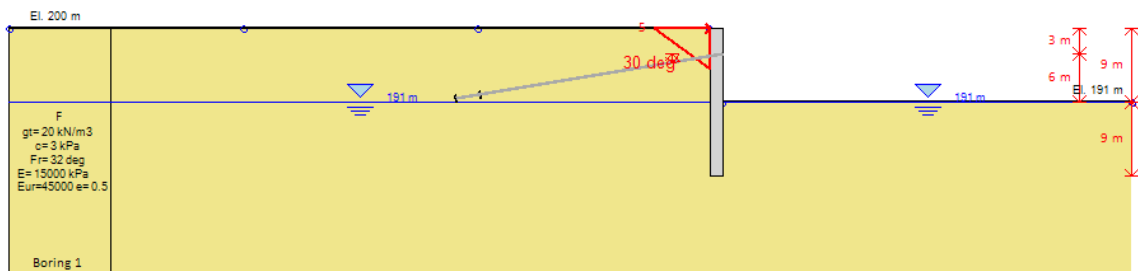


## Verification of a helical anchor geotechnical capacity

The purpose of this example is to verify geotechnical capacity calculations for a helical ground anchor. The example below shows a 9m excavation with a helical anchor installed 3m below the top of the wall and at a 30 degree inclination.

Design Section



The following information is used to determine the geotechnical pullout resistance of the helical anchor:

End offset: 0.152 m (distance from end to first helical plate)

Effective helix area:  $0.06271\text{m}^2$

Helix diameter: 0.3048m (12inches)

Number of plates: 2

Plate spacing: 1m

Ultimate helix cap: 841.05 kN

Soil density above water:  $19\text{ kN/m}^3$

The first task is to determine the elevations of each plate, this can be done by finding the length to each plate from the anchor head:

$$L_{plate1} = L_{anchor} - 0.152m = 11m - 0.152m = 10.848m$$

$$L_{plate2} = L_{plate1} - 1m = 9.848m$$

Then the corresponding elevations at each plate are:

$$EL_{plate1} = 197m - L_{plate1} \times \sin(30) = 191.576m$$

$$EL_{plate2} = 197m - L_{plate2} \times \sin(30) = 192.076m$$

The effective vertical stress then at each plate is:

$$\sigma'_{V,plate1} = 19 \text{ kN/m}^3 \times (200 - EL_{plate1}) = 160.056 \text{ kPa}$$

$$\sigma'_{V,plate2} = 19 \text{ kN/m}^3 \times (200 - EL_{plate2}) = 150.556 \text{ kPa}$$

With the individual bearing method the bearing capacity can then be calculated at each plate as:

$$Q_h = A_h (9 c + \gamma D N_q) \leq Q_{h, str}$$

$$\text{Where } N_q = 0.5 (12 * \phi)^{\phi/54} \text{ and for } \phi = 32 \text{ deg then } N_q = 17$$

Then for each plate:

$$Q_{h,1} = A_{h,1} (9 c + \gamma D N_q) = 0.06271 \text{ m}^2 \times (9 \times 3 \text{ kPa} + 160.06 \times 17 \text{ kPa}) = 172.3 \text{ kN}$$

$$Q_{h,2} = A_{h,2} (9 c + \gamma D N_q) = 0.06271 \text{ m}^2 \times (9 \times 3 \text{ kPa} + 150.56 \times 17 \text{ kPa}) = 162.2 \text{ kN}$$

Then the total ultimate geotechnical pullout resistance with the individual plate bearing method is:

$$Q_h = Q_{h,1} + Q_{h,2} = 334.5 \text{ kN}$$

With an allowable FS= 2.0 the allowable geotechnical capacity is:

$$Q_{h,ALLOW} = Q_h / 2 = 167.2 \text{ kN}$$

Now also calculate the capacity with the cylinder method:

On the cylinder sides:

$$Q_{\text{cylinder.sides}} = \pi \times D \times \text{spacing} \times [\tan(\phi_{\text{average}}) \times (\sigma'_{V,\text{plate1}} + \sigma'_{V,\text{plate2}})/2 + c_{\text{average}}] \Rightarrow$$

$$Q_{\text{cylinder.sides}} = \pi \times 0.3048\text{m} \times 1\text{m} \times (\tan(32) \times (160.056\text{ kPa} + 150.556\text{ kPa})/2 + 3\text{ kPa}) \Rightarrow$$

$$Q_{\text{cylinder.sides}} = 95.8\text{ kN}$$

The last plate (Plate 2) has a bearing capacity of:  $Q_{h,2} = 162.2\text{ kN}$

Then the total ultimate cylinder strength is:

$$Q_{\text{cylinder}} = Q_{\text{cylinder.sides}} + Q_{h,2} = 95.8\text{ kN} + 162.2\text{ kN} = 258\text{ kN}$$

Since the cylinder strength is smaller than the individual bearing method the ultimate anchor capacity is:

$$Q_{h,\text{ult}} = Q_{\text{cylinder}} = 258\text{ kN}$$

Which is verified by the program as the following figure shows:

