Developer's Tip

Setting up the Initial Stress State for Surface Models

> *"How do I define the initial stress field under a non-horizontal ground surface? How do I set up the initial stress field under an embankment using Phase^2?"*

Initial Stress for a Surface Excavation with Non-Horizontal Ground Surface

There are a number of methods that one can use to set up the initial stress condition under a non-horizontal ground surface, prior to excavation. For example:

1) settling the whole model under its own weight
2) using a combination of field stress and body force with some ground surface elevation usually at the highest elevation of the ground surface
3) excavating (or building up) the slope with a combination of 1 and 2.

The method you use generally relates to how the material is deposited, from both a geological and man-made perspective. In the case of a normally consolidated soil you would most likely use method 1, while a rock mass that has undergone folding would use method 2. An embankment or excavated slope would most likely use method 3. In all cases, the primary consideration is the horizontal stress and its magnitude. In method 1, the horizontal stress is due to the Poisson effect:

$$\sigma_H = \sigma_V \frac{\nu}{(1-\nu)}$$

where: σ_H = horizontal stress, σ_V = vertical stress, ν = Poisson's ratio

With method 2, the horizontal stress is tectonically induced and can have values much higher than those in method 1. Whichever method you select, we generally suggest that people use the first stage to equilibrate the model and then use subsequent stages to do any excavation. One can then factor out these first stage displacements by using the Data > Stage Settings option in the Interpreter.

Initial Stress for an Embankment Model

In the case of an embankment, the material below the embankment should have an initial element loading of "Field Stress and Body Force". Define a Gravity stress field with the reference elevation equal to the ground surface, and enter horizontal/vertical stress ratios to simulate the horizontal stresses that you think exist in the field (without the embankment).

The embankment is then added to the model, as a material with an initial element loading of "Body Force Only". When you run the analysis, you will see settlement in the first stage due to the embankment load. You will also see a redistribution of stress due to the embankment.

The following link, embankment.zip, contains a simple model that illustrates this.

