Minerals Council South Africa

EXAMINATION PAPER

SUBJECT: CERTIFICATE IN STRATA CONTROL (COAL) **SUBJECT CODE: COMSCC** **DATE: 04 OCTOBER 2022** **TIME: 14h30 – 17h30**	**EXAMINER:** C. SELAI **MODERATOR:** R. MALOGWA **TOTAL MARKS:** [100] **PASS MARK:** (60%)

NUMBER OF PAGES: 8

THIS IS NOT AN OPENBOOK EXAMINATION – ONLY REFERENCES PROVIDED ARE ALLOWED

SPECIAL REQUIREMENTS:

1. **Answer All the Questions**. Answer the questions **legibly** in English.
2. Write 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.

3. Show all calculations **and check calculations on which the answers are based.**
4. Hand-held electronic calculators may be used for calculations. **Reference notes may not be programmed into calculators.**
5. Write **legibly** in ink on the **right-hand page** only – **left hand pages will not be marked**.
6. Illustrate your answers by means of sketches or diagrams wherever possible.
7. **Final answers** must be given to an accuracy which is typical of practical conditions, however, be careful not to use too few decimal places during your calculations, as rounding errors may result in incorrect answers.

NB: Ensure that the correct unit of measure (SI unit) is recorded as marks will be deducted from answers if the incorrect unit is used even if the calculated value is correct.

8. In answering the questions, full advantage should be taken of your practical experience as well as data given.
9. Please note that you are not allowed to contact your examiner or moderator regarding this examination.
10. Cell phones AND OTHER SMART DEVICES are **NOT** allowed in the examination room.

QUESTION 1. PILLAR DESIGN

The overburden consists of shale, sandstone, and siltstone with a 30m thick dolerite sill sandwiched between these sedimentary layers. Answer the following questions using pillar strength formula of your choice.

1.1. What is the safety factor of the pillars in a panel where the mining height is 3.5m with the pillar centre distance of 20m, the depth to roof of 106.5m and the bordwidth of 6.6m? (10)

1.2. What will the safety factor be if the mining height increases by 28%? (5)

1.3. Determine the safety factor if in addition to increased mining height the pillars scale by 5%. (5)

1.4. What is the pillar safety factor if the pillars were developed using a continuous miner without scaling on both the pillars and roof? (3)

1.5. Comment on the pillar stability based on the safety factors calculated in 1.1 – 1.4 above, in comparison with the safety factor operational norms? (2)

[25 MARKS]

QUESTION 2. ROOF SUPPORT

2.1 What do you understand by the term contact shear strength when applied to resin roofbolting? (5)

2.2. Name and briefly describe the methodology used to determine the contact shear strength. (5)

2.3. The mine rockfall data indicates a 95% cumulative fall out thickness of 0.5m comprising of a shale layer with density of 2500kg/m^3 and average tensile strength of 3MPa. The falls occur before support installation in a coal mine section with bord width of 6.8m. Further investigation indicates approximately 0.3m water head above the roof. What is the cause of these falls? (6)

2.4. What measures would you recommend to prevent these falls in future? (4)

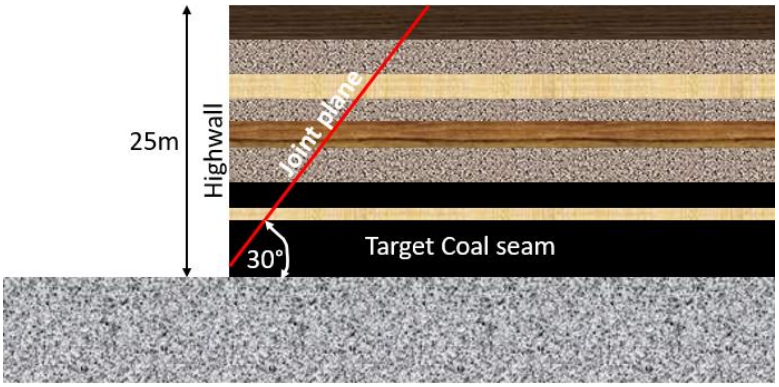
2.5. List five components of a bolting system, which determine the quality of an installed support in a coal mine section (5)

[25 MARKS]

QUESTION 3. JOINT STRENGTH/STABILITY

A joint exists in a vertical highwall face (see sketch below) earmarked for portal development for underground mining. The joint surface strikes parallel to the highwall face. Given the following information, answer the questions that follow:

- Density of rock = 2500kg/m³
- Gravitational acceleration = 9.81 m/s^2
- State all your assumptions, where necessary



