Minerals Council South Africa

CHAMBER OF MINES OF SOUTH AFRICA

EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA CERTIFICATE IN ROCK MECHANICS 3.2 (COAL) **SUBJECT CODE:COMRMC3.2** **EXAMINATION DATE:** 11 OCTOBER 2018 **TIME:** 14:30 – 17:30	**EXAMINER:** W. Mahne **MODERATOR:** L. Prinsloo **TOTAL MARKS:** [100] **PASS MARK:** 60%

Formatiert: Schriftart: Nicht Fett

Formatiert: Abstand Vor: 6 Pt.

NUMBER OF PAGES: ~~12~~ 9 (Including cover page)

SPECIAL REQUIREMENTS:

1. **Answer *ALL* questions and read these requirements**
2. References other than those provided are not permitted.
3. Hand-held electronic calculators may be used.
4. Put your ID number on the outside cover of each book used and on any graph paper or other loose sheets handed in.

NB: your name must not appear on any answer book or loose sheets.

5. **Write in ink on the ~~RIGHT HAND~~RIGHT-HAND SIDE of the paper only (only the right hand pages will be marked).**
6. Show all calculations on which your answers are based.
7. Illustrate your answers by sketches of diagrams wherever possible.
8. In answering these questions, full advantage should be taken wherever necessary of your practical experience as well as of the data given.
9. Answers must be given to **an accuracy that is typical of practical conditions**.
10. In presenting answers, candidates are encouraged to use **tabulations** and **~~diagrams~~diagrams,** or answers must be written in **bullet** points – **No long paragraphs**.
11. Cell phones are **NOT** allowed in the examination room

QUESTION 1

a) Discuss the latest shallow mining guidelines (5)

b) The following mining information has been provided by the Geologist for two new mining blocks that needs to be evaluated for maximum sales tonnes:

Block 1:

- Coal seam height = 4.0m,
- Depth to the coal seam roof = 27.0m, and
- Yield 70%.

Block 2:

- Coal seam height = 3.0m,
- Depth to the coal seam roof = 30.0m, and
- Yield 90%.

What is the maximum mining height that can be mined in each block?

Which of the two mining blocks will provide the maximum sales tonnes?

(20)

[25]

QUESTION 2

Investigations were done into the support requirements for a coal mine roof. It was found that the roof can be supported by suspension and that the maximum bolt spacing should not exceed 3.5m in any direction. The thickness of the roof layer to be supported is 1.2m, consisting of 0.6m of Ccoal and 0.6m of laminated Sshale and Ssiltstone.

The roof is to be supported with point anchored resin M20 rolled thread rebar with 450 MPa strength in 25mm diameter holes. Tests indicated that shear strength of the rock/resin contact plane is 1.5Mpa and the required factor of safety (FoS) is 1.5.

a) Complete the following table:

Bolt spacing (m)	Weight to be supported (KN)
1.0	
1.5	
2.0	
2.5	
3.0	

3.5	

(6)

b) For the selected spacing what should the minimum length of rebar be?

(5)

c) What length of resin capsule will be required if the capsule diameter is 23mm?

(4)

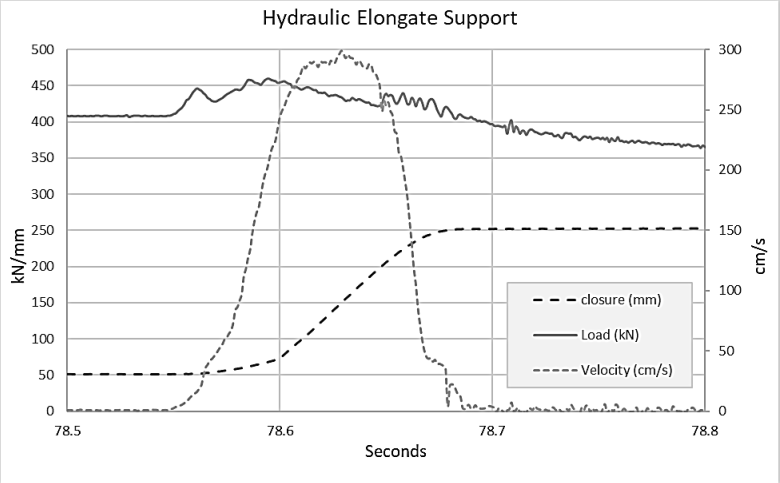
d) Compare the conditions under which the suspension principle for roof support is adequate with those under which beam creation is required.

(5)

e) Outline the steps to be followed in the design of roof support system based on beam creation.

(5)

f) Based on the information available in the graph below, describe how an elongate hydraulic support unit reacts during an increased load and rapid closure scenario.