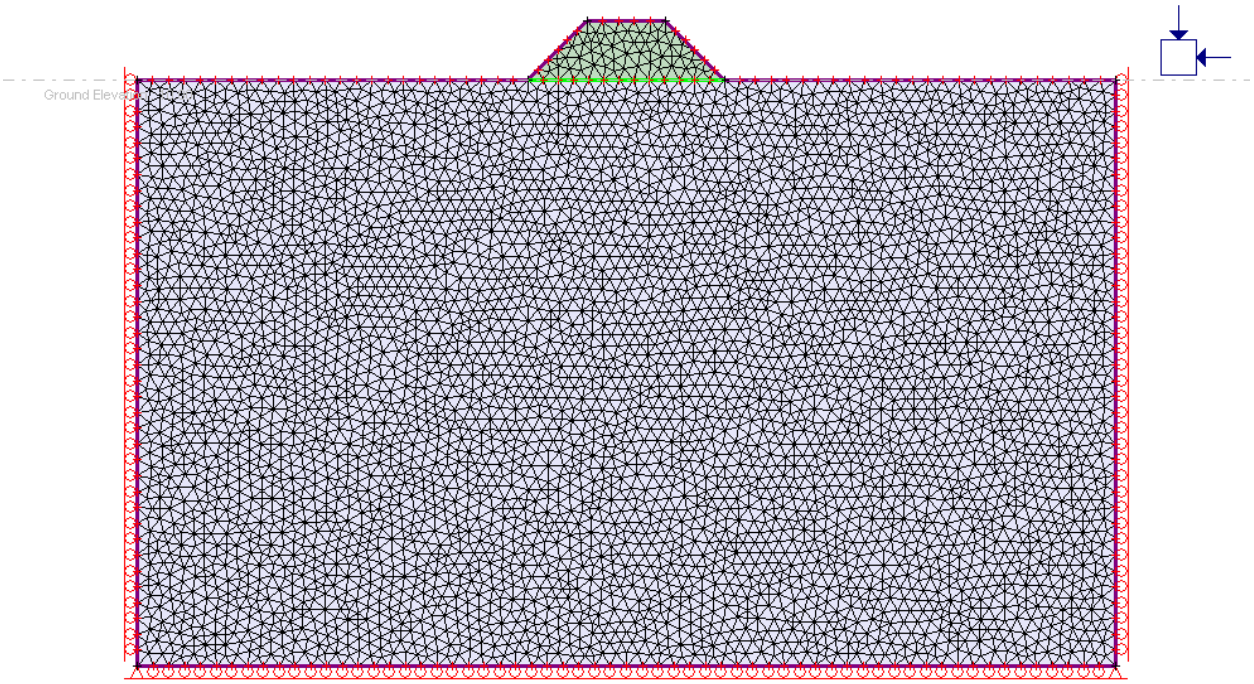

Figure 1: Embankment model. Field stress = gravity. Initial element loading (foundation material) = field stress + body force. Initial element loading (embankment) = body force only.

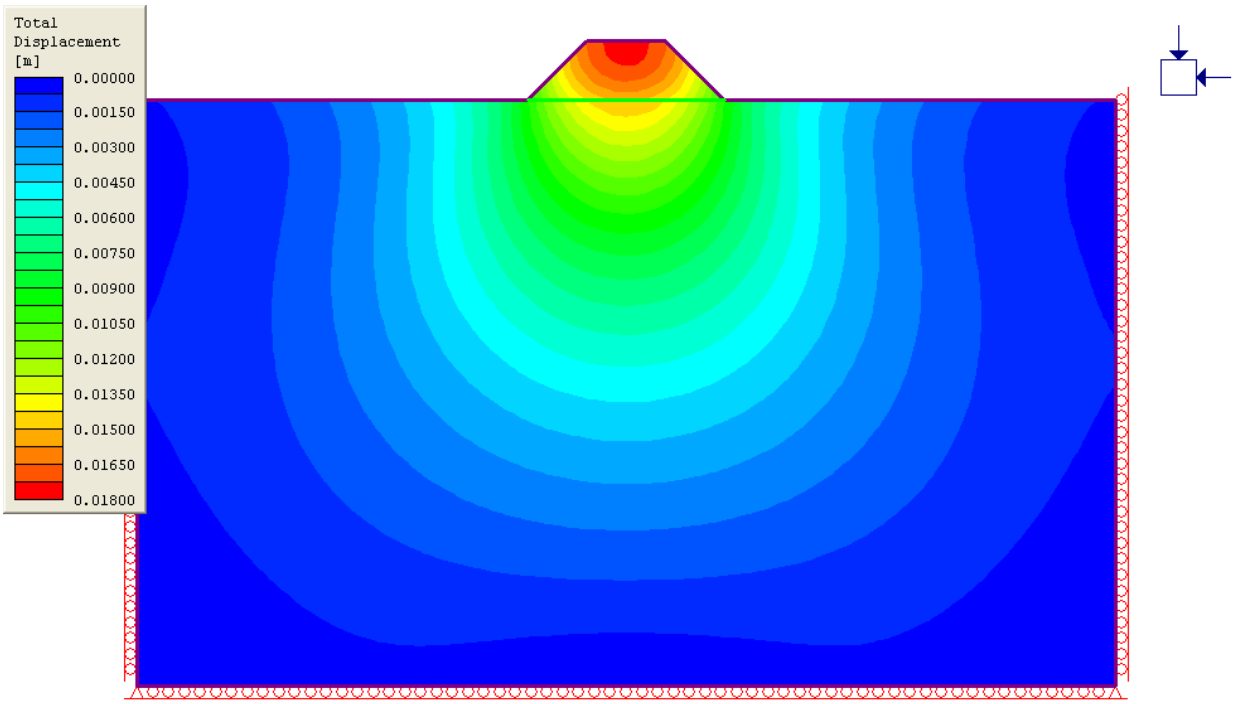

Figure 2: Embankment model – total displacement contours.