22/03/21 · Numerical Modelling – 2

Minex for stratified deposits (Eg: Coal)

Surpac → collar
→ Survey
→ Translation
} Mandatory Tables

Borehole ID (BHID)	Y collar	X collar	R.L of collar	Depth	Path
					linear

BHID	Max. Depth	Dip	Azimuth

Assay table (Iron Ore mine data)

BH ID	From	to	Fe	SiO_2	Al_2O_3

Steel Manufacturing from Iron Ore

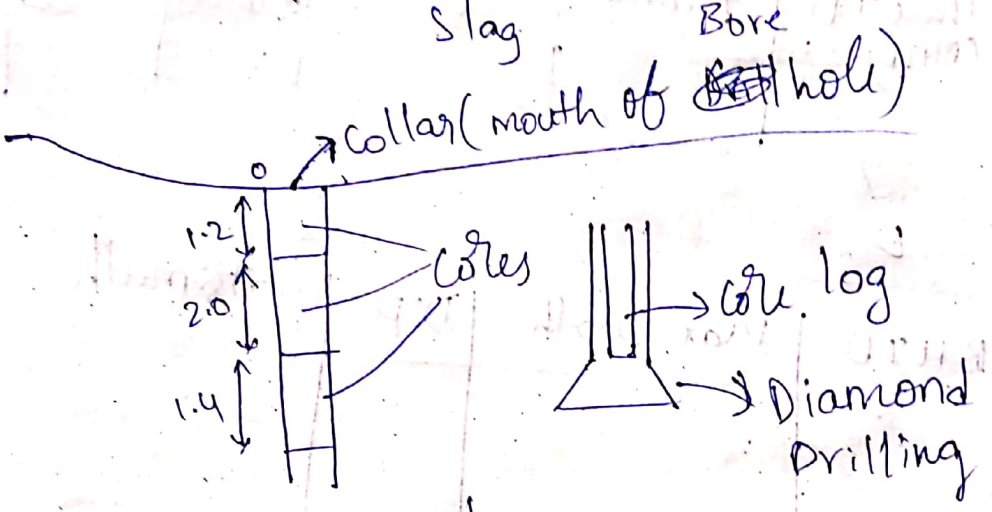
Iron ore deposits : Haematite (Fe_2O_3)
Magnetite (Fe_3O_4)

Iron ore + Coking Coal + limestone

('C' is a reducing agent)

$SiO_2 + Al_2O_3 + Fe$

Slag



From	To
0	1.2
1.2	3.2
3.2	4.6

Assay table

Table Name (whether Assay, Collar or survey)

Assay	Fe	Na	-999
assay	SiO_2	na	-999
assay	Al_2O_3	na	-999

Table name — Field

- Database → Database → Drill holes
  for drillhole data

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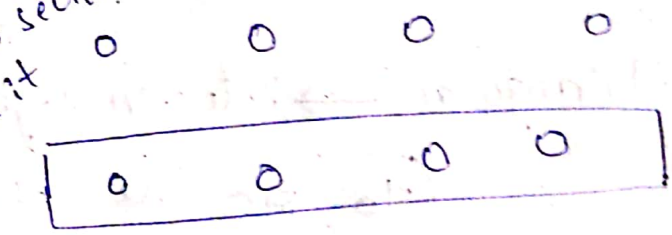
Set as work Directory

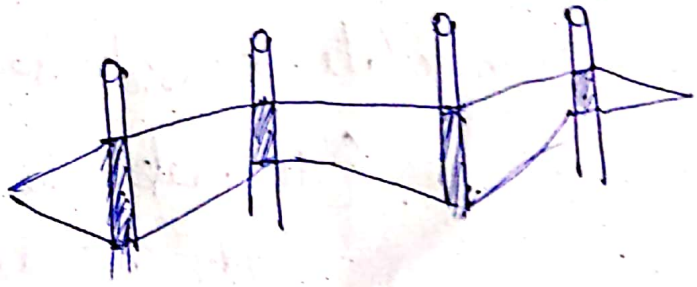
For sections:

Database

longitudinal
cross section method

Divide into sections
& Extrapolate it





Database → section → Define

↓

section definition method (- Northing
- Easting
- Elevation
- Best fit to selected drillhole)

we follow - Graphically select section

Zone of influence for a section.