(5)

[30]

QUESTION 3

A fatal Fall of Ground (FoG) accident occurred as a result of a failure in an intersection of bord and pillar workings. Detail the facts to be considered and recorded by the rock engineer when investigating the roof fall accident on site.

- In-loco examination.

- Any additional information you need ~~take into account~~consider.
- Fall of ground report.

(15)

[15]

QUESTION 4

Your M~~m~~ine M~~m~~anager requests an investigation into the potential for increased extraction of a 7 roadway bord and pillar panel. The depth of the overburden is 80.0 m, pillar centre 16.0 m, bord 6.0 m; mining height 2.5 m. The seam is overlain by a 20.0 m competent sandstone.

Write a concise report detailing potential extraction, risks, options and the recommendations you would suggest in your study, including from the initial phase to rock engineering aspects of mining the pillars.

(15)

[15]

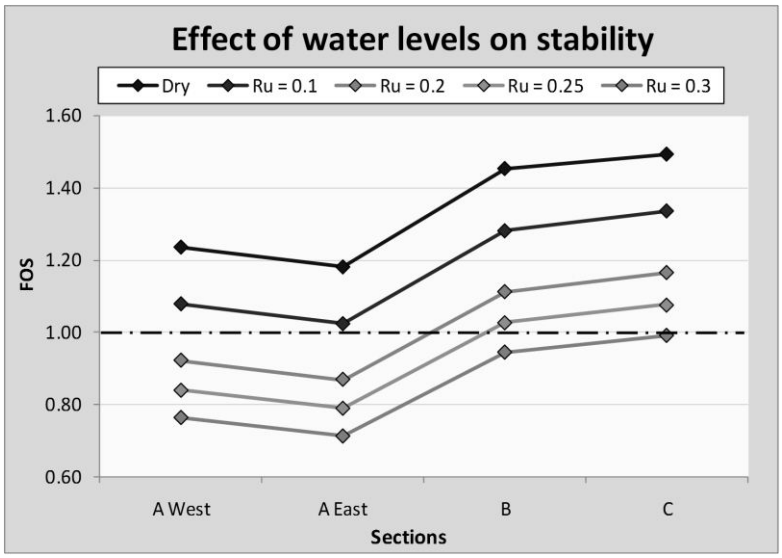
QUESTION 5

a) Based on the information available in the graph below, discuss the effect of water levels on the stability of spoils at Opencast area 1.

~~a)~~

Four different sections were monitored where cracks could be observed. The analyses were conducted using the Limit Equilibrium program SLIDE and the water pressure was modelled using the Ru pore pressure coefficients. The Ru coefficient used in SLIDE simply models the pore pressure as a fraction of the vertical earth pressure for each slice in the analysis.

Formatiert: Einzug: Links: 0,63 cm, Keine Aufzählungen oder Nummerierungen



(5)

b) The manager at Opencast Area 1 is worried about a tension crack on the crest of the Western spoil pile, next to the travelling road and conveyor belt, in close proximity to High wall portals.

~~b)~~

The estimated angle of the slopes based on the angle of repose of loose soils is 35^0 ~~degrees~~ overall steepening to approximately 60^0 ~~degrees~~ towards the bottom of the spoils. The height is approximately 55.0m. Loose boulders can be observed on the spoil and undercutting is present in the toe area.

Discuss the potential mechanism(s) of failure and negotiate recommendations to prevent failure.

(10)

[15]

TOTAL MARKS:[100]

Formatiert: Standard, Keine Aufzählungen oder Nummerierungen

Formatiert: Standard, Einzug: Links: 0 cm

Equation Sheet

Candidates may find some of the following equations useful, although other equations may also be used.

Pillars

$$\sigma = 7{,}2\frac{w^{0{,}46}}{h^{0{,}66}}$$

$$\sigma = 5.47\frac{w^{0{,}8}}{h}$$

$$\sigma = 6.61\frac{w^{0{,}5}}{h^{0.7}}$$

$$\sigma = 4{,}3\left(0{,}64 + 0{,}36\frac{w}{h}\right)$$

$$\sigma = 3.5\frac{w}{h}$$

$$\sigma = k\frac{R_0^b}{V^a}\left\{\frac{b}{\varepsilon}\left[\left(\frac{R}{R_0}\right)^{\varepsilon} - 1\right] + 1\right\}$$

$$\sigma = \frac{.0786}{V^{0.0667}}\left\{R^{2.5} + 181.6\right\}$$

$$w_e = \frac{4A}{C}$$

$$SF_{cm} = SF\left(1 + \frac{0.6}{w}\right)^{2.46} \quad SF_{cm} = SF\left(1 + \frac{0.6}{w}\right)^{3}$$

