1.1 REQUIRED w/h = 3. SINCE h = 4, a MINIMUM PILLAR WIDTH OF 12m IS REQUIRED.

CHECK AGAINST SF REQUIREMENT: SF > 1.6 ∴ WIDTH = 12m.

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

h = 2.5m w = 7.5m	h = 4m w = 12m
$R_{area} = 1 - \frac{w^2}{c^2} = \frac{1 - 7.5^2}{(7.5+6)^2}$ = 69%	$R_{area} = 1 - \frac{w^2}{c^2} = \frac{1 - 12^2}{(12+6)^2}$ = 55%.
R_{DOL} = 2.5m x 0,69 = 1.7m equivalent h	R_{DOL} = 4m x 0,55 = 2.2m equivalent h.

∴ 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 ϕ HOLE = 27mm WITH REAMING, ρ = 0,025 MN/m^3

ASSUME 1.45m LENGTH OF 1.5m BOLT IN HOLE ∴ ANCHOR = 0,25m

BOLT DENSITY = (7m x 2m) / 4 BOLTS = 3.5m^2 / BOLT.

SHEAR FORCE / BOLT = 3.5m^2 x 1.2m x 0,025 MN/m^3 = 1,05 MN

CONTACT AREA = 0,25m x π 0,027m = 0,0212 m^2

SHEAR STRESS = F/A = 4.9 mPa >> 2 MPa AVAILABLE

∴ 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.