

Stress-Strain Relationship of Concrete under Compression

-- Elasto-Plastic and Fracture Model --

Plasticity and Fracture

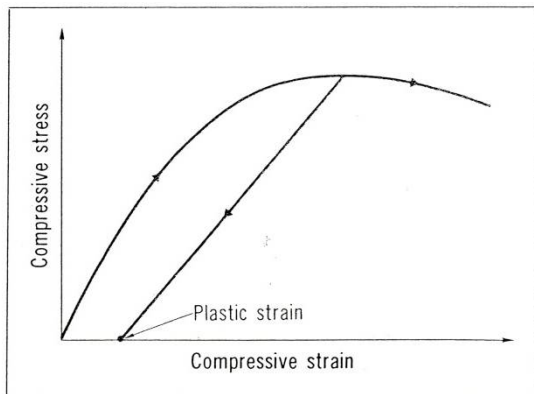


Fig.4.4b Definition of plastic strain

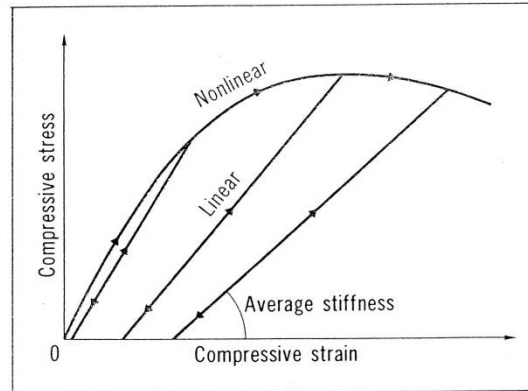


Fig.4.4a Compressive stress - strain relation of concrete

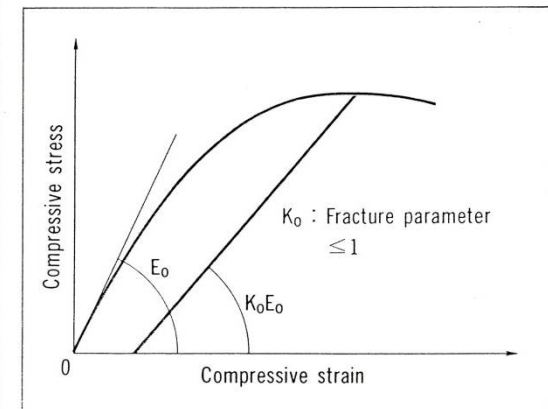


Fig.4.4c Definition of fracture

Basic Assumptions

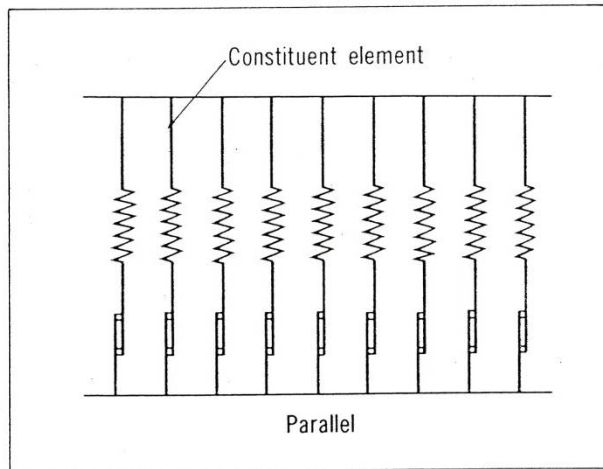


Fig.4.4d Assumption 1 : Concrete is composed of some constituent elements in parallel

