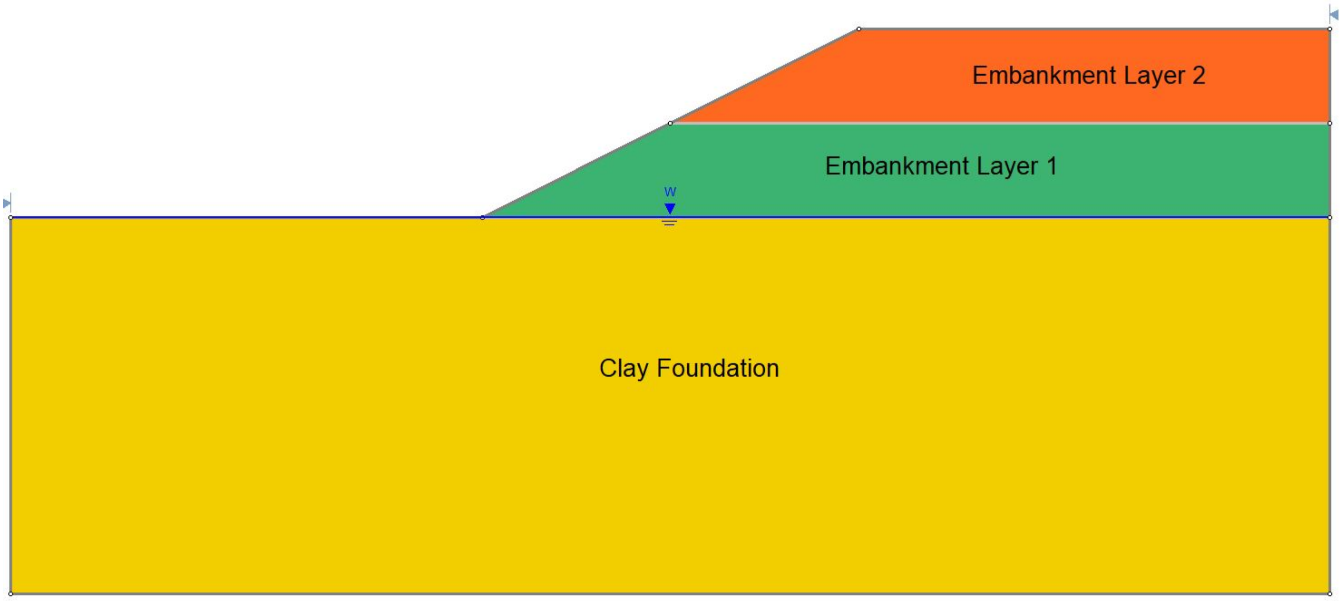
rocscience

Staged Embankment on Clay

1. Introduction

The following analysis models the staged construction of an embankment on a clay foundation. The clay foundation is modelled with the SHANSEP strength model. The two layers of the embankment are modelled as Mohr-Coulomb materials.

