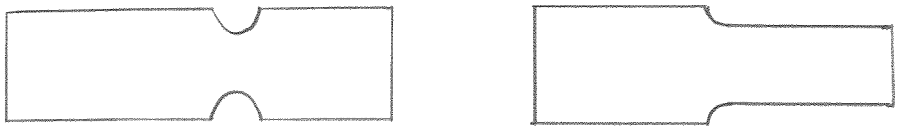
# CLASS # 19 - STRESS BEHAVIOR IN BEAMS - ELASTIC & PLASTIC

OBJECTIVES:
1. STRESS CONCENTRATION IN BEAMS WITH NOTCHES
2. DESCRIBE IN ELASTIC BENDING
3. EXAMPLE

## ① PREVIOUSLY ASSUMED PRISMATIC:

- WHAT IS STRESS IN CROSS SECTION? $\boxed{\sigma = \frac{My}{I}}$ (FLEXURE FORMULA)

- BUT, SAY WE HAVE CHANGE IN MEMBER



"NOTCHED" "FILLET"

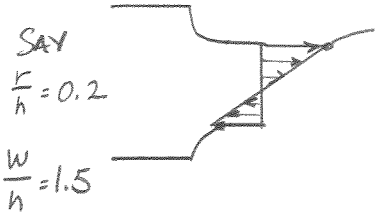
- WE WANT TO KNOW MAX STRESS IN VICINITY of ABRUPT CHANGE:

USE STRESS-CONCENTRATION FACTOR, K

$$\boxed{\sigma_{max} = K \cdot \frac{Mc}{I}}$$

LOOK UP ON CHART

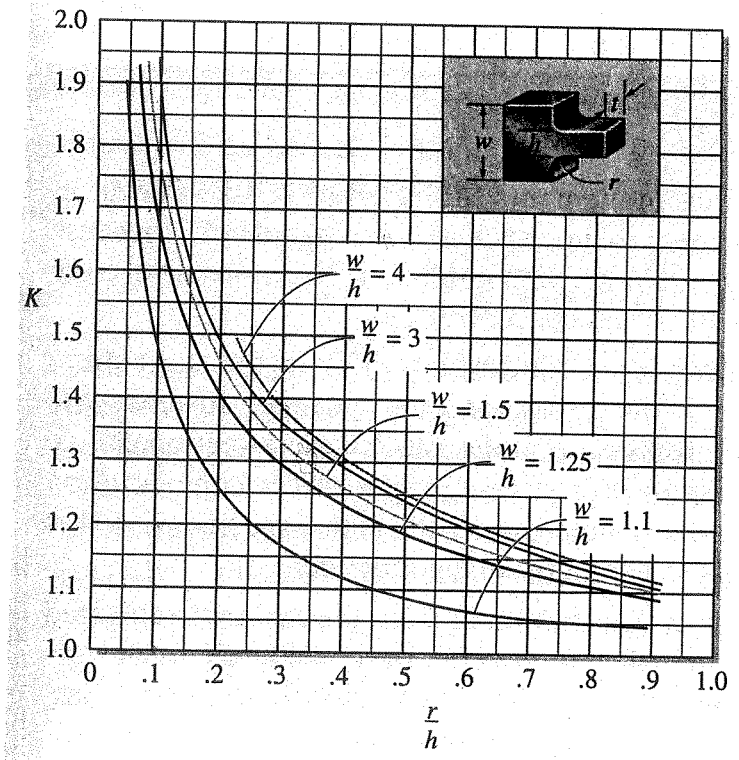
- FOR EXAMPLE

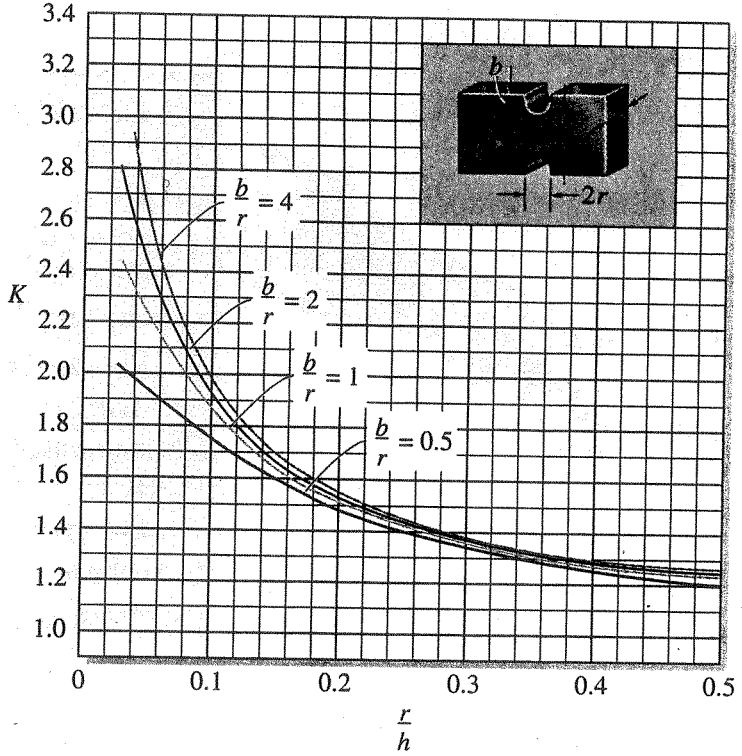



234 MPa (BASED ON REGULAR FLEXURE FORMULA)

$\sigma_{max} = K(234\,MPa)$

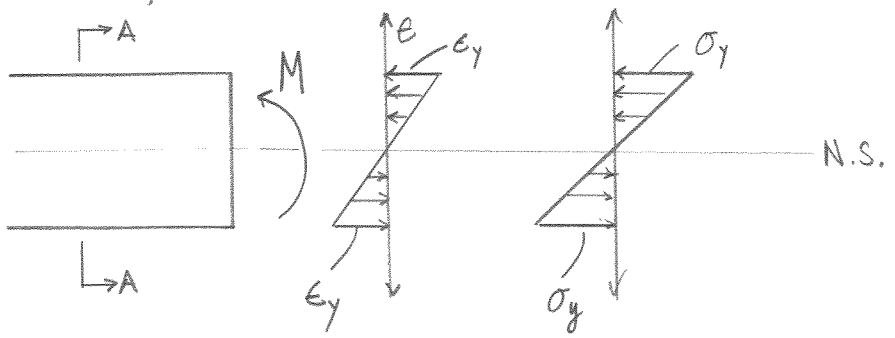
$= 340\,MPa$

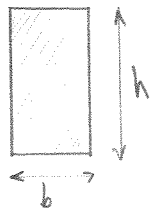

2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
K
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
r/h
w/h = 4
w/h = 3
w/h = 1.5
w/h = 1.25
w/h = 1.1
w
h
r


3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
K
0
0.1
0.2
0.3
0.4
0.5
r/h
b/r = 4
b/r = 2
b/r = 1
b/r = 0.5
b
2r

## ② INELASTIC BENDING:

FIRST, WHAT IS MAXIMUM ELASTIC MOMENT?




$$M_y = \int_A y\,(\sigma\,dA) = \int_{-h/2}^{-h/2} y\left(\frac{2\sigma_{max}}{h}\right) y\; b\,dy$$

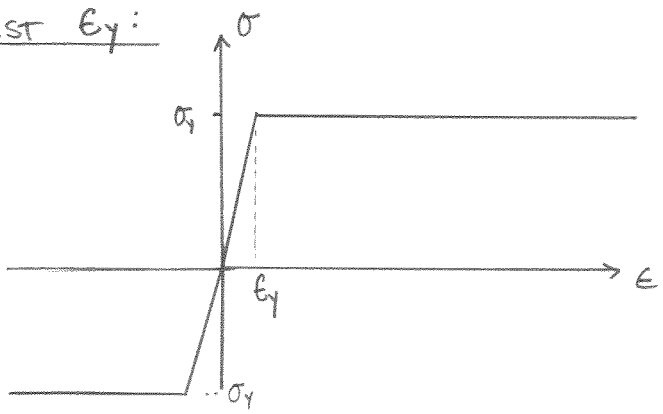
$$= \frac{2b}{h}\sigma_{max}\int_{-h/2}^{+h/2} y^2\,dy$$

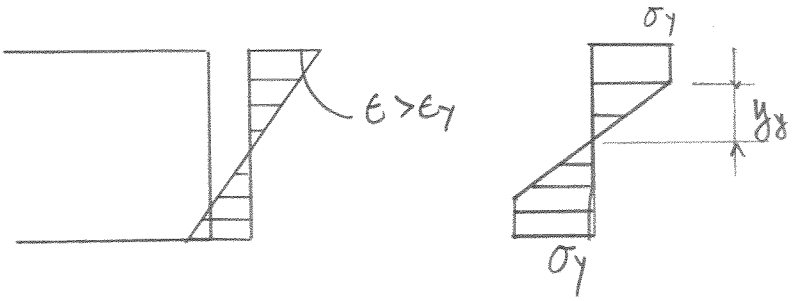
$$= \frac{2b}{h}\sigma_{max}\left.\frac{y^3}{3}\right|_{-h/2}^{h/2}$$

$$= \frac{2b}{h}\sigma_{max}\left(\frac{h^3}{24}+\frac{h^3}{24}\right)$$

$$\boxed{M_y = \frac{bh^2}{6}\sigma_y}$$

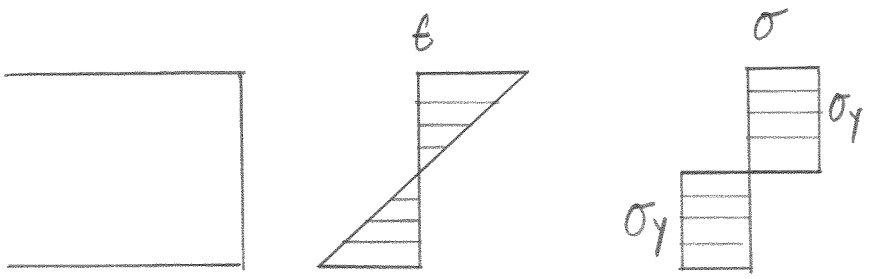
LOAD PAST $\epsilon_y$:




$$M = \frac{3}{2} M_y \left(1 - \frac{4}{3} \frac{y_y^2}{h^2}\right)$$

IS THERE A LIMIT? YES!




$$M_p = \frac{\sigma_y bh}{2} \cdot \frac{h}{2} = \frac{1}{4} bh^2 \sigma_y = M_p$$

$$M_p = \frac{3}{2} M_y$$

SINCE CAN NOT TAKE ANY MORE LOAD, CALLED, "PINNING"