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Analysis of Raft Foundations on Elastic Soil Support

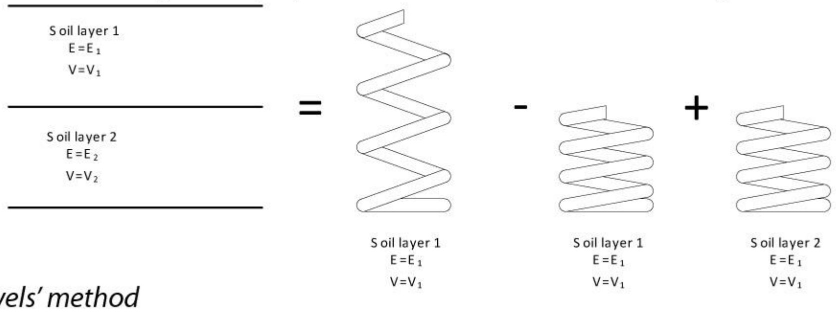
Multi-Layered Soil (Part 2) - EHSPAK

In the previous edition, we discussed the importance of involving soil-structure interaction in the analysis of foundations to furnish appropriate designs (June 2012 page 1). Simplified methods for representing the underlying soil were explained; in-addition to mentioning the methodologies introduced in the EHSPAK. To account for more accurate soil profile modelling, one must include multi-layering in soil support stiffness calculation.

In practical applications, it is very rare to find a soil medium with a layer thick enough to consider it alone as the supporting element; it is very common to have a multilayered soil profile. In order to modify the previously mentioned "Elastic Half Space" models to consider multi-layered soils, different methodologies (implemented in the EHSPAK) are briefly described below:

Staviridis method

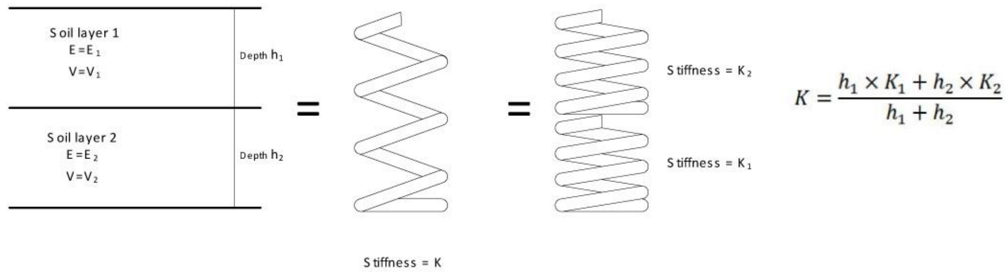
This method adopts a superposition scheme to calculate the equivalent soil stiffness:



No need to transform E and v to k

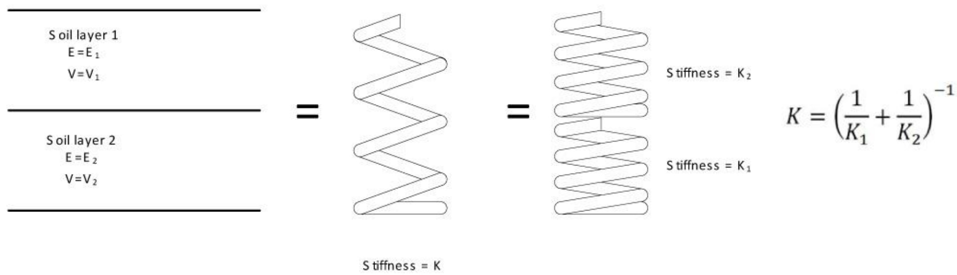
Bowels' method

This method calculates the equivalent soil stiffness using a weighted average method:



Equivalent spring method

This method simply calculates the equivalent soil spring by modeling the layers as springs that are connected in series.



How the EHSPAK works?

