# Formulaire 2017: Mécanique des roches

$\sigma_n = F_N / A_p = (F/A) \cos^2\theta$

$\tau = F_S/A_p = (F/A) \sin\theta\cos\theta$

$\sigma_n = \sigma_1 \cos^2\theta + \sigma_3 \sin^2\theta$

$\tau = \sin\theta\cos\theta(\sigma_1 + \sigma_3)$

$$\left[\sigma n - \frac{(\sigma 1 + \sigma 3)}{2}\right]^2 + \sigma s^2 = \left[\frac{(\sigma 1 - \sigma 3)\cos 2\theta}{2}\right]^2 + \left[\frac{(\sigma 1 - \sigma 3)\sin 2\theta}{2}\right]^2$$

$\tau = c + \sigma n \tan \phi$

$$\sigma_1 = \sigma_3 \cdot K_p + \sigma_c$$

$$\phi = \sin^{-1} \frac{Kp - 1}{Kp + 1}$$

$$\sigma_{Tensile} = \frac{2 \cdot F_{Compressive}}{\pi \cdot D \cdot L}$$

$$c = \frac{\sigma_1 - \sigma_3 \cdot Kp}{2 \cdot \sqrt{Kp}}$$

$(\sigma_1 - \sigma_3)^2 - 8\, \sigma_t\, (\sigma_1 + \sigma_3) = 0$

$\tau^2 = 4\, \sigma_t\, (\sigma_n + \sigma_t)$

$$\sigma_1 = \sigma_3 + \sqrt{m_i \cdot \sigma_3 \cdot \sigma_{ci} + \sigma_{ci}^2}$$

$$\sigma_1 = \sigma_3 + \sigma_{ci} \sqrt{m_i \cdot \frac{\sigma_3}{\sigma_{ci}} + 1}$$

$$\frac{\sigma_1}{\sigma_{ci}} = \frac{\sigma_3}{\sigma_{ci}} + \sqrt{m_i \cdot \frac{\sigma_3}{\sigma_{ci}} + 1}$$

$$(\sigma_1 - \sigma_3) = \frac{2\,(c_w + \sigma_3 \tan\phi_w)}{(1 - \tan\phi_w \cot\beta)\sin 2\beta}$$

$(\sigma_1 - \sigma_3)_{min} = 2(c_w + \sigma_3 \tan\phi_w)\, [(1 + \tan^2\phi_w)^{½} + \tan\phi_w]$

$\sigma_1/\sigma_c = \{[\sigma_3\, (1 + \sin\phi)] / [B\, \sigma_c\, (1 - \sin\phi)] + 1\}^B$

$\sigma_{ti} = \frac{2.P}{\pi.\varphi.l}$

$Q = A\, K\, (h1 - h2)/L$

$K = k.\rho.g/\mu$

$E_s = \rho v_p^2$

$G_s = \rho v_s^2$

$\nu_s = [1-2(v_s/v_p)^2] / \{2[1-(v_s/v_p)^2]\}$

$RQD = \Sigma L_i / L \times 100\%, \quad L_i \geq 10$ cm

$RQD = (L1 + L2 + \ldots + Ln) / L \times 100\%$

$\lambda = 1 / s_j$ [#/m]

$\lambda = n / L$

$RQD = 100\,(0.1\lambda + 1)\, e^{-0.1\lambda}$

$\tau_p = \sigma_n \tan(\phi + i)$

$\tau_r = \sigma_n \tan \phi r$

$\tau_p = \sigma_n \tan \phi_r$

$$\tau_p = \sigma_n \tan\left(JRC \cdot \log_{10} \frac{JCS}{\sigma_n} + \phi_r\right)$$

$k = g\, d^2 / 12\, \nu$

$Q = A\, i\, g\, d^2 / 12\, \nu$

$d_e = JRC^{2.5} / (d/d_e)^2$

$k_f = k_r [1 - B\, Ln(\sigma_n'/\sigma_r')]^2$

$$Q = \frac{RQD}{J_n} \cdot \frac{J_r}{J_a} \cdot \frac{J_w}{SRF}$$

$N = (RQD / J_n)\,(J_r / J_a)\,(J_w)$

$RMi = \sigma_{ci}\, J_p$

$RMR = 9 \ln Q + (44 \pm 18)$

$RMR = 13.5 \log Q + 43$

$GSI = RMR - 5$ (pour $GSI > 25$)

$$\sigma_1 = \sigma_3 + \left(m_b \cdot \sigma_3 \cdot \sigma_{ci} + s \cdot \sigma_{ci}{}^2\right)^a$$

$$\frac{\sigma_1}{\sigma_{ci}} = \frac{\sigma_3}{\sigma_{ci}} + \left(m_b \cdot \frac{\sigma_3}{\sigma_{ci}} + s\right)^a$$

