

Chapter 5

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.1 CONCLUSIONS

Vibration analysis of single-anchor inflatable dams is performed in this thesis. The cases of the dam without external water, with external water, and with parallel flow are considered. Natural frequencies of vibration and the corresponding mode shapes are computed. The cross-sectional perimeter, length, material properties (thickness, modulus of elasticity and Poisson's ratio), internal pressure, and external water head and parallel flow velocity are given.

The static analysis of the dam involves finding the equilibrium configurations of the dam for different internal pressures and external water heads (in the case of the dam impounding water). The shapes exhibit nonlinear behavior. The change in the equilibrium configurations is more pronounced for the lower pressures (5 kPa or less) than for the higher pressures (15 kPa and more). For the case of the dam impounding water on one side, the effect of the water is to push the dam towards the other side. The results presented in this thesis correspond to internal pressures of 1 kPa and 30 kPa, and external water heads of 0.5 m and 1.5 m, respectively.

The vibration analysis of the dam makes use of the equilibrium configurations obtained after performing the static analysis. Vibration behavior of the dam for the cases without water, with water, and with external parallel flow are studied and compared. For the case of the dam impounding hydrostatic water, the effects of external water head and internal pressure are studied. The presence of external hydrostatic water tends to reduce the natural vibration frequencies of the structure. The change in frequencies depends upon the internal pressure and the external water head. Due to the presence of external hydrostatic water, the natural frequencies of vibration reduce by a maximum of 11 %.

Finally, the case of the dam impounding water flowing parallel to the dam is considered. The hydrodynamic pressure due to the external parallel flow results in added inertia (i.e., added mass) which tends to reduce the vibration frequencies of the dam. The reduction depends upon the internal pressure, external water head, and flow velocity. In this thesis, vibration results of the dam corresponding to flow velocities of 1 m/s and 5 m/s are presented. In the two cases considered, the frequencies reduce by a maximum of 17.2 % as compared to the frequencies of the dam without any external water. The change in the values of added mass results in a change in the mode shapes of the dam.

5.2 SUGGESTIONS FOR FURTHER RESEARCH

The suggestions presented here pertain to the vibration analysis of inflatable dams. The different kinds of loading on a single-anchor dam produce the maximum stresses near the vicinity of the anchor-line. Detailed analyses of the effects of the loading on the dam need to be performed in order to ascertain the critical load values at which the structure may collapse. Also, stability analysis of the dam under dynamic conditions (such as inclined external flows, waves, etc.) needs to be done so as to understand the response of the structure under such conditions.

The effect of the fin on the dam also needs to be studied. Vibration analysis of the dam under overflow conditions needs to be done with and without the fins and the results must be compared to see the effect of such fins. The fin generates separation and therefore introduces additional difficulty to the analysis of the overflow problem.

Efforts are also needed to perform vibration analysis of the dam with external flow taking into account the viscosity of the flow domain. This would require solving the Navier-Stokes equations and thus the problem moves closer to the computational fluid dynamics domain. Such an effort could also help understand the effects of considering viscosity and turbulence effects in analyzing the vibration behavior of inflatable dams.