UNIVERSITY OF SOUTH AUSTRALIA

School of Natural and Built Environments

ANNUAL EXAMINATION

Monday 18 October 2004, 8.50 am
Mawson Lakes Room H2-34

MINE SURVEYING AND BLASTING (RENG 3012)
BLASTING MODULE

Time: TWO Hours
OPEN BOOK

In addition candidates are allowed 10 minutes to read the paper before the examination begins.

Answer **ALL FOUR** questions.

Notes and textbooks may be used.

Marks will be deducted where units are either missing or incorrect.

Add appropriate comments to explain and discuss your solutions. A portion of the marks will be awarded for your explanation and discussion of each question.

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QUESTION 1

It is proposed that an open pit mine will be developed by bench blasting with 203 mm diameter blastholes loaded with ANFO of density 0.95 g/cm^3. Assessment of the rock conditions indicates that a powder factor of 0.7 kg/m^3 will be required. Use 'rule of thumb' methods to develop a preliminary estimation of the following blast parameters to excavate a bench with a cut width of approximately 26 m and a length of approximately 80 m:

Parameter	Marks
1. Bench height (m)	2
2. Stemming length (m)	2
3. Subdrill (m)	2
4. Stemming size (mm)	1
5. Charge concentration (kg/m)	1
6. Charge length (m)	2
7. Charge weight per hole (kg)	1
8. Volume of rock broken per hole (m^3)	3
9. Burden to achieve required powder factor (m)	3
10. Blasthole spacing (m)	2
11. Number of blasthole rows	2
12. Number of blastholes in each row	2
13. Total volume of rock broken in blast (m^3)	2

total 25 marks

QUESTION 2

Design the layout of a burn cut based on a pattern of **three** concentric squares/diamonds containing a charged hole at each corner, giving a total of 12 charged holes. The central void will be formed from **five**, 76 mm diameter uncharged reamer holes.

Calculate the void ratio for the first square of the cut.

Indicate the delay number for each charged hole.

What maximum advance per round would you recommend for this burn cut design?

25 marks

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QUESTION 3

A layered rock mass forming the wall of an open pit coal mine has an average fracture spacing of 0.15 m and a density of 2.3 tonnes/m^3. Point Load tests on intact samples of the rock gave an average I_{s50} of 1.2 MPa. The dominant discontinuity set in the rock mass, formed by bedding planes, has a dip direction/dip angle of 250/10. Tests on these discontinuities indicated a basic friction angle of 30º with a roughness angle of about 5º.

It is proposed that the rock mass will be blasted using 165 mm diameter holes drilled in a pattern adjacent to the existing face of dip direction/dip angle 125/65, to a depth of 20 m with an average burden of 5 m.

Using whatever data you deem to be relevant and applying whatever scheme you believe is appropriate, estimate the required powder factor for this coal mine. Briefly discuss the validity of your results.

25 marks

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QUESTION 4

The construction of a road cutting adjacent to a modern industrial development will require the excavation of rock by blasting. The rock mass is a relatively unfractured dolerite with a density of 2,600 kg/m^3 and a P-wave velocity of 3,500 m/sec. An initial blast design has proposed the use of 90 mm diameter charges in 100 mm diameter blastholes drilled to a burden of 2 m.

At their closest point, the foundations of a factory are located 75 m from the blasting site. Mats will be used to contain fly-rock.

Apply Berta's method to estimate the maximum mass of charge per delay (rounded to the nearest kg) in order to limit the predicted particle velocity to no more than 25 mm/sec at the closest factory. Briefly explain and discuss your solution.

A summary of relevant data is tabulated below.

Description	Parameter	Units	Values
Mass of charge per delay	Q	kg	To be determined
Distance from blast to observation point	r	m	75m.
Breaking factor	n_t	-	0.4
Impedance of explosive	Z_e	kg/m^2/sec	9.50×10^6
Impedance of rock	Z_r	kg/m^2/sec	13.5×10^6
Blasthole diameter	D	mm	100
Charge diameter	d	mm	90
Specific energy of explosive	E_t	MJ/kg	4.5
Duration of vibration, number of cycles	n_p	-	5
Frequency attenuation factors: solid rock	k_f	-	0.02
Rock density	ρ_r	kg/m^3	2,600
Seismic velocity	V_p	m/sec	3,500
Particle velocity	v	mm/sec	maximum of 25 mm/sec

Note:

Impedance factor $n_1 = 1 - \dfrac{(Z_e - Z_r)^2}{(Z_e + Z_r)^2}$

and

Coupling factor $n_2 = \dfrac{1}{e^{D/d} - 1.72}$

25 marks