eng., AIJ*, vol. 78 No.685, pp. 495-502, 2013.