- Distance forward of plane = $\frac{1}{2}$ (distance b/w 2 sections)
- Distance backward of plane = $\frac{1}{2}$ (Distance b/w 2 sections)

Enquiry → Bearing & distance b/w 2 points
(to find out distance b/w two points)

Database → section → previous (or) Next
(to view a section)

→ To digitise section (intersecting the cut off grade line)

Solids → Triangulate → Between segments
(To join the sections)

solids → Triangulate → inside segments
(to make the hollow body into a closed solid)

Solids → validation → Validate objects & trisolations
(To know whether the solid is closed or not)
(also to know the errors if any)

solids → solids tools → Report volume of solids

(to know the volume of solid & surface area of solid)

↑

Solid Modelling is done

Compositing → Benchwise compositing

→ Down the hole compositing.

Database → composite → i) Down the hole

ii) Bench ~~Grade~~ Elevation

Type :-

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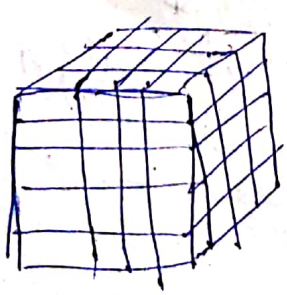
→ Block Modelling :-



Block model → New

Block model → Attributes → New

(To add Fe, SiO_2, Al_2O_3 values to block)

Block model → Estimation → Inverse distance estimation

File → new → layers

Design → pit Design → New ramp

Edit → point → move

Design → Expand segment → Multiple bench design

~~Height~~

✓ (by bench height)

Surface →

Solid model → Composting → Block model

↓

pit Design

25/03/24

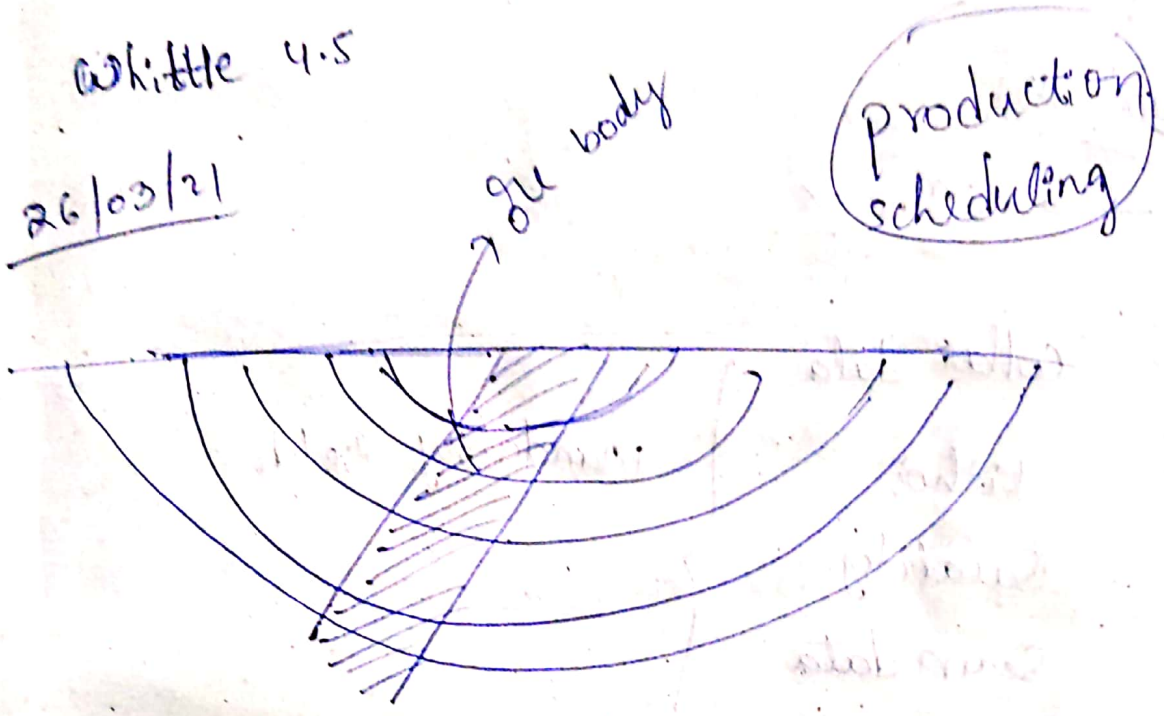
MCAF (Mining Cost Adjustment factor)

