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Impact behaviour of spherical-roof contoured-core (SRCC) sandwich panel under the low-velocity impact (LVI): A numerical investigation

Quanjin Ma [a,b,*], M.R.M. Rejab [a,b,*], Shukur Abu Hassan [c], Haichao Hu [d], Mohammad Azeem [e], Ahmad Yunus Nasution [a,f]

[a] Structural Performance Materials Engineering (SUPERME) Focus Group, Faculty of Mechanical & Automotive Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[b] School of Mechanical Engineering, Ningxia University, 750021 Yinchuan, China
[c] Faculty of Engineering, Universiti Teknologi Malaysia, Skudai, Johor, Malaysia
[d] School of Mechanical and Engineering, Tianjin Sino-German University of Applied Sciences, Tianjin 300350, China
[e] Mechanical Engineering Department, Universiti Teknologi Petronas, Perak, Malaysia
[f] Mechanical Engineering Department, Engineering Faculty, Universitas Sumatera Utara , Jl.Dr.T. Mansur, 20155 Medan, Sumatera Utara, Indonesia

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ABSTRACT

Sandwich panels are multifunctional composite structures with two stiffer skin sheets and core, which have better mechanical properties than traditional structures. It is challenging to improve the energy-absorption characteristics and impact resistance while maintaining the required mechanical performance under quasi-static and dynamic loadings. Various core designs of sandwich structures have been studied on the failure mechanism under dynamic loading. This paper was investigated the impact behaviour of sandwich panels with spherical-roof contoured core (SRCC) design under low-velocity impact (LVI) loading impact loading, which is used in finite element modelling. The core structure and two skin sheets were used carbon fibre-reinforced plastic (CFRP). It was used the cohesive element to predict the adhesive interface between the skin sheet and the spherical-roof core. The three-dimensional (3D) Hashin failure criterion was implemented to predict the impact behaviour. The single-peak load curve on the load versus displacement curve was observed on type 1 with 5.71 kN, and the double-peak load curve was found on type 2 with 7.12 kN. Furthermore, it was calculated that the internal energy of the SRCC sandwich panel was 51.67 J with type 2, which was 1.81 times higher than type 1.

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1. Introduction

It is reported that sandwich structures have been broadly used in many application fields, such as aerospace [1], automotive [2], marine/military industries [3], and civil engineering [4], which was due to higher strength-to-weight ratio [5] and good structural stability characteristics [6]. Sandwich panels consist of two thin/stiff face sheets and a relatively lightweight core [7], which provides good structural response under quasi-static and dynamic impacts. For aerospace applications, the low-velocity impact case is an interesting research topic [8], which focuses on localised damage to the skin sheets and core [9]. During the service period, sandwich panels can be vulnerable to various impact threat situations [8], such as windborne objects, bird attacks, and dropped tools during the maintenance period [10]. Therefore, the impact resistance capability of sandwich panels is considered the critical evaluation indicator under quasi-static and dynamic loadings [11,12].

Abbreviations: SRCC, Spherical-roof contoured-core; LVI, Low-velocity impact; CFRP, Carbon fibre-reinforced plastic; VUMAT, A vectorized user-defined material subroutine; C3D8R, A three-dimensional eight-node reduction integral element; COH3D8, A three-dimensional eight-node cohesive; SDVs, Solution-dependent variables; FT, Fibre tensile damage; FC, Fibre compression damage; MT, Matrix tensile damage; MC, Matrix compression damage.

* Corresponding authors at: Structural Performance Materials Engineering (SUPERME) Focus Group, Faculty of Mechanical & Automotive Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia.

E-mail addresses: neromaquanjin@gmail.com (Q. Ma), ruzaimi@ump.edu.my (M.R.M. Rejab).

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