SEISMIC ANALYSIS OF TORSIONALLY COUPLED MULTISTOREY BUILDINGS ON LAYERED SOIL STRATUM

By

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Dedicated
to

K. Satyanarayana, K. Rajeswaramma;   Parents

P. Panduranga Rao, P. Padmavathi;   Parents-in-law

CERTIFICATE

This is to certify that the thesis entitled, "**Seismic Analysis of Torsionally Coupled Multistorey Buildings on Layered Soil Stratum**" being submitted by **Mr. K. Rama Mohana Rao to the Indian Institute of Technology, Delhi,** for the award of the degree of **Doctor of Philosophy** in Civil Engineering is a record of bonafide research work carried out by him. Mr. K. Rama Mohan Rao has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis, which to the best of my knowledge has reached the requisite standard.

The material contained in this thesis has not been submitted, in part or in full to any other University or Institute for the award of any degree or diploma.

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(K.Rama Mohana Rao)

ABSTRACT

Limited research work on the seismic response of torsionally coupled multistorey framed buildings resting on elastic half-space has been reported in the literature. ATC3 Code gives specifications for the reduction factor to be applied to the base shear obtained assuming foundation to be fixed. The distribution of storey shears along the height of the building with compliant foundation is, however, assumed to be the same as for the building with fixed foundation. No studies are available on the adequacy of this provision. The present study is an effort in this direction. The effect of foundation compliance on the distribution of storey shears along the height of the torsionally coupled building comprising of frames and shear walls resting on layered soil stratum underlain by bedrock is studied. Each floor of the building is assumed to have 3 d.o.f- a translation along the each of the principal axis and a rotation about vertical axis and footing is assumed to have 5 d.o.f (a translation along each of the two orthogonal axes and rotations about three axes).

Finite Layer Method has been adopted to obtain complex impedance functions of raft footings on layered soil stratum in vertical, horizontal, rocking and torsional motions. Design charts have been presented for evaluating the impedance functions for rectangular rafts resting on normally consolidated soils having parabolic variation of shear wave velocity.

For analysis of foundation-superstructure system the substructure method has been used. Equations of motion of the system incorporating foundation impedance functions are written in time domain, converted into frequency domain and response is obtained. Using inverse Fast Fourier Transform Technique the seismic response is then determined.

Two cases of seismic inputs are considered: i) at the footing level and ii) at the

bedrock level. In the later case the earthquake is assumed to propagate vertically upwards in shear mode. The time history of the earthquake is generated from the specified response spectrum when the input is at the footing level and from the Kanai-Tajimi spectrum when the input is at the bedrock level.

It is shown that the distribution of storey shears along the height in the building or in stiffening elements obtained assuming the foundation to be compliant is not the same as that obtained assuming the foundation to be fixed. It is also shown that the response obtained using codal provision is higher than that obtained using detailed analysis incorporating foundation compliance or otherwise. It is further shown that significantly different seismic responses occur when the same bedrock motion propagates through soil layers of different depths.

LIST OF CONTENTS