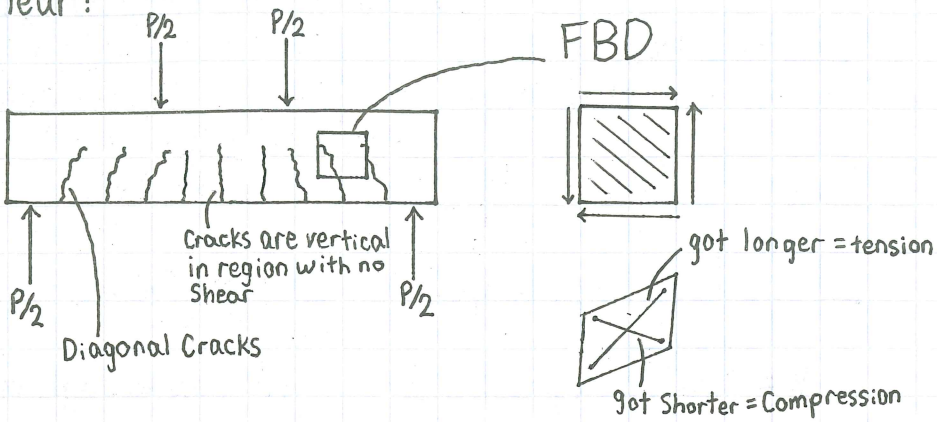
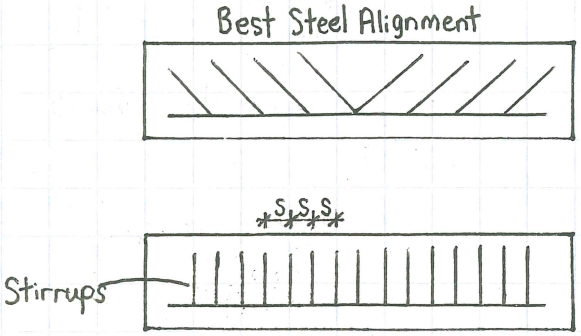
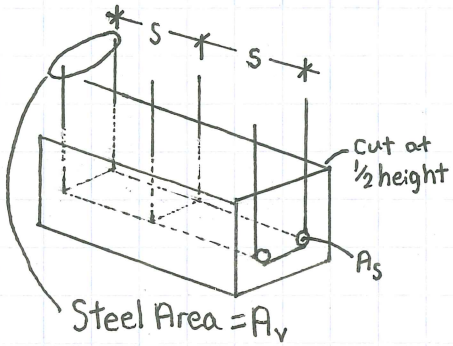
# CIV102 - STRUCTURES and MATERIALS

Topic: Reinforced Concrete Design for Shear

## 1) Shear!

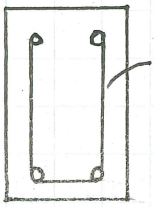



Steel Area = $A_v$

= (Area of Bar)(# of legs across width)

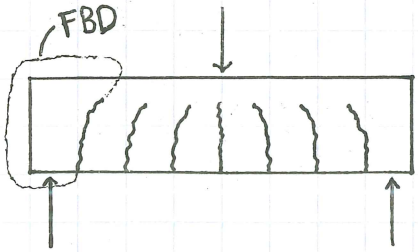


2 legs of stirrups

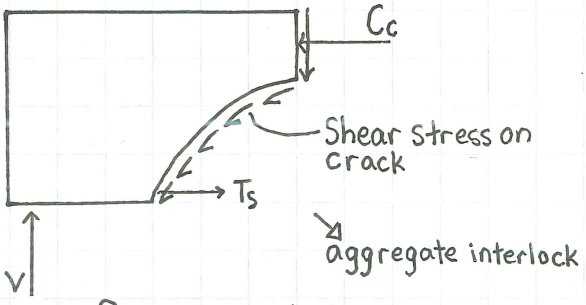
- if 10M = 100mm²

$A_v = 200mm^2$

## 2) How is Shear carried?

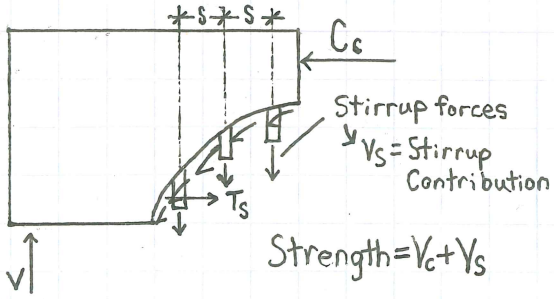



### a) If no stirrups




- Concrete contribution to shear Strength $V_c$

### b) With Shear Reinforcement




Strength = $V_c + V_s$

$V_c$ has no size effect if you have stirrups

$V_c$ shows a size effect. Members with larger depth, d or h, show lower shear stress @ failure

# 3) Design for Shear

$V_{ultimate} = V_c + V_s \leq V_{max}$

$V_{safe} = \frac{V_c}{FOS} + \frac{V_s}{FOS} \leq \frac{V_{max}}{FOS}$ → To avoid concrete crushing in diagonal compression

↳ 2.0 ↳ 1.67 ↳ 2.0

$V_{max} = 0.25 f_c' \cdot b_w \cdot j \cdot d$

## If we have no stirrups

$V_c = \frac{230\sqrt{f_c'}}{1000 + 0.9d} b_w \cdot j \cdot d$

$V_s = 0$

## If we have more than minimum stirrups

We have enough if $\frac{A_v \cdot f_y}{b_w \cdot s} \geq 0.06\sqrt{f_c'}$

$V_c = 0.18\sqrt{f_c'}\, b_w \cdot j \cdot d$

$V_s = \frac{A_v \cdot f_y \cdot j \cdot d}{s} \cot\theta \qquad \theta = 35°$