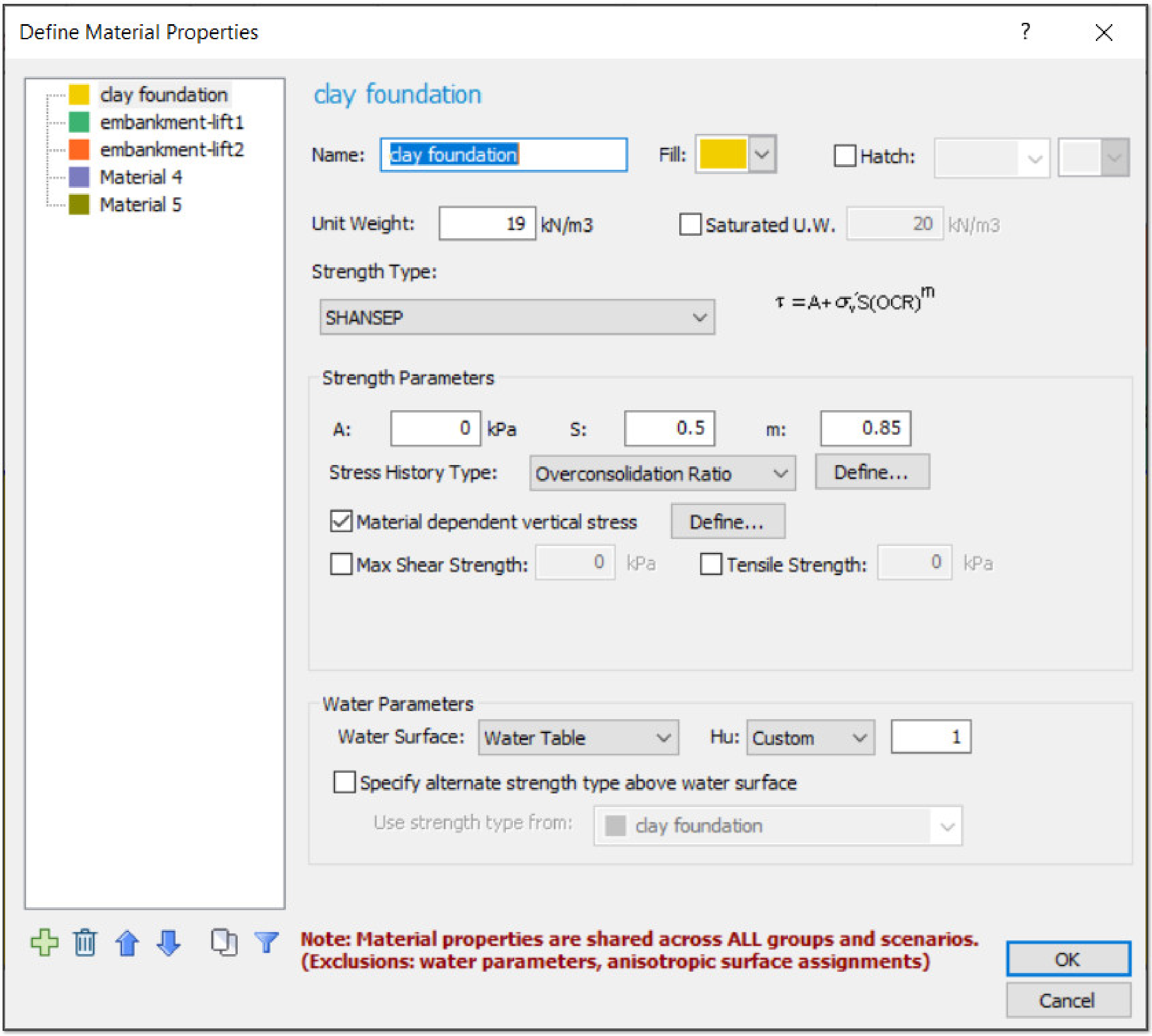


The SHANSEP model in Slide2 allows for the modelling of pore pressure dissipation in a clay foundation due to the staged addition of multiple layers of embankment material. The user must know for the current geometry configuration, the degree at which all the embankment layers affect the vertical effective stress in the clay foundation. This means the amount of pore pressure dissipation in the clay due to the time of existence of the embankment layers will be taken into account. The vertical effective stress in a SHANSEP material is important for the determination of shear strength. See the SHANSEP help topic for more information.