3.1. Describe laboratory testing method used to determine basic friction angle along the joint plane. (5)

3.2. List the parameters you would record as part of mapping joints exposed on the highwall (5)

3.3. Identify and briefly describe potential failure mechanism along the joint plane (3)

3.4. What software would you consider appropriate to assess stability of the joint driven failure mechanism? (2)

3.5. Barton and Choubey developed the following equation for determining joint shear strength. What does each parameter in the equation mean? (4)

$$\tau = \sigma_n \tan(\emptyset_b + JRC.log_{10}(JCS/\sigma_n)$$

3.6. Use Barton and Choubey equation to calculate the shear strength (τ) along the joint plane above, given the following: $\emptyset_b$ = 28°, JRC = 17, JCS = 110MPa. (7)

3.7. Calculate the Factor of safety against slide along the joint plane. (4)

[30 MARKS]

QUESTION 4. MULTIPLE CHOICE

4.1. The following lengths of individual pieces of core have been recovered from a total length of drill run of 3m: 0.1 m, 0.3 m, 0.7 m, 0.5m. The RQD is: (5)

a) 1.4%
b) 50%
c) 47%
d) None of these is correct

4.2. Geological Strength Index (GSI) is based upon the following parameters (2)

a) Rock Strength & Joint Orientations
b) Geological Structure & Joint Surface Characteristic
c) RQD
d) All of the above

4.3. A reverse fault intersects a highwall of a strip mine and displaces the seam: The coal seam will be: (1)

a) Displaced upwards
b) Displaced downwards
c) Not displaced
d) None of the above

4.4. The tributary area theory for determining the load on pillars (2)

a) Assumes that the whole weight of overburden is shared equally by the pillars if the panel size is less than the area of a circle drawn with a radius 0.75 to 1.0 times the depth below surface.
b) Assumes that each individual pillar supports the weight of overburden immediately above it.
c) Can be applied equally in designing non-uniform sized pillars
d) All of the above.

4.5. For surface subsidence in high extraction panels (2)

a) The total magnitude of surface subsidence is significantly less than the original mining height
b) The total subsidence is reached quickly within 24 hours of goaf occurring
c) The subsidence profile is more pronounced
d) None of the above.

4.6. Full column resin roof bolts with dual speed resin can be classified as (1)

a) Stiff-passive support
b) Soft-active support
c) Stiff-active support
d) Soft-passive support

4.7. Roof guttering occurs (2)

a) The most likely mode of failure is tensile failure of weak highly laminated roof
b) Favourably at the corners, at the skin of the rock, where the difference between the stress perpendicular and parallel to skin are greatest and shear stress reaches maximum
c) Solely as a result of high horizontal stresses
d) All of the above.

4.8. The strength of a coal pillar (2)

a) Decreases with decreasing size of pillar
b) Increases as the width to height ratio increases
c) Increases as the depth of coal seam increases
d) Both a and b

4.9. The amount of roof sag (1)

a) Increases with an increase in modulus of elasticity
b) Increases in proportion to the power of the bord width all else being equal
c) Reduces with an increase in thickness of roof beam all else being equal
d) None of the above.

4.10. The stiffness of coal pillar will be decreased by (2)

a) Pillar splitting if the panel width is greater than the mining depth
b) Presence of dykes
c) Reducing the road widths
d) Both a and b

[20 MARKS]

TOTAL MARKS [100]

Strata Control (Coal) Formula sheet

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

$$e\% = 1 - \frac{w_1 w_2}{C_1 C_2}$$

$$S = 3.5\left(\frac{w}{h}\right)(MPa)$$

$$L = \frac{25HC^2}{w^2}$$

$$L = \frac{[25(H-T)+30T)]C^2}{w^2}$$

$$\eta = \eta_o\,(1+\frac{2\Delta w_0}{w})^{2,46}$$

$$n = SF\frac{pgt}{Pf}$$

$$Lb = \frac{d_c^2\ Lc}{D^2 - d^2}$$

$$\tau = \frac{Pf}{\pi.D.Lb}$$

$$\eta = \frac{\gamma\, L^4}{23\, E\, t^2}$$

$$\sigma_{nj} = \frac{\gamma L^2}{2t}$$

$$\sigma_j = \frac{3\gamma L^2}{t}$$

$$FS = 288\frac{w^{2.46}}{Hh^{0.66}(w+b)^2}$$

$$\sigma_s = 7.2\frac{R_0^{0.5933}}{V^{0.0667}}\{\frac{0.5933}{\varepsilon}[(\frac{R}{R_o})^{\varepsilon} - 1] + 1\}$$

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

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

$$SF' = SF\left(\frac{h}{h+\Delta h}\right)^{0,66} \qquad SF' = SF\left(\frac{h}{h+\Delta h}\right)$$