CHAPTER 2

SCOPE AND OBJECTIVES

An aircraft instruments panel board is housing high precision instruments. The vibration of the panel board due to running of the aircraft engine, gust, turbulence etc. can affect the performance of these instruments.

In an aircraft instrument panel board the sizes, shapes and the locations of the cutouts and the masses of the instruments that are fitted in the respective cutouts are practically unalterable. Instead of the conventional aluminium alloy panel boards, composite panel boards can be effectively used to take advantage of the directional properties of the orthotropic composites in modifying the dynamic characteristics of the aircraft instrument panel boards.

The parameters that influence the natural frequencies of a composite panel board are the thickness of the panel board, the locations of the cutouts, the distribution of the mass of the instruments, the volume fraction of the fibers, the arrangement of the different layers of the laminate and the type and locations of the supports. In addition to the above, proper selection of resin and fiber composition also can change the vibration characteristics.

These parameters have influence on the inplane and bending stiffness characteristics of the panel board, which in turn have effect on the natural frequencies. Since the panel board is a plate structure having multiple cutouts, uneven distribution of mass and stiffness and complicated boundary conditions, closed form solutions are not possible. Approximate solutions can be obtained
using the finite element analysis with a reasonable accuracy. The results of the
analysis depend on the material and elastic properties used as the input data.

Once the numerical solutions obtained are comparable with the
experimental results, further investigations can be performed using the same
numerical procedure for few other fiber orientations and layer arrangements to
obtain a fair idea on the variations of the dynamic properties of the composite
panel board. This will help in choosing suitable fiber orientations, layer
arrangements and number of layers to have the desired dynamic characteristics
of the panel board.

This work aims to study the effects of the arrangements of the various
layers of the laminate, number of layers and the fiber orientations on the first
three natural frequencies of a composite aircraft instrument panel board made
of E-glass/Poly vinyl ester with a fiber content of around 50%. In this study, a
typical aircraft panel board is analyzed for its first three natural frequencies
using different thicknesses, fiber orientations and arrangement of various
layers, both numerically and experimentally. The two results are compared for
the accuracy of the numerical tool and further the same numerical model is used
to determine the first three natural frequencies of a few more composite panel
boards with different fiber orientations, layer arrangements and thicknesses.