The Behaviour of the Process Region at Large Scale Yielding

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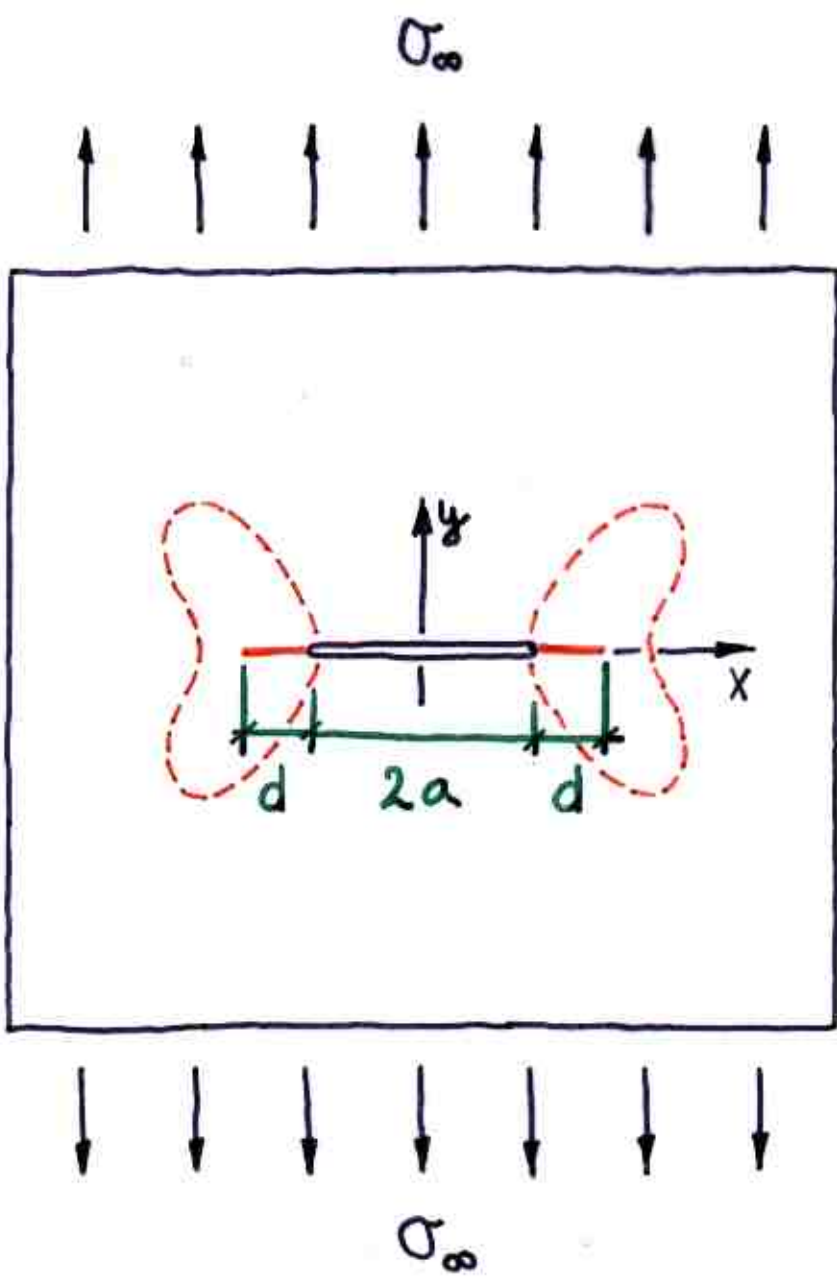
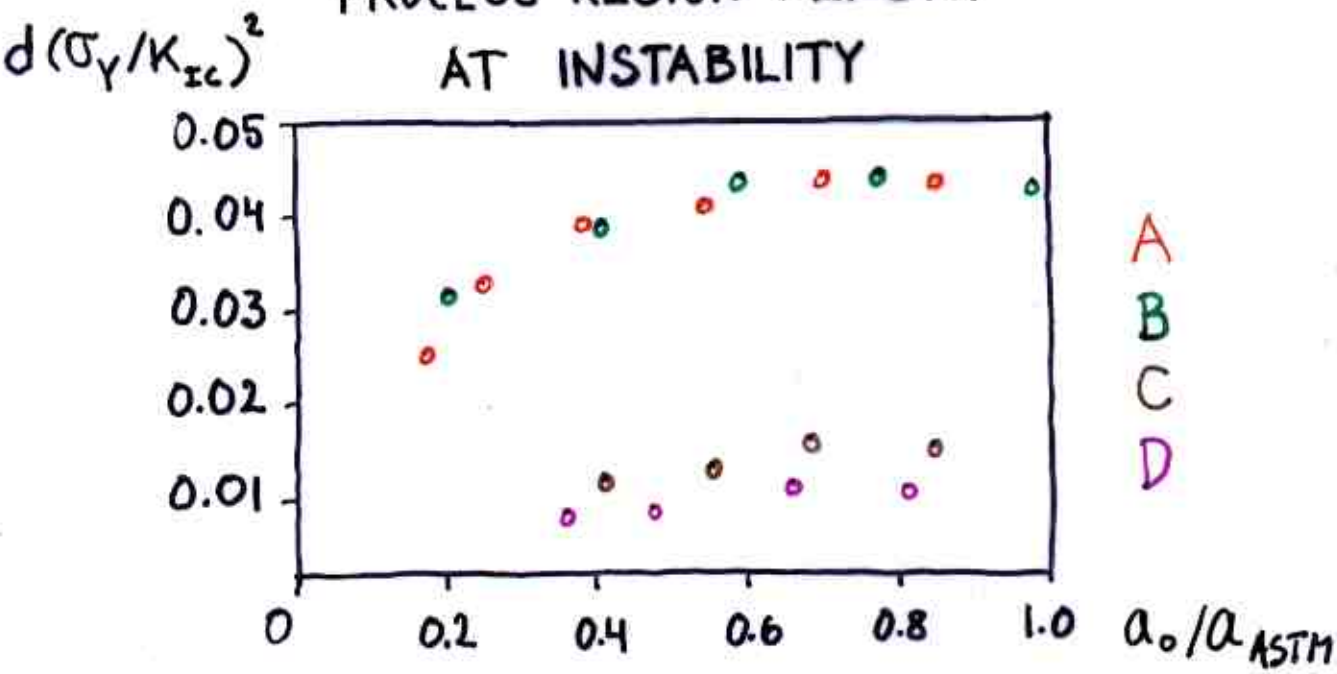