$m_b = m_i \exp[(GSI-100)/28]$

si $GSI > 25$, $s = \exp[(GSI-100)/9]$ ; $a = 0.5$

si $GSI < 25$, $s = 0$ ; $a = 0.65 - GSI/200$

$E_m = 25 \log_{10} Q$ pour $Q > 1$

$E_m = 10\ (Q\ \sigma_{ci} / 100)^{1/3}$

$E_m = 2\ RMR - 100$ pour $RMR > 50$

$E_m = 10^{(RMR - 10)/40}$ pour $20 < RMR < 85$

$E_m = 10^{(15 \log Q + 40)/40}$

$E_m = (\sigma_{ci} / 100)^{0.5} \cdot 10^{(GSI-10)/40}$

$$q_p = \sigma_1 = \sigma_{ci} \cdot \left(1 + \sqrt{m_i + 1}\right)$$

$$q_p = \sigma_1 = \sqrt{s} \cdot \sigma_{ci} \cdot \left(1 + \sqrt{{m_b}/{\sqrt{s}} + 1}\right)$$

$q_a = C_{f1}\ q_p / FS = C_{f1}\ \sigma_1 / FS$

$$q_a = \frac{C_{f1} \cdot q_p}{FS}$$

$q_a = q_p / FS = (C_{f1} \cdot c \cdot N_c + D \cdot \gamma \cdot N_q + ½ \cdot C_{f2} \cdot B \cdot \gamma \cdot N_\gamma) / FS$

$N_\phi = \tan^2(45 + ½\phi)$

$N_c = 2\ N_\phi^{½}\ (N_\phi + 1)$

$N_\gamma = N_\phi^{½}\ (N_\phi^2 - 1)$

$N_q = N_\phi^2$

$q_a = (C_{f1} \cdot c \cdot N_c) / FS$

$$\sigma_z = \frac{3Q}{2\pi}\frac{z^3}{R^5} = \frac{3Q}{2\pi z^2}\frac{1}{[1 + \left(\frac{r}{z}\right)^2]^{\frac{5}{2}}}$$

$$\sigma_r = \frac{Q}{2\pi}\left[\frac{3zr^2}{R^5} - \frac{1 - 2\nu}{R(R + z)}\right]$$

$$\sigma_\theta = \frac{Q}{2\pi}(1 - 2\nu)\left[\frac{1}{R(R + z)} - \frac{z}{R^3}\right]$$

$$\tau_{rz} = \frac{3Q}{2\pi}\frac{z^2 r}{R^5}$$

$$\tau_{\theta z} = \tau_{r\theta} = 0$$

$\delta = C_d \cdot q \cdot B \cdot (1 - \nu^2)/E$

$\delta = C'_d \cdot q \cdot B \cdot (1 - \nu^2)/E$

$e < B/6$, $q_1 = (Q/B)\ (1 + 6e/B)$

$q_2 = (Q/B)\,(1 - 6e/B)$

$e > B/6$, $q_1 = (4/3\ Q) / (B - 2e)$

$Q_s = \tau_s \cdot \pi \cdot D \cdot L / FS$

$\tau_a = \tau_s / FS \approx R \cdot \sigma_{m(s)}^{½} = R \cdot \sigma_{cm}^{½}$

$Q_b = ¼ \cdot \pi \cdot D^2 \cdot \sigma_{1m(b)} / FS$

$\delta = Q \cdot l / (D \cdot E_{m(s)})$

$\delta = (4 \cdot Q/\pi \cdot D^2) \cdot (L/E_p) + (4 \cdot Q/\pi \cdot D^2) \cdot [RF' \cdot C_d \cdot D \cdot (1 - \nu^2)/E_{m(b)}]$

$FS = [c \cdot A + (\Sigma w - \Sigma u) \cdot \tan\phi] / \Sigma H$

$Q_a = ½ \cdot \pi \cdot D \cdot L_b \cdot \tau_{ult} = \pi \cdot D \cdot L_b \cdot \sigma_c / 20$

$W_c = ⅓ \cdot \gamma_r \cdot \pi \cdot L^3 \cdot \tan^2\theta$

$F_r = \sigma_{tm} \cdot \pi \cdot L^2 / \cos^2\theta$

$$F_s = \frac{W \cdot \cos\beta \cdot \tan\varphi + c^* \cdot A}{W \cdot \sin\beta} = \frac{\tan\varphi}{\tan\beta} + \frac{c^* \cdot A}{W \cdot \sin\beta}$$

$Q = (F_r + W_c \cdot \cos\psi) / FS$

$$F_s = \frac{(W \cdot \cos\beta - U) \cdot \tan\varphi + c^* \cdot A}{W \cdot \sin\beta}$$

$$U = \frac{1}{2} \cdot \gamma_w \cdot \frac{H_w}{2} \cdot \frac{H_w}{\sin\beta} = \frac{1}{4} \cdot \gamma_w \cdot \frac{H_w^2}{\sin\beta}$$ exutoire ouvert

$$U = \frac{1}{2} \cdot \gamma_w \cdot \frac{H_w^2}{\sin\beta}$$ exutoire fermé

$k_1 = (e_1/d_1) \cdot k_{f1} + k_m$

$k_2 = (e_2/d_2) \cdot k_{f2} + k_m$

$$V = \frac{1}{2} \cdot \gamma_w \cdot h_w^2 \ ;\ U = \frac{1}{2} \cdot \gamma_w \cdot h_w \cdot L$$ exutoire ouvert

$$V = \frac{1}{2} \cdot \gamma_w \cdot h_w^2 \ ;\ U = \frac{1}{2} \cdot \gamma_w \cdot L \cdot (2 \cdot h_w + L \cdot \sin\beta)$$