Block model → attributes → News

Blocks → Air Block
→ Waste
→ Ore

Whittle 4.5

26/03/21



If selling price ↑^{s} , pit expands

↓^{s} , pit Contracts

If Cost of Mining ↑^{s} pit Contracts

↓^{s} pit expands

strategic planning + To maximise NPV

production scheduling → (for long term goals)

Whittle

Life of Hydraulic shovel = 7-8 years

" " Electric rope shovel = 15 years

" " drill machine = 7-8 years

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→ Mine-X

Collar data
Litho
Quality
Seam data
} mandatory fields

- Collar data.CSV :

Company name ↑

Borehole ID	X	Y	R.L	Depth	Azimuth	Dip	Type

- Lithology.CSV :

Borehole ID	From	To	Rock type

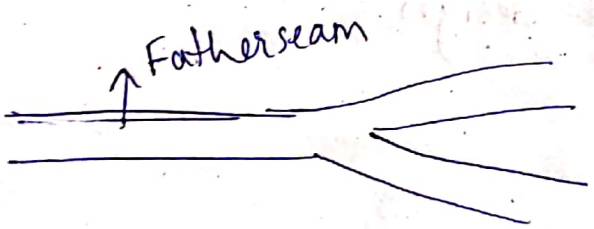
- Seam.Data.CSV

Borehole ID	From	To	Class	Seam

- Quality

BorholeID	From	To	Ash	VM	Moisture	UHV	Fixed C

Borehole → Load → Load Collar data



Borehole → Load → Load Seam data
(Assign different colours for different seams)

Borehole → load → load Quality data (sample)

Borehole plotting :

Borehole → plot → profile.

Borehole → plot → Borehole display

Mount → Create → section

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Seam model → Multi Seam multi Variable

SR → Seam Roof

SF → seam floor

ST → seam thickness

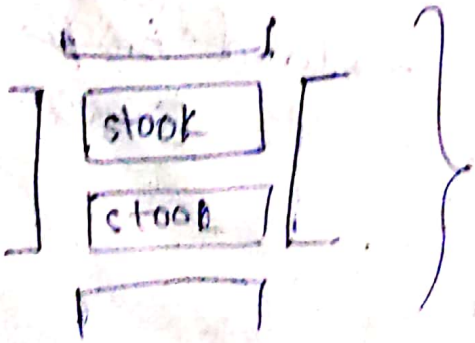
Seame model → Resources Report

finally pit design

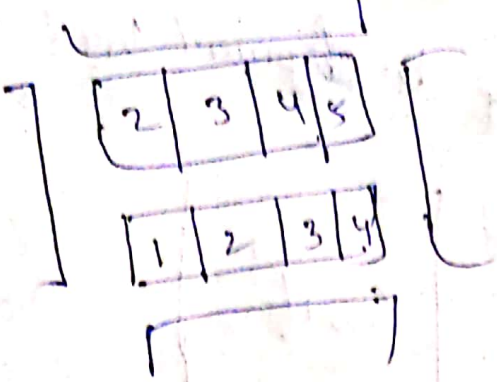
01/04/21

→ Design of Coal Pillar

panel size depends on Inubation period



Depillaring operation



$$S_p = 7.2 \frac{W^{0.46}}{h^{0.66}} \text{ Mpa}$$

$$FOS = \frac{\sigma_p}{S_p}$$

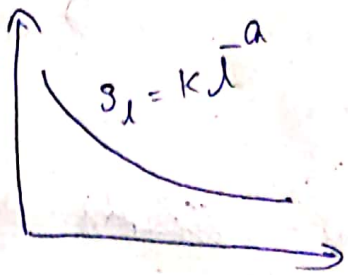
$$S_p = S_1 \left(0.64 + 0.36 \frac{w_p}{m}\right) \rightarrow \text{For square pillars}$$

m = height of pillar.

