

**Spring Semester, 2008**  
**53:086 Civil Engineering Materials**  
**Department of Civil & Environmental Engineering**  
**College of Engineering, The University of Iowa**

Assignment #10

Due: Thursday 8 May 2008

Note: Consult PCA's The Concrete Masonry Handbook, by Panarese, Kosmatka, and Randall (1991) for questions 1-5 below if you cannot find the necessary material in Ch 8 of the text.

**Question #1: (10 points)**

There is a fundamental difference between the way that fired clay units interact with moisture and the way that cast concrete units interact with moisture. What is it, and how does it affect the long term deformation characteristics of each?

**Question #2: (10 points)**

- a) What is efflorescence of masonry?
- b) How can it be avoided?

**Question #3: (15 points)**

A concrete masonry unit is tested for compressive strength and produces the following results:

- Failure load = 593 KN
  - Gross area = .074 m<sup>2</sup>
  - Gross volume = .014 m<sup>3</sup>
  - Net volume = .006 m<sup>3</sup>
- a) Would the unit be categorized as solid or hollow, and why?
  - b) What is the net area compressive strength of the unit?

**Question #4: (10 points)**

A solid concrete masonry unit is tested for absorption and the following characteristics were measured:

- Mass of the unit as received = 8.723 kg
  - Mass of the unit when saturated with water = 9.273 kg
  - Mass of the unit when oven-dried = 8.296 kg
- a) What is the absorption capacity of the CMU?
  - b) What is the "as received" moisture content of the CMU relative to the absorption capacity?

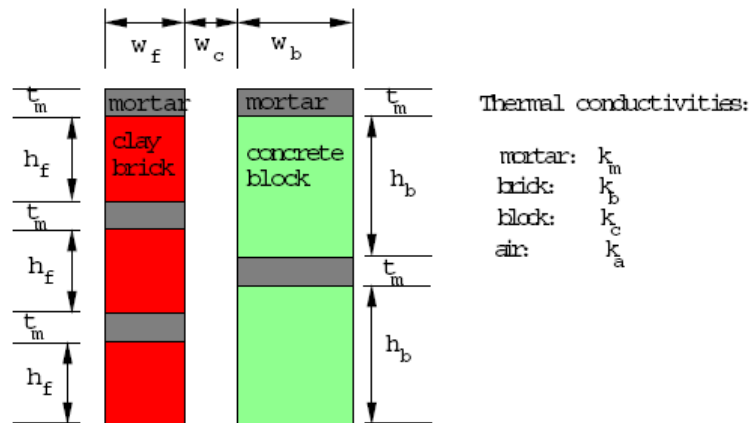
**Question #5: (15 points)**

A solid, severe weathering brick was tested for absorption consistent with ASTM C67 with the following data results:

- Dry mass of the specimen = 1.695 kg
  - 24-hour (cold water) saturated mass of the specimen = 1.901 kg
  - 5-hour (boiling water) saturated mass of the specimen = 1.916 kg
- a) What is the absorption by 24-hour submersion?
  - b) What is the absorption by 5-hour boiling?
  - c) What is the absorption capacity of the brick?

**Question #6: (20 points)**

- a. For the cavity masonry wall shown below, please derive an expression for the thermal resistivity of the wall in terms of the thermal conductivities of the clay brick, the concrete block, the mortar, and air, and the dimensions shown.
- b. Would you expect the cavity to improve the thermal resistivity of the wall? Please explain why or why not.



Brick and block cavity wall.

**Question #7: (20 points)**

Do a bit of research to find out some details of a historic and monumental structure (other than the two presented in class) that was constructed primarily out of masonry. Provide the following information on your structure:

- When, where, and by whom the structure was built;
- The type of masonry construction: size of the units; comprising material; the joint material; the comprising material;
- Special issues that may have arisen during construction;
- Historical failures and/or repairs to the structure;
- A photographic image or sketches of the building from the time of its initial construction.