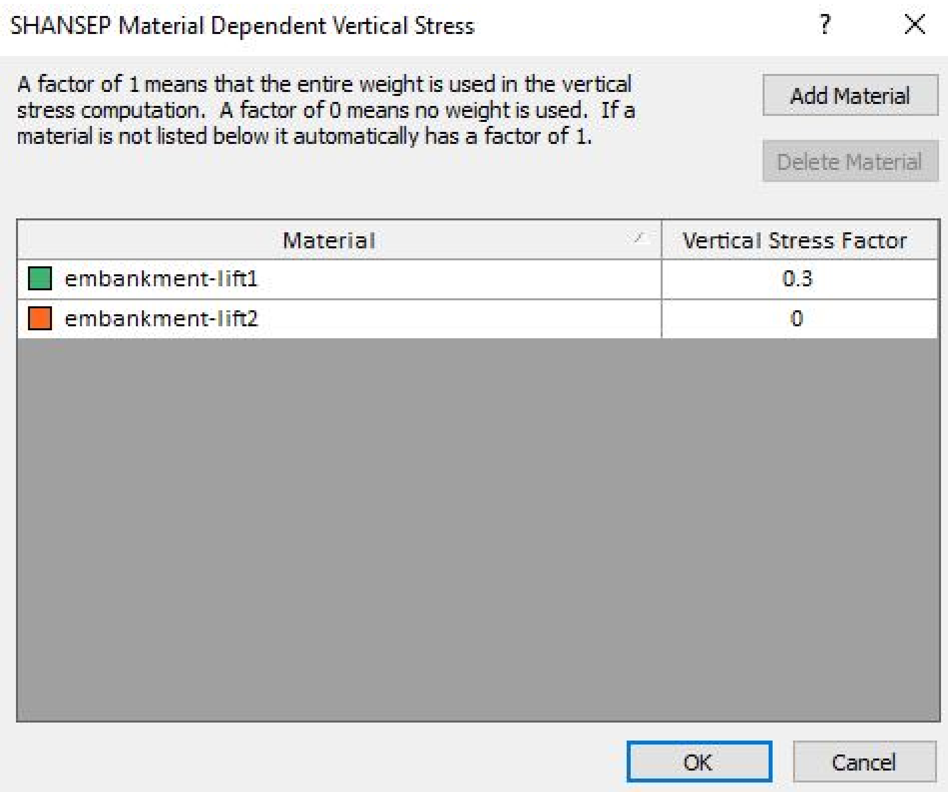
In the following example, an embankment is constructed in two lifts or layers, on a clay foundation. The stability of the embankment is calculated immediately after the construction of the second top lift. Excess pore pressure increases in the clay between the end of construction of the first lift and the end of construction of the second lift are due to the load transfer of the entire weight of the second lift to pore pressure. As a result, there is no effective stress increase in the clay due to the existence of the second lift. However, in the time taken to complete the construction of the second lift, excess pore pressures due to the construction of the first lift have dissipated by 30% in the clay foundation. As a result, the effective stresses in the clay increase due to a load transfer of 30% of the weight of the first layer.

Select **File > Recent Folders > Tutorials Folder** and read in the file *Tutorial 31 Staged Embankment on Clay - SHANSEP method.slmd*.

Open the **Define Material Properties** dialog. Select the first material, the clay foundation. Notice the **Clay foundation** material **Strength Type** is set to SHANSEP with the following parameters.



Notice the **Material Dependent Vertical Stress** option is turned on. This is how you define how other materials in the model affect the vertical stress in the clay foundation. Click the **Define** button. You will see the following dialog.



Notice the **vertical stress factor** for the first lift is 0.3. This means that 30% of the weight of the first layer is transferred to a vertical stress increase in the clay foundation. Notice the vertical stress factor for the second lift is 0.0. This means that the entire weight of the second lift is transferred to an increase in excess pore pressure and that there is zero increase in effective stress in the clay foundation due to the addition of the second lift.

Close the SHANSEP material-dependent vertical stress dialog.

Select the **embankment materials** and notice they are set to **Mohr-Coulomb** materials.

