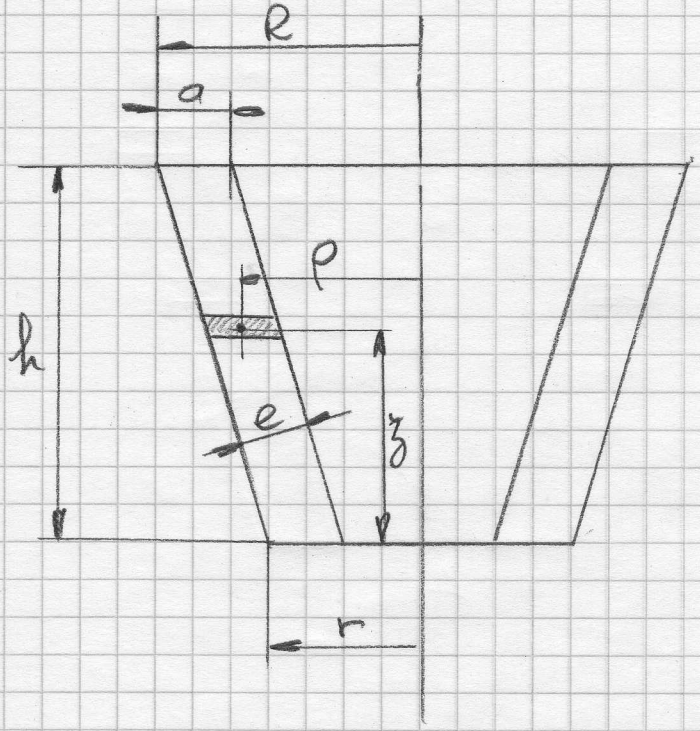
idem mais en utilisant R, r, e et h



$$a = \sqrt{e^2 + \left(e\,\frac{(R-r)}{h}\right)^2}$$

$$\rho = r - \frac{a}{2} + (R-r)\cdot\frac{z}{h}$$

$$dv = 2\pi a\left(r - \frac{a}{2} + \frac{(R-r)z}{h}\right).dz$$

$$V = 2\pi a \int_0^h \left(r-\frac{a}{2}\right)dz + \frac{(R-r)}{h}\cdot z\cdot dz$$

$$V = 2\pi a\left[\left(r-\frac{a}{2}\right)z + \frac{(R-r)}{h}\cdot\frac{z^2}{2}\right]_0^h$$

$$V = 2\pi a\left(\left(r-\frac{a}{2}\right)h + \frac{(R-r)}{h}\cdot\frac{h^2}{2}\right)$$

$$V = \pi h a(R+r-a)$$

$$\Sigma dv.z = 2\pi a\int_0^h \left(\left(r-\frac{a}{2}\right) + \frac{(R-r)}{h}z\right)\cdot z\cdot dz$$

$$= 2\pi a\int_0^h \left(r-\frac{a}{2}\right)z\,dz + \frac{(R-r)}{h}\cdot z^2 dz$$

$$= 2\pi a\left[\left(r-\frac{a}{2}\right)\frac{z^2}{2} + \frac{(R-r)}{h}\cdot\frac{z^3}{3}\right]_0^h$$

$$= 2\pi a h^2\left(\frac{r}{2} - \frac{a}{4} + \frac{(R-r)}{3}\right) = \pi a R^2\left(r - \frac{a}{2} + \frac{2}{3}R - \frac{2}{3}r\right)$$

$$= \pi a h^2\left(\frac{(2R+r)}{3} - \frac{a}{2}\right)$$

$$z_G = \frac{\pi a h^2\left(\frac{2R+r}{3} - \frac{a}{2}\right)}{\pi a h\,(R+r-a)}$$

$$\boxed{z_G = \frac{h\left(\left(\frac{2R+r}{3}\right) - \frac{a}{2}\right)}{(R+r-a)}}$$