Buckling resistance of a Miura origami-based tube

Yangqing Liu*, Jianguo Cai[a], Jian Feng[a]

*Southeast University, Key Laboratory of C & PC Structure of Ministry of Education of China, National Prestress Engineering Research Center of China
Sipailou 2#, Nanjing 210096, China
Email: yq_liu@outlook.com

[a] Southeast University, Key Laboratory of C & PC Structure of Ministry of Education of China, National Prestress Engineering Research Center of China

Abstract

Origami is an ancient art of forming planar materials to spatial structures by folding the materials along predetermined creases. The intricate structures gain unusual properties, thus bringing origami-inspired engineering applications including metamaterials [1], packaging [2] and so on. Among the applications, Miura origami pattern is most widely studied due to its simplicity in geometry and motion.

Two-fold Miura origami, also known as curved Miura origami, can be used to form a tube with appropriate parameters. Different from the typical rigid origami concept [3], this manuscript divides the creases of the Miura origami-based tube in two groups. One is for creases considered as perfect hinges, and the other for creases having the same rotational stiffness as the panels. Four arrangements of the creases are discussed to improve the buckling resistance of the tube by using finite element simulations and one of them turns out to be a proper way, as shown in Fig. 1. Then, the crease scheme is applied in long tubes subject to axial compression. The simulation results show that global buckling could be avoided within the axial compressive deformation rate of 2.5% and the axial loading force versus deformation rate curves are given in Fig. 2.

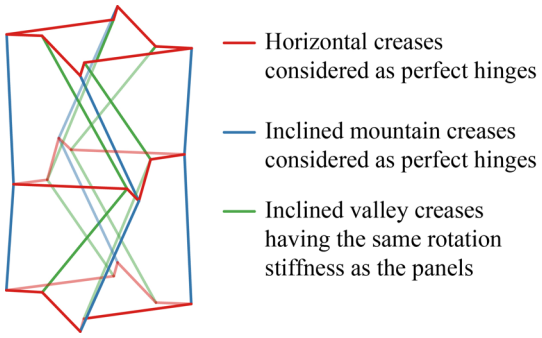

Fig. 1 Arrangement of creases

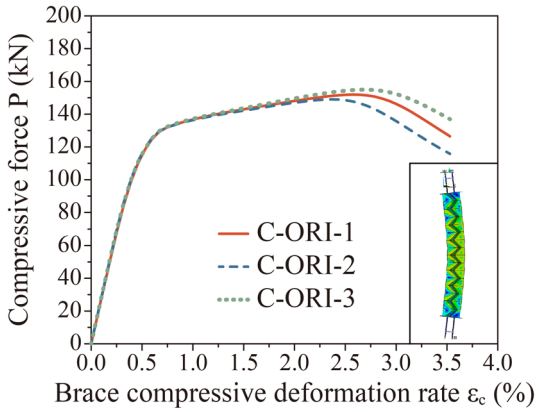

Fig. 2 Force versus deformation rate curves

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