A Numerical Investigation of TBA.....!!!1

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Chapter 1

A review of the literature

1.1 Flow induced vibrations

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Fluid-elastic galloping is one of the most commonly observable flow-induced vibration on a slender body. Since this phenomenon is most common in civil structure, such as buildings and iced-transmission lines, the term “aeroelastic galloping” is commonly used as the body is immersed in air. However, this mechanism can occur on a slender body immersed in any Newtonian fluid, provided that the conditions to sustain the galloping mechanism are satisfied. This work is based on a general Newtonian flow,thus the term “ fluid-elastic galloping” is used throughout this thesis.

1.2.1 Excitation of galloping

When a bluff body moves along the transverse direction of the fluid flow, it generates a force along the transverse direction. This force, also known as the induced lift is a resultant of the velocity of the fluid and the motion of the body. When this body is attached to an oscillating system (i.e. a simple spring, mass and damper system), the induced lift becomes the periodic forcing of the system. Galloping is sustained if the induced lift is in phase with the motion of the body. This could be explained further by using a square cross section as an example.

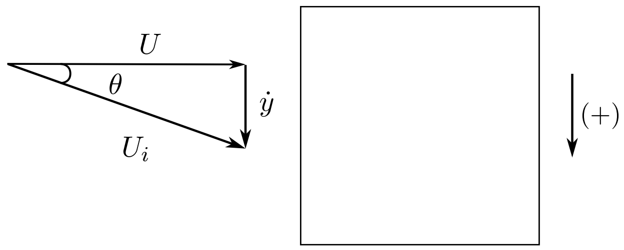

Figure 1.1: Induced angle of attack on the square prism due to the resultant of free-stream velocity of the fluid and transverse velocity of the body.

An induced angle of attack is formed on the square cross section as illustrated in Figure 1.1 as a resultant of the fressrteam velocity U and the transverse velocity of the body $\dot{y}$. As a result a force is formed in phase with the motion of the body in the square cross section. This mechanism could be observed on other bodies which are prone to galloping. The sign convention in this figure (and generally in this scope of research) states that downward direction is positive. Hence, the force generated in a galloping body could be also identified as a "negative lift"

1.2.2 Qusasi-state theory

According Païdoussis et al. (2010), Glauert (1919) provided a criterion for galloping by considering the auto-rotation of an aerofoil and Den Hartog (1956) has provided a theoretical explanation for iced electric transmission lines. However, the study by Parkinson and Smith (1964) could be identified as the pioneering study of galloping. A weakly non-linear oscillator model was developed by them to predict the response of the system. Essentially the quasi-steady assumption was made to develop this theory assuming that the instantaneous lift force of the oscillating body is equal to that of the lift force generated by the same body at the same induced angle of attack at the fixed support scenario.

The oscillator equation was solved using the Krylov and Bogoliubov method. Details of this method would not be mentioned as it is not used in the present study to solve the oscillator equation. The results obtained form experiments carried out at $Re = 2200$ and a mass ratio around 1164 had a good agreement with the theoretical data which is shown in Parkinson amplitude data the figure .

Bibliography

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