1. The underlying soil is divided into series of stiffness patches (areas). It has to be noted that soil springs are modeled as area springs rather than the point springs modeled in the finite element software.
2. For each patch, a unit load is applied and the resulting displacement is calculated at all patches. Displacement is calculated using any of the EHSPAK models explained earlier.
3. Using the displacement-force relation, stiffness coefficients are calculated to populate the stiffness matrix.

All steps mentioned above are carried out automatically without iterations.

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Prof Rashed (BE4E Principal and Technical Director [*right*]) have visited the NTUA this past July (2012), and met **Prof L. Stavridis** [*left*] in the structural department. Both of them have discussed the recent developments and the strengths of the PLPAK – EHSPAK which implement the method proposed by Prof Stavridis for multi-layering soil system. Both entities have epressed their intentions of cointued collaboration between both groups over the coming period.

Comparison between a Winkler model and an EHSPAK model

A simple raft (Fig. 1) was analysed using the two available methods in the PLPAK: Winkler modelling and elastic half-space modelling. The Winkler model transformed the soil support into equivalent springs with single stiffnesses, whereas the EHS model took into account the multi-layering of the underlying soil (using the Steinbrenner solution mode). The two layers of soil are shown in Fig. 2, used in the EHSPAK. The results are displayed

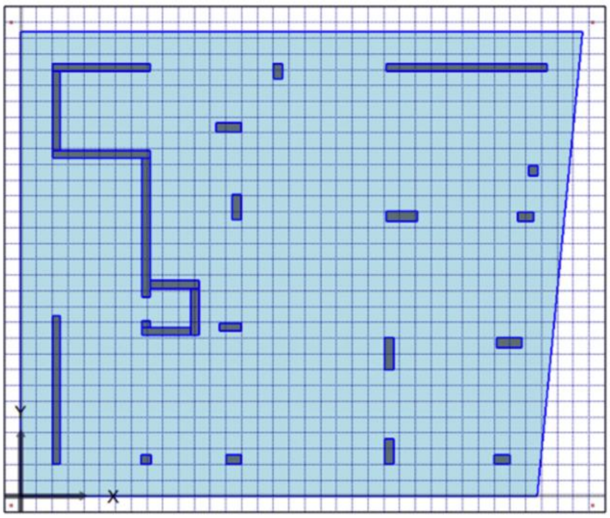

Figure 1 : Raft generated by the PLGen

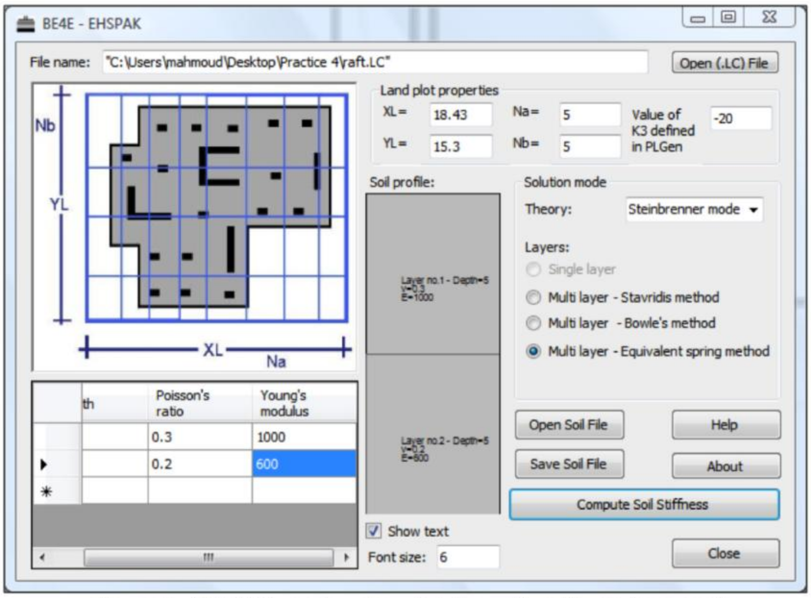

Figure 2 : EHSPAK window showing the soil profile and properties