THERMAL EFFECT IN PRESSURE FLUCTUATION: INTERNAL FLOW

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6:162 Say: My contact prayer, and my rites, and my life, and my death, are all to Allah, Lord of the worlds.
I am grateful and would like to express my sincere gratitude to my supervisor Assoc. Prof. Dr. Kahar Osman for his guidance, continuous encouragement and constant support during the project.

I would like to indicate the effort and help that I found from CFM lab members.

I acknowledge my sincere indebtedness and gratitude to my parents for their love, dream and sacrifice throughout my life. The words are not enough to properly describe my appreciation for their devotion, support and faith in my ability to attain my goals.

Thanks also extended to all the great minds in FKM that helped me to bring this study to this level.
In industrial processes, turbulent flows are known to sometimes generate significant levels of noise and consequent vibrations of the structures. As well the involvement of the heat in the most engineering processes; this study focus on the effect of temperature of the internal flow in the tube has been investigated numerically to study the vibration tendency on the tube structure. The Fluent software has been used with LES solution provided for more accurate results. The results show the direct relation of the temperature in the vibration tendency. The results also show that the diameter of the tube has inverse relationship to the vibration tendency of the structure.
ABSTRAK

Table of Contents

DECLARATION ii
DEDICATION iii
ACKNOWLEDGEMENTS iv
ABSTRACT v
ABSTRAK vi
TABLE OF CONTENTS vii
LIST OF TABLES xii
LIST OF FIGURES xiv
LIST OF ABBREVIATIONS xiv

1 Introduction 6
  1.1 Problem statement 7
  1.2 Objectives 7
  1.3 Scope of the study 7
  1.4 Significant of the study 8
2 Literature review 9
  2.1 Overview 9
  2.2 Fluid Structure Interaction 10
  2.3 Flow-Induced Vibration (FIV) 14
    Vortex Induce Vibration (VIV) 20
    Large Eddy Simulation (LES) 23
  2.4 Internal Flow 25
  2.5 Temperature Effect at Heat Exchanger 26
Research Methodology

3.1 CFD

3.1.1 Mass conservation in 3D
3.1.2 Momentum equation in 3D
3.1.3 Large Eddy Simulation
3.1.4 Navier-Stokes Equation
3.1.5 Reynolds average Navier-Stokes (RANS)
3.1.6 Pressure Implicit with Splitting of Operators

3.2 The Model

3.3 Fluent (CFD)

Results and Discussion

4.1 Diameter and Temperature Effect on The Pressure Fluctuations
4.2 Frequency Domain Results of the Pressure Fluctuation

