Evaluation of Vibration Characteristics of a Pipe with Various Fluid Densities

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***Abstract*—Vibration characteristics of pipe conveying fluid with sudden enlargement-sudden contraction were studied in this paper. The problem was modeled mathematically, and simulated numerically. The governing equations of motion for a pipe conveying fluid were derived using beam theory and the mathematical model was solved using transfer matrix method in MATLAB-R2012 environment. The simulation was carried out by Mechanical APDL in ANSYS 14. Two types of fluids; namely, water and oil were used to demonstrate the effect of density on the natural frequencies and their corresponding mode shapes. The support type selected for this investigation is flexible support. The small and large diameters of the investigated pipe were 12.7mm, 25.4mm made of copper. The external force was assumed to apply at mid length of the large diameter. A good agreement between the mathematical solution and the numerical simulation was achieved. In all cases, it was found that the natural frequencies with any fluid flow were lower than the case of pipe without fluid flow. The work can be extended for further cases of pipe geometries, and for two phases fluid flows.**

Keywords: *Induced vibration, Pipe conveying fluid, Flow structure interaction, Pipe supports, Pipe flow, Beam theory.*

I. INTRODUCTION

The flow through a pipe with sudden enlargement and contraction occurs in many industrial applications and is characterized by increased pressure losses caused by flow separation close to the change in the cross sectional area. This increasing in pressure losses will increase the erosion rates and the heat in the regions where separated flow occurs (Mahdi A. A. 2001).

The most important flow characteristics are the nature of flow (laminar or turbulent), velocity and pressure. Normally the nature of flow is circular and depended on the Reynolds Number