$$S_p = S_1 \left(0.64 + 0.54 \frac{w_p}{m} - 0.18 \frac{w_p^2}{lm}\right)$$

for rectangular pillars

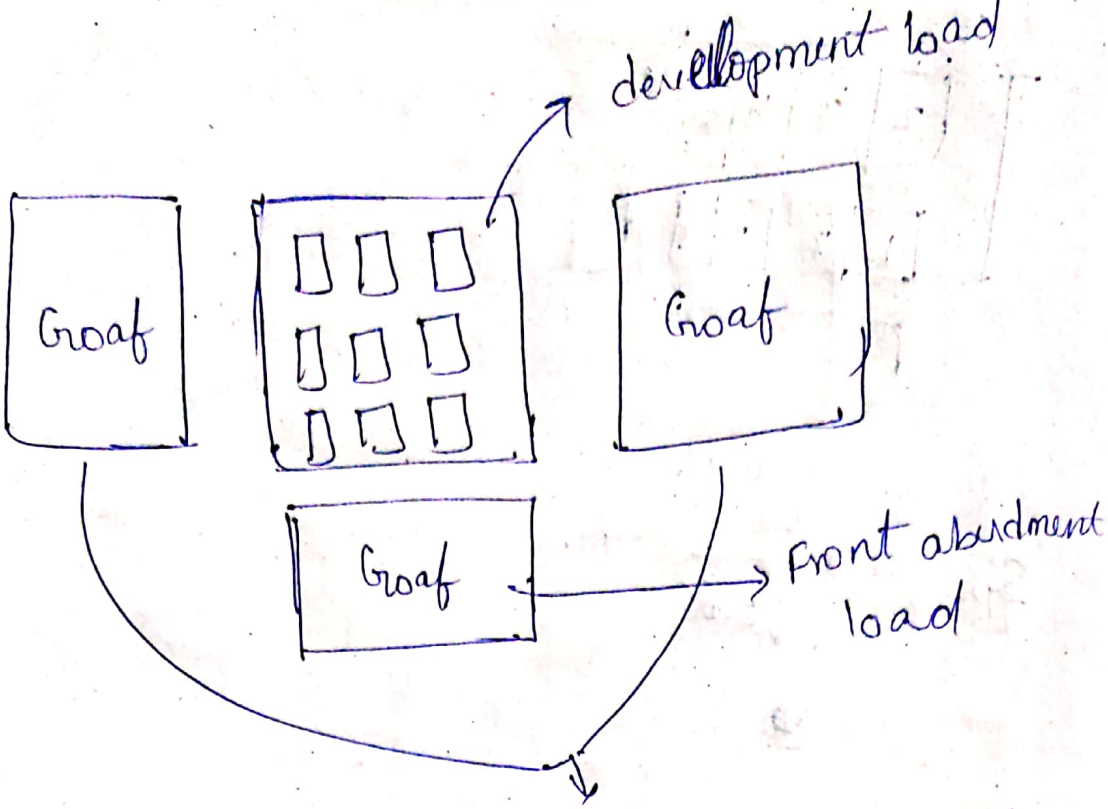
$$S_l = k l^{-a}$$



$$\ln S_l = \ln k - a \ln l$$

$S_1 \approx 6 - 7$ Mpa

$= 6.5$ Mpa



phase - II Software :

File → save as →

view → limits (0, 0) (100, 100)

View → ~~Layers~~ → grids (1, 1)

