Journal of Advances and Scholarly Researches in Allied Education
Vol. 18, Issue No. 1, January-2021, ISSN 2230-7540

A Statistical Study between Beam and Layered Soil Using a Two-Parameter Elastic Foundation

Er. Bhupendra Pratap Dongri[1]* Dr. Ashis Kumar Samal[2]

[1] Structural Engineering, M. Tech, GIETU, Gunupur, Odisha

Abstract – The thesis provides a finite element model of a beam that rests on a layered soil with two parameters. The conduct of the soil and the beam are supposed to be linear and uniform. The shear strain of the beam portion and the base of the soil are analysed together by the pressure energy expressions. This method elaborates and integrates the steadiness matrix of each factor in the study of the finite element. To demonstrate the appropriate method and the capability of the numerical programme designed for this purpose, different examples are developed first. Secondly, the research is expanded to explore how soil properties affect the spectrum of the interface and the beam responses. Third, a parametric analysis is carried out to illustrate the impact on interface interface spectrum of the location of springs, the soil characteristics, the depth of the soil base and the ballast sheet. Furthermore, shear deformations demonstrate the important effect on the beam, the configuration and the action of the interface. The findings achieved reveal relevant results for the interface spectrum and the beam answers.

The thesis provides a finite element model of a beam that rests on a layered soil with two parameters. The behaviour, continuous, homogeneous isotropic, of the soil spectrum and the beam. The shear strain of the beam portion and the base of the soil are analysed together by the pressure energy expressions. This method elaborates and integrates the steadiness matrix of each factor in the study of the finite element. To demonstrate the appropriate method and the capability of the numerical programme designed for this purpose, different examples are developed first. Secondly, the research is expanded to explore how soil properties affect the spectrum of the interface and the beam responses. Third, a parametric analysis is carried out to illustrate the impact on interface interface spectrum of the location of springs, the soil characteristics, the depth of the soil base and the ballast sheet. Furthermore, shear deformations demonstrate the important effect on the beam, the configuration and the action of the interface. The findings achieved reveal relevant results for the interface spectrum and the beam answers.

Keywords -Static soil-beam interaction, Layered soi, Two-parameter elastic foundation model Finite element method Elastic foundation Ballasted layer-r Soil properties.

----------------------------------x----------------------------------

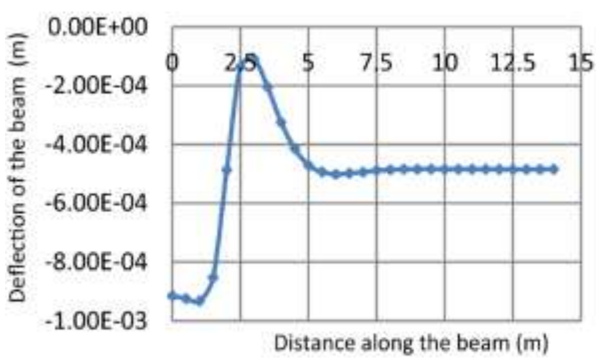
INTRODUCTION

In various fields of engineering, such as belt base, track tracks for railways, buildings, dams and airport paths, the beam principle on elastic soil framework has been commonly used. Because of the heterosity, physical structure and existence of soil imperfections and pores the soil mechanic displays a highly nuanced attitude towards foundations. The latest State of the Art Study has shown concepts, status and different methods for analysing the relationship of soil structures. Quantifying the relationship between the soil and structure remains a concern to this day. The primary task of this study is the simulation of the interaction between the system and the soil base. Compared with numerical experiments utilising the two parameter soil basis model of beams resting in isotropic or anisotropic half-space elastic solutions, analytical solutions have been limited (Johnson 1985; Kachanov et al. 2003). Various soil-based modelling models, which are divided into three categories (1) continuum models, (2) mixed models and (3) spring models were primarily established in the numerical sector. In the mechanical definition, the medium is continuously spread over the half-speace by a linear elastic isotropic action that can be described as the constitutional rule (Irgens 1980). Reissner has created the solution for a simplified continuum with the fnite element idealisation (1967). The Continuum may be studied using a number of computational approaches such as FEM, BEM or hybrid methods between FEM and BEM useful for the soil-structure interaction study. The Continuum is an interactional analysis. FEM is well established and commonly utilised in several methods to research the relationship of soil-structure and BEM demonstrates many advantages in the field of modelling with strong concordance with infnite and semi-infnite areas (Bolteus 1984; Tezzon et al.