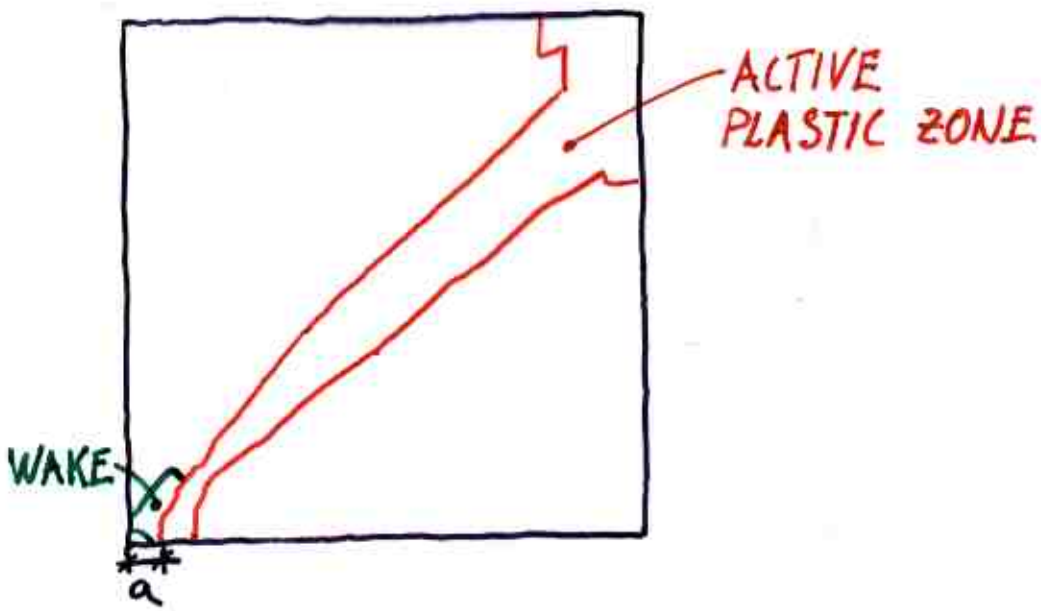
- INFINITE PLATE
- PLANE STRAIN
- SYMMETRY

PROCESS REGION LENGTH AT INSTABILITY



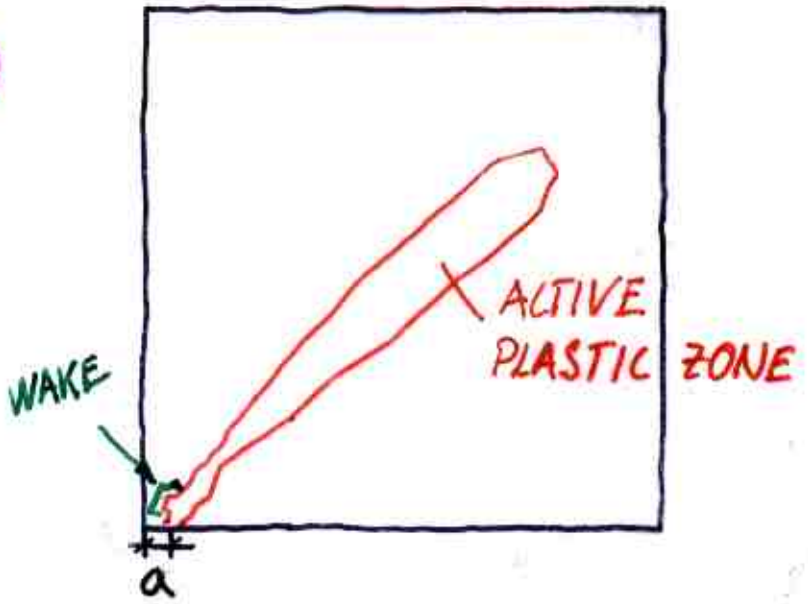
$\sigma_\infty/\sigma_Y = 1.12$, $\sigma_D = 2.5\sigma_Y$, $H = 0.01E$

