PREFACE

Stiffened panels are being used as a lightweight structure in aerospace, marine engineering, retrofitting of building and bridge structure. Specific strength and local buckling of the stiffened panel are increased with increasing depth of stiffeners. Local buckling of the panel can be reduced by keeping depth of stiffener as small as possible and increasing number of the stiffeners. Critical buckling load and global buckling mode shape of the laminated composite hat-stiffened panel have been studied for the design and use in lightweight structures.

It is observed that the substantial research works have been conducted on the panels which are manufactured with laminated composite material with different shape of stiffeners to attain lightweight structure with superior buckling capacity. A very few literature are available for determination of maximum buckling capacity of the hat-stiffened panel with different inclination of trapezoidal type of stiffener (hat-stiffener) panels with variation different parameters.

Parametric study on hat-stiffened panel under in-plane compressive load is presented with simply supported boundary conditions. Finite Element (FE) models are analyzed by using FE software ABAQUS. A database is provided for FE analysis of different types of the hat-stiffened (60^0-hat-stiffened and 75^0-hat-stiffened) panels with variation of pitch length stiffeners, depth of stiffeners, panel orthotropy ratio and smeared extensional stiffness ratio of stiffeners to that of skin with three plies configuration. The optimum smeared extensional stiffness ratio of stiffener to that plate per pitch $(EA)_S/(EA)_P$ increases with increasing panel orthotropy ratio (D_1/D_2) but decreases with increasing ratio of in-plane extensional stiffness of skin (A_{11}/A_{22}) of different ply configuration of the skins for maximum buckling load per unit area of the stiffened panel. The 60^0-hat-stiffened panel shows significantly better results in comparison to 75^0-hat-stiffened panel for all cases of D_1/D_2 of three skins. On the basis of the study, few significant parameters of buckling behaviour are considered and general guidelines are developed for the design of the better hat-stiffened panel.

An efficient analytical computational tool, an artificial neural network (ANN) has been used to analyze and compare with finite element analysis (FEA) results of the laminated composite hat-stiffened panels. FE models have been used to generate data set of four different parameters. The four parameters are orthotropy ratio of the panel, extensional stiffness ratio of skin in the longitudinal direction to the transverse direction, the ratio of twisting stiffness to transverse flexural stiffness and smeared extensional stiffness ratio of stiffeners to that of the plate. The good network architecture is achieved after several iterations to predict the buckling load of the stiffened panel. ANN prediction for unknown new data set is in good agreement with FE analysis results of different cases, which shows that ANN tool can be used for the design of complex structural problems in civil engineering, especially optimization of the laminated composite stiffened panel.

The experimental studies on two hat-stiffened panels with equally spaced stiffeners have been carried out with application of axial compression load on the panel for determination of the pre-buckling and post buckling behaviour. A non-linear buckling analysis on the hat-stiffened panel load has also been performed under compression load with application of finite element tool ABAQUS. From strain analysis at different locations, the local buckling of skin has been observed before the buckling of the panel, and a visual damage has been found near the skin-stiffener and debonding skin-stiffener of the panel during failure of the hat-stiffened panel. The compressive load-axial displacement curve of the experiments has correlated well with simulated FE model result for prediction of the buckling behaviour of the panel up to the failure load. The out of plane displacement pattern shows that the compression failure originated at edges of the panel and gone to skin-stiffener bonding, and finally failure of the panel occurred due to debonding between skin-stiffener.