SIMPLE ESTIMATION TECHNIQUE OF MECHANICAL PROPERTIES OF INHOMOGENEOUS POROUS STRUCTURES

Kuniharu Ushijima[1], Dai-Heng Chen[2] and Wesley J. Cantwell[3]

[1] Tokyo University of Science, 6-3-1, Niijyuku, Katsushika-ku, Tokyo1258585 Japan,
kuniharu@rs.tus.ac.jp
[2] Jiangsu University, 301 Xuefu Road, Jingkou, Zhenjiang, 212013, China,
dhchen@ujs.edu.cn
[3] Khalifa University of Science and Technology, PO Box 127788, Abu Dhabi, UAE,
wesley.cantwell@kustar.ac.ae

Cellular materials such as honeycomb, foams and lattice have been widely used in many modern engineering components owing to their superior mechanical properties per unit mass. Over the decades, vast numbers of research papers regarding the mechanical properties of cellular materials have been published [1, 2, 3, 4, 5, 6]. Also, due to the recent advanced manufacturing technology, the complicate porous structures can be fabricated easily. The authors have been studied the mechanical properties of intact micro-lattice core panel. The micro-lattice structures can be manufactured by using the selective laser metal melting technology[7].

In this paper, the estimation of equivalent elastic moduli of inhomogeneous porous structures were proposed, and applied to some models such as sandwich panels, honeycomb and lattice core with defects. In this proposed estimation, the displacement spread in a material is assumed to be expressed by a simple hyperbolic function, and the theorem of minimum potential strain energy with constraint is used for calculating the elastic moduli. This estimation technique can be applied to not only the continuum materials but also porous materials.

REFERENCES

[1] L.J. Gibson and M.F. Ashby, *Cellular Solids: Structure and Properties*. Cambridge University Press, 1997.

[2] C. Chen and, T.J. Lu and N.A. Fleck, Effect of imperfections on the yielding of two-dimensional foams, *J. Mech. Phys. Sol.*, Vol. **47**, pp. 2235–2272, 1999.

[3] X.E. Guo and L.J. Gibson, Behavior of intact and damaged honeycombs: a finite element study, *Int. J. of Mech. Sci.*, Vol. **41**, pp. 85–105, 1999.

[4] C. Chen and T.J. Lu and N.A. Fleck, Effects of inclusions and holes on the stiffness and strength of honeycombs, *Int. J. of Mech. Sci.*, Vol. **43**, pp. 485–504, 2001.

[5] A.J. Wang and D.L. McDowell, Effects of defects on in-plane properties of periodic metal honeycombs, *Int. J. of Mech. Sci.*, Vol. **45**, pp.1799–1813, 2003.

[6] X. Liu and N. Liang, Effective elastic moduli of triangular lattice material with defects, *J. Mech. Phys. Sol.*, Vol. **60**, pp.1722–1739, 2002.

[7] K. Ushijima and W.J. Cantwell and D.H. Chen, Prediction of the mechanical properties of micro-lattice structures subjected to multi-axial loading, *Int. J. Mech. Sci.*, Vol. **68**, pp.47–55, 2013.