SEISMIC ANALYSIS OF CONICAL FRUSTUM ELEVATED WATER TANKS

by

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SYNOPSIS

A dynamic model using the finite element and the finite difference methods, which makes possible the inclusion in the analysis of the hydrodynamic structure-liquid interaction forces is proposed for the seismic analysis of conical frustum elevated water tanks. The structure-foundation interaction is also taken into account.

THE METHOD OF ANALYSIS

The structure of the elevated water tank (Fig.1) is discretized in n axisymmetric finite elements. The water in the reservoir is considered to be an elastic incompressible continuum. The equations of motion of the structure subjected to the acceleration a(t), are:

$$[M]\{\ddot{D}\} + [C]\{\dot{D}\} + [K]\{D\} = -[M]\{1\}\,a(t) + \{H(t)\} + \{S(t)\} \qquad (1)$$

$[M]$, $[C]$, $[K]$ are respectively, the lumped mass, the damping and the stiffness matrices, $\{D\}$ is the nodal displacements vector, $\{H(t)\}$ is the dynamic vector of the structure-liquid interaction forces and $\{S(t)\}$ is the vector of the structure-foundation interaction forces.

The problem is firstly solved for a harmonic excitation. The pressure amplitudes in complex frequency are obtained by solving Laplace's equation for the appropiate boundary conditions, for each vibration mode considered, by the finite difference method and then the vector $\{H(\omega)\}$ is established. The vector $\{S(\omega)\}$ is expressed for a simplifed swaying and rocking model. The complex frequency response for the entire structure is calculated afterwards from Eq.1

The time domain response for an arbitrary acceleration a(t) is determined by the Fourier synthesis of the complex frequency responses via FFT.

The elevated water tank in Fig.1 was analysed by a computer program using the method presented above.

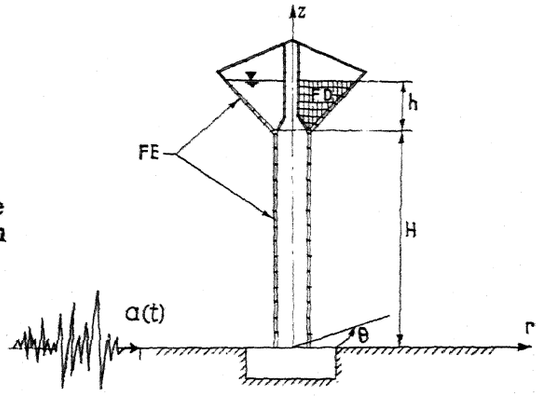

Fig.1 FD - Fin. Diff. Mesh
FE - Fin. Elem. Mesh

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DISCUSSION

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The authors presented an interesting study on seismic analysis of conical frustum elevated water tanks. The authors are to be commended also for their significant contribution to the dynamic design of conical elevated water tanks taking into consideration the hydrodynamic structure - liquid interaction and structure-foundation interaction forces. The writer would like to know some views on the subject.

The authors presented equation (i) considering nodal displacements vector in this analysis. The writer will be pleased to know if the authors give a little clear picture about these displacements considered in his approach. For three dimensional analysis, is it possible to take into account the end-fixity problem of the different connecting elements for the liquid retaining structure through the authors finite element and finite difference approach ? Because, this gives a large effect on the stiffness of overall structure.

The writer also wishes to know how lateral load distribution and resulting stresses among the different elements will be obtained ?

Author's Closure

Not received.