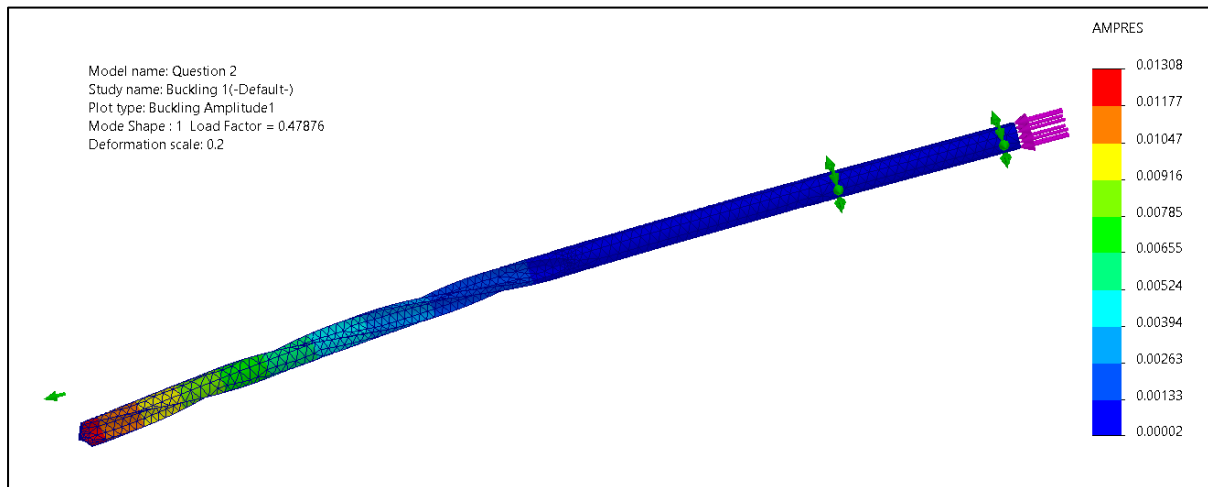


**a. The critical buckling load using FEA simulation:**

Result of buckling study shown below:



The buckling factor of safety from the FEA simulation shown below:

List Modes

Study name: Buckling 1

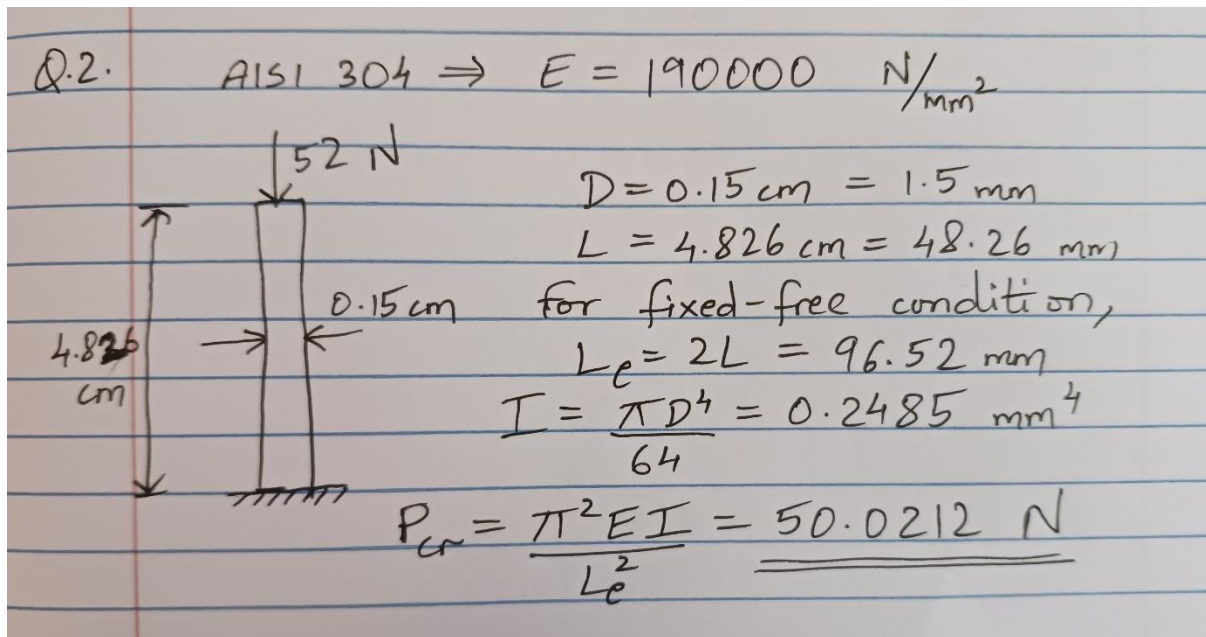
Mode No.	Buckling Factor of Safety
1	0.47876

Close Save Help

The image shows a software window titled 'List Modes' for a study named 'Buckling 1'. It contains a table with two columns: 'Mode No.' and 'Buckling Factor of Safety'. The first row shows Mode No. 1 with a Buckling Factor of Safety of 0.47876. At the bottom of the window are three buttons: 'Close', 'Save', and 'Help'.

