RESPONSE OF FOUNDATION WELLS OF BRIDGES DURING EARTHQUAKE

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Analysis for prediction of seismic response of bridges founded on wells is usually carried out by making a lumped mass model, the mass and stiffness properties being determined from sizes and weights of different portions of the structure and the modulus of elasticity of the material, the soil resistance being replaced by equivalent springs. In this study the response of a typical pier-well system of a bridge subject to earthquake motion has been compared using the spring stiffness determined from (a) the concept of modulus of subgrade reaction (Terzaghi 1955) and (b) elastic half space theory, assuming the soil resistance at the base to be the same as for a surface footing and the resistance at the sides produced by an independent elastic layer above the footing base. The values of the rotational spring at the base and translational spring on the sides were determined from Richart et al (1970) and Beredugo and Novak (1972) respectively, assuming them to be frequency independent. The well considered in the analysis had a cross-section of 'Double-D' type with outer dimensions 14m x 20m, the diameter of end portions 14m, height of the well above base 33m and depth of embeddment below maximum scour 20.4m. The soil was predominantly clayey in nature. The lumped mass model of the system consisted of 16 masses in the longitudinal direction and 19 masses in the transverse direction. The values of time period and maximum values of moments, shear and deflections obtained by considering the stiffness values from the two approaches are compared in the table:

QUANTITY	MODULUS OF SUBGRADE REACTION		ELASTIC HALF SPACE THEORY	
	LONGITUDINAL DIRECTION	TRANSVERSE DIRECTION	LONGITUDINAL DIRECTION	TRANSVERSE DIRECTION
Time Period (I mode) sec	5.416	5.551	1.675	1.429
Maximum Moment* t-m	4837	6650	11807	14653
Maximum Shear* t	429	551	891	672
Maximum Deflection mm	66.0	74.3	47.6	41.9

* Square root of sum of squares of values in first three modes.

It is observed that in the present case the concept of modulus of subgrade reaction results in over estimation of time periods and under estimation of stiffness values compared to the other case. Fields tests on an existing well foundation in clayey deposits (Arya et.al, 1973) had also shown that the theoretically computed stiffness values using the concept of modulus of subgrade reaction were considerably smaller than the values obtained from free vibration and lateral load tests.

REFERENCE

Arya, A.S. and Kumar, K. (1973), "Field Test for Lateral Stiffness of Well Foundations of Narmada Bridge At Broach", Symposium on Behaviour of Earth and Earth Structures Subjected to Dynamic Loads, Roorkee, India,

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DISCUSSION

D.J. Ketkar (India)

Can the response of foundation wells be improved by using cable anchors ?

Do the authors recommend it for Bridges in India ?

Author's Closure

Regarding the question by Mr. Ketkar, the authors wish to state that the cable anchors would in general increase the stability of the well. As far as the dynamic response is concerned, the increased stiffness of foundation due to use of cable anchors will reduce the time period of the structure which in turn may have the effect of decreased displacements of the pier cap and increased forces in the substructure.

The usefullness of cable anchors in bridges in India would obviously depend upon the geometry of the well, material properties of the well and the soil conditions at the site.