

Examination Paper • Eksamenvraestel

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA CERT. IN ROCK MECHANICS – PAPER 2 (COAL OPTION)	EXAMINER: J N VAN DER MERWE
SUBJECT CODE: COMRME	MODERATOR: B MADDEN
EXAMINATION DATE: 12 MAY 2004	TOTAL MARKS: [100]
TIME: 09h00 – 12h00	PASS MARK: 60%

NUMBER OF PAGES: 6

SPECIAL REQUIREMENTS:

1. Answer **ALL** questions.
2. References, other than those specified below, are not permitted.
3. Put your examination 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.

4. Show all calculations on which your answers are based.
5. Hand-held electronic calculators may be used.
6. Write on the **right hand side** of the page only.
7. Illustrate your answers by sketches or diagrams wherever possible.
8. Answers must be given to an accuracy which is typical of practical conditions.
9. In answering the questions, full advantage should be taken of your practical experience as well as data given.
10. In answering the questions, state any assumptions made.
11. A formula handout will be issued.

Chamber of Mines Certificate in Rock Engineering

Coal Option: Paper 2

June 2004

1 Question 1

Briefly describe how the following tests are performed, what the results are used for and the limitations of each:

- (a) Duncan Swell Test [4 Marks] 3
- (b) Slake Durability Test [4 Marks] 3
- (c) Impact Splitting Test [4 Marks] 3
- (d) RQD [3 Marks] 2

[Total Marks: 15]

2 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 3.5 m in any direction. The thickness of the roof layer to be supported is 1.1 m, consisting of 0.5 m of coal and 0.6 m of laminated shale and sandstone.

The roof is to be supported with point anchored resin and M20 rolled thread rebar with 600 MPa yield strength in 25 mm diameter holes. Tests indicated that the shear strength of the resin/rock contact plane is 2 MPa. The required safety factor 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	

Bearing in mind the tensile strength of the rebar, select the most suitable bolt spacing from the table. [7 Marks]

- (b) For the selected spacing, what should the minimum length of the rebar be? [5 Marks]
- (c) What length of resin capsule will be required if the diameter of the capsule is 22 mm? [5 Marks]
- (d) Compare the conditions under which the suspension principle for roof support is adequate with those under which beam creation is required. [5 Marks]
- (e) Outline the steps to be followed in the design of a roof support system based on beam creation. [8 Marks]

[Total Marks : 30]

Question 3

- (a) Describe the following three mechanisms and explain how they can result in pillar system failures -
- (i) Roof failure [4 Marks]
 - (ii) Floor failure [4 Marks]
 - (iii) Progressive pillar scaling [4 Marks]
- (b) What is the so-called Tributary Are Theory and what are its limitations? [3 Marks]

[Total Marks: 15]

Question 4

A coal mine panel, 150 m wide at a depth of 60 m, is to be re-mined by pillar splitting. The developed pillar centres were 14 m square with 5 m wide roadways and the mining height was 3 m. Splitting will be done by driving a 5 m wide roadway square through the pillars (i.e. leaving two fenders, each 9 m long by 2 m wide).

- (a) What was the original safety factor of the pillars? [3 Marks]
- (b) What will be the failure probability after splitting? [4 Marks]
- (c) If the remaining fenders fail, how much subsidence can be expected? [4 Marks]
- (d) If the pillars fail, can the failure be expected to be violent or progressive? [4 Marks]
- (e) Motivate your opinion. [3 Marks]
- For the amount of coal to be extracted from this panel, is this the best method under the circumstances? Motivate your answer by comparing it to an alternative method. [6 Marks]

[Total Marks: 20]

Question 5

Detach the table attached to the back of this paper and use it to fill in your answers, by clearly marking the "True" or "False" column opposite each question number. Do not indicate "True" only – also mark the "False" column if you believe the statement to be incorrect.

Remember to fill in your examination number on the sheet.

Marks will be deducted for incorrect answers.

5.1

The Coalech 2020 research initiative is primarily aimed at:

- (a) developing mining methods to mine the remaining deeper coal reserves safely
- (b) finding methods to reduce the environmental impact of coal mining
- (c) prolonging the lives of mines in the Witbank/Highveld coal fields
- (d) finding practical methods to implement the SIMRAC findings

5.2

The deeper longwall mining is done,

- (a) the more subsidence will occur for constant panel depth, due to greater weight of the overburden
- (b) the same amount of subsidence will occur if the panel width is increased in the same ratio as the mining depth
- (c) the smaller the magnitude of induced tilt on the surface
- (d) the less likely sub surface erosion is to occur

5.3

Sub surface erosion

- (a) only occurs in sandy overburden conditions
- (b) is a water driven process
- (c) only occurs in the Vaal Basin
- (d) ceases four to five years after mining has been completed

- 5.4 The SIMPROSS organisation
- competes with SIMRAC for state funding of mining related research
 - is the Minerals Processing branch of the SIMRAC organisation
 - manages the SIMRAC-funded research
 - is concerned with mine profitability in addition to mine safety
- 5.5 The rate of pillar scaling
- is inversely proportional to the safety factor
 - is directly proportional to the mining height
 - is the same in all coal fields for the same safety factor
 - increases as the pillars get progressively smaller
- 5.6 Membership of SANIRE
- is a pre-requisite for ECSA registration
 - is compulsory for appointment as a mine or shaft rock engineer
 - is only open to South African nationals
 - guarantees legal assistance in case of mining related prosecution
- 5.7 Failure of under-sized in-panel coal pillars
- is unlikely to occur if inter-panel pillars are wider than ten times their height
 - is more likely to occur in wider panels than narrower panels
 - can be predicted in time by micro seismic monitoring
 - will invariably result in less subsidence than longwalling at mining depth shallower than 80 m.
- 5.8 Mobile Breaker Line supports
- were first used in South Africa in the 1980's
 - were developed in the Australian coal mines
 - were developed by the USBM (Now NIOSH) in the USA
 - are commonly used in longwalling as gate road supports in the USA
- 5.9 For the same roof conditions, South African coal mines generally
- install more roofbolts than Australian coal mines
 - install about the same number of roofbolts than coal mines in the USA and Australia
 - install more intensive monitoring systems than mines in the USA and Australia
 - experience less instability than coal mines in the USA and Australia
- 5.10 The post-failure modulus of a coal pillar
- is the same for all pillars in the same geographical area irrespective of pillar size
 - is the negative of the pre-failure modulus
 - can never be positive
 - is a function of the width-to-height ratio of the pillar prior to failure

[Total Marks: 20]