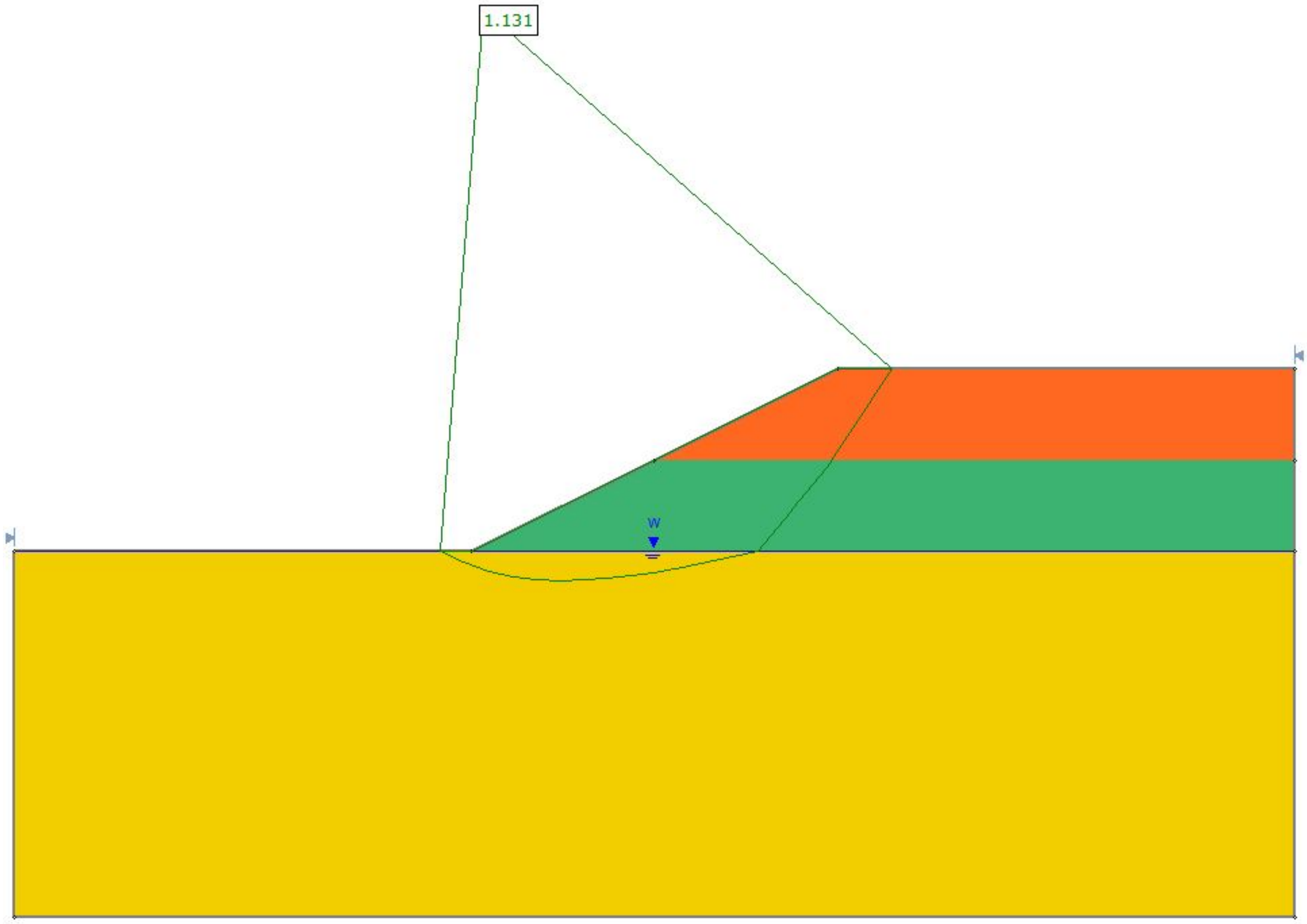
Close the **Material properties** dialog.

In the analysis, we will look at **non-circular failure surfaces** and use the Cuckoo Search optimization method for locating the global minimum failure surface. We will be computing the Spencer and GLE factors of safety.

Click the **Compute** button.

When the analysis is finished press the **Interpret** button.

Notice the factor of safety is around 1.13, see below.

