2a						
bord width	7	m				
laminated thickness	0.8	m				
bolt diameter	0.02	m				
bolt length	1.8	m				
row spacing	2	m				
bolts per row	4	m				
hole dimater	0.026	m				
resin / rock interface	2	MPa				
assume rock density	0.025	MN/m3				
1. Calculate mass of rock per bolt						
7*2*0.8*0.025/4			0.07	MN/bolt		
2. Calculate shear strength across interface						
F=σA; A=pi*(0.026+0.001)*(1.8-0.8) and A= pi*(0.026+0.001)*(1.5-0.8)						
F(1.8m bolt)	0.169646003	MN		1m		0.412623927
F(1.5m bolt)	0.118752202	MN		0.7m		
				0.41m	anchor needed for load on bolt	
SF(1.8m bolt)	2.423514333					
SF(1.5m bolt)	1.696460033					
2d						
resin diameter	0.023	m				
gap	0.05	m				
hole diameter	0.03	m				
1. Calculate volume of gap						
V=pi*0.03^2/4*0.05	3.53429E-05	m3				
2. Calculate resin capsule length to give equivalent volume						
L=0.004712/(pi*0.023^2/4)	0.085066163	m				
3a						
t	1					
Scenario 1	6.8					
Scenario 2	7.2					

Assumed cut corner allowance	0	
assume rock density	0.025	MN/m3

1. Calculate intersection diagonal

Scenario 1: sqrt(2*6.8^2)+cut corner allowance	9.616652224	
Scenario 2: sqrt(2*7.2^2)+cut corner allowance	10.18233765	

2. Calcuate tensile stress in beam

σ=yL^2/2t (t,y value can be assumed or ommited)

Scenario 1	1.156
Scenario 2	1.296

3. Calculate percentage increase

(0.648-0.578)/0.578	0.121107266

3b

layer	0.1	
σ	2	
density	0.025	MN/m3

cantilever formula would also be accepted as layer thickness may vary, layer may be cut into, joints may be present, layer may break prior to support…

σ=3yL^2/t, L=sqrt(σt/3y)	1.632993162	diagonal between bolts to othogonal		
σ=yL^2/2t, L=sqrt(2σt/y)	4	diagonal between bolts to othogonal		
		sqrt(1.633^2/2)	1.1547005	or
		sqrt(4^2/2)	2.8284271	

4a

Its shallow therefore controlling critera is almost certainly w:h so start there

4*3	12	m

Can check SF to make sure

Strength = 7.2*12^0.46/4^0.66	9.044743919	MPa
e = ((12+6)^2-12^2)/(12+6)^2	0.555555556	
Load = (0.025 (assumed)*30)/(1-0.556)	1.6875	Mpa
SF = strength / load	5.359848248	

4b

At reduced height, pillar width = 2.5*3	7.5	m		
e = ((7.5+6)^2-7.5^2)/(7.5+6)^2	0.691358025			
compare 55% of 4m to 69% of 2.5m	2.222222222	vs	1.7283951	0.2857143
change in mining height = (4-2.5)/4	0.375			
change in extracted volume = (2.22-1.72)/2.22	0.222222222			

Therefore a 37.5% reduction in mining height translates to a 22% reduction in extracted volume