MIN350

TOPICS IN MINE DESIGN1

FINAL EXAM –APRIL 17, 2001

OPEN BOOK EXAM

INSTRUCTOR: PROFESSOR W. F. BAWDEN

COMPLETE ALL FOUR OF THE FOLLOWING QUESTIONS

QUESTION # 1: **[30 MARKS]**

An open pit copper operation has the following cost data:

Mill recovery rate = 85%
Mill concentrate grade = 25%
Smelting loss = 4 Kg/tonne concentrate
Refining loss = 2 Kg/tonne blister copper

Production (operating) costs excluding stripping costs in US $/tonne:
- Mining cost = $1.50
- Milling cost = $2.50
- General and Administration [at 15% of mine + mill cost] = $0.75

Amortization and Depreciation
- Assume 20% of total production costs

Shipment of concentrate to smelter = $1.50/tonne concentrate
Smelting cost = $60.00/tonne concentrate
Shipment of blister copper to refinery = $50/tonne blister copper
Refining cost = $150.00/tonne blister copper
Selling and delivery cost = $0.03/Kg copper
General plant cost = $0.15/Kg copper

Assume stripping cost = mining cost

Figure #1 shows an ore grade – block model section of the orebody. Perform the following analysis.

(i) Develop the net value – ore grade – strip ratio curve for the orebody. [Note: assume that the net value - ore grade – strip ratio curve is linear]

(ii) Assuming 45°slopes and a 50 meter minimum pit bottom find the pit limits for the section shown on Figure #1.

[NOTE: Indicate and label all trial pit shells on figure #1 and clearly label individual shells in your calculations. Sign and return Figure #1 with your exam.]

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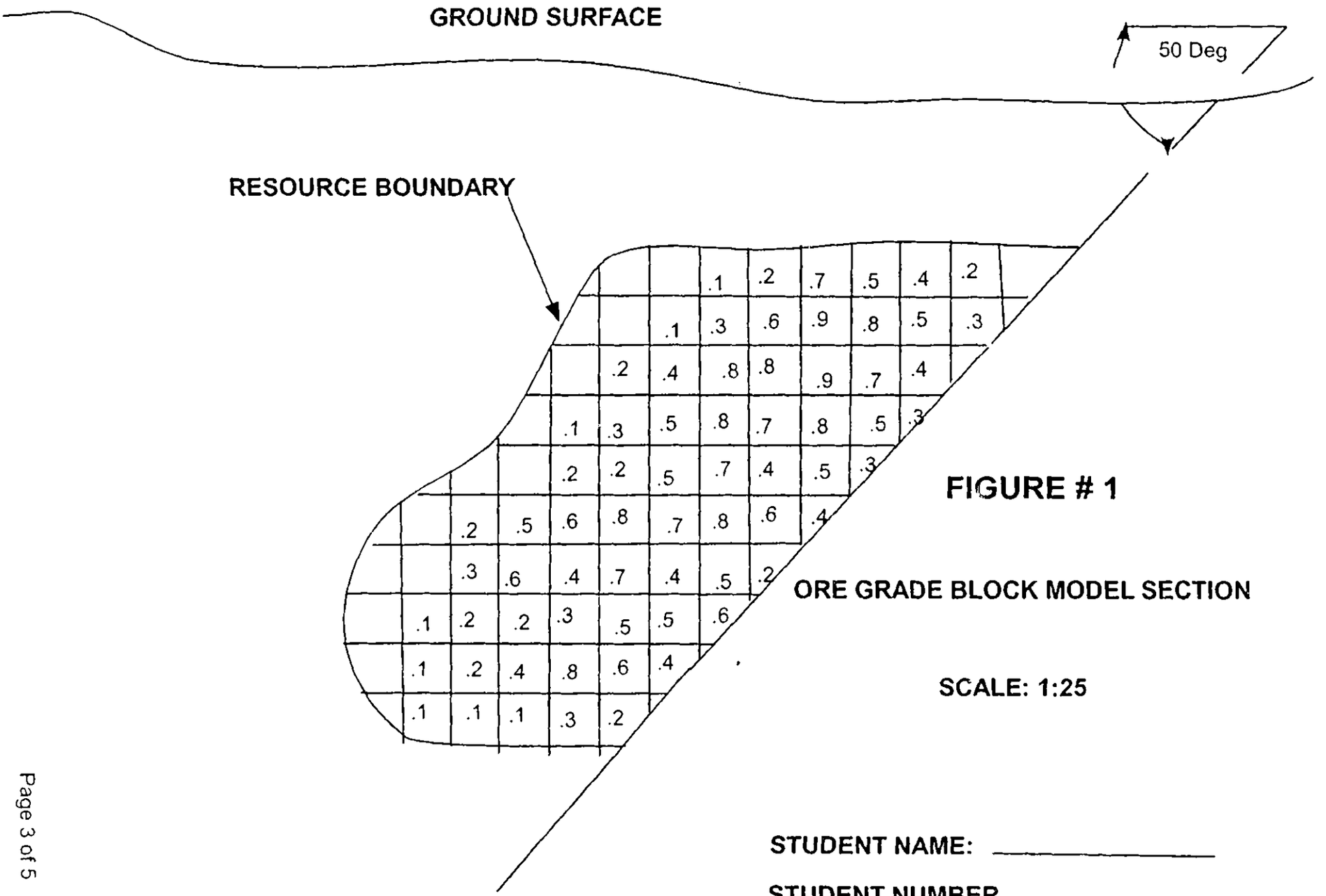

