Magic Maths

Formulae

$$f_1(W) := \frac{W}{(w+t)\cdot 2} + \frac{W\cdot\tan(\beta)\cdot l}{w\cdot t + \frac{t^2}{3}} + \frac{W\cdot\tan(\alpha)\cdot l}{w\cdot t + \frac{w^2}{3}}$$

$$f_2(W) := \frac{W\cdot\tan(\beta)}{2\cdot(w+t)} \qquad f_3(W) := \frac{W\cdot\tan(\alpha)}{2\cdot(w+t)}$$

Overlord amazing solution

$$P_W := \frac{W\cdot f_{max}}{\sqrt{\left(f_1(W)\right)^2 + \left(f_2(W)\right)^2 + \left(f_3(W)\right)^2}}$$

Notice that Overlord soltuion is independent of W

$$\mathrm{maple}\left(simplify\left(\frac{d}{d\,W} P_W\right)\right) = 0$$

Symbolic solution

$$P_{WS} := \mathrm{maple}\left(\mathrm{solve}\left(\sqrt{\left(f_1(W)\right)^2 + \left(f_2(W)\right)^2 + \left(f_3(W)\right)^2} - f_{max},\ W\right)\right)_1$$

It's a really complicate expression

$$P_{WS} = \overline{\sqrt{t\cdot\left(t\cdot\left(t\cdot\left(w\cdot\left(w\cdot\left(\left(\tan(\beta)^2+\tan(\alpha)^2\right)\cdot\left(t\cdot\left(2\cdot w\cdot(59\cdot w+30\cdot t)+9\cdot t^2\right)+60\cdot w^3\right)+2\cdot\left(w\cdot\left(t\cdot\left(59\cdot w+6\cdot\left(5\cdot t+2\cdot l\cdot(21\cdot\tan(\beta)+26\cdot\tan(\alpha)\right)\right)\right)+6\cdot\left(w\cdot\left(\right.\right.\right.\right.\right.\right.\right.\right.}}$$

It's the same!!!. Amazing

$$\mathrm{maple}\left(simplify\left(P_W - P_{WS},\ symbolic\right)\right) = 0$$

Numerical values

$\alpha := 12\ \mathrm{deg}$ $\qquad$ $\beta := 7\ \mathrm{deg}$ $\qquad$ $f_{max} := 2182\ \frac{\mathrm{lbf}}{\mathrm{in}}$

$t := 1.53\ \mathrm{in}$ $\qquad$ $w := 4.2\ \mathrm{in}$ $\qquad$ $l := 3.11\ \mathrm{in}$

Numeric evaluation of the symbolic solution

$$P_{WS} = 49737.0504\ \mathrm{N}$$

Usual and generic SMath implementation for the solver

$u := \mathrm{N}$ $\qquad$ $\mathrm{Clear}(W) = 1$ $\qquad$ Notice that actually W isn't defined yet!

$$eq := \sqrt{\left(f_1(W)\right)^2 + \left(f_2(W)\right)^2 + \left(f_3(W)\right)^2} - f_{max}$$

$$P_{WN} := u\cdot\mathrm{roots}\left(\begin{array}{|l} W := W\ u \\ eq \end{array},\ W\right) = 49737.0504\ \mathrm{N}$$

The same as the symbolic solution

W isn't defined, this give an error ...

$$P_W = \blacksquare$$

Just define any dummy W value ...

$$W := 6\ \mathrm{kip}$$

and see the miracle maths in the overlord solution

$$P_W = 49737.0504\ \mathrm{N}$$

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