Exécutoire fermé

$$F_S = \frac{(W \cdot \cos\beta - U - V \cdot \sin\beta) \cdot \tan\varphi + c^* \cdot A}{W \cdot \sin\beta + V \cdot \cos\beta}$$

$$F_s = \frac{\left(W \cdot \cos\beta - U - V \cdot \sin\beta + P_a \cdot \sin\left(\beta + \theta\right)\right) \cdot \tan\varphi}{W \cdot \sin\beta + V \cdot \cos\beta - P_a \cdot \cos\left(\beta + \theta\right)}$$

$$c_a = \frac{S_a}{S} \cdot \tau_a \cdot \sqrt{\frac{\sigma_c}{\sigma_f}}$$

$$F_s = \frac{N \cdot \tan\varphi + c^* \cdot S + c_a \cdot S}{T}$$

$$F_s = \frac{N \cdot \tan\varphi + c_a \cdot S}{T}$$

$$F_s = \frac{\left(W \cdot \cos\beta - U - V \cdot \sin\beta\right) \cdot \tan\varphi + c_a \cdot S}{W \cdot \sin\beta + V \cdot \cos\beta}$$

$$F_s = \frac{N_1 \cdot \tan\varphi_1 + N_2 \cdot \tan\varphi_2 + c_1^* \cdot S_1 + c_2^* \cdot S_2}{W \cdot \sin\beta}$$

$$N_1 = \frac{W \cdot \cos\beta \cdot \sin\theta_2}{\sin\left(\theta_1 + \theta_2\right)}$$

$$N_2 = \frac{W \cdot \cos\beta \cdot \sin\theta_1}{\sin\left(\theta_1 + \theta_2\right)}$$

$$F_s = K \cdot \frac{\tan\varphi}{\tan\beta}$$

$$K = \frac{\sin\theta_1 + \sin\theta_2}{\sin\left(\theta_1 + \theta_2\right)}$$

$$F_s = \frac{\tan\varphi}{\tan\beta} + \frac{c^* \cdot A}{W \cdot \sin\beta}$$

$$F_s = \frac{M_{stab,0}}{M_{déstab,0}} = \frac{b}{h \cdot \tan\beta}$$

$V = ½\,\gamma_w \cdot h^2 \cdot \cos\beta$

$U = ½\,\gamma_w \cdot h \cdot b \cdot \cos\beta$ exutoire ouvert

$U = ½\,\gamma_w \cdot b \cdot (2 \cdot h \cdot \cos\beta + b \cdot \sin\beta)$ exutoire bouché

$$F_s = \frac{\tau_{rés}}{\tau_{sol}} = \frac{\left(W \cdot \cos\beta - U\right) \cdot \tan\varphi + c^* \cdot A}{W \cdot \sin\beta + V}$$

$$F_s = \frac{M_{stab,0}}{M_{déstab,0}} = \frac{W \cdot \cos\beta \cdot b/2}{W \cdot \sin\beta \cdot h/2 + V \cdot h/3 + U \cdot 2h/3}$$

$P \cdot h_2 \geq W_1 \sin\beta \cdot {}^{h}1/_2 - W_1 \cos\beta \cdot {}^{b}1/_2$

$$P \geq \frac{W_1 \cdot (\sin\beta \cdot h_1 - \cos\beta \cdot b_1)}{2 \cdot h_2}$$

$W_2 \cos\beta \cdot {}^{b}2/_2 + P \tan\varphi \cdot b_2 \geq P \cdot h_2 + W_2 \sin\beta \cdot {}^{h}2/_2$

$$P \leq P_B = \frac{W_2 \cdot (\cos\beta \cdot b_2 - \sin\beta \cdot h_2)}{2 \cdot (h_2 - \tan\varphi \cdot b_2)}$$

$P + W_2 \sin\beta \leq (W_2 \cos\beta + P \tan\varphi) \cdot \tan\varphi$

$$P \leq P_G = \frac{W_2 \cdot (\cos\beta \cdot \tan\varphi - \sin\beta)}{1 - \tan^2\varphi}$$

RMR ajusté = RMR + [(A*B*C) + D]

$\dot{\varepsilon} = (\sigma_1 - \sigma_3)^n \, e^{(-H/(RT))}$

$$\dot{\epsilon} = \text{AVm} \, \frac{wCoDoe^{-Q/RT}}{RT} \frac{\sigma_n}{d^3}$$

$$\dot{\varepsilon} = A_V \frac{\sigma V}{RT} \cdot \frac{D_V}{d^2}$$

$$\dot{\varepsilon} = A_B \frac{\sigma V}{RT} \cdot \frac{\delta D_B}{d^3}$$