$$SF^{/} = SF\left(\frac{w - \Delta w}{w}\right)^{2.46} \quad SF^{/} = SF\left(\frac{w - \Delta w}{w}\right)^{3}$$

$$SF^{//} = \left(\frac{h}{h + \Delta h}\right)^{0.66} \quad SF^{//} = \left(\frac{h}{h + \Delta h}\right)$$

$$Load = \frac{\left[.025(H - T) + .03T\right]C_1C_2}{w_1w_2}$$

$$e\% = 100\left[\frac{h_m}{h_s}\left(1 - \frac{w^2}{C^2}\right)\right]\frac{W}{W + P}$$

$$E_{cp} = \frac{0{,}562w_e}{h} - 2{,}293$$

$$R = m\left[\frac{h}{T}\right]^x$$

$$d = w - \left[0{,}00714 S_{\min} HhC^2\right]^{0{,}333}$$

$$S_{\min} = 0.4$$

$$T = \left[\frac{d}{mh^x}\right]^{\frac{1}{1-x}}$$

Region	m	x
Vaal Basin, Klip River and South Rand	1,3888	0,804
Witbank No 2 and 4 Seams	0,1624	0,8135
Witbank No 5 Seam	0,105	-0,3061

Roof Support

$$\sigma_t = \frac{qB^2}{2t^2}$$

$$q = \rho g(t_s + t_w)$$

$$\sigma_t = \frac{fq_c s^2}{2t^2}$$

$$s = 1.414 t_{\min}\sqrt{\frac{\sigma_{tm}}{fq_c}}$$

$$q_c = q_l + \frac{q_u E_l - q_l E_u}{E_l + E_u}$$

$$l_a = \frac{\rho g s^2 t_w}{\tau_c \pi d_h} + .05$$

$$\eta = \frac{SF\rho gt}{P_d}$$

$$\sigma_{ts} = \frac{4W_b}{\pi d_b^2}$$

$$l_c = \frac{l_a\left(d_h^2 - d_b^2\right)}{\left(d_h - .002\right)}$$

$$t_{sb} = \frac{fk\rho gB^2}{2\sigma_{tm}}$$

$$\tau_b = \frac{3k\rho gB}{4}$$

$$\tau = C_c + C_b + \frac{F_b}{s_b^2}\tan\phi$$

$$F_b = \frac{s}{\tan\phi}\left[\frac{3\rho gkBs}{4} - \sigma_r d_h\right]$$

$$F_T = F_b \rho gk t_{sb} s^2$$

$$l_a = \frac{F_T}{\pi d_h \tau_c}$$

$$\eta = \frac{\gamma B^4}{32Et^2}$$

$$\sigma_s = \frac{4F_T}{\pi d_s^2}$$

$$\beta = \arctan\left(\frac{L/2}{\eta}\right) - \arctan\left(\frac{\eta}{L/2}\right)$$

$$R = \frac{L/2}{Cos\beta}$$

$$d\theta = \frac{\pi}{2} - \arctan\left(\frac{R - \eta - h_l}{L/2 - d}\right)$$

$$S = t_l d\theta$$

$$\sigma_r = \frac{\tau_l S_b}{d_b}$$

$$\varepsilon_r = \frac{\sigma_r}{E_r}$$

$$S_r = \varepsilon_r\left(d_h - d_b\right) + R_s$$

$$SSF = \frac{S}{S_r}$$

Subsidence

$$S_{m,he} = 0{,}39h\left(\frac{W}{H}\right)^{0{,}32}$$

$$S_{m,pf} = 0.1h_e$$

$$h_e = he$$

$$S_x = \frac{S_{\max}}{2}\left[\tanh\left(\frac{7x}{W} - 1{,}645\right) + 1\right]$$

$$L_c = 2T\sqrt{k + \frac{\beta}{D}} + 2(H - D)\tan\theta$$

$$\beta = \frac{c - b\gamma d}{\gamma_m \tan\phi} - \frac{kl}{2}$$

$$\beta = \frac{1.53}{\gamma_m} - 0.8$$

$$\gamma_m = \gamma_s \frac{D - T}{D} + \gamma_d \frac{T}{D}$$

$$\gamma_m = 0.025\frac{D - T}{D} + 0.03\frac{T}{D}$$

$$T_m = 21.6S_m + 7$$

$$\varepsilon_{m+} = 4.2S_m + 1.7$$

$$\varepsilon_{m-} = -9.1S_m - 2.8$$

Physics

$$E_k = \frac{1}{2}mv^2$$

$$v_i = \sqrt{2gd}$$