(A)



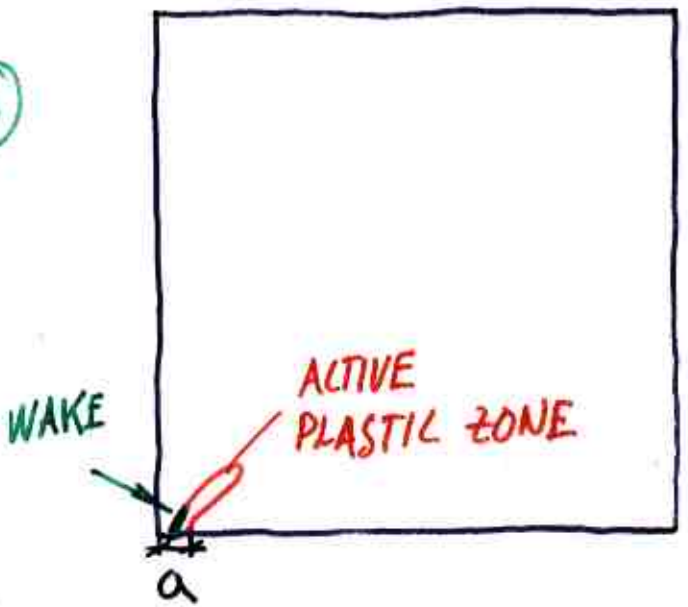
$\sigma_\infty/\sigma_Y = 0.98$, $\sigma_D = 3.1\sigma_Y$ AND $H = 0.001E$

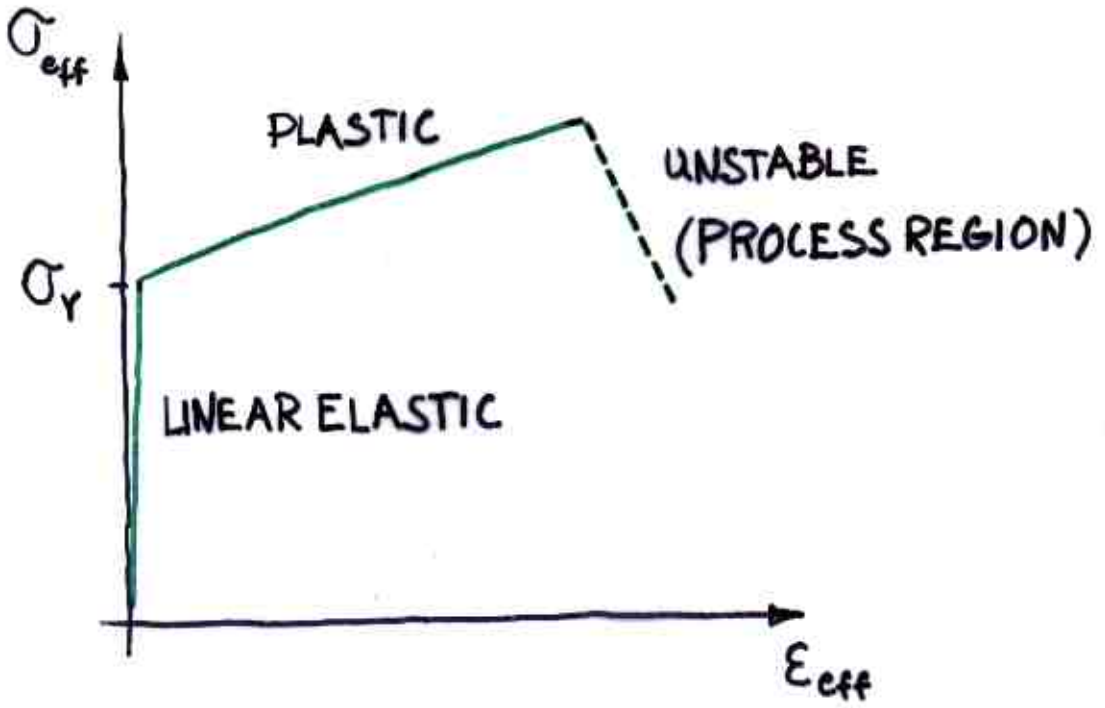
(D)



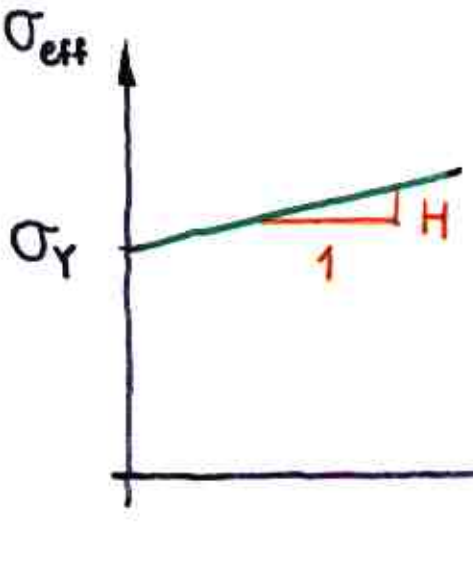
$\sigma_\infty/\sigma_Y = 0.8$, $\sigma_D = 2.5\sigma_Y$ AND $H = 0.001E$

