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# Dynamics and Stability of Conical/Cylindrical Shells Conveying Subsonic Compressible Fluid Flows with General Boundary Conditions

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**Abstract**

A fast and efficient reduced order formulation is presented for the first time to study dynamics and stability of conical/cylindrical shells with internal fluid flows. The structural and fluid formulations are developed based on general assumptions to avoid any deficiency due to modeling. Their respective solutions and the final solution to the coupled field problem are also developed in a way to be capable of capturing any desirable set of boundary conditions. In addition to the flexibility provided by the solution methodology and generalization provided by the formulation, current solution proposes an additional advantage over others which is the minimal computational cost due to the special reduced order model proposed. Therefore, stability margins of the problem at hand can be obtained both efficiently and accurately. Proposed formulation is verified by comparing the results of the present study with the results available in literature for cylindrical/conical shells at different boundary conditions. Comprehensive parameter studies are performed in order to draw general insights over the effects of boundary conditions, semi-vertex angle and compressibility on the dynamics and stability margins of conical shells with internal fluid flows.

*Keywords:* Conical shells, Fluid-Structure Interaction, Reduced Order Model, Compressibility Effects, Static Condensation.



## 1. Introduction

There are a variety of engineering problems where a structural component is in contact with some sort of stationary or flowing fluid. Such problems fall into the category of fluid-structure interactions where the coupled system is inherently different from any of the segregated fluid or structural components. Many practical applications of such problems can occur in shell-type structures. Among all the available shell geometries, cylindrical shells have attracted the most attentions and a very detailed insight is obtained during the past decades over the problems of cylindrical shells interacting with fluids. Conical shells interacting with fluid flows, on the other hand, are not fully addressed in literature. The few available studies on conical

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