MODAL ANALYSIS OF A FREE CIRCULAR PLATE VIA THE FINITE ELEMENT METHOD

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February 8, 2001

A finite element model of a circular plate is shown in Figure 1. The model parameters are shown in Table 1.



Figure 1. Finite Element Model of a Circular Plate

| Table 1. Model Parameters | | |
|---------------------------|-------------------|--|
| Parameter | Value | |
| Number of Nodes | 908 | |
| Number of Elements | 1718 | |
| Element Type | Plate | |
| Thickness | 0.5 inch | |
| Diameter | 62.0 inch | |
| Boundary Condition | Free Edge | |
| Material | Aluminum | |
| Mass Density | 0.10 lbm/in^3 | |
| Elastic Modulus | 10.7e+06 lbf/in^2 | |
| Software | FEMAP/Structural | |

The finite element results are given in Table 2. The theoretical frequencies are calculated from Reference 1.

| Table 2. Finite Element Results | | | |
|---------------------------------|-----------------------|-------------------------------|-----------------------------|
| Mode Number | FEM Frequency (Hz) | Theoretical Frequency (Hz) | Mode Shape Phase Diagram |
| 1 | 27.0 | 27.0 | + + + |
| 2 | 46.5 | 46.8 | + |
| 3 | 62.6 | 63.0 | + - + |
| 4 | 104.8 | 105.7 | + - + |
| 5 | 109.7 | 111.2 | |
| 6 | 167.9 | 170.4 | |





The first mode has two nodal diameter lines. The shape is similar to a saddle.



Figure 3. Second Mode, 46.5 Hz The second mode has one nodal circle.



Figure 4. Third Mode, 62.6 Hz The third mode has three nodal diameter lines.



Figure 5. Fourth Mode, 104.8 Hz

The fourth mode has one nodal diameter line and one nodal circle.



Figure 6. Fifth Mode, 109.7 Hz The fifth mode has four nodal diameter lines



Figure 7. Sixth Mode, 167.9 Hz The sixth mode has five nodal diameter lines

<u>Reference</u>

1. Arthur W. Leissa, Vibration of Plates, NASA SP-160, National Aeronautics and Space Administration, Washington D.C., 1969.