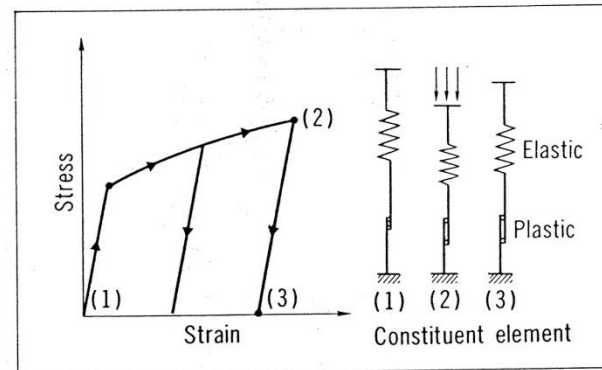


Fig.4.4e Assumption 2 : Elasto-plastic material for a constituent element

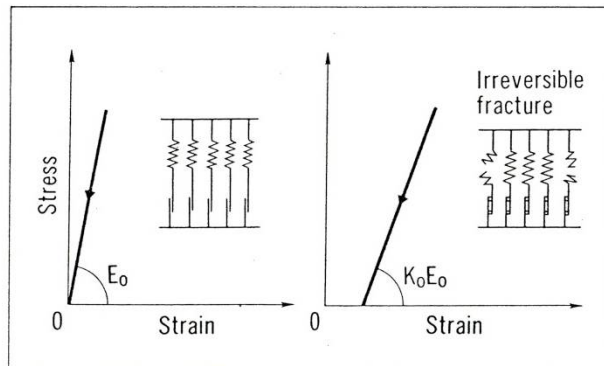


Fig.4.4f Assumption 3 : Fracture of constituent elements

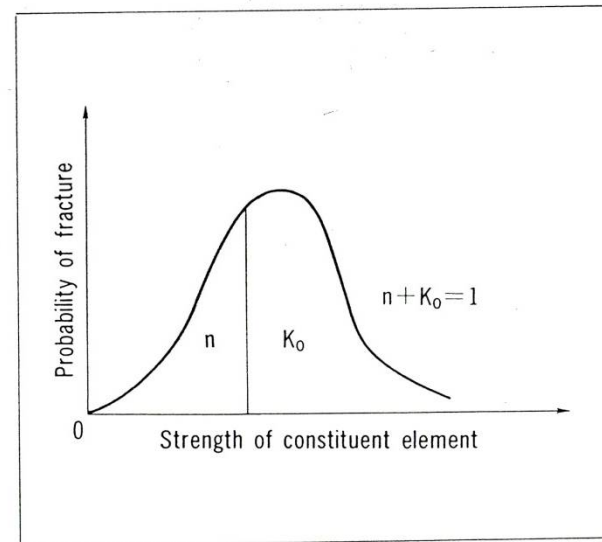


Fig.4.4g Assumption 4 : Strength distribution of constituent elements

Formulation of Plastic Strain and Fracture Parameter

Plastic strain:

$$\varepsilon_p = \varepsilon_{\max} - \frac{20}{7} \left\{ 1 - \exp\left(-0.35 \frac{\varepsilon_{\max}}{\varepsilon_{co}}\right) \right\} \varepsilon_{co}$$

Fracture Parameter:

$$K = \exp\left[-0.73 \frac{\varepsilon_{\max}}{\varepsilon_{co}} \left\{ 1 - \exp\left(-1.25 \frac{\varepsilon_{\max}}{\varepsilon_{co}}\right) \right\}\right]$$

