ABSTRACT

Plates on elastic foundations present widespread applications in civil engineering, for example, roadways, railway tracks, bridges, and airfields. These structures are subjected to static as well as dynamic loads. The study of numerical approaches has advanced to new dimensions in recent years, leading to more precise and efficient solution procedures. There are numerous situations where the Engineer has to use simple empirical techniques to design foundations that transfer the loads from the superstructure to the soil underneath. The "plate on elastic foundation" concept is widely used to solve typical soil foundation interaction problems. Appropriate analysis of the influence of suddenly applied load-moving mass requires proper modelling. An efficient vibration control process can be appropriately designed if the dynamic behaviour of the structural system is well estimated at the designed stage to prevent structural damage. Developing more realistic foundation models and simplified methods to solve this complex soil-structure interaction problem is essential for safe and economical design.

The present study attempted a workable approach for response analysis of plates on modified Vlasov foundations incorporating higher-order shear deformation theory (HSDT). The Poisson ratio of the soil is assumed to be constant from the top to a rigid surface to evaluate the soil parameters, i.e. Winkler/vertical parameter and shear parameter. Furthermore, the modulus of elasticity can be considered constant, varying linearly from top to bottom and quadratically from top to bottom. Finally, to evaluate the activated soil mass, the mass density of the soil is assumed to be constant for dynamic response analysis.

For static response analysis, different types of loading and boundary conditions for various irregular structural geometries are considered. In addition, free vibration and dynamic response analyses are carried out for stepped and suddenly applied loads. The results are compared with similar studies by other researchers, which show excellent conformity.

The present formulation's benefit is that it can efficiently analyze thin to thick rectangular, skew and solid circular plates resting on elastic foundations. The formulation is simple and requires less computational effort, resources and time. Moreover, parametric studies are carried out to obtain a response for different foundation parameters, loading and boundary conditions and types of loading.

Keywords: Modified Vlasov Model; Shear modulus; HSDT; Skewed Plate; Activated mass; Finite Element; Lock-free; Normal strain; Shear correction factor.

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