

1.1 REQUIRED $w/h = 3$. SINCE $h = 4$, a minimum pillar width of 12m IS REQUIRED.

CHECK AGAINST SF REQUIREMENT: $SF > 1.6$ \therefore
WIDTH = 12m.

1.2 AGAIN BASED ON w/h REQUIREMENT, AT $h = 2.5$ m
 $w = 7.5$ m.

$h = 2.5$ m $w = 7.5$ m	$h = 4$ m $w = 12$ m
$R_{area} = 1 - \frac{w^2}{c^2} = \frac{1 - 7.5^2}{(7.5 + 6)^2}$ $= 69\%$	$R_{area} = 1 - \frac{w^2}{c^2} = \frac{1 - 12^2}{(12 + 6)^2}$ $= 55\%$
$R_{vol} = 2.4 \text{m} \times 0.69$ $= 1.7 \text{m equivalent } h$	$R_{vol} = 4 \text{m} \times 0.55$ $= 2.2 \text{m equivalent } h.$

\therefore EVEN ALTHOUGH h IS REDUCED BY $\frac{4 - 2.5}{4} = 37.5\%$
TOTAL EXTRACTION OF SEAM IS ONLY REDUCED BY $\frac{2.2 - 1.7}{2.2}$
 $= 22.7\%$.

1.3 2 OR 3 POINTS WITH SOME EXPLANATION

2.1 ASSUME $\phi_{\text{HOLE}} = 27\text{mm}$ WITH REMAINING, $\rho = 0,025\text{MN/m}^3$
ASSUME 1.45m LENGTH OF 1.5m BOLT IN HOLE $\therefore \text{ANCHOR} = 0,25\text{m}$
BOLT DENSITY = $(7\text{m} \times 2\text{m}) / 4 \text{ BOLTS} = 3.5\text{m}^2 / \text{BOLT}$.
SHEAR FORCE / BOLT = $3.5\text{m}^2 \times 1.2\text{m} \times 0,025\text{MN/m}^3 = 1,05\text{MN}$
CONTACT AREA = $0,25\text{m} \times \pi \times 0,027\text{m} = 0,0212\text{m}^2$
SHEAR STRESS = $F/A = 4.9\text{MPa} \gg 2\text{MPa}$ AVAILABLE
 \therefore BOLT LENGTH CAN NOT PROVIDE ADEQUATE ANCHORAGE.

2.2 2 OR 3 POINTS WITH SOME EXPLANATION

2.3 BASIC THEORY.

3.1 TENSILE STRESS CHANGES BY THE SQUARE OF SPAN.

$$\therefore \Delta = \frac{7.2^2 - 6.8^2}{6.8^2} = 12.1\%$$

3.2 - 3.4 BASIC THEORY.

4.1 - 4.7 BASIC THEORY.