APPENDIX B

THE PANEL METHOD

This section discusses the panel method used to solve the fluid-structure interaction between the external water and the dam. The method utilizes the boundary element method to solve the potential flow problem. The method was first developed by Hess and Smith and now is widely used to solve such problems.

The basic idea behind the method is to replace the fluid-structure boundary by a set of sources such that the combined strength of all the sources is equivalent to the source strength of the flow. This is accomplished by discretizing the fluid-structure boundary into a number of quadrilateral panels and placing sources of constant strength at the centroids of such panels. The Laplace's equation is then solved for the boundary and the source strength of each panel computed.

Although the basic methodology remains the same for solving all potential flow problems, the boundary conditions specified on the fluid-structure boundary depend upon the type of structure used.

In the present study the following procedure is adopted to solve the fluid-structure interaction problem. First, the boundary panels are discretized. For the surface of the dam in contact with water the elements used in the finite element analysis are used as the panels. The coordinates for these panels are obtained from the static equilibrium shape. The other boundaries, i.e., the bottom, two sides, and the far away boundary, are then divided into rectangular panels. The centroids and areas of all these panels are then computed. The normal velocities on the panels are then computed by using the nodal displacements for each mode obtained from the free vibration analysis from ABAQUS. These normal velocities are then used to specify the boundary conditions to compute the flow potential.

The added mass and other coefficients are then computed by integrating the source strengths over all the panels which are in contact with the fluid. Standard definitions are used for this purpose. The expressions used for computing the added mass and damping coefficients can be found in Chapter 4.

It is suggested that the reader refer to Hess and Smith (1964) for further details.