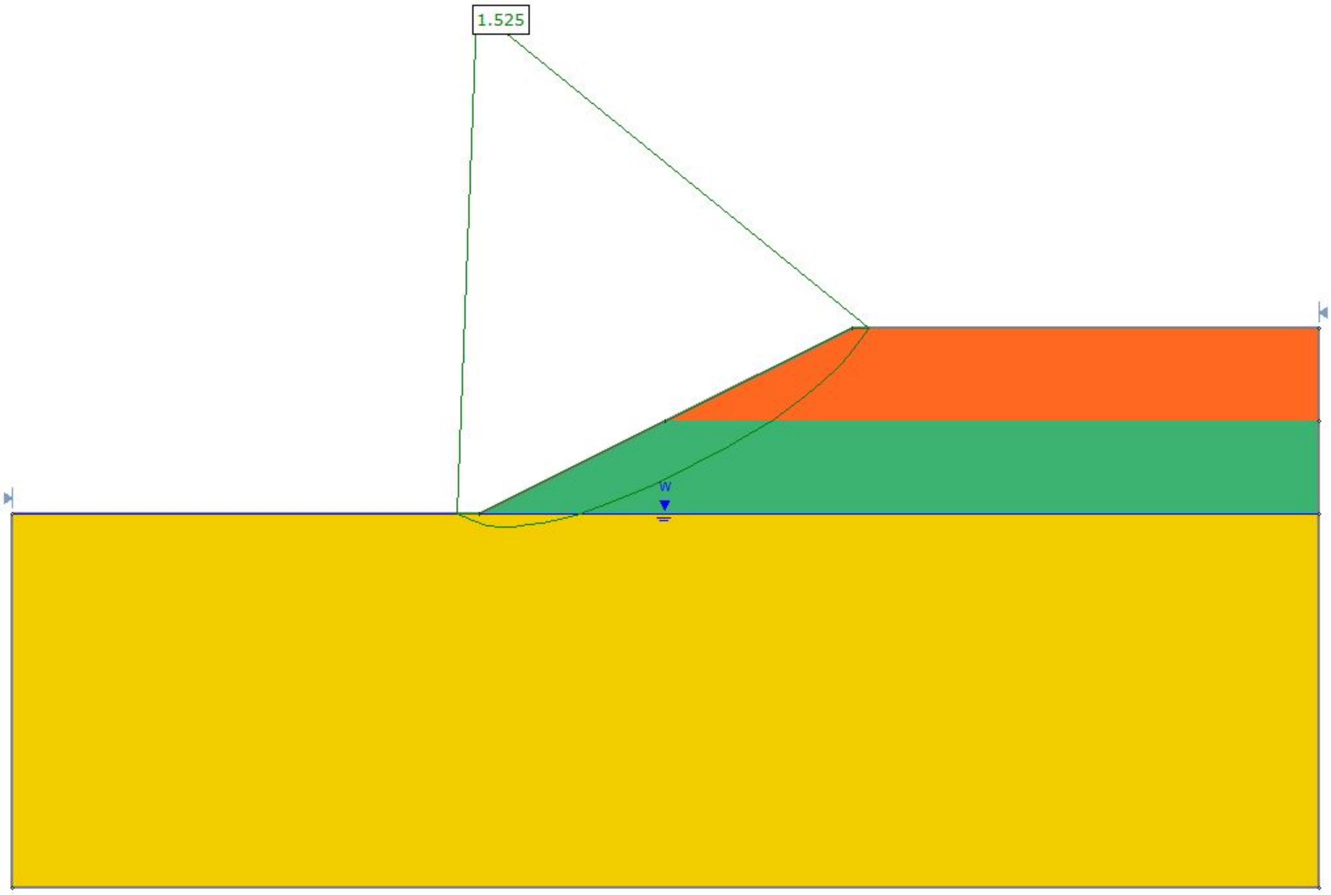


This would be the short-term factor of safety of the embankment immediately after placement of the top lift.

Now go back to the Modeler. Change the factors in the **Material dependent vertical stress** dialog to 0.8 for the first lift and 0.4 for the second lift. This means 80% dissipation of the excess pore pressure due to lift 1 and 40% dissipation of excess pore pressure due to lift 2. Exit the material properties dialog.

