An Experimental Study on the Vibration Characteristics of Kevlar/Ep Sandwich Plate with Unsymmetrical Faces and Aluminum Honeycomb Core Sandwich Structure

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ABSTRACT

In the design of high-speed vessel, the weight saving is considered as the most important area. The sandwich structure has been known as having an excellent strength with a relatively low density ratio. Since the sandwich type has higher bending rigidity for the same cross section over to other types, it can have longer frame distances. Therefore, the sandwich structure can reduce the weight significantly.

In this study, three different types of plate vibration characteristics are compared.

First part of this study is an experiment for aluminum honeycomb core sandwich plates that have different face thickness and cell sizes with all clamped boundary condition. The experimental data are compared with analytical solution and the simulation data obtained from NISA (Numerical Integration Elements for System Analysis, Finite Element Method Package Program).

Second part of the study is an structural experiment for Kevlar/Ep FRP sandwich that have unsymmetrical faces. The experimental data are used for analytical solution. In this thesis, the Reissner-Mindlin’s plate theory shear deformation and rotary inertia were considered is studied from Hamilton’s principle and rectangular sandwich model is applied to the plate theory. This thesis is that the results of the equation of motion given by Hamilton’s principle compared with that of Rayleigh-Ritz method given by energy relationships.

Third part of the study is an experiment for stiffened plate which have equivalent mass to aluminum honeycomb core sandwich plates. The experimental data are compared with that of aluminum honeycomb core sandwich plates. The result can show that aluminum honeycomb core sandwich plate is more stiff than stiffened plate in the equivalent mass condition.

Fourth part of the study is an experiment for idealized midship section of high-speed vessel which is composed of aluminum honeycomb core sandwich plate, and then compare experimental data with the NISA (Numerical Integration Elements for System Analysis, Finite Element Method Package Program) simulation data.

This study will illustrate the vibration aspects of sandwich structure and also provide the designer with a general guideline for vibration characteristics of aluminum honeycomb core sandwich (AHCS) structure and anti-vibration design criteria.

KEY WORDS: Aluminum Honeycomb core, Kevlar/Ep Fli, AHCS, sandwich plate, foam core,

INTRODUCTION

Structural sandwiches are a special form of laminated composite in which thin, strong, stiff, hard, but relatively heavy facings are combined with thick, relatively soft, light, and weaker cores to provide a light-weight composite much stronger and stiffer in most respects than the sum of the individual stiffness and strengths.

The basic principle is much the same as that of "T"beam, which is an efficient structural shape because as much as possible of the material is placed in flanges situated farthest from the center of bending neutral axis. In a structural sandwich the facings take the place of the flanges, and the core takes the place of the web.

The facings act together to form an efficient internal stress couple or resisting moment counteracting the external imposed bending moment. The core resists the shear stresses set up by the external loads, and it has the further important function of stabilizing the facing against wrinkling or buckling.

In the design of high-speed vessel, the weight saving is considered as the most important area. The sandwich structure has been known as having an excellent strength with a relatively low density ratio. Since the sandwich type has higher bending rigidity for the same cross section over to other type, it can have longer frame distances. Therefore, the sandwich structure can reduce the weight significantly.

The absence of vibration characteristics data for sandwich structure, the present paper focuses on vibration characteristics of Kevlar/Ep sandwich and AHCS structure which will be used in high speed vessel. The analytical consideration for Kevlar/Ep sandwich plate illustrate the vibrational behavior of sandwich plate. The experimental results of stiffened plates which have equivalent mass condition to AHCS plate can proof the high bending stiffness of sandwich plate. The experiment carried out for AHCS and mid ship section model of high speed ship which consist of sandwich plate