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Seismic Analysis On Cylindrical Tanks Subjected To Horizontal Acceleration

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ABSTRACT

The dynamic behaviour of inviscid fluid contained in horizontally accelerated cylindrical tanks is taken into account. Mechanical equations describing the fluid motion area unit developed and simplified by use of tiny amplitude wave approximations, facultative expressions for the various modes of vibrations, sloshing frequencies and also the free surface displacements to be obtained. The expression without charge surface displacement is developed in such the simplest way that the time histories of the free surface displacement may be calculated for tanks subjected to real earthquake accelerograms. Comparisons of expected and finite component analysis of various modes of vibration of the cylindrical tank, sloshing frequencies and free surface displacements of a model cylindrical storage tank subjected to curved acceleration was found to be in shut agreement.

I. INTRODUCTION

The unstable performance of liquid retentive structures may be a matter of special importance. while not AN assured water system, uncontrolled fires after a significant earthquake might cause considerably additional injury than the earthquake itself, as occurred within the nice 1906 point of entry earthquake. If the outbreaks of malady that regularly follow harmful earthquakes area unit to be avoided, it's essential that safe provides of drink area unit on the market. Spillage of harmful will cause injury repeatedly the values of the affected tank and contents. This paper considers the overall downside of horizontally accelerated cylindrical tanks containing in mucilaginous fluid. tiny amplitude wave approximations area unit accustomed acquire expressions without charge surface displacements, pressure distribution. The natural frequencies of vibration of cylinder area unit calculated by decisive the ‘added mass’ of the fluid. This additional mass of the fluid is additional up with the structural mass to get the various modes of vibration of the cylinder.

II. MATHEMATICAL FORMULATION

To calculate the additional mass constant of the fluid within the cylinder, a strip model is employed. the fundamental assumption of the strip model is to contemplate a slender strip between z and z+dz, placed sufficiently off from the ends z=0 and z= H, the axial flow element is negligible; moreover it's assumed that the tip effects extend over alittle axial length solely. From the structural position, once writing the shell equations the axial element of motion is discarded then area unit the axial variations of displacement field.

As the structural and fluid issues have constant axial symmetry it's comfortable to retain only 1 of the 2 mode families. Therefore, within the gift downside, the additional mass matrix, as expressed within the structural mode basis is diagonal and also the mode shapes of the shell area unit constant as in vacuum. The generalized force exerted by the fluid on a shell strip of unit length is [1]:

A. Free surface sloshing time history

The sloshing of the fluid within the cylindrical tank takes place thanks to the x-component of the acceleration imparted thanks to the unstable activity. the entire set of the declared downside is given by the subsequent system of equations[2]:

Introduction of this into higher than set of eqns. and introducing the linearizing approximation of 1st order quantum mechanics, that assumes that free surface waves have a comparatively tiny amplitude, consists of neglecting all non linear terms and evaluating the ensuing free surface boundary conditions on the plane z=0

III.FEA MODELING OF THE CYLINDRICAL TANK

The 3D cylindrical tank and also the fluid subjected to unstable excitation may be born-again into a second axisymmetric downside [6] and solved mistreatment the business FEA packages on the market like Ansys eleven.0. an in depth rationalization for the FEA modeling has been avoided during this section. For the modeling the sloshing downside in Ansys, the cylinder wall is sculptural with quadrilateral four node component PLANE forty two with every node having a pair of degrees of freedom i.e uxor and uy The fluid domain has been sculptural with four node quadrilateral parts FLUID seventy nine, having a pair of degrees of freedom at every node i.e the interpretation DOF uxor and uy . the bottom of the tank is in remission for all DOF. The unstable excitation knowledge (here a curved wave) may be input to the structure at the bottom during a tabular column. At the fluid structure interface the fluid parts ought to be coupled in such the simplest way, in order that it transmits solely traditional forces to the cylinder wall and is often in grips with the surface of the cylinder i.e it will move solely in transversal direction. On the road of symmetry the fluid parts area unit affected within the radial direction. Modal analysis is dispensed mistreatment Block Lanczos methodology for the primary five modes and mode shapes.

IV. Results and Discussion

From the mathematical expression derived earlier, the natural frequency of the tank containing fluid, the sloshing frequency and also the time history of the free surface subjected to unstable forces area unit calculated and compared to the results obtained analytically from Ansys. From the obtained graphs, it may be seen that the in theory obtained time history and also the analytically obtained time history vary, this will be attributed to ignoring of non linear terms from the governing differential eqns.

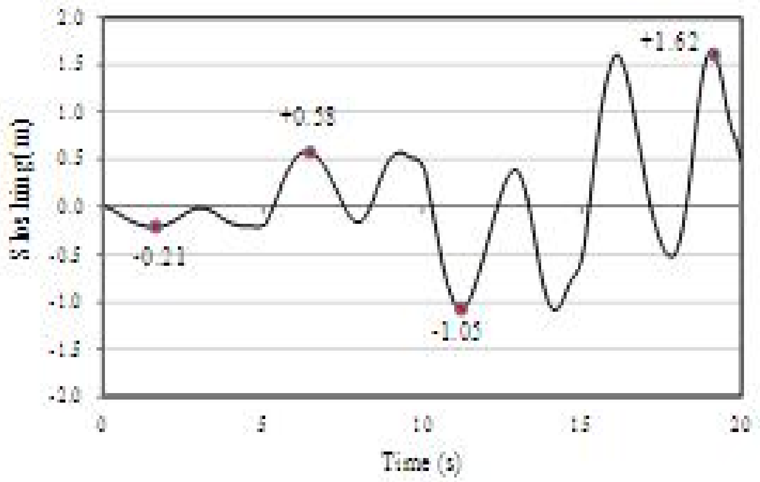

Fig:-1 Time history of free surface sloshing(analytical)

V. Conclusion

The natural frequencies of the cylinder, sloshing frequency and also the time history of the free surface sloshing made up our minds in theory and valid mistreatment Ansys eleven.0.

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