Joint Separation Calculations

The external force is compared to the force needed to cause separation. Both are calculated in the section below and a UF is used to compare the two and ascertain if the joint will separate.

$$F_{sep\_max} := \frac{F_{preload}}{1 - C} = 12537.187 \ lbf$$

External force at which separation will occur for maximum torque value

$$UF_{sep} := \frac{F_{external}}{F_{sep\_max}} = 0.479$$

$UF_{sep} = 0.479$

PASS: UF <= 1

Utilization factor against joint separation is less than 1 therefore the joint will not separate

Resultant Axial Stress

The resultant axial stress on each screw is calculated as follows.

$$F_{res\_axial} := C \cdot F_{external} + F_{preload} = 11835.278 \ lbf$$

Resultant axial load on screw

$$\sigma_{screw} := \frac{4 \cdot F_{res\_axial}}{\pi \cdot d_r^{\,2}} = 38515.359 \ psi$$

Resultant stress in screw due to axial load

$$UF := \frac{\sigma_{screw}}{\sigma_a} = 0.58$$

$UF = 0.58$

PASS: UF <= 1

Utilization factor against yield less than 1 therefore screws not expected to fail by yield.

Bearing Stress

$$n_{thread} := \text{floor}\left(\frac{L_{grip}}{p}\right) = 10$$

Number of engaged threads

$$\sigma_{bearing} := \frac{2 \cdot F_{res\_axial}}{\pi \cdot d_m \cdot n_{thread} \cdot p} = 10.955 \ ksi$$

Bearing stress in screw due to axial load

$$UF := \frac{\sigma_{bearing}}{\sigma_a} = 0.165$$

$UF = 0.165$

PASS: UF <= 1

Von Mises Stress

$$\sigma_{axial} := \frac{-4 \cdot F_{res\_axial}}{\pi \cdot d_r^{\,2}} = -38.515 \ ksi$$

Axial stress in screw due to resultant axial load

$$\sigma_{bending} := \frac{6 \cdot F_{res\_axial}}{\pi \cdot d_r \cdot n_{thread} \cdot p} = 36.137 \ ksi$$

Bending stress in screw due to resultant axial load

$$\sigma_{VM} := \sqrt{\frac{(\sigma_{bending} - 0)^2 + (0 - \sigma_{axial})^2 + (\sigma_{axial} - \sigma_{bending})^2}{2}} = 64.662 \ ksi$$

Von Mises stress

$$UF := \frac{\sigma_{VM}}{\sigma_a}$$

$UF = 0.974$

PASS: UF <= 1

Utilization factor less than 1 therefore the screws will not fail