2015). Given the difficulty of the issue of contact, analytical solutions are seldom utilised and the desired alternatives are numerical. The FEM is still often used in this field, although it has inconvenience with respect to the absorbent frontier modelling of the SEM. The FEM takes a high number of fnite elements to discrete the domain but the issue can be resolved with BEM where the domain limit can only be discerned (Padron et al. 2011; Ai and Cheng 2013; Ribeiro and Paiva 2014). In this research, an efficient two parameter layered soil model has been used to study the issue of soil-structure interaction. Both the beam and the substratum are represented with the FEM shear deformation integration. However, the mesh must be removed from the charged area in order to ensure the disappearance at the substratum border. Two-dimensional fnite elements have been refurbished in the loaded region to increase computational performance. For adhesive interaction with the air strain condition of the soil base, the modelling uses the plane stress state. In addition, the parametric analysis is developed to demonstrate (1) the horizontal behaviour of the ground, and (2) the mechanical characteristics of the ground.

Physical modeling

The reciprocal loading effect and the base reactions will cause transverse defections of a thin elastic beam. Actually, at any stage on the interface medium, Layered soil reaction forces are proportional to defection. The Winkler model is also deficient since the displacement discontinuity between the loaded and unloaded areas of the base surface is present. A continuous function over the whole surface of the displacement field (Fig. 1). The Winkler model is based upon the same, discreet elastic springs characterised by their mechanical property, Ks, that form vertical floor sections of the foundation (Fig. 1b). The contribution of the device media between the base and the beam must be combined in order to increase the forecast of the whole machine activity. The literature reveals many methods that interpret the relationship between soil and beam.



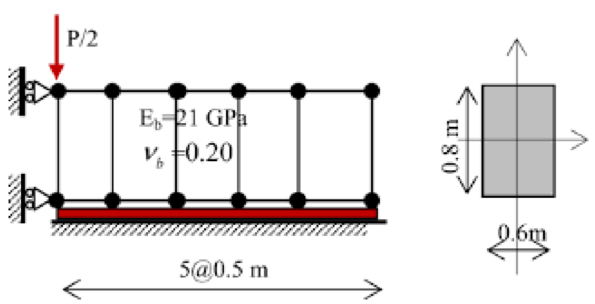
NUMERICAL STUDY

Validation of the program

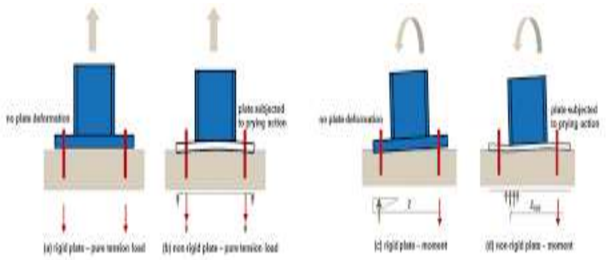
Firstly, the Winkler-based beam is used to demonstrate the capacity of the numerical software intended for this purpose. This beam is investigated by mesh-free approach (Binesh 2012). The solar basis reaction modulus is 104 kN/m3 and the concentric load of 100 kN from the left side of the beam is added at 2 m. (Fig. 7). The beam is 14 m long and the exhaust rigidity is assumed to be 2604.167 kN/m2, which is equal to a 0.25 m thick beam in flat stress and 2 to 103 MPa modulus from Young. It is assumed that the Poisson ratio is 0.25. The model consists of 73 nodes and 14 numerical integration blocks in the base mesh. The findings are seen in Fig. 8a using the mesh-free approach and the correct solution. There is good consensus, for comparison, between the exact solution, the mesh-free process and this technique that contradicts the exactness and efficiency of the numerical solution suggested. Figure 9 shows continuum interface node lateral displacements. In the left region of the force applied, the fgure indicates significant displacements, but a small difference followed by mild displacement of the distance. The horizontal model of contact as seen in Figure 10. In this situation, both vertical and horizontal springs are inserted at the same time. To escape the handicap in the Winkler model, it is possible to justify horizontal springs. In the study, horizontal displacement differs from that achieved by the Winkler method as it comes to lateral contact. An gain of 45.13% with x=0 m at 100% for x x 5m along the duration of the soil in this case was strongly observed (Fig. 11). The side-effect occurs on vertical moves without any effect (Fig. 12).

Analysis of the beam on a rigid base

On a rigid ground floor base is called the length of a L=5 m beam, width b=0.60 m and the height h=0.80 m. At the middle, the beam load is 500 kN. Just half of the beam is examined for the symmetry explanation (Fig. 13).



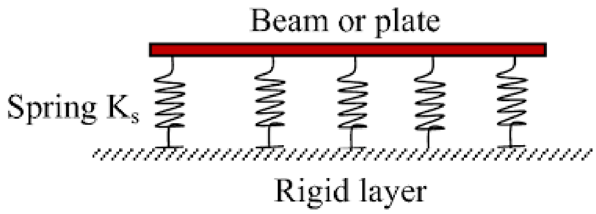
the impact of soil properties on interaction response The mechanical properties of the beam and the ground are stated in Fig. 16. In horizontal direction, a fne mesh is chosen but vertically a consistent mesh is presumed. The soiled base is H=30 m, L=54 m, Young Es and Poisson Ratio = 0.30. The department is based on the surface. In Figures 17 and 18, continuum interface responses affect the mechanical properties of soils. Where there are poor mechanical properties of the earth, horizontal and vertical displacements are very important. The improvement of soil properties is observed by Es from 15 MPa to 45 MPa of 35.33 percent.



The maximum horizontal displacement falls from 1.15 to 0.35 to 1.10 to 0.35 to 110 to 3.89 and 10−3 m for vertical displacement from 11 to 10−3 m (Fig. 17), respectively (Fig. 18). In these circumstances, increase in soil behaviour, horizontal displacement rises to 10−3 to 0.154 − 10−3 m (43.13 per cent) (Fig. 17) and to 1.85 − 10−3 m (47.55 per cent). As soil properties shift from E=45–100 MPa, horizontal displacement is strongly observed, as seen in this case.

In the same definition, on figures 19 and 20, displacements of upper nodes of beams occur with substantial soil proprieties (Fig. 19), but partial indépendance of soil properties and vertical displacements of beam nodes. are defined in figures 20. (Fig. 20). Important displacements by Es = 15 MPa are obtained and accompanied by a large ballast layer influence. The need for strength and reliability of railway tracks due to train speed and axle load is now.

A vibration effect must be minimised (2) railroad stabilisation, load distribution layer and (4) assist longitudinal and lateral lanes, in order to prevent forced cargo loads and thermal rail tension. The vibration effect must be minimised (3) the structural noise isolation in populations along track routes; In this analysis, between the ground and beam (Fig. 23), a ballast coating is applied, which does not affect the interface continuum horizontally or vertically. The ballast layer has a marked effect on the beam action (fig. 24, 25) and has a twofold reciprocal function in the absorption of the ballast layer; lateral displacement decreases as the height rises (fig. 24). (Fig. 25). Finally, the diffuse displacement fields are studied between the beam and the ground. The uneven distribution between the thrilling and the compressive regions is irregular within the medium (Fig. 26). The applied load area is located with maximum vertical displacements and the remainder are standard digressions (Fig. 27).



The numerical results demonstrate the rapid convergence of the derived formulation and enable us to research numerous interactive problems with the soil-structure. A parametric analysis was conducted which can draw conclusions:

- The lateral relationship between the beam-soil basement behaviour has an important impact.
- The characteristics of the soil have an important influence on the relationship between the beam and the soil.
- The profundity of the elastic base has a normal effect on the beam-soil basis and on the beam.
- The incorporation of ballast sheet (high layer) leads to an influence in the longitudinal direction on the relationship with the beam base.
- The formula of the finite element was developed independently of the limit conditions of the beam. This technique can be used conveniently in other beam boundary conditions.

CONCLUSION

The current study illustrates the impact on the beam reaction, considering the two-parameter Vlašov base model, of spatial variations of the soil Young module. On the basis of a parametric analysis, an increase of the soil elastic module coefficient of variance (a) has been observed (b) 0 45 metres 10 metres 0 RiskGeo © ASCE 2011 1163 © ASCE 2011 2011 Geo-Risk University of Waterloo downloaded from ascelibrary.org on 08/03/15. ASCE copyright. Any privileges reserved for personal use only. Mean deflection and bending moment maximal beam values. In comparison with the beam reaction for uniform soil, it has also been observed that larger correlation distance and coefficient of variance values provide higher levels of beam deflection and flexing moment. However, this influence is suppressed at low soil heterogeneity and distances of correlation.

REFERENCES

1. Ai ZH & Cai J.B. (2016). Static interaction analysis between a Timoshenko beam and layered sols by analytical layer

element/boundary element method coupling. Appl. Mathem Model 40: pp. 9485–9499

2. Ai ZY & Cheng YC (2013). Analysis of vertically loaded piles in multilayered transversely isotropic soils by BEM. Eng Anal Bound Elem 37: pp. 327–335

3. Avcar M. (2016). Effect of material non-homogeneity and two-parameter elastic foundation on fundamental frequency parameters of Timoshenko beam. Acta. Phys. Pol A 130: pp. 375–378

4. Binesh S.M. (2012). Analysis of beam on elastic foundation using the radial point interpolation method. Cient Iran A 9(3): pp. 403–409

5. Bolteus L. (1984) Soil-structure interaction a study based on numerical methods. Ph. D. thesis.

6. Division of structural design Chalmers University of technology, Goteborg, Sweden, 1984, pp. 165

7. Bourgeois E, de Buhan P, Hassen G. (2012). Settlement analysis of piled-raft foundations by means of a multiphase model accounting for soil-pile interactions. Comput Geotech 46: pp. 26–38

8. Cen S, CHen X-M, Fu X-R (2009). Quadrilateral membrane element with analytical element stiffness matrices formulated by the new quadrilateral area coordinate method. Int J Meth Eng 77: pp. 1172–1200

Corresponding Author

Er. Bhupendra Pratap Dongri*

Structural Engineering, M. Tech, GIETU, Gunupur, Odisha