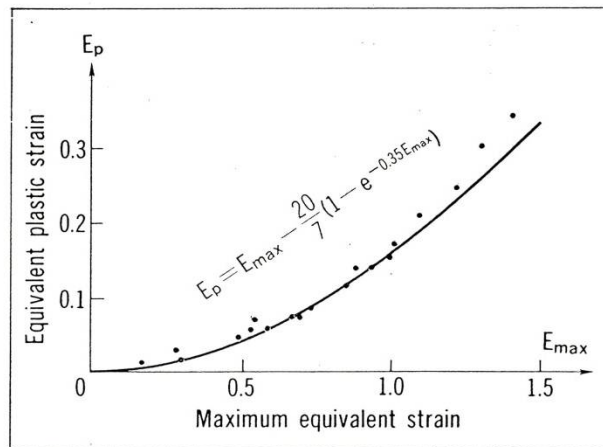


Fig.4.5j Formulation of equivalent plastic strain

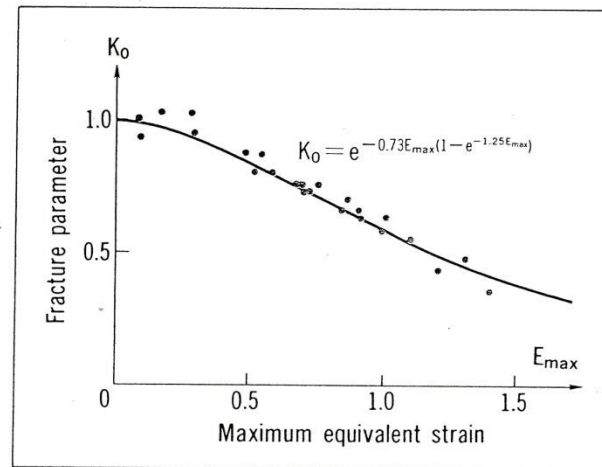


Fig.4.5l Formulation of fracture parameter

Modification for Smeared Crack Model for Concrete in RC

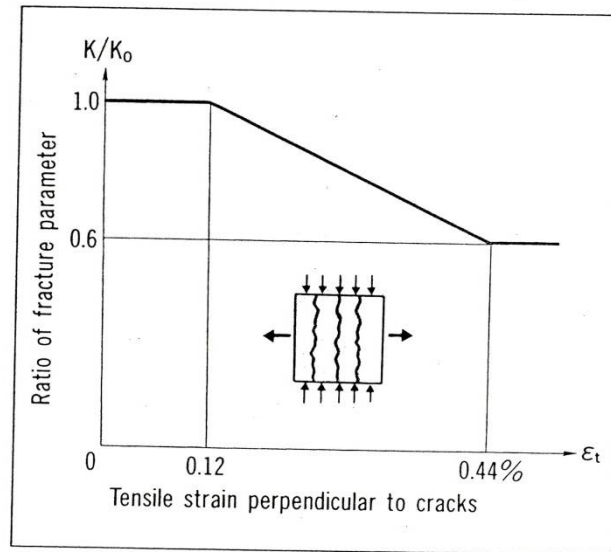
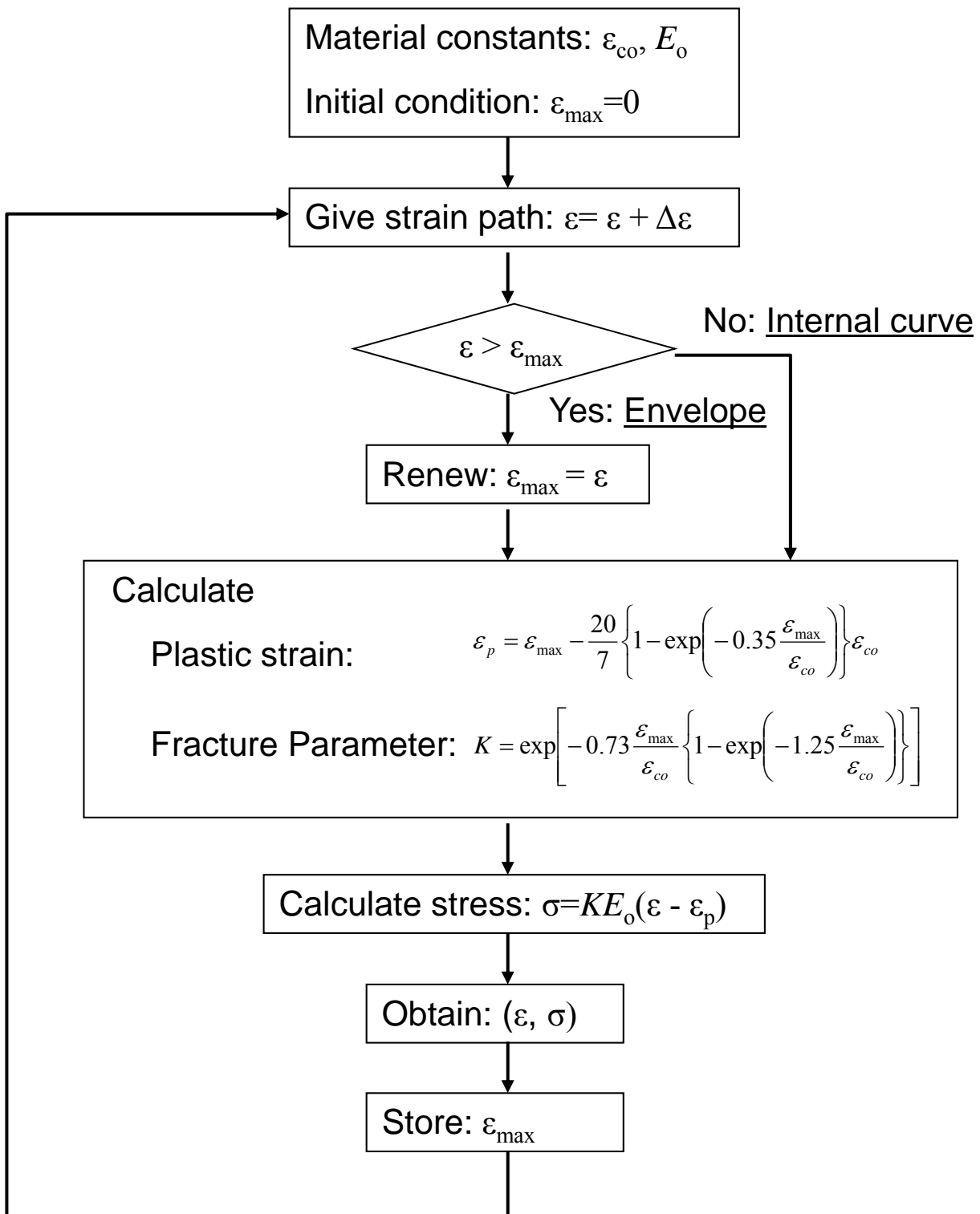


Fig.2.3g Reduction in fracture parameter
 K : Fracture parameter for cracked concrete
 K_0 : Fracture parameter for uncracked concrete



Flow chart for 'Elasto-Plastic and Fracture Model'

Assignment

Calculate stress under the given strain path and draw stress-strain curve using the Elasto-Plastic and Fracture Model

$\varepsilon' = 0, \sigma' = 0 \rightarrow$ (loading) $\rightarrow \varepsilon' = 1000\mu \rightarrow$ (unloading) \rightarrow
 $\sigma' = 0 \rightarrow$ (reloading) $\rightarrow \varepsilon' = 2000\mu \rightarrow$ (unloading) \rightarrow
 $\sigma' = 0 \rightarrow$ (reloading) $\rightarrow \varepsilon' = 3000\mu \rightarrow$ (unloading) \rightarrow
 $\sigma' = 0 \rightarrow$ (reloading) $\rightarrow \varepsilon' = 3500\mu \rightarrow$ (end)

material constants: $\varepsilon'_{c_0} = 2000\mu, E_0 = 30\text{GPa}$