

**Department of Building, Civil & Environmental Engineering**  
**BCEE 451 Construction Engineering**  
**Midterm Examination – 2011/02/18**

**Instructions:**

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1. This is a closed book exam.
  2. Answer all questions.
  3. Show all calculations and clearly state all assumptions made.
  4. Marks allocated for each question are shown at the end of the question in brackets [ ].
  5. Only departmental approved calculators are allowed.
  6. The Duration of this examination is **70 minutes**. *Good luck!*
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1) a) What is the purpose of specifications? [3]

Specifications supplement drawings by providing information that cannot be shown in graphic form, or information that is too lengthy to be placed within the drawings.

Specifications guide bidders in the preparation of cost proposals as well as field execution of the work.

Specifications also guide the contractor through the processes of ordering materials and construction and installation of the facility.

Specifications provide information regarding:

- The quality of materials
- The quality of workmanship
- Erection and installation methods
- Test and inspection requirements and methods

b) Discuss the difference between performance specifications and prescriptive specifications providing an example of each. [4]

**Performance specifications** state how the finished product must perform without dictating how the contractor must do the work. In other words, they focus on the end result.

An example of performance specifications would be a requirement for concrete that has a 28-day strength of 3,500 psi. It is the contractor's responsibility to provide concrete that meets the requirement.

**Prescriptive specifications** state how the work is to be performed and therefore focus on the method rather than the end result. An example of a prescriptive specification would be to place wall studs 16 inches on centre and nail using a specific pattern.

c) In the event that specifications and drawings contradict each other, which should you follow? State why? [3]

In the event that specifications and drawings contradict each other, we should follow the specifications since the specifications provide more detailed information, and are therefore less likely to have an error (typo) associated with them.

2) [Hint: to correctly answer this question, extract the appropriate soil values from the relevant tables]

a) Find the volume of excavation in loose cubic metre (LCM) for the large area shown in figure 1. The excavation has been divided into a grid for estimation purposes, showing the depth of cut at various locations. The soil type is common earth. [4]

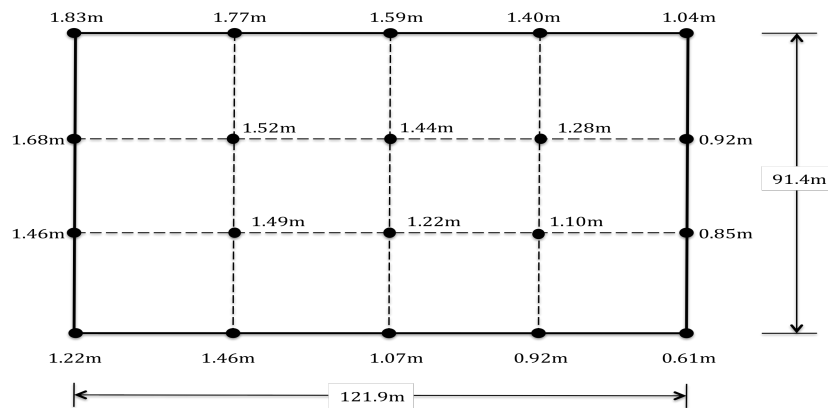


Figure 1: Large area to be excavated

Sum of depths at corner points  
 $1.83 + 1.04 + 1.22 + 0.61 = 4.70\text{m}$

Sum of depths at border points  
 $1.77 + 1.59 + 1.40 + 0.92 + 0.85 + 0.92 + 1.07 + 1.46 + 1.46 + 1.68 = 13.12\text{m}$

Sum of depths at interior points  
 $1.52 + 1.44 + 1.28 + 1.49 + 1.22 + 1.10 = 8.01\text{m}$

$$\begin{aligned} \text{Average depth} &= \frac{\text{Sum}(\text{depth} \times \text{weight})}{\text{Sum of weights}} \\ &= \frac{4.70 + 2(13.12) + 4(8.01)}{48} = 1.31\text{m} \end{aligned}$$

$$\begin{aligned} \text{Area} &= 121.9 \times 91.4 = 11,142\text{m}^2 \\ \text{Volume} &= 11,142\text{m}^2 \times 1.31\text{m} = 14,595\text{ BCM} \end{aligned}$$

From table 2.5 swell for common earth is 25%, therefore volume in loose measure is  $14,595\text{ BCM} \times 1.25 = 18,244\text{ LCM}$

b) If the soil in part (a) is carted away and used to backfill a large ditch having a volume of  $25,000\text{m}^3$ , calculate what percentage of the ditch will be filled assuming that the soil will be compacted. [3]

We are carting away 18,244LCM of common earth. This is then being compacted.

We must convert LCM to BMC then adjust by the shrinkage factor.  
 $14,595\text{BCM} \times 0.9$  (from table 2-5) = 13,135CCM

Percentage volume of the ditch that will be filled =  $13,135/25,000 = 52.5\%$

c) Find the base width and height of a triangular spoil bank of excavated gravel. The 'in-place' dimensions of the excavation are 5m x 8m x 3.5m. [3]

From table 2-6, angle of repose of gravel =  $35^\circ$   
 From table 2-5, swell for sand and gravel = 12%

Volume =  $5 \times 8 \times 3.5 = 140\text{BCM} \times 1.12 = 156.8\text{LCM}$

$B = [4(156.8) / 1\text{m} \times \tan 35]^{1/2} = 29.93\text{m}$

$H = 29.93\text{m} \times \tan 35 / 2 = 10.47\text{m}$

3) Estimate the expected production in Bank Cubic Metres (BCM) per hour of a large hydraulic excavator-backhoe. The material being excavated is a mixture of sand and gravel, and the excavator has a heaped bucket capacity of 1.8 LCM. The average depth of cut is 5.3m and the maximum depth of cut is 7.1m. The average swing of the excavator is  $75^\circ$  and job efficiency is 50 min/h. [10]

Recall, Production (LCM) =  $C \times S \times V \times B \times E$

C, Standard cycles per hour (table 3-3) = 150 cycles/60 min  
 Depth of cut =  $5.3/7.1 = 74.6\%$ , say 75, interpolate from table 3-4 for swing depth factor

S, swing depth factor = 1.025

V, Heaped bucket volume = 1.8 LCM

B, bucket fill factor (table 3-2) = 0.95

E, job efficiency = 50 min/h =  $50/60 = 0.833$

Production =  $150 \times 1.025 \times 1.8 \times 0.95 \times 0.833 = 219 \text{ LCM/h}$

Load factor (table 2-5) = 0.89

Production in BCM/h =  $219\text{LCM/h} \times 0.89 = 194.91\text{BCM/h}$

- 4) a) What is a temporary structure in construction?  
Provide three brief examples of temporary structures in construction. [4]
- b) You are a general contractor interested in bidding on a housing development project in Moncton New Brunswick. This will be your first project undertaken outside of Quebec. The client has given permission for you to visit the site, i.e. for you to carry out your site investigation. Briefly discuss some of the things you will seek to ascertain / accomplish during the site investigation process. [6]

END of Exam

See Attached Sheets for Formulae and Tables

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