

M E 329.3 – BUILDING THERMAL DESIGN

# Midterm Examination

ME 491

February 15, 2001

Time: 1.5 Hours

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TEXTBOOKS AND NOTES ALLOWED.

STATE ALL ASSUMPTIONS AND JUSTIFY, WHERE POSSIBLE.

REFERENCE ALL DATA USED

Marks

