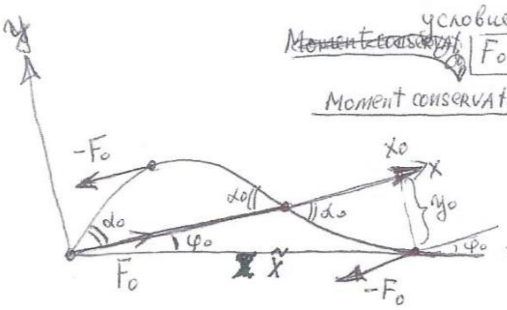
Extra - Rumple 3



условие сохр-ния момента

~~Moment conservat~~ $\boxed{F_0 \cdot y = -\varkappa K}$, where $K = \frac{1}{R} = \frac{y''}{(1+y'^2)^{3/2}}$ curvati

Moment conservation

$\varkappa = EI$, E - elastic modulus, I - second area moment

(Elastic theory of bending)

$$\Rightarrow \boxed{\frac{F_0}{\varkappa}\, y = \frac{-y''}{(1+y'^2)^{3/2}}} \qquad (*)$$

$$\exists\ \frac{F_0}{\varkappa} \equiv 2A\ ;\quad z(y) = y'\ ;\quad y'' = \frac{dz}{dx} = \frac{dz}{dy}\frac{dy}{dx} = z'z\ :\quad (*) \Rightarrow \frac{-zz'}{(1+z^2)^{3/2}} = 2Ay\ ;$$

$$\frac{-d(1+z^2)}{2(1+z^2)^{3/2}} = 2A\,y\,dy\ ;\quad d\left(\frac{1}{(1+z^2)^{1/2}}\right) = A\,d(y^2) \Rightarrow \frac{1}{\sqrt{1+y'^2}} - \frac{1}{\sqrt{1+tg^2\alpha_0}} = Ay^2$$

$$\text{OR}\quad \boxed{\cos\varphi - \cos\alpha_0 = Ay^2}\ ;\ \boxed{c\varphi - c\alpha_0 = Ay^2}$$

$$y \overset{(\pm)}{=} \frac{1}{\sqrt{A}}\sqrt{c\varphi - c\alpha_0}\ ;\quad dy = \overbrace{\frac{1}{2\sqrt{A}}}^{\text{Sign}(y)}\frac{-s\varphi\, d\varphi}{\sqrt{c\varphi - c\alpha_0}} = tg\varphi \cdot dx \Rightarrow dx = \frac{1}{2\sqrt{A}}\,\frac{-c\varphi\, d\varphi}{\sqrt{c\varphi - c\alpha_0}}\,\text{sign}(y)$$

$$\Rightarrow \boxed{X_0 = \frac{1}{2\sqrt{A}}\left[\underbrace{\int_{\alpha_0}^{-\alpha_0}\frac{-c\varphi\, d\varphi}{\sqrt{c\varphi - c\alpha_0}}}_{\text{Sign}(y) = +1} + \underbrace{\int_{-\alpha_0}^{-\varphi_0}\frac{-c\varphi\, d\varphi}{\sqrt{c\varphi - c\alpha_0}}}_{-1 = \text{Sign}(y)}\right] = \frac{1}{2\sqrt{A}}\left(\int_{-\alpha_0}^{\alpha_0} + \int_{\varphi_0}^{\alpha_0}\right)\frac{c\varphi\, d\varphi}{\sqrt{c\varphi - c\alpha_0}}}\ ;\ \boxed{y_0 = \frac{1}{\sqrt{A}}\sqrt{c\varphi_0 - c\alpha_0}}$$

Conditions for rumple "end". Must be $\boxed{ctg\varphi_0 = \frac{X_0}{y_0}}$,

$$\text{i. e.}\quad \boxed{ctg\varphi_0 = \frac{1}{2\sqrt{c\varphi_0 - c\alpha_0}}\left(\int_{-\alpha_0}^{\alpha_0} + \int_{\varphi_0}^{\alpha_0}\right)\frac{c\varphi\, d\varphi}{\sqrt{c\varphi - c\alpha_0}}}$$

φ_0 & α_0 connection

$$\text{OR For computation:}\quad \boxed{ctg\varphi_0 = \frac{1}{\sqrt{c\varphi_0 - c\alpha_0}}\left(-4\int_0^{\alpha_0} - 2\int_{\varphi_0}^{\alpha_0}\right)\frac{c\varphi\, d\left(\sqrt{s\frac{\alpha-\varphi}{2}}\right)}{c\frac{\alpha-\varphi}{2}\sqrt{2s\frac{\alpha+\varphi}{2}}}} \qquad (**)$$

Rumple length $\quad \sqrt{A}\,L = \int dx\sqrt{1+tg^2\varphi} = \left(-4\int_0^{\alpha_0} - 2\int_{\varphi_0}^{\alpha_0}\right)\frac{d\left(\sqrt{s\frac{\alpha-\varphi}{2}}\right)}{c\frac{\alpha-\varphi}{2}\sqrt{2s\frac{\alpha+\varphi}{2}}}$

Rumple base $\quad \sqrt{A}\,\tilde{X} = \frac{1}{c\varphi_0}\int dx = \frac{1}{c\varphi_0}\left(-4\int_0^{\alpha_0} - 2\int_{\varphi_0}^{\alpha_0}\right)\frac{c\varphi\, d\left(\sqrt{s\frac{\alpha-\varphi}{2}}\right)}{c\frac{\alpha-\varphi}{2}\sqrt{2s\frac{\alpha+\varphi}{2}}}$ $\qquad (***)$

$L/\tilde{X} = 9/7$

~~$\alpha_0 \approx 59°$~~
~~$\varphi_0 \approx 16°$~~

Algorithm for given $\alpha_1 \leq \alpha_0 \leq \alpha_2$ 1) from (**) find φ_0 2) from (**) find L/X and adjust to $9/7$