AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Design and Production Engineering

Mechanical and Physical Behaviour of Polyurethane Foam Sandwich Panel

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Mechanical Engineering

(Design and Production Engineering)

by

Mohamed Atef Sayed Ahmed

Bachelor of Science in Mechanical Engineering
(Design and Production Engineering)
Faculty of Engineering, Ain Shams University, 2014

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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Mechanical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

Sandwich materials is one of the most commonly used in all applications due to lightness, durability and reliability with proper strength, toughness and rigidity. However, in recent times their use has increased significantly because of their widespread in structural applications. Structural sandwich panels generally used in Egypt comprise polyurethane foam core and high strength flat steel faces bonded together using separate adhesives by reaction injection molding technique. Previously, polyurethane (PU) Foam core was sandwiched with same thin two faces material.

In this work, the Metallic-PU and Hybrid-PU sandwich composites were prepared by hand lay-up technique. Metallic-PU sandwich composites contained commercial purity Aluminum (Al) or Galvanized steel sheets (G.S) with different thicknesses (0.5,1&2 mm) as upper and lower facesheets with Commercial polyurethane (PU) foam (ρ = 45 Kg/m3) in core with different thicknesses (10,20&30 mm). Hybrid sandwich composites contained Aluminum/LDPE composite sheets (Al-c) or fiberglass/polyester (F.G) composite sheets (3 mm) as upper facesheet and galvanized steel sheets (0.5 mm) as lower facesheet with PU foam in core with different thicknesses. These modifications lead to enhancing the mechanical and physical properties of metallic and hybrid polyurethane sandwich composites with limited increase of sandwich composite weight.

There are three important parameters should to be investigated in this research. The effect of changing in polyurethane foam core thickness, facesheet thickness and upper facesheet material was studied on the mechanical and physical properties of metallic and hybrid polyurethane sandwich composites. The mechanical properties of metallic and hybrid polyurethane sandwich composites were studied through performing the Compression & 3-point bending tests on different sandwich composites. Specific bending flexural strength was calculated for different sandwich composites. Also, sound and thermal insulation test performed to characterize its physical properties.

Keywords: Polyurethane, Metallic-PU sandwich composite, Hybrid-PU sandwich composite, compression test, 3-pt bending test, specific bending flexural strength, thermal insulation, sound insulation.

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