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
4a		sqrt(4^2/2)	2.8284271

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