

**Delft University of Technology**  
**Final Examination Mining Engineering I (TA3110)**

**November 3, 2004**

**Part II - Surface Mining**

**Open Book Writing**

*(90 Minutes Duration)*

**NOTES:**

1. This part of exam contains 3 groups of questions. Read the questions carefully before you start answering.
  2. All the units appearing in this exam are metric units unless where specially stated. Please be careful at any time when unit conversion is required.
  3. Any non-communicating calculator is permitted. This is an Open Book exam.
  4. If problem exists as to the interpretation of any question, the candidate should consult the exam supervisor for clearance. Reasonable assumptions acceptable if the supervisor encourages, but any assumptions made should be clearly stated the reason which should be submitted with the answer paper.
  5. Marks assigned to each question have been stated on the question sheets on a 100% basis, which contributes 50% of the total mark of the overall course, i.e., your final mark of this part of exam will be multiplied by 50% as the contribution to your overall mark of this course.
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## 1. General concepts of surface mining

Please choose **5** of the following 6 questions to answer. Clearly indicate the number of questions to be answered. If all the 6 are answered, only the first 5 will be marked **(30, 6 each)**.

- (1) Describe briefly the major surface mining methods, including in which case each mining method might be used and general production process.
- (2) Waste disposal becomes more and more a critical environmental restriction to a surface mining operation. Please,
  - a) discuss the major methods of dump building
  - b) give a list of factors you think most important when you are committed to do dump design, so that the environmental and safety regulations can be enforced.
- (3) When you are committed to conduct a mine design, what procedures you should follow? In each design stages, what main tasks you have to accomplish?
- (4) Stripping ratio has been considered a critical factor that defines the profitability of an open pit mine operation. Please discuss:
  - a) how many different types of stripping ratio you have to look at when you are performing an open pit design
  - b) what stripping ratio is more critical and thus should be used for the determination of optimal pit
- (5) Discuss the major similarities and differences between open pit mining and open cast (strip) mining, especially on suitability, mining equipment and production cycle.
- (6) Please describe the concepts and mechanisms of extended bench and pull-back operations in the area strip mining production (use sketch if it helps). When do you think these operations may be needed?

## 2. Pit geometry (30, 15 each)

- (1) For an open pit operation, in order to reduce the overall stripping ratio to a maximum extent, it has always been an objective to achieve the steepest final pit wall. However, the final pit wall is determined by its components that have to be defined carefully in consideration of physical limitations and regulatory restrictions.
  - Please specify what critical components of a pit might affect the final



pit slope;

- Using a sketch if it helps to illustrate how to define the geometry of these components so that the angle of the final pit wall can be maximized. The discussion should include how practical limitations and regulatory constraints on these components might affect your final design.

(2) A pit is using shovel and truck system to handle the blasted material on the working benches. The shovel is digging along the bench face and advancing towards only one direction. The angle of repose is  $45^{\circ}$ . For safety purposes, the equipment clearance should be minimum 1.5 m.

If the truck is positioned to the loading spot by using 3-point maneuver system. What should be the minimum working bench width if the truck specifications are read as below?

- Gross Machine Weight: 137 ton
- Weight distribution:
  - empty: 47.3% front; 52.7% rear
  - loaded: 34.2% front; 65.8 rear
- Max. Payload: 240 ton/ 147.5 m<sup>3</sup>
- Engine power : 2300 hp
- Height: 6.90m
- Overall Length: 13.10 m
- Working Width: 8.02 m
- Tire diameter: 3.5 m
- Turning Circle (Radius): 30.2m

### 3. Production (40: (1)=10;(2)=10;(3)=20)

An open pit mine is operating at a capacity of 50,000 tonnes/day on 15-meter benches, and following traditional drilling, blasting and shovel loading and truck haulage production system. The S.G of the material is 3.5 T/M<sup>3</sup>.

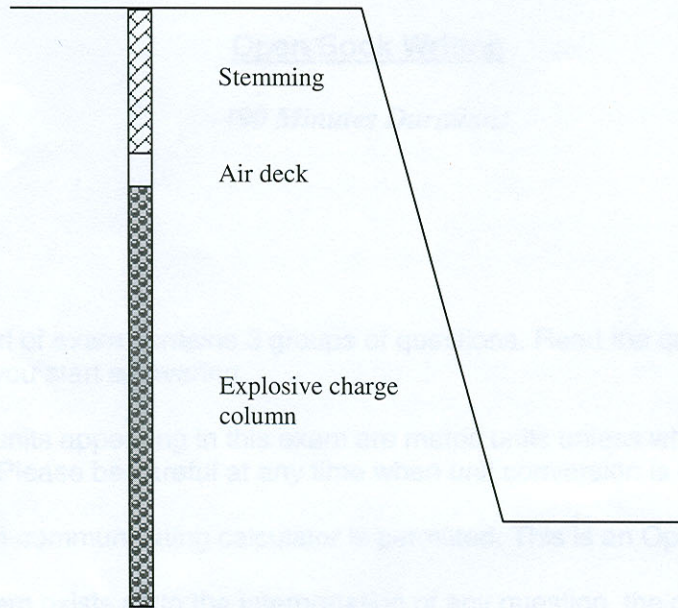
(1) Blasting hole is designed to be on a 6m x 6m square pattern with 1.5 meters of sub-grade drilling. The rotary drill selected has a penetration rate of 5.5 minutes per meter which needs 8.0 minutes to relocate to start drilling a new hole. Drilling operates for 7.5 hours out of every shift and 2 shifts per day.

Please estimate how many drills should be working at the same time in pit so that the daily production requirement can be met?

(2) The holes are 25 cm in diameter, and they are loaded with ANFO at a density of 0.90 grams per cc. If the drill hole is loaded with a collar



(stemmed) height of 4 meters and 0.5 meters of air deck (refer to the picture below), is this a reasonable blasting by looking at the powder factor of the explosive?



- (3) The material has been indicated to have a swell factor of 45%. A shovel and truck fleet is used for blasted material loading and transportation. The shovel type has been selected which provides the following specifications:
- loading cycle: 1 min/path
  - loading efficiency: 85%
- a) The shovel and truck fleet operates on the basis of 8 hours per shift, 2 shifts a day, and the shovel loads the trucks with 3 passes. What should be the reasonable truck size?
- b) If the cycle time of the truck is, with all the factors that affect the efficiency of truck operation considered, in average of 24 minutes per trip, and the truck availability is in average 80%, how many trucks might be needed to keep the shovel working effectively?