National Exams May 2014

07-Bld-A5

Building Science

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is an OPEN BOOK EXAM and so candidates are permitted to make use of any textbooks, references or notes that they wish.
3. Candidates may use one of two calculators, the Casio or Sharp approved models. Write the name and model designation of the calculator, on the first inside left hand sheet, of the exam work book.
4. **FIVE (5)** questions constitute a complete exam paper.
5. The first five questions as they appear in the answer book will be marked.
6. Each question is of equal value.
7. This examination paper includes **Four (4) PAGES and Six (6) QUESTIONS**. You are responsible for ensuring that your copy of the paper is complete. Please bring any discrepancy to the attention of your invigilator.

Problem (1) (20 Points)

Part (A) (10 points)

Discuss the required characteristic(s) of a material to be used as part of an air barrier system.

Part (B) (10 points)

Calculate air flow rate through 8 mm plywood sheathing under the effect of a pressure difference of 24 kPa. The total surface area of the sheathing is 30 m^2. Comment on the adequacy of plywood for use as part of an air barrier system.

Problem (2) (20 Points)

Part (A) (5 points)

Discuss the required physical properties of a material to be used as a thermal insulator.

Part (B) (15 points)

A house has a composite wall made of a 20 mm thick Plywood siding, a 100 mm thick Fiber Glass blanket (k = 0.04 W/m. K), and a 10 mm thick Gypsum Board. The outside and inside air temperatures are -15 °C (258.15 K) and 20 °C (293.15 K), respectively. The total wall surface area is 300 m^2.

i. Determine an expression of the total thermal resistance of the wall, including inside and outside convection effects. Assume typical wind speed.

ii. Determine the total heat loss through the wall.

iii. If wind speed changes from the typical value to 45 mile per hour, determine the percentage increase in the heat loss.

iv. What is the controlling resistance that determines the amount of heat flow through the wall?

Problem (3) (20 Points)

Calculate total irradiation reaching a solar collector installed on a building located in Toronto, Ontario (44° North latitude and 80° West longitude) at 1:00 PM on July 21. The collector is facing East with an angle of tilt equals to 60°.

Problem (4) (20 Points)

Consider a house wall made of a 160 mm thick concrete slab, 80 mm thick type 3 Extruded Polystyrene (EXPS), 30 mm thick airspace, and 90 mm thick face brick. The interior temperature and relative humidity are 21 °C (294.15 K) and 50%. The exterior temperature and relative humidity is -14 °C (259.15 K) and 80%.

i. What is the water vapor pressure at each interface due to vapor pressure diffusion through the wall?

ii. What is the relative humidity at each interface of the assembly?

iii. Would condensation take place within this wall? If it would occur, at which interface?

Problem (5) (20 Points)

Part (A) (5 points)

Discuss the relationship between surface temperature and wave length of thermal radiation emitted by a surface. What is the average wave length of thermal radiation emitted at normal building temperatures?

Part (B) (15 points)

Calculate the mass flow rate of moisture exchanged between a room at 22 °C (295.15 K) and 55% RH and outside air at -5 °C (268.15 K) and 80% RH if 200 CFM of air leaves the room. How much sensible and latent heat exchanged as a result of this airflow? Did the space loose or gain these heats?

Problem (6) (20 Points)

Part (A) (5 points): The interior environmental conditions within building are of great interest to building designers. Identify and discuss these conditions?

Part (B) (5 points): Identify and discuss basic types of building interior environments.

Part (C) (5 points): Discuss the recommended type of conditioning for (i) a Museum, and (ii) a dust sensitive manufacturing facility.

Part (D) (5 points): Discuss the parameters that affect pressure within a building.

End