(B)





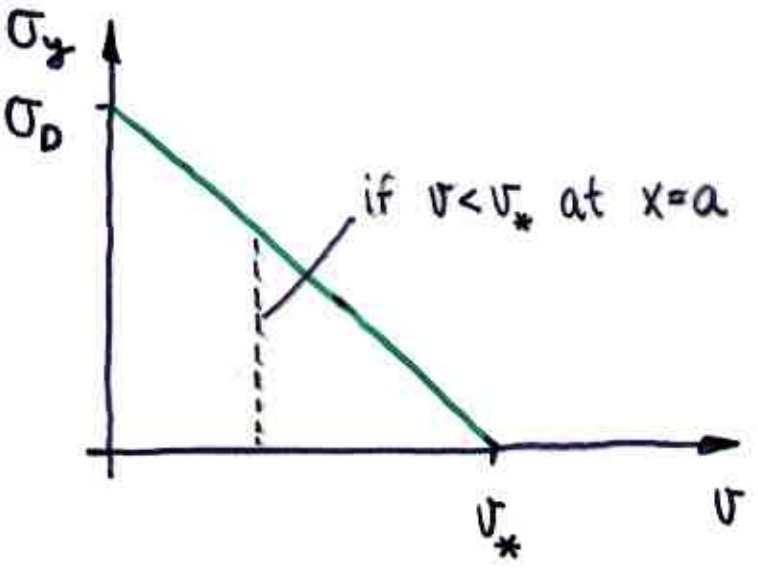
- LINEAR ELASTIC: E, $\nu = 0.3$
- PLASTIC: VON MISES YIELD CRIT. AND FLOW RULE

