

ORDRE DES INGÉNIEURS DU QUÉBEC

SESSION - NOVEMBER 2017

All documentation permitted
Calculators: Permitted models only
Duration of the exam: 3 hours

14-MI-A4

SURFACE MINING METHODS AND DESIGN

Question 1 (10 points)

Illustrate a vertical section of an open pit, including the terminology associated with it.

Question 2 (10 points)

When designing an open pit, mining engineers use different safety factors as well as probability of events to define the overall slope angle of the pit walls. Please explain how and why these elements are used when designing an open pit.

Question 3 (10 points)

Several physical parameters can influence the profitability of an open pit mining operation. Please list these parameters?

Question 4 (20 points)

Two separate areas are in operation on the same level (bench) in an open pit mine. The first area is the ore loading area (Area A) for the primary crusher and the second (Area B) is the waste loading area dedicated to the waste pile.

Using the following data:

- Two trucks have a theoretical capacity of 175 tonnes. This capacity is 100% achieved in the case of waste rock but 95% in the case of ore, the latter having a slightly lower density than the waste rock.
- Loading time, in single loading (only one side at a time), is estimated to be 5.5 minutes for area A and 7.5 minutes for area B due to poor rock fragmentation during blasting.
- In both areas, the waiting and maneuvering time at the loading point is the same (5 minutes).
- The time required to go from the level exit (ramp entrance) and the waste pile is 25 minutes, while the return is 20 minutes.
- The crusher being located at an intermediate level in the pit, transportation time between the level exit (ramp entrance) and the crusher is 15 minutes, while the return is 10 minutes.
- The unloading time for the waste rock is 2.5 minutes and it is 3 minutes at the crusher given the waiting line at this location.
- Area A and area B are located 150 and 350 meters respectively from the exit of the levels. The average speed achieved on the level by the trucks is estimated at 12 km / hour for area A and 15 km / hour for area B.

- a) Calculate the productivity of each truck (in tonnes / hour) (8 points)
- b) What are your proposals to increase the productivity of each of the trucks? (4 points)
- c) Given that the mill is to be supplied at a rate of 10 000 tonnes per day and that the supply will only come from area A over the next few days, how many trucks would you use in area A in order to ensure that the mill will not run out of ore. The mill runs 24 hours a day and the mine on two 8-hour shifts, but actually only 13 hours a day considering the delays. (8 points)

Question 5 (10 points)

A production truck operator perceives an obstacle and must activate the braking system. You must determine the stopping distance of this production truck going down in a ramp. Without presenting the specific equation, list the parameters to be considered in order to calculate the stopping distance of the truck.

Question 6 (20 points)

Design of roads or ramps in open pit mines:

- a) What are the parameters to be considered when selecting road surface material for a road or ramp in an open-pit mine? (6 points)
- b) You have to do the design of roads and ramps for an open pit mine. What parameters will you need to consider for a safe design? (14 points)

Question 7 (10 points)

Using the following information from the vertical sections of two open pits:

- Depth of the pits to be considered:
 - o 270 meters (pit A)
 - o 540 meters (pit B)
 - Bench height : 15 meters
 - Bench width : 10 meters
 - Bench face angle : 75 degrees
 - Ramp elevation on the section :
 - o 135 meters (pit A)
 - o 270 meters (pit B)
 - Ramp width : 40 meters
- a) Calculate the overall slope angles for pits A and B (4 points)
 - b) Calculate the inter-ramp slope angles for pits A and B (2 points)
 - c) When you compare the slope angles obtained, what conclusions can you draw from the results obtained in a) and b) (4 points)

Question 8 (10 points)

Several phases lead to production in an open pit mine. At what phase of the development of a mine does the engineering team have the most relative ability to influence future production costs? Please explain your answer.