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# EFFECT OF SOIL-STRUCTURE INTERACTION ON BASE-ISOLATED MACHINE FOUNDATIONS

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## ABSTRACT

Machine foundations help in distribution of the machine loads and mitigation of vibrations developed due to the rotating machine parts. When vibration control devices are used, the design approaches of the machine foundations thereof are still in the development stage. Especially, the flexibility of underlying soil is ignored in the designs, which may influence the dynamic response significantly. In the present study, a numerical model is developed to investigate the effect of soil-structure interaction (SSI) on the dynamic response of base-isolated machine foundation founded on a homogenous elastic soil layer subjected to earthquake ground motions. Frequency-independent expressions for stiffness and damping coefficients are used to model the SSI. Parametric studies on dynamic response of the base-isolated framed-type machine foundation are conducted for various parameters such as fundamental time period of machine foundation, isolation time period, bearing yield strength, and yield displacement considering different soil types. This research concludes that the SSI decreases the natural frequencies of the entire system, which is significant in higher modes especially for rigid machine foundations resting on weak soil strata. Hence, the SSI activates the higher mode participation, resulting amplified responses in the base-isolated machine foundation.

## NOMENCLATURE

$A$ Dimensionless parameter used in Wen's model
$F_0$ Normalized yield strength of the base-isolator
$F_b$ Restoring force of the base-isolator
$F_y$ Bearing yield strength of the base-isolator
$G$ Shear modulus of the soil
$I_f$ Moment of inertia of the foundation raft
$M$ Total mass of the base-isolated machine foundation
$N$ Operating speed of rotary machine
$T_b$ Time period of the base isolator
$T_s$ Time period of the framed-foundation
$W$ Total weight of the base-isolated machine foundation
$Z$ Non-dimensional hysteretic displacement
$a$ Equivalent radius of circular footing
$c_b$ Damping of the base isolator in horizontal direction
$c_h$ Damping of the soil in horizontal direction
$c_s$ Damping of the frame in horizontal direction
$c_\theta$ Damping of the soil in rocking direction
$h$ Foundation to deck height
$k_b$ Post-yield stiffness of the base isolator in horizontal direction
$k_h$ Stiffness of the soil in horizontal direction
$k_s$ Stiffness of the frame in horizontal direction
$k_\theta$ Stiffness of the soil in rocking direction