We get the buckling factor of safety as **0.47876**. Based on this we can calculate the critical load by,

**Critical buckling load** = Load x Buckling FOS = (52 N) x (0.47876) = **24.89552 N**.

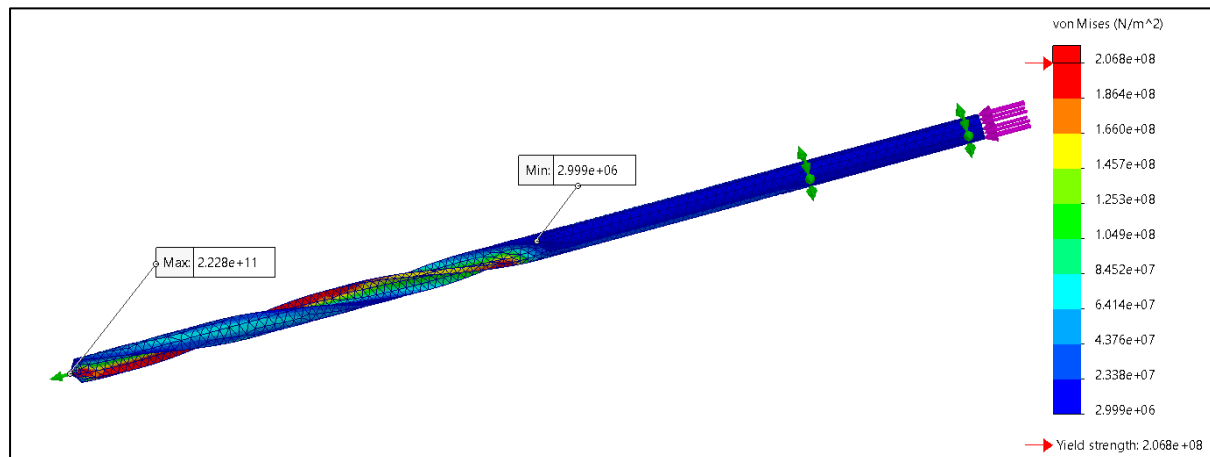
**b. The critical buckling load using the classical buckling theory:**

From manual calculations we get critical buckling load for the fixed-free end conditions as **50.0212 N**.

There is a huge difference between the classical calculations and the FEA results. The error is **50.2%** which suggests that the assumptions of the elastic buckling do not apply to the problem as it is.

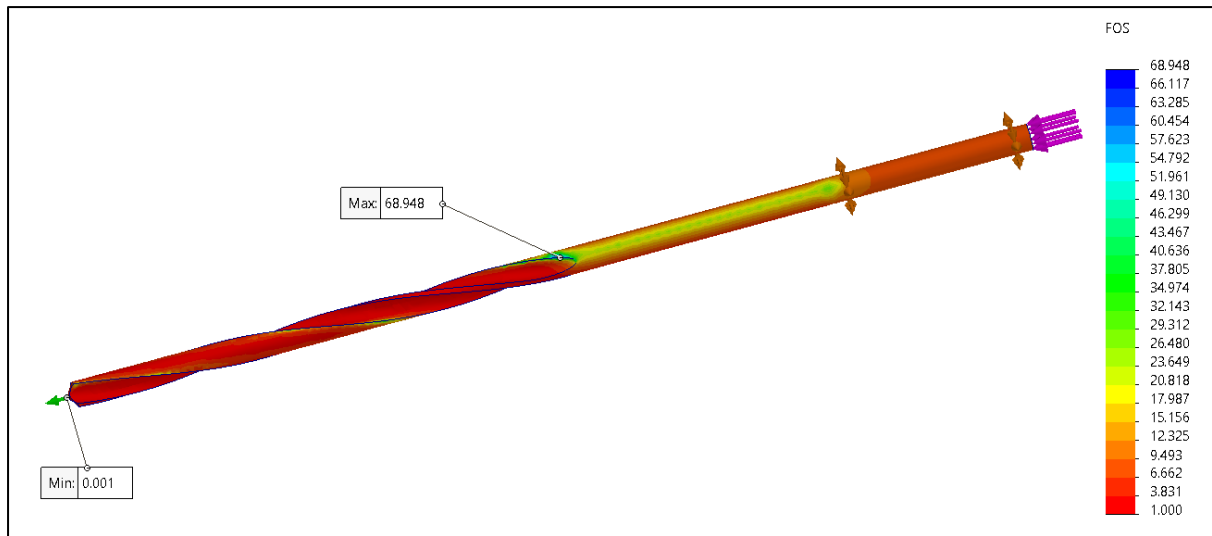
**c. Determine if the drill bit buckles or yields first:**

