











Mathcad Professional - [Hourglasskito.mcd]

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Normal Arial 10 B I U

Catenaryworks problem

$s := 4\text{ m}$ length of the struts $R := 1\text{ m}$ radius from center to vertex of the triangles $L := 2 \cdot R \cdot \cos(30\text{ deg})$ $L = 1.732\text{ m}$ side of the equilateral triangles of cable

$s_p(\alpha) := 2 \cdot R \cdot \left(\sin(30\text{ deg}) \cdot \sin\left(\frac{\alpha}{2}\right) + \cos(30\text{ deg}) \cdot \cos\left(\frac{\alpha}{2}\right) \right)$ projected length on horizontal plane of the struts

$\gamma_s(\alpha) := \arcsin\left(\frac{s_p(\alpha)}{s}\right)$ angle the struts form with the vertical $h(\alpha) := s \cdot \cos(\gamma_s(\alpha))$ overall height of the outfit

$c_p(\alpha) := 2 \cdot R \cdot \sin\left(\frac{\alpha}{2}\right)$ projected length on horizontal plane of the retentor cables at faces

$\gamma_c(\alpha) := \arctan\left(\frac{c_p(\alpha)}{h(\alpha)}\right)$ angle the retentor cables at faces form with the vertical

$f_{sp}(\alpha) := 1\text{ tonf} \cdot \frac{\sin\left(90\text{ deg} + \frac{\alpha}{2}\right)}{\sin(60\text{ deg})}$ projection of the compressive force in the strut when the radial force is 1 tonf

$f_{cp}(\alpha) := 1\text{ tonf} \cdot \frac{\sin\left(30\text{ deg} - \frac{\alpha}{2}\right)}{\sin(60\text{ deg})}$ projection of the tensile force in the retentor cable when the radial force is 1 tonf

The proportion between these two forces ensures the resultant is in the radial direction. Since we know the horizontal projections, and the angles both the strut and the retentor cable form with the vertical we can derive the vertical projection of force they stand when the radial force is 1 tonf

$f_{spv}(\alpha) := \frac{f_{sp}(\alpha)}{\tan(\gamma_s(\alpha))}$ $f_{cpv}(\alpha) := \frac{f_{cp}(\alpha)}{\tan(\gamma_c(\alpha))}$

$\alpha := 20\text{ deg}$ unwarranted guess for the angle for which vertical and horizontal equilibrium is feasible

Given

$f_{spv}(\alpha) = f_{cpv}(\alpha)$

$\text{True_}\alpha := \text{find}(\alpha)$ **True_α = 30 deg** $f_{spv}(\text{True_}\alpha) = 2.022\text{ tonf}$ $f_{cpv}(\text{True_}\alpha) = 2.022\text{ tonf}$ OK +

$f_{\text{cable_triangle}} := \frac{1\text{ tonf}}{\cos(30\text{ deg})}$ **f_cable_triangle = 0.577 tonf** $f_{\text{strut}} := \frac{f_{sp}(\text{True_}\alpha)}{\sin(\gamma_s(\text{True_}\alpha))}$ **f_strut = 2.309 tonf** $f_{\text{retentor_cable}} := \frac{f_{cp}(\text{True_}\alpha)}{\sin(\gamma_c(\text{True_}\alpha))}$ **f_retentor_cable = 2.044 tonf**

Press F1 for help. AUTO Page 1

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