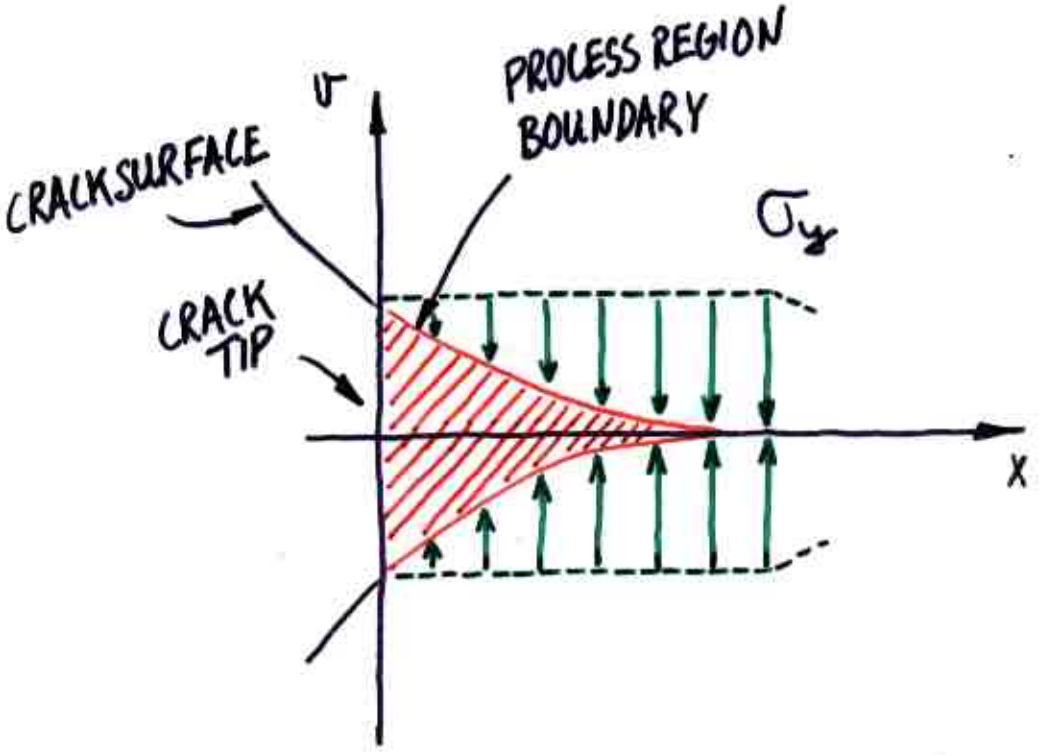


$$H = \frac{d\sigma_{eff}}{d\varepsilon^P_{eff}}$$

$$H = 0.01E,\ 0.001E$$

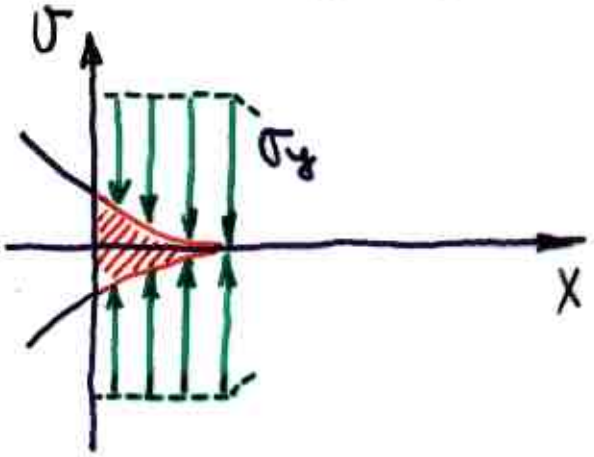
- UNSTABLE MATERIAL





$$\sigma_D = 2.5\,\sigma_Y \;, 3.1\sigma_Y$$

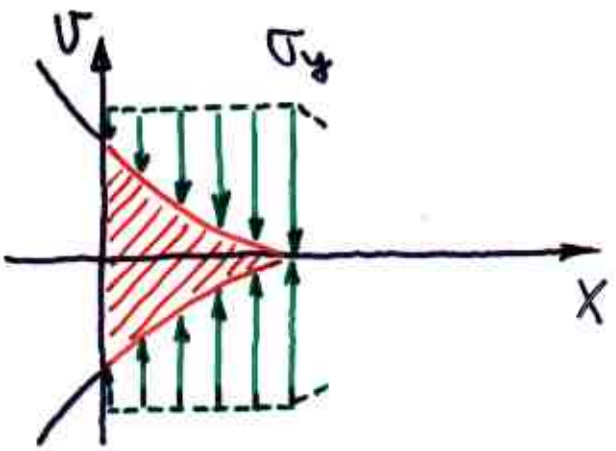
DEVELOPING PROCESS REGION



$a = a_0$

$v < v_*$

at $X = a$



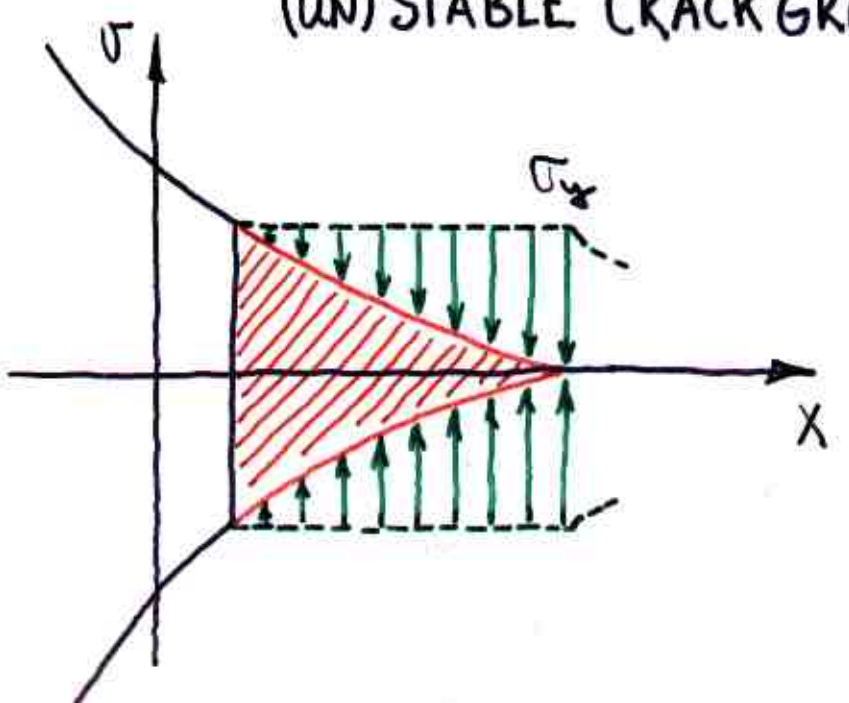
PROCESS REGION FULLY DEVELOPED

(UN) STABLE CRACK GROWTH

$a > a_0$

$v = v_*$

at $X = a$



MATERIALS

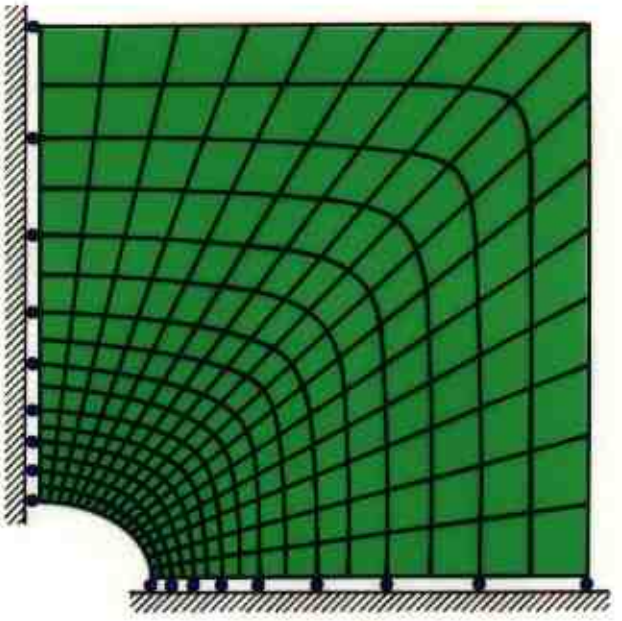
A
$$\begin{cases} \sigma_D = 2.5\,\sigma_Y \\ H = 0.01\,E \end{cases}$$