To check for yielding we conduct a static study. The Von-Mises contour plot is shown below:

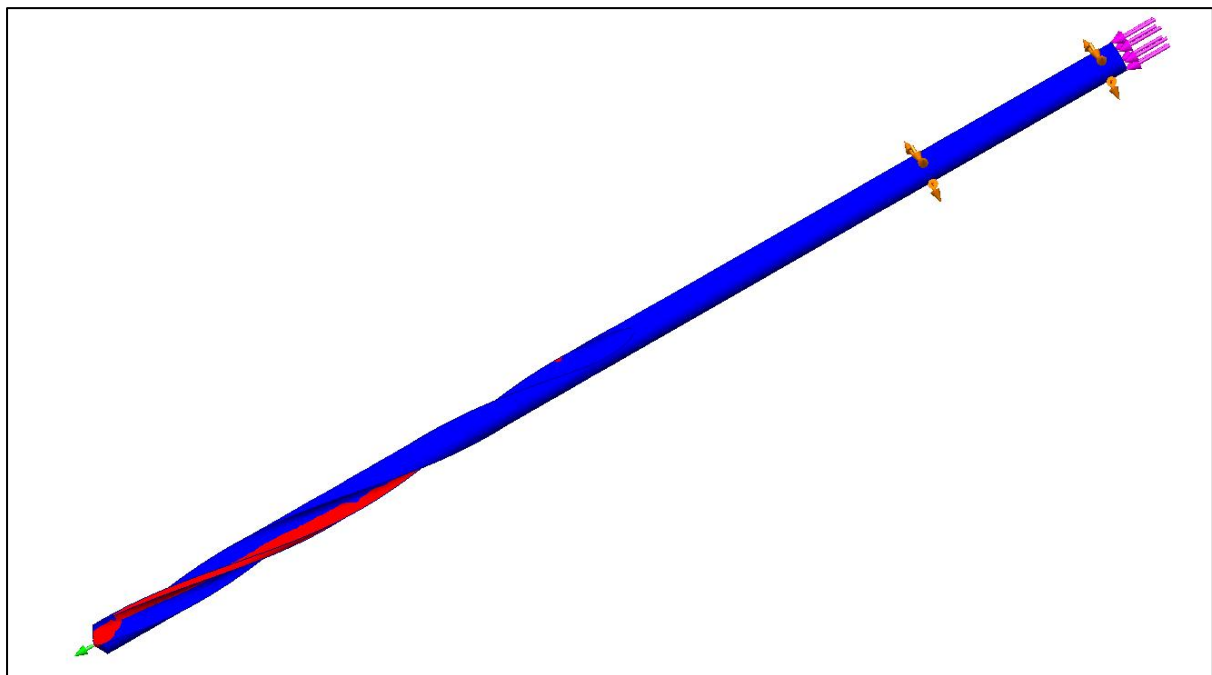


We can see that the Von-Mises stress plot shows concentrations on the cutting edge of the drill where it exceeds the yielding limit but elsewhere the material does not fail. This could be an artifact of the stress concentration due to the vertex tip where concentrated loads are generated and distributed throughout the cutting edge. To confirm this, we also checked the factor of safety plots related to yielding.

Below contour plot is for Factor of Safety related to yielding plot over its entire range starting from 1:



To highlight the concentrated areas, we take a look at contour plot only highlighting red areas with factor of safety less than 1 (**FOS<1**), shown below:



From the stress and factor of safety contour plots related to yielding, it can be said that the drill does not fail completely because of yielding but only the cutting edge and vertex tip might have highly concentrated stresses. And bulk of the drill bit has factor of safety related to yielding greater than 1.

On the other hand, when we look at buckling factor of safety, which is 0.47876 (less than 1), it clearly suggests that the drill bit will fail due to buckling.

**Thus, the drill bit buckles first.**