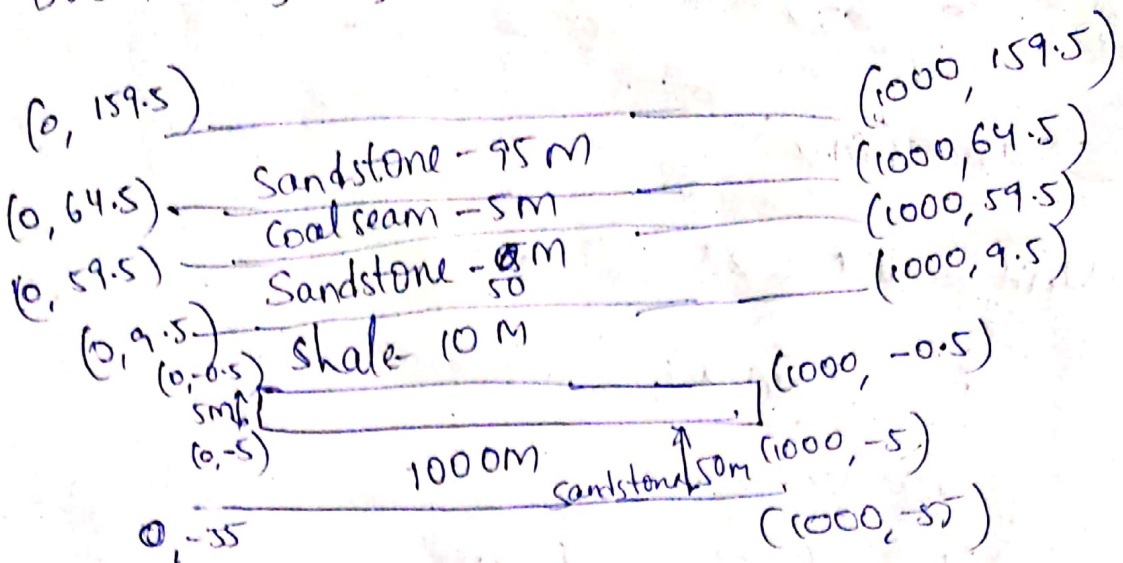
Thickness = 4.5 m

depth = 160 m

gallery = ~~300~~ 4.2 m

pillar width = 30.5 m

Boundaries → Add Material



Boundaries → Add Externals

Material-1 (Coal)
Material-2 (Sandstone)
Material-3 (Shale)

Right click → Assign material

properties → Define material

Unit weight
coal . 0.015

(Young's Modulus) E = 1500

poisson's ratio : 0.3

material type : plastic

T . : 1.5 , Dilation = 15°

: 30° = 30°

= 2 Mpa , = 2 Mpa

shale , Unit weight : 0.020

E = 2 Gpa = 2000 Mpa

V = 0.27 . plastic

T = 2 Mpa , 32° , 2.5 Mpa

16°, 32°, 2.5

Sandstone

Unit weight 0.025

E = 5 Gpa

ν = 0.25

Mohr Coloumb	plastic
3 Mpa	17.5
35°	35°
3 Mpa	3 Mpa

Mesh → Discretize the mesh

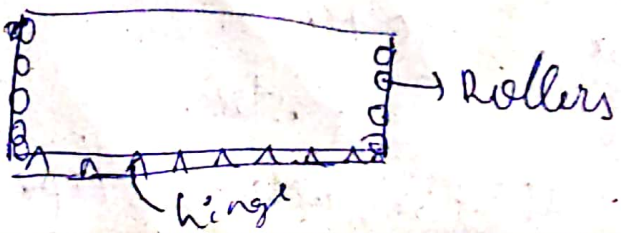
Mesh → setup

loading → Field stress

Type: gravity

1.5

Displacement → Free (then select boundaries)



30.5
- 4.2
26.3 x 5
131.5

2 bM
430.5

404.5
26.
430.5
4.2
434.7
26
46

490.9
4.2
495.1
464.9
26
495.1
1 26
521
4.2
525.3

Boundary → Add material

524.8

434.2
26
460.4
4.2

434.7
460.7
464.9

Right click → Assign material → Excavate

494.6
26
520
5

Compute (To run)

Query → Add material

Right click → copydata

404.2
26.0
430.2

434.4
+ 26
460.4
4.2

464.6
+ 26
490.6

(400, -2)
404.2
(434.4, -2)
(400, -5)
404.2
430.2
-5
434.4-5
464.6, -5
490.6
494.8

494.8
26.
520.8
4.2
525.0

525.0
26.0
551.0
4.2
555.2

02/04/21

60000 × 0.85

5.10 × 10^7

5100

12
51 km
4

250 m × 2500 m → size of panel

periodic weighting :