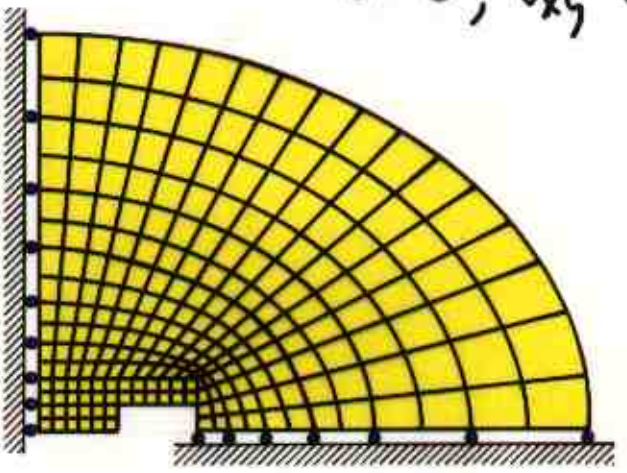
B
$$\begin{cases} \sigma_D = 2.5\,\sigma_Y \\ H = 0.001\,E \end{cases}$$

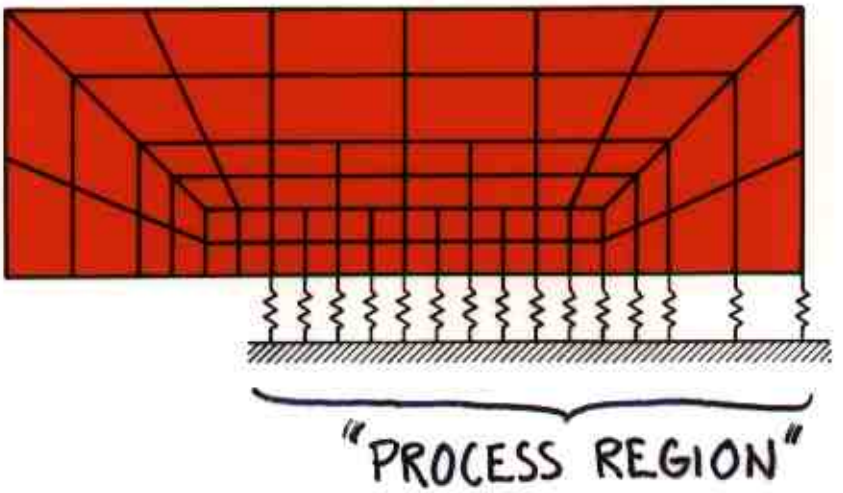
C
$$\begin{cases} \sigma_D = 3.1\,\sigma_Y \\ H = 0.01\,E \end{cases}$$

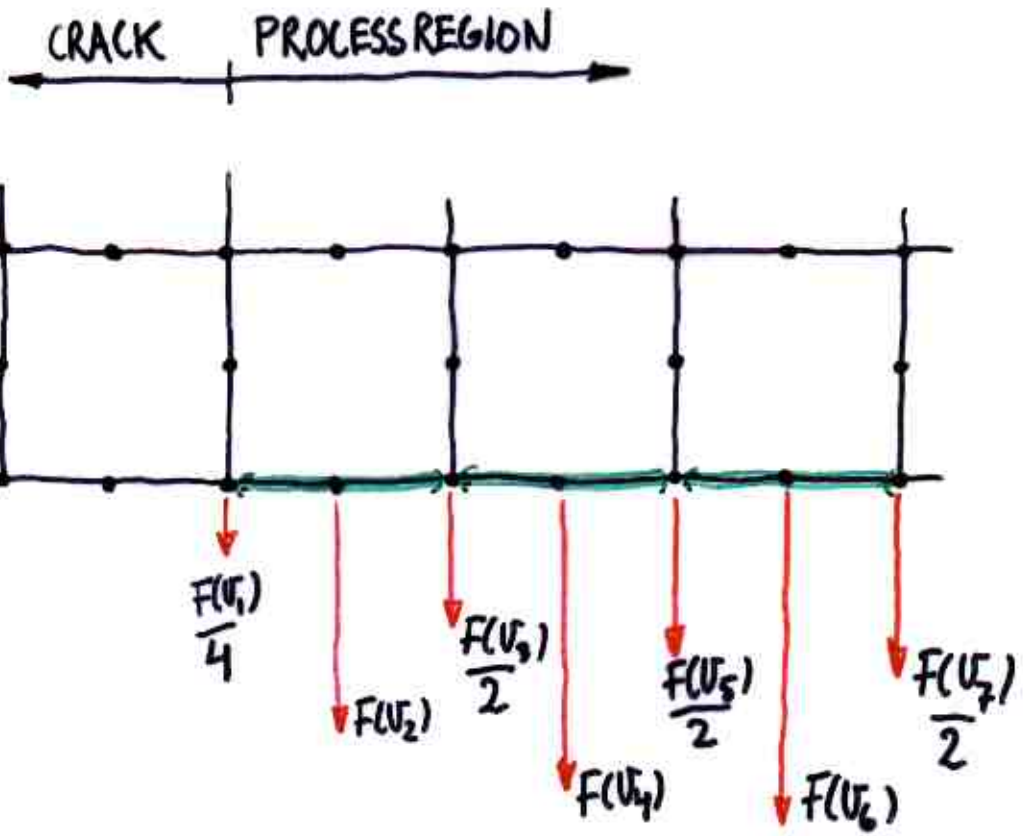
D
$$\begin{cases} \sigma_D = 3.1\,\sigma_Y \\ H = 0.001\,E \end{cases}$$