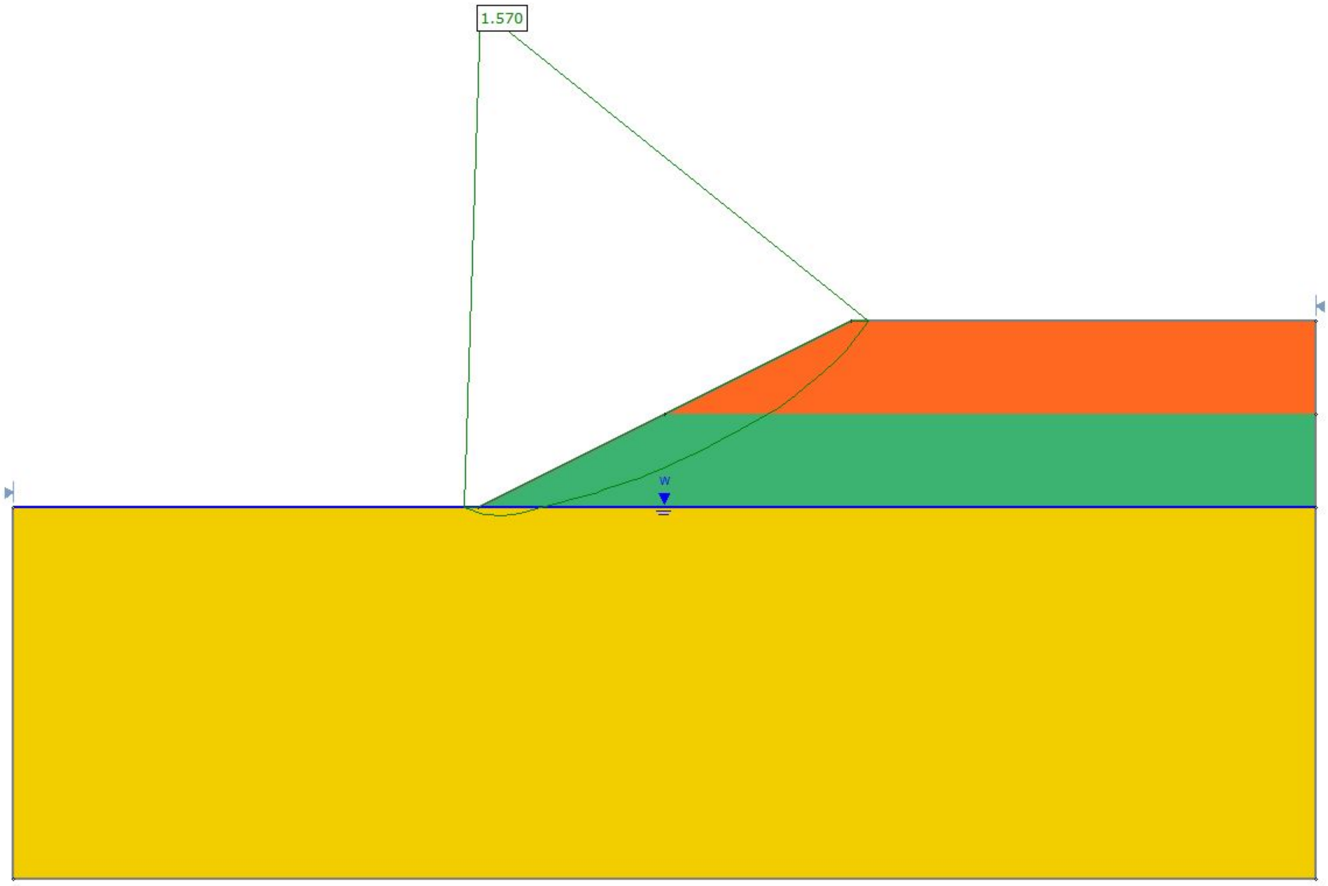
Save to a different filename and press **Compute**. When completed go to **Interpret**

Notice the factor of safety has increased to a value of around 1.5. See below.



Finally, let's look at the long-term factor of safety. Go back to the Slide2 modeller and go to the material properties dialog. For the clay foundation, uncheck the **material-dependent vertical stress** option. This means that the entire weights of the two lifts act to increase the effective vertical stress within the clay foundation. Save and run **Compute**.

The long-term factor of safety is 1.57, see below. A considerable difference between the short-term value of 1.12 seen earlier.


1.570
W