

ORDRE DES INGÉNIEURS DU QUÉBEC

SESSION - MAY 2018

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)

When carrying out technical and economic studies for the exploitation of an open-pit mine, two pits are designed: ultimate pit and final pit. What distinctions do you make between these two types of pits?

Question 2 (16 points)

In an open pit mine, a deposit of thickness « T » can be extracted in many ways. For example, the engineering team could decide to have benches of 15 meters or 7.5 meters.

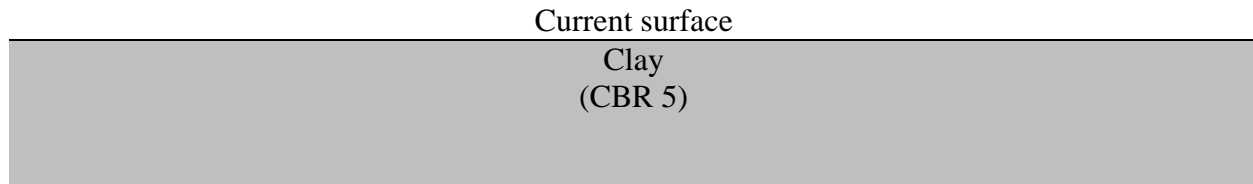
What are the advantages and disadvantages of selecting higher and wider benches compared to smaller benches?

Question 3 (10 points)

The nested pit technique is widely used in the design of an open pit. Please illustrate this technique and explain it.

Question 4 (20 points)

At the conceptual stage of a potential mining project, you must design a road that will provide access to a new mineralized zone 5 kilometers away from the current mine site. It is planned to have two lanes for this road. The maximum speed of the vehicles will be 30 km / hour and the number of vehicles per hour will be 100. Soil samples have been taken at various places of the future road. Here is a typical simplified vertical section of the situation:



Gravel pits nearby can provide sand (CBR 20), coarse crushed stone (CBR 70) and fine crushed stone (CBR 95). The price of coarse crushed stone is about double the price of sand, while the price of fine crushed stone is 75% higher compared to coarse stone. The largest vehicles on this road will be Caterpillar 785D trucks. The weights of this truck are 115,000 kg when empty and 250,000 kg when loaded.