Conclusion

References
Table of Figures

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>SCHEMATIC DIAGRAM FOR FLOW EFFECT ON THE STRUCTURE (BELVIN, R. 2002)</td>
<td>15</td>
</tr>
<tr>
<td>2-2</td>
<td>CLASSIFICATION OF FIV</td>
<td>19</td>
</tr>
<tr>
<td>3-1</td>
<td>3D VIEW ILLUSTRATION OF FLOW</td>
<td>32</td>
</tr>
<tr>
<td>3-2</td>
<td>THE MESHED MODEL</td>
<td>38</td>
</tr>
<tr>
<td>3-3</td>
<td>CFD PROCESS</td>
<td>40</td>
</tr>
<tr>
<td>4-1</td>
<td>AVERAGE TOTAL PRESSURE (0.09 M DIAMETER, 298K)</td>
<td>43</td>
</tr>
<tr>
<td>4-2</td>
<td>TOTAL PRESSURE (0.09 M DIAMETER, 363K)</td>
<td>43</td>
</tr>
<tr>
<td>4-3</td>
<td>TOTAL PRESSURE (0.09 M DIAMETER, 463K)</td>
<td>43</td>
</tr>
<tr>
<td>4-4</td>
<td>TOTAL PRESSURE (0.09 M DIAMETER, 518K)</td>
<td>44</td>
</tr>
<tr>
<td>4-5</td>
<td>TOTAL PRESSURE (0.09 M DIAMETER, 600K)</td>
<td>44</td>
</tr>
<tr>
<td>4-6</td>
<td>TOTAL PRESSURE (0.06M DIAMETER, 298K)</td>
<td>44</td>
</tr>
<tr>
<td>4-7</td>
<td>TOTAL PRESSURE (0.06M DIAMETER, 363K)</td>
<td>45</td>
</tr>
<tr>
<td>4-8</td>
<td>TOTAL PRESSURE (0.06M DIAMETER, 463K)</td>
<td>45</td>
</tr>
<tr>
<td>4-9</td>
<td>TOTAL PRESSURE (0.06M DIAMETER, 518K)</td>
<td>45</td>
</tr>
<tr>
<td>4-10</td>
<td>TOTAL PRESSURE (0.06M DIAMETER, 600K)</td>
<td>46</td>
</tr>
<tr>
<td>4-11</td>
<td>TOTAL PRESSURE (0.0254 M DIAMETER, 298K)</td>
<td>46</td>
</tr>
<tr>
<td>4-12</td>
<td>TOTAL PRESSURE (0.0254 M DIAMETER, 363K)</td>
<td>46</td>
</tr>
<tr>
<td>4-13</td>
<td>TOTAL PRESSURE (0.0254 M DIAMETER, 463K)</td>
<td>47</td>
</tr>
<tr>
<td>4-14</td>
<td>TOTAL PRESSURE (0.0254 M DIAMETER, 518K)</td>
<td>47</td>
</tr>
<tr>
<td>4-15</td>
<td>TOTAL PRESSURE (0.0254 M DIAMETER, 600K)</td>
<td>47</td>
</tr>
<tr>
<td>4-16</td>
<td>THE FFT FREQUENCY (0.09 M DIAMETER, 363K)</td>
<td>48</td>
</tr>
<tr>
<td>4-17</td>
<td>THE FFT FREQUENCY (0.09 M DIAMETER, 463K)</td>
<td>48</td>
</tr>
<tr>
<td>4-18</td>
<td>THE FFT FREQUENCY (0.09 M DIAMETER, 518K)</td>
<td>49</td>
</tr>
<tr>
<td>4-19</td>
<td>THE FFT FREQUENCY (0.09 M DIAMETER, 600K)</td>
<td>49</td>
</tr>
</tbody>
</table>
LIST OF ABBREVIATIONS

DNS - Direct Numerical Simulations
LES - Large Eddy Simulations
FSI - Fluid–Structure Interaction
CFD - Computational Fluid Dynamic
FIV - Flow-Induced Vibration
VIV - Vortex Induce Vibration
RANS - Reynolds-averaged Navier-Stokes
GS - Grid Scale
SGS - Subgrid Scale
CL - Coefficient of Lift
CD - Coefficient of Drag
INTRODUCTION

Piping systems conveying liquids are subjected to severe transient loadings whenever changes in the momentum of the fluid or piping structure are abruptly induced due to planned or accidental actions. Typical sources of transients are (Rocher, R. 2012):

1. valve slam
2. startup and shutdown of pumps
3. loss of coolant in nuclear reactors
4. vibrations induced by operating equipment installed on the line
5. Earthquakes.

Fluid around a structure can significantly change the structure’s vibration characteristics. The presence of a inactive fluid decreases the natural frequencies and increases the damping of the structure. A dense fluid couples the vibration of elastic structures which are adjacent to each other. Fluid flow can induce vibration. A turbulent fluid flow exerts random pressures on a structure, and these random pressures induce a random response. The structure can resonate with periodic components of the wake. (Blevins, R. 2000)

If a structure is sufficiently flexible, the structural deformation under the fluid loading will in turn change the fluid force. The response can be unstable with very large structural vibrations once the fluid velocity exceeds a critical threshold value.
Vibration induced by fluid flow can be classified by the nature of the fluid structure interaction as effects which are largely independent of viscosity include added mass and inertial coupling. Unsteady pressure on the surface of a structure, due to either variations in the free stream flow or turbulent fluctuations, induces a forced vibration response. Strong fluid-structure interaction phenomena result when the fluid force on a structure induces a significant response which in turn changes the fluid force.

1.1 Problem statement

The volume flow rate of $0.024\text{m}^3/\text{s}$ (Lee, H. et al., 2009) is used to examine effect of the heated water flow on the circular tube. Cross bonding to different temperatures with values 298 K (Lee, H. et al., 2009) 363K (Lee, H. et al., 2009) 600K (Pironkov, P. 2010)

1.2 Objectives

To determine the effect of the temperature in internal flow related to FSI.

1.3 Scope of the study

1. Numerical solution will be used.
2. Include the pipe flow with and without temperature effect.
3. Investigate the effect of change of diameters of the pipe in constant flow rate.
1.4 Significant of the study

The heated tube has been widely used in the industrial application such as HVAC systems, heat exchangers, boilers, turbines, refineries reactors and most of the petro-chemical industry process.
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