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Thermodynamical bending analysis of P-FG sandwich plates resting on nonlinear visco-Pasternak's elastic foundations

Abdeldjebbar Tounsi[1], Adda Hadj Mostefa[2], Abdelmoumen Anis Bousahla[*2], Abdelouahed Tounsi[4,5,6], Mofareh Hassan Ghazwani[**7], Fouad Bourada[8] and Abdelhakim Bouhadra[8,9]

[1]Industrial Engineering and Sustainable Development Laboratory, University of Rélizane, Faculty of Science & Technology, Mechanical Engineering Department, Algeria
[2]Industrial Engineering and Sustainable Development Laboratory, Department of Civil Engineering, University of Rélizane, Faculty of Science & Technology, Algeria
[3]Laboratoire de Modélisation et Simulation Multi-échelle, Université de Sidi Bel Abbés, Algeria
[4]YFL (Yonsei Frontier Lab), Yonsei University, Seoul, Korea
[5]Department of Civil and Environmental Engineering, King Fahd University of Petroleum & Minerals, 31261 Dhahran, Eastern Province, Saudi Arabia
[6]Department of Civil and Environmental Engineering, Lebanese American University, 309 Bassil Building, Byblos, Lebanon
[7]Mechanical Engineering Department, Faculty of Engineering, Jazan University P. O. Box 45142, Jazan, Kingdom of Saudi
[8]Material and Hydrology Laboratory, University of Sidi Bel Abbes, Faculty of Technology, Civil Engineering Department, Algeria
[9]Department of Civil Engineering, Faculty of Science and Technology, Abbès Laghrour University of Khenchela, Algeria

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Abstract. In this research, the study of the thermoelastic flexural analysis of silicon carbide/Aluminum graded (FG) sandwich 2D uniform structure (plate) under harmonic sinusoidal temperature load over time is presented. The plate is modeled using a simple two dimensional integral shear deformation plate theory. The current formulation contains an integral terms whose aim is to reduce a number of variables compared to others similar solutions and therefore minimize the computation time. The transverse shear stresses vary according to parabolic distribution and vanish at the free surfaces of the structure without any use of correction factors. The external load is applied on the upper face and varying in the thickness of the plates. The structure is supposed to be composed of "three layers" and resting on nonlinear visco-Pasternak's-foundations. The governing equations of the system are deduced and solved via Hamilton's principle and general solution. The computed results are compared with those existing in the literature to validate the current formulation. The impacts of the parameters (material index, temperature exponent, geometry ratio, time, top/bottom temperature ratio, elastic foundation type, and damping coefficient) on the dynamic flexural response are studied.

Keywords: thermoelastic flexural response; FG sandwich plates; 2D integral theory; visco-Pasternak's foundation

1. Introduction

Generally, conventional sandwich plate structures consist of three elements (face sheets and one core in the middle bonded by adhesive). Thus, they provide high stiffness at relatively low weight. These features have led sandwich plates to find wide applications. They are mainly utilized in mechanical engineering, civil engineering, spacecraft, marine and aircraft industry as thin-walled structures but at present the application of these structures has been extended to petrochemical, and automobile other industries (Chakrabarti and Sheikh 2005, Wang *et al.* 2010, Yeh 2013, Altenbach *et al.* 2018, Mehar *et al.* 2019, Rajabi and Mohammadimehr 2019). Over the past several decades, these structures have experienced major difficulties with durability due to the accumulation of stresses in the adhesive interfaces core /face sheet (Burlayenko and Sadowski 2014, Qu and Meng 2017, Szekrényes 2018, Funari *et al.* 2018, Seguel and Meruane, 2018). As a consequence, a local separation through debonding often occurs between the core and face sheets. Additionally, sandwich materials don't provide high operating temperatures. These disadvantages can be overcome by using functionally graded material (FGMs) in which the variation of physical properties is gradual (vary smoothly) and continuous in one or more directions (Akbaş 2015, Adıyaman *et al.* 2016, Attia 2017, Almitani 2018, Avcar 2019, Ahmed *et al.* 2019, Sayyad and Ghumare 2019, Al-Maliki *et al.* 2020, Kar and Panda 2020, Kurpa and Shmatko 2020, Cuong-Le *et al.* 2020ab, Singh and Harsha 2020a, Gafour *et al.* 2020, Fu *et al.* 2020, Selmi 2020, Singh *et al.* 2020, Yaylaci *et al.* 2020a, Khatir *et al.* 2021, Yaylaci *et al.* 2021abc, Akbas 2022, Öner *et al.* 2022, Yaylaci *et al.* 2022abc, Chinnapandi *et al.* 2022, Rezaiee-Pajand *et al.* 2022, Cuong-Le *et al.* 2022a, 2020b, Alimoradzadeh and Akbas 2022, Du *et al.* 2022, Cho 2022a , Azandariani *et al.* 2022, Polat and Kaya 2022). In this

*Corresponding author, Professor
E-mail: bousahla.anis@gmail.com
**Corresponding author, Professor
E-mail: ghazwani@jazanu.edu.sa

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