Yield pressure = 45 Mpa

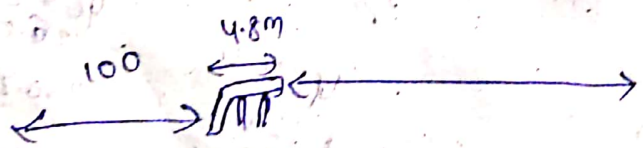
4 legged chock shield support

4 × 800 Tonn

Mining height = 3.5 m

File → save as → Longwall ~~setting~~ setting

View → Grid

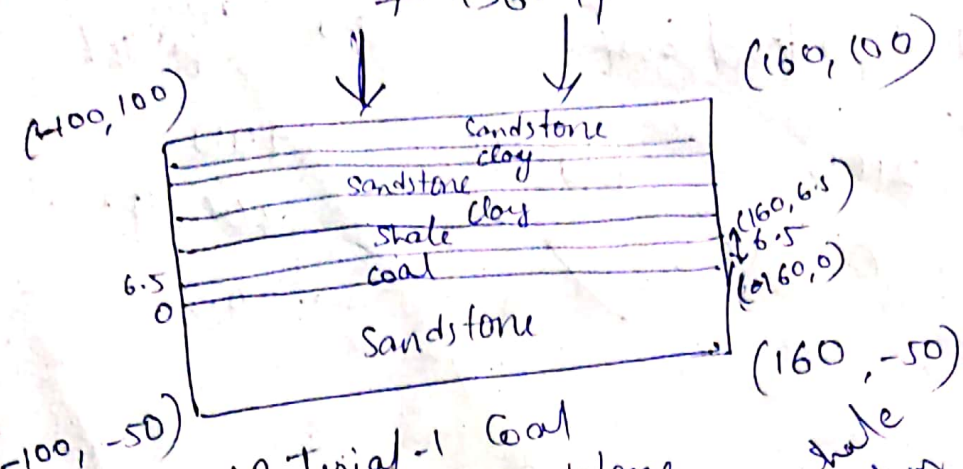


150
+ 10
+ 100
260m

Boundary → Add External

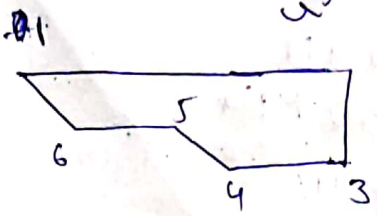
1	160	-50
2	160	100
3	-100	100
4	-100	-50

7.436 Mpa



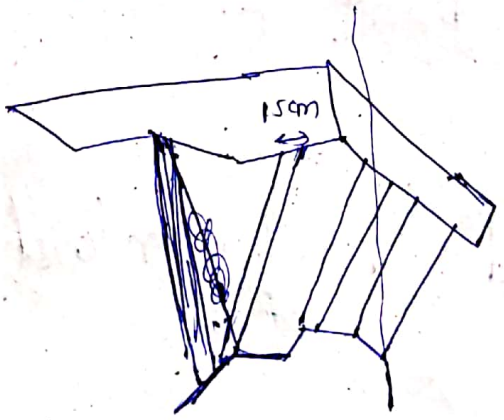
Material - 1 Coal
- 2 sandstone
3 - shale
4 - clay

canopy

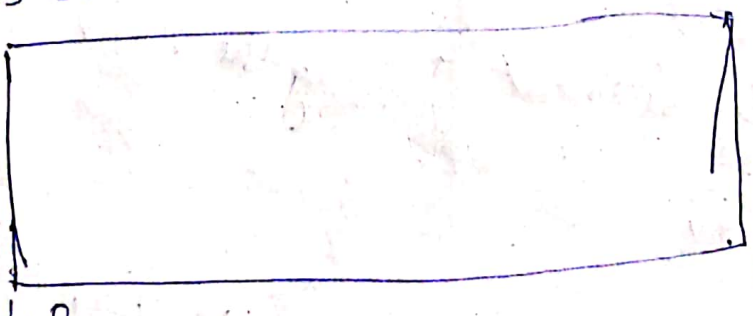


1	0,	3.2
2	4.8,	3.2
3	4.8,	2.8
4	2.8	2.8
5	2.8,	3.0
6		

4.05
3.90
5



-0.1, 3.2



(. , 0)

-0.1, 0

well packed goaf:

2100
E = 500 Mpa
ν = 0.25

Elastic

partially packed

1900
200 Mpa
0.3

weak packed

M40
100 Mpa
0.40

power support

Unit weight = 0.08

E = 2000 Gpa

ν = 0.1

Front leg

0.08

E = 200 Gpa
85

ν = 0.1

Rear leg

0.08

E = 200 Gpa
90

ν = 0.1

Add distribution load (7.436 Mpa)

Query

Vertical Displacement } along the roof

σ_{yy}

σ_{xx}, τ_{xy} } Front, Rear legs

σ_{yy}

File → Save as → longwall web cutting

~~-9.85, 0~~ , ~~-9.15, 3.2~~

↗ web cutting

-0.95, 0 -0.95, 3.2

-0.05, 0 -0.05, 3.2

Vertical displa } web cutting

σ_{yy}

σ_{xx}
σ_{yy}
τ_{xy} } Front, rear legs

Transformation :

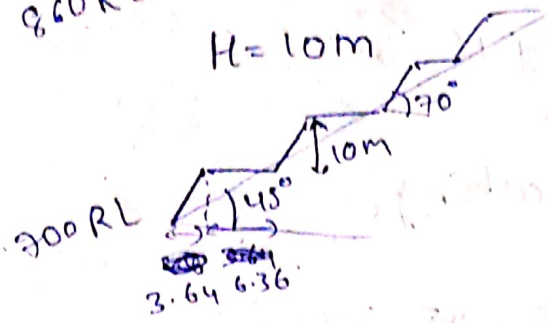
Yielded

Mat - 5 - well packed soaf
- 6 - Medium packed soaf
- 7 - loose packed soaf

03/04/21

→ Slope stability :

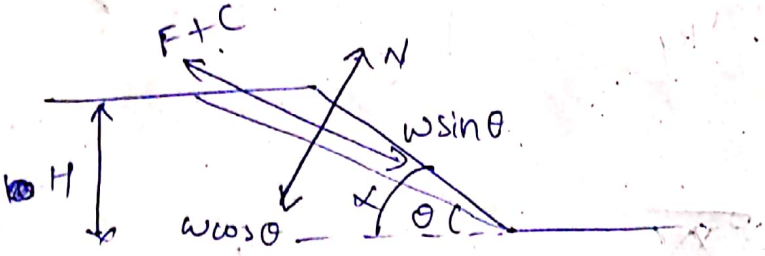
860 RL

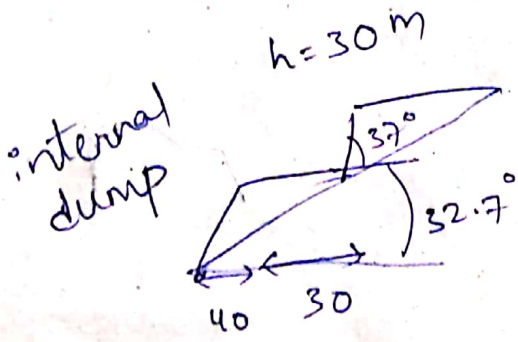


16 benches
depth: 170m
singareni

$$FOS = \frac{CA + Wl\cos\theta \tan\phi}{Wl\sin\theta}$$

$$Wl = \frac{\gamma h^2}{2}(\cot\theta - \cot\alpha)$$





internal

6 benches.

File → save as → slope stability

View → grid

Boundaries → Add External

760 m

20 benches

benches (20) → First 2 benches (5m bidden width, 5m Exposed width, height = 5m)

5 60

Prepare Data in Excel then copy and "paste in current cell"

External

Material properties

Top soil 1100 density

2100 → 100 Mpa 0.3
0.2, 20°, 0.01, 10, 20°, 0.01

Coarse

2400 → 9500 Mpa 0.27
3, 32°, 3, 16, 32°, 3

1500

Coal

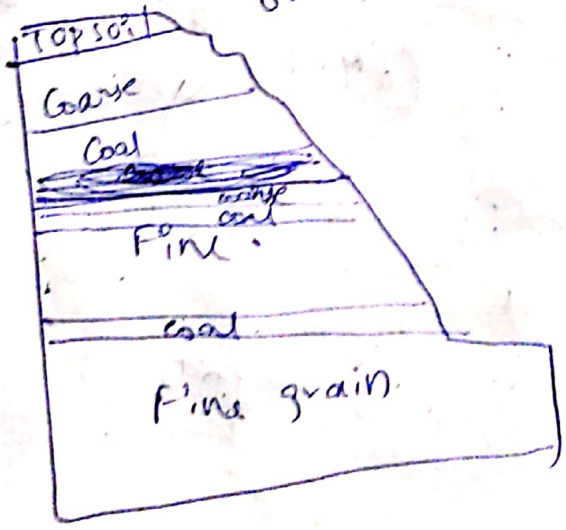
1900 1 Mpa, 0.25
0.0, 36°, 0.019, 18, 36°, 0.019

