Experimental and numerical evaluation of fatigue behavior of reinforced foam core sandwich structure

Peiyan Wang[a], Li Xiaoyu[b], Zhufeng Yue[a]

[a]School of Mechanics, Civil Engineering and Architecture, Northwestern Polytechnical University, Xi'an 710129, P.R.China

[b]Baotou North Chuangye Limited Company, Inner Mongolia First Machinery Group, Baotou 014032, China

*Corresponding author: pywang@nwpu.edu.cn

Abstract: Fatigue crack growths of reinforced foam core sandwich composite structure loaded in three-point bending under room temperature, low temperature and hygrothermal environment have been investigated. The S-N curve under room temperature was also given. Flexural fatigue test results confirmed the obvious effect of low temperature and hygrothermal environment on the fatigue life of reinforced foam core sandwich structure. Core shear was found to be the dominant failure mode under fatigue loading condition at all three environments. The fatigue life with brittle type core shear failure at low temperature significantly increases while that with ductile type core shear failure decreases. Three-dimensional numerical simulation of the progressive collapse of reinforced foam core sandwich structure was conducted using user subroutine USDFLD in FEM software ABAQUS/Standard. The maximum stress failure criterion and Hashin failure criterion were used to judge the foam core and skin, respectively. Static finite element analysis explains the crack initial location under fatigue loading conditions. Because of the existence of resin stringer, the crack propagation path to some extent changes, that's why that the resin stringer can improve the fatigue properties of foam core sandwich structure.

Key words: Reinforced foam core sandwich, Flexural fatigue property, Crack propagation, failure criterion