Equivalent of Yield Surface (OCC)

$$F_1 = \frac{\lambda - K}{V_0}\left(\frac{q}{Mp} + \ln\frac{P}{P_{c0}}\right) - \varepsilon_v^p$$

$$F_2 = q + Mp \ln\frac{P}{P_c}$$

* Key point: Hardening law

F_1: Hardening law $\in \varepsilon_v^p \rightsquigarrow P_c$

F_2: " $\in P_c$

(1): Isotropic hardening law:

$$d\varepsilon_v^p = \frac{\lambda - K}{V_0}\,\frac{dp_c}{p_c} \Rightarrow \varepsilon_v^p = \frac{\lambda - K}{V_0}\ln\frac{P_c}{P_{c0}}$$

$$(1) \Leftrightarrow F = \frac{\lambda - K}{V_0}\left(\frac{q}{Mp} + \ln\frac{P}{P_{c0}}\right) - \frac{\lambda - K}{V_0}\ln\frac{P_c}{P_{c0}} = 0$$

$$\Leftrightarrow \quad \frac{q}{Mp} + \ln\left(\frac{P}{P_{c0}}\,\frac{P_{c0}}{P_c}\right) = 0$$

$$\Leftrightarrow \quad \frac{q}{Mp} + \ln\frac{P}{P_c} = 0$$

$$\Leftrightarrow \quad q + Mp\ln\frac{P}{P_c} = 0$$

Equivalence of Yield Surface (MCC)

. $F_1 = \dfrac{\lambda - \kappa}{v_0}\left[\ln\left\{1 + \left(\dfrac{q}{Mp}\right)^2\right\} + \ln\dfrac{p}{p_{c0}}\right] - \varepsilon_v^p$

. $F_2 = \dfrac{q^2}{M^2} + p(p - p_c)$

* Key point: Hardening law

F_1: Hardening law $\in \varepsilon_v^p \rightsquigarrow p_c$

F_2: Hardening law $\in p_c$

(1): Isotropic hardening law:

$$d\varepsilon_v^p = \frac{\lambda - \kappa}{v_0}\frac{dp_c}{p_c} \Rightarrow \varepsilon_v^p = \frac{\lambda - \kappa}{v_0}\ln\frac{p_c}{p_{c0}}$$

$$(1) \Leftrightarrow F_1 = \frac{\lambda - \kappa}{v_0}\left[\ln\left\{1 + \left(\frac{q}{Mp}\right)^2\right\} + \ln\frac{p}{p_{c0}} - \ln\frac{p_c}{p_{c0}}\right] = 0$$

$$\Leftrightarrow \left[1 + \left(\frac{q}{Mp}\right)^2\right]\frac{p}{p_{c0}}\frac{p_{c0}}{p_c} = 1$$

$$\Leftrightarrow \left(1 + \frac{q^2}{M^2 p^2}\right)p = p_c$$

$$\Leftrightarrow \frac{q^2}{M^2} + p(p - p_c) = 0$$