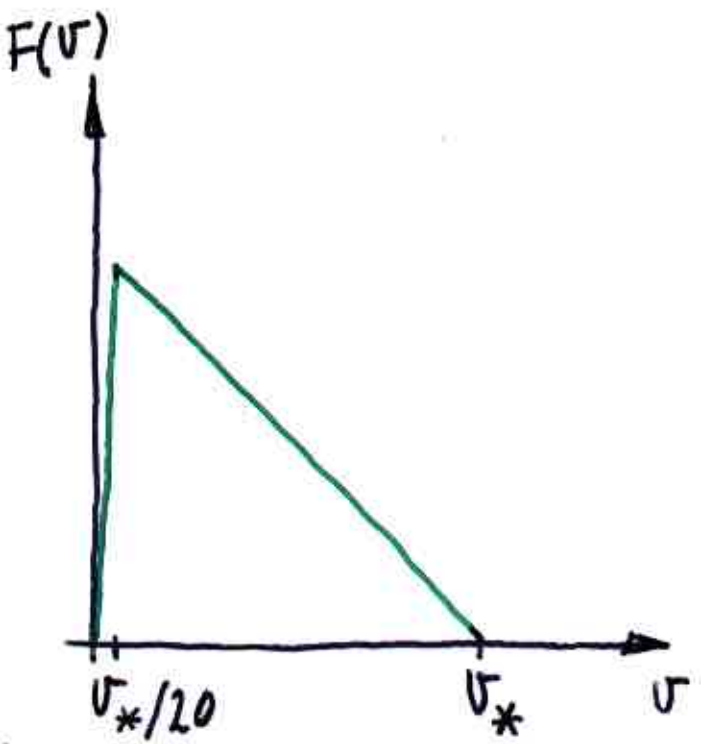
FINITE ELEMENT MESH





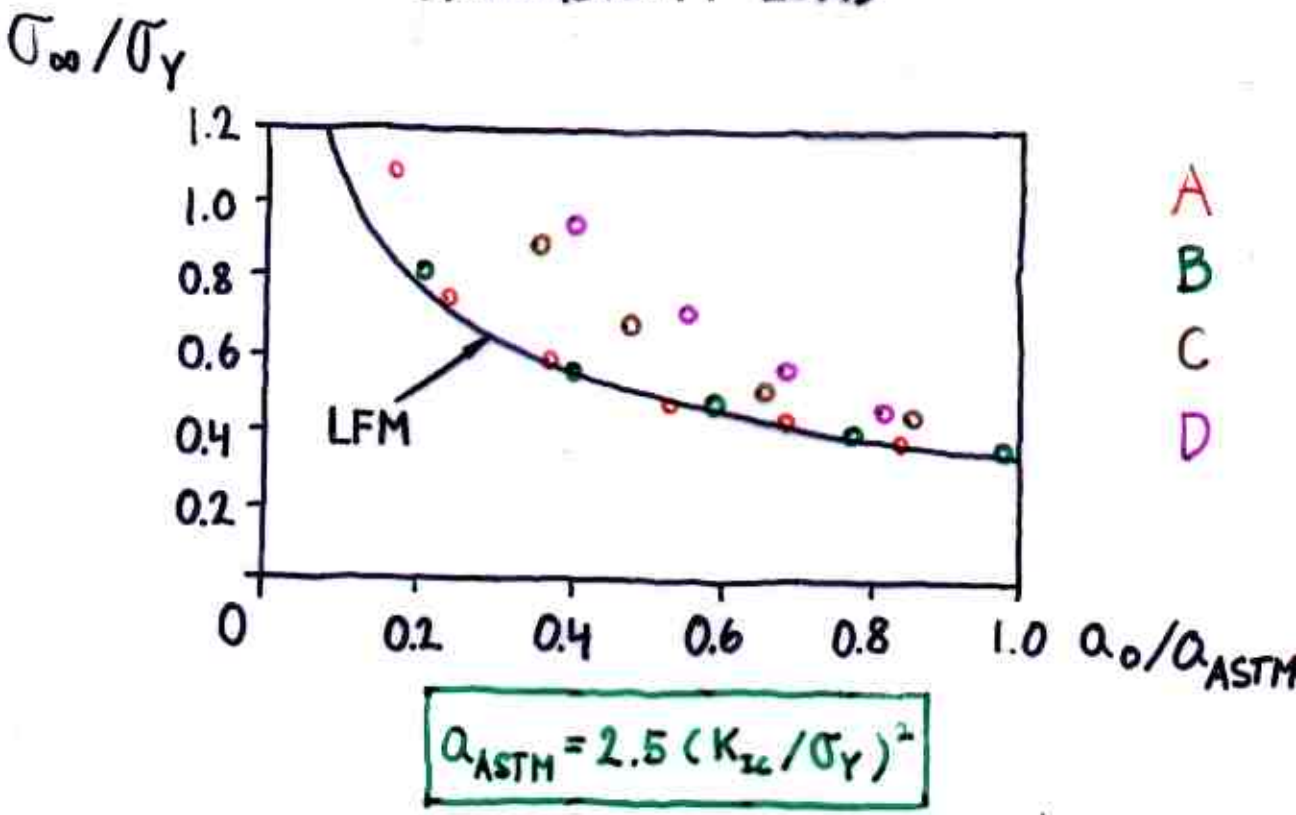



CRACK
PROCESS REGION
F(v1)/4
F(v2)
F(v3)/2
F(v4)
F(v5)/2
F(v6)
F(v7)/2


F(v)
v*/20
v*
v

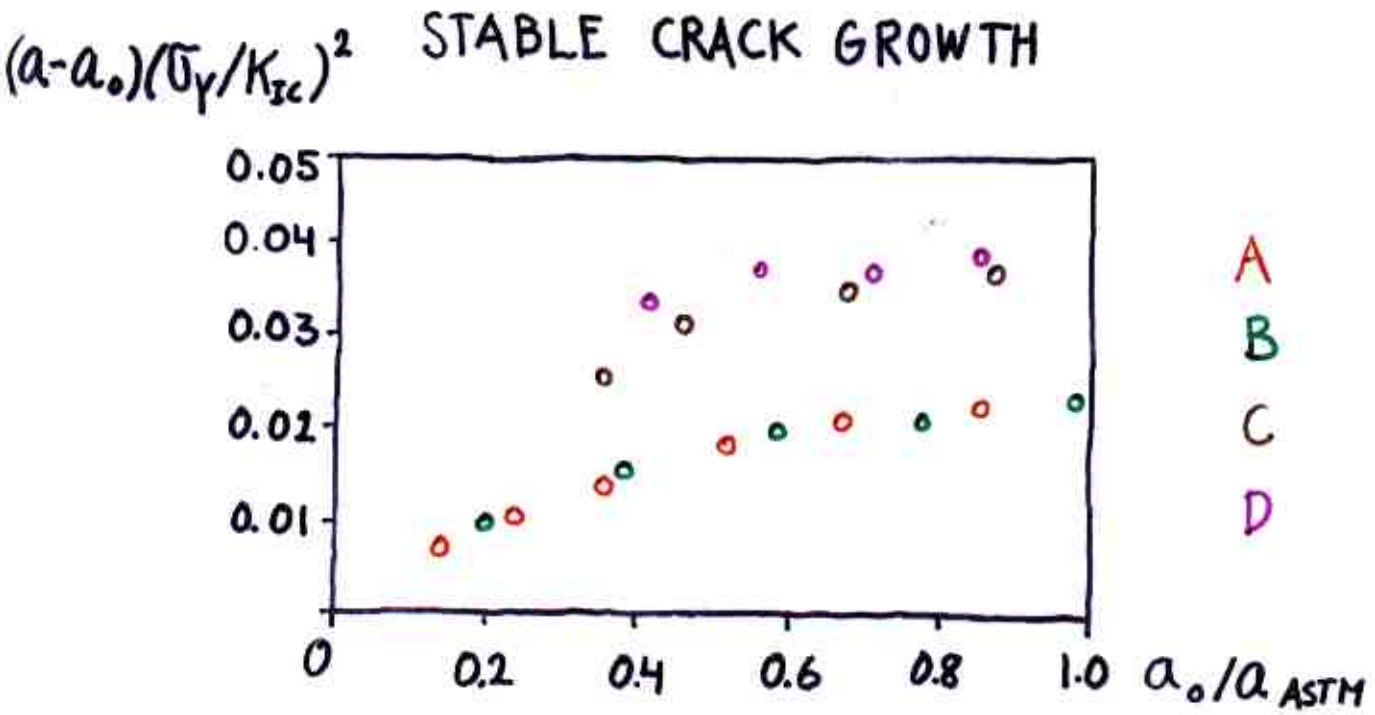
SMALL CRACKS

INSTABILITY LOAD



$$a_{ASTM} = 2.5\,(K_{Ic}/\sigma_Y)^2$$

STABLE CRACK GROWTH



AT LARGE CRACKS

DISSIPATED ENERGY PER UNIT CRACK EXTENSION :

$$\frac{(1-\nu^2)K_{Ic}^2}{E}$$

ENERGY DISSIPATED IN THE PROCESS REGION:

$$\sigma_* \sigma_D$$

$\sigma_* \sigma_D / \left[\frac{(1-\nu^2)K_{Ic}^2}{E}\right]$	MATERIAL
74 %	A
67 %	B
22 %	C
12 %	D