ABSTRACT

Free vibration and supersonic flutter of multi-span curved panels have been studied in this thesis using the wave propagation method based on Floquet's principle.

For free vibration analysis, the periodic structures considered are the following:

(i) *A full circular cylindrical shell of finite length (Figure 1.1).*

(ii) *A row of curved panels of finite length (Figure 1.4).*

(iii) *A curved panel of infinite length supported along its curved edges at regular intervals (Figure 1.5).*

(iv) *A curved panel of finite length resting on a two dimensional array of line supports (Figure 1.6).*

(v) *A circular ring as a particular case of the full circular cylindrical shell (Figure 4.4).*

For flutter analysis, a curved panel of infinite length supported at regular intervals (Figure 1.5) subjected to an axial supersonic flow is considered.

Propagation constant versus natural frequency curves have been obtained in all the above cases. The present investigations have resulted in the following new conclusions. It is shown that by a proper choice of periodic elements it is possible to identify the bounding frequencies and the corresponding mode shapes of the whole periodic structure with that of a single periodic element of known boundary conditions. It is also shown that all the natural frequencies of a curved multi-supported panel can be read off from the propagation constant curves or surfaces, irrespective of the number of elements constituting the structure. Similar properties are shown to exist in the case of flutter of multi-span curved panels. This is perhaps the first successful application of the periodic structure concept to the flutter analysis of multi-span curved panels.

Exact differential equation approach is adapted for the circumferential wave propagation of a full shell and a row of curved panels of finite length. Characteristic beam functions have been used in the strain and kinetic energy expressions to study the axial wave propagation of an infinitely long curved panel on periodic supports. A

conventional finite element method has also been developed for the analysis orthogonally supported curved panels with and without the periodic structure concept to demonstrate the power of using the periodic structure concept. Finally the same finite element method has been extended to analyse the axial wave propagation characteristics of periodic curved panels subjected to supersonic flow.

Wherever possible, the results of the present work have been compared with published data.