FIGURE # 1

ORE GRADE BLOCK MODEL SECTION

SCALE: 1:25

STUDENT NAME: _____

STUDENT NUMBER _____

QUESTION #2: **[25 MARKS]**

You are preparing a feasibility study for a new open pit mine. It has been determined that the mine will use 250 tonne trucks to haul 15,000 tonnes per 8 hour shift of copper ore from the pit bottom to the concentrator. The one way haulage distance is 3 Km. The haulage road has a grade of 8% and a rolling resistance of 2%. The truck travels at an average speed of 20 Km per hour in both directions. Assume that each truck carries 200 tonnes and works 50 minutes per hour. Assume that the spotting/loading/turn and dump time is 2.8 minutes.

[NOTE: 1 tonne = 10 KN = 1000 Kilograms; 1 Kg = 2.25 lb]

(i) Determine how many trucks will be required.

(ii) The open pit mine discussed above will use conventional dual rear wheel haul trucks of 250 tonne Gross Vehicle Weight including payload. The load distribution is 33% to the front tires and 67% to the rear duals. The tire inflation pressure is 640 Kpa. Estimate the maximum tire load at a depth of 0.3 meters below the wear surface.

(iii) Outside the pit limit the haul trucks from (i) will travel over haul roads having a highly plastic clay subgrade [CBR =4]. A fairly clean sand subbase [CBR = 20] will be used in this road design. What should the subbasse thickness be/

(iv) What materials would you recommend for construction of the remainder of the road bed, including the wearing surface?

(v) What key characteristics should the wear surface possess?

QUESTION #3: **[30 MARKS]**

A copper- nickel orebody has been discovered and you are part of a consulting team working on the preparation of a bankable feasibility study. The deposit consists of a tabular, very competent massive sulphide ore [S.G. = 4] hosted in a volcanic pile of rhyolite, andecite and dacite host rocks [S. G. = 3]. The host rocks are of good to medium quality. The top of the orebody is located 400 meters below ground surface. The orebody strikes east - west and dips 40 degrees to the north. The ore is 50 meters thick on average and is continuous for 350 meters on strike between bounding north – south regional faults. The orebody has been drilled off to reserve status to a depth of 700 meters and the resource is open at depth below this. Economics suggests that a high mill throughput of 5,000 tonnes per day would be optimal. The ore and host rock quality suggests that host rock spans of up to 20 meters will be acceptable with proper ground support and vertical walls for the full orebody height should be stable. The orebody is located in a populated area and one of the permitting requirements is that no mine induced surface deformations occur. Clearly state any assumptions used in your answers.

(i) Calculate the reserve tonnage and select a mining method. Justify your selection of mining method in terms of productivity required to achieve the desired mill throughput [e.g. is the number of active stopes or working faces reasonable?].

(ii) Describe the access infrastructure required in order to begin production in the initial production block from 700 meter depth to the top of the orebody. Assume shaft access and include the location and depth of the shaft. Provide a justification for your choice of shaft location and depth.

(iii) Describe the infrastructure required for ore and waste materials handling underground in order to deliver the required ore tonnage to the mill.

(iv) For the mining method selected describe in detail the development required in order to allow extraction of an individual stope. Either in written and/or with sketches describe the detailed extraction sequence for a typical production stope.

(v) How will surface deformations be controlled? Describe any infrastructure required as part of this process.

(vi) Suggest a general production sequence to generate required production tonnage. Discuss any other problems that might result from the selected production sequence.

QUESTION # 4: **[15 marks]**

(i) The top surface of a new 5 meter thick coal seam planned for extraction is located at a depth of 150m. Shaft sinking costs $10,000 US/meter. Drifting at grades to ± 20 % costs $2,200 US/meter. Assuming equal productivity from both systems would you recommend shaft hoisting or a belt conveyor up a slope?

(ii) How would you determine the optimum production rate for the mine?

(iii) A headframe mounted friction-sheave hoist operates two skips in balance under the following conditions;

shaft depth	500 meters
skip live load	8 tonnes
skip dead/live load ratio	1.2
hoist ropes	4 @ 25.4 mm flattened strand, normal strength
sheave diameter	3 meters.

The criteria for rope slippage is that $T_{Loaded}:T_{Empty} < 1.7$.

(a) Will rope slip occur?

(b) What is the rope slippage relation? If rope slip occurs what can be done to overcome this?