OB

Dump Material $\phi = 36^\circ$

$c = 19$ kpa

$c = 0.019$



Loading → Gravity → 1-5

strength factor) (FOS)

Max. shear strain

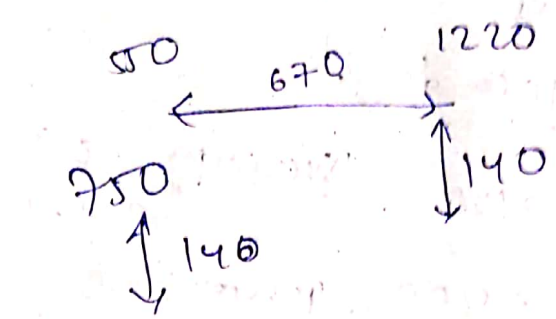
Vertical displacement

horizontal displacement

} for PSL

File → save as → Internal

Boundaries → Add External



100 180

0 180 -30

480 30 150

70 150

440 -30

(0,480) 100 120

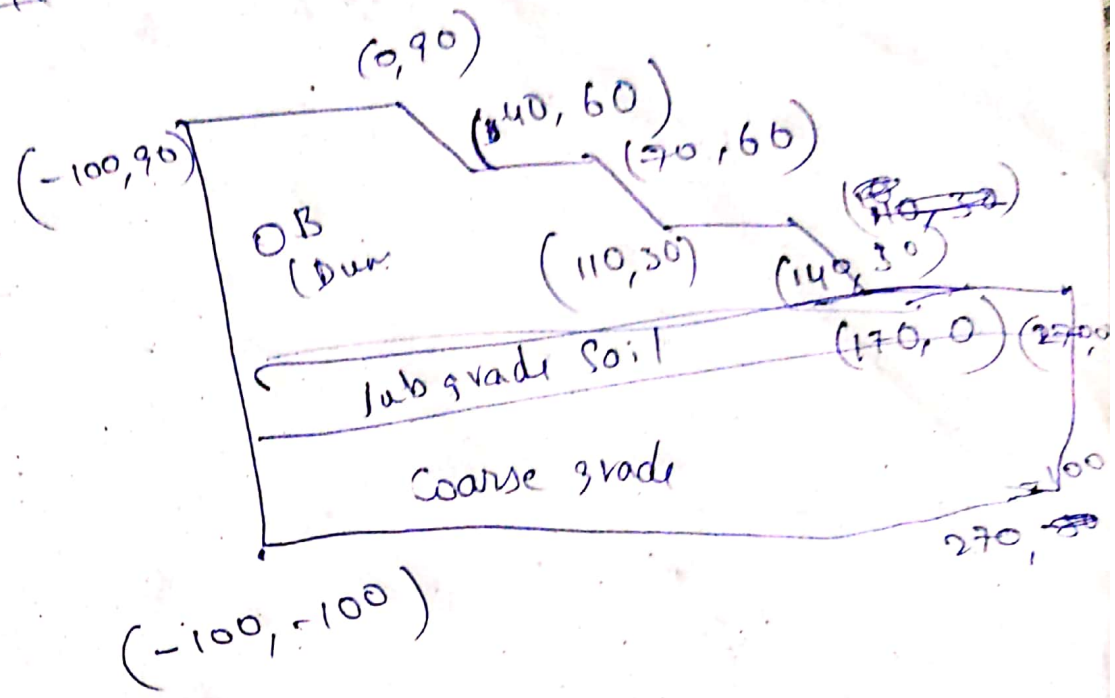
400

340 140 120

100

View → save as → External

- 100 90



Sub grade

0.02	1.5	15
3000	30	30
0.32	2	2