

ABSTRACT

(Er. Amreet R Tuladhar)

Behavior of Eccentrically Loaded Isolated Spread Footings Under Earthquake

In Kathmandu valley, mostly in core city areas, most of the buildings are constructed attached to each other; placing columns at the property line. In such buildings, if the isolated spread footing system is adopted then the columns lying at the property line invariably transfer axial load through one sided footing; as the base slab of footing can't be extended beyond the property line.

Various literatures recommend the necessity of combined footings in such case. Nevertheless, the prevailing construction practice is such that such eccentric footings are constructed usually without the provision to counteract this eccentricity.

The major objective of this research work was to assess the vulnerability of this type of footing under the earthquake taking into account the effect of supporting tie beams at plinth level and brick masonry walls under it in two soils types; soft and stiff. Soil parameters considered were that of "organic" and "sandy gravel" representing soft and stiff soil types respectively. It aimed to study the response of such footings in terms of displacements and stresses generated within the supporting soil mass and its structural components.

Finite element modeling tool has been used for the modeling purpose of the concerned footing in SAP 2000 (ver 8.0). An existing building that best represents the prevailing construction practice has been considered for this purpose. Eight-Noded solid elements with three translational degrees of freedom per node have been used as a discrete element. Soil structure interaction has been incorporated in detail taking into account of its intrinsic non-linear behavior with multi-linear link elements at the footing base. Spring constants for these link elements were computed based on "elastic half space theory". Load deformation curve of the foundation has been modeled as the "elastic-strain hardening plastic" model to account foundation non-linearity. Also, in order to allow the variability in soil parameters, lower and upper bound solution approaches have been carried out with a wide range of factor "four" in between.

It has been observed that such footings are totally unsafe in case of "organic soil" that greatly exceeded the ultimate displacement capacity corresponding to lower bound solution approach both in gravity and earthquake load cases. Also solution corresponding to upper bound solution in same soil type has shown that such foundation remained within elastic limit in case of gravity loading. Whereas in an upper bound approach in earthquake loading, foundation exceeded its elastic limit but remained well below its ultimate capacity. Likewise, footings on "sandy gravel" soil corresponding to both the solution approaches were found below the elastic limit under the gravity loading. Whereas same was found at the verge of yielding in case of earthquake loading corresponding to lower bound solution; but remained below the elastic limit in upper bound approach. Also, tendency of lifting up of the free edge of such footing was found greater in case of footing resting on stiff soils as "sandy gravel". No such phenomenon was observed in soft soils as "organic soil".