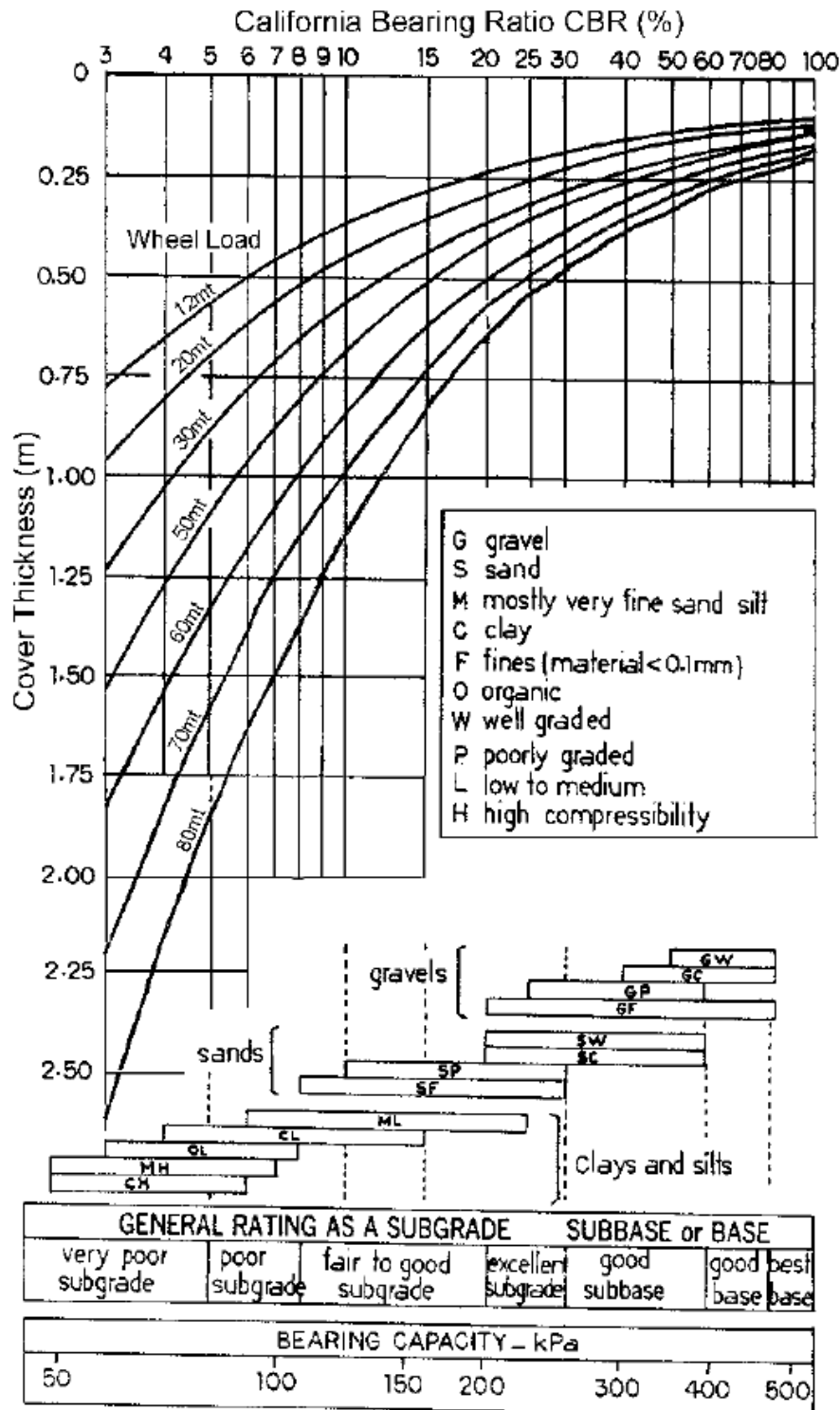
The weight distribution is as follows:

- Rear axle (loaded): 67%
- Front axle (loaded): 33%
- Rear axle (empty): 46%
- Front axle (empty): 54%



Based on this information, please illustrate, in one or more cross-sections, the minimum thicknesses of material required for the construction of the road.

Note: The CBR curves are below.



Question 5 (10 points)

Let suppose a road with a transverse slope of 4% to the right with vehicles traveling at a speed of 56 km / h. The horizontal section opens on a curve to the left, with an elevation of 6% to the left. Please determine:

- The transverse gradient change
- The recommended transverse gradient variation
- The total distance for the transition
- The distribution of the transition in the rectilinear section and in the curved section of the road

Question 6 (10 points)

What are the technical factors that contribute to the increase in diesel fuel consumption of open pit trucks (liters of fuel per kilometer traveled)?

Question 7 (24 points)

The Lerchs-Grossman method, applied to a single vertical section, is relatively simple compared to its 3D application, at least when applied manually.

Apply the Lerchs-Grossman method for the vertical section on next page (5m x 5m x 5m blocks) and determine:

- The optimal value of this vertical section (\$ / t)
- The shape of this section (consider 45-degree wall angles)
- The waste / ore ratio (consider that the ore and the waste have the same density of 2.9)

Value of the blocks (\$/t):

-6	-6	-6	7	9	7	11	10	4	2	2	-6	-6	-6	-6
-6	-6	-6	-6	10	9	12	7	4	2	4	-6	-6	-6	-6
-6	-6	-6	-6	12	16	7	7	3	2	-6	-6	-6	-6	-6
-6	-6	-6	-6	3	8	7	12	10	8	3	-6	-6	-6	-6
-6	-6	-6	-6	2	6	6	15	9	7	3	-6	-6	-6	-6
-6	-6	-6	-6	2	4	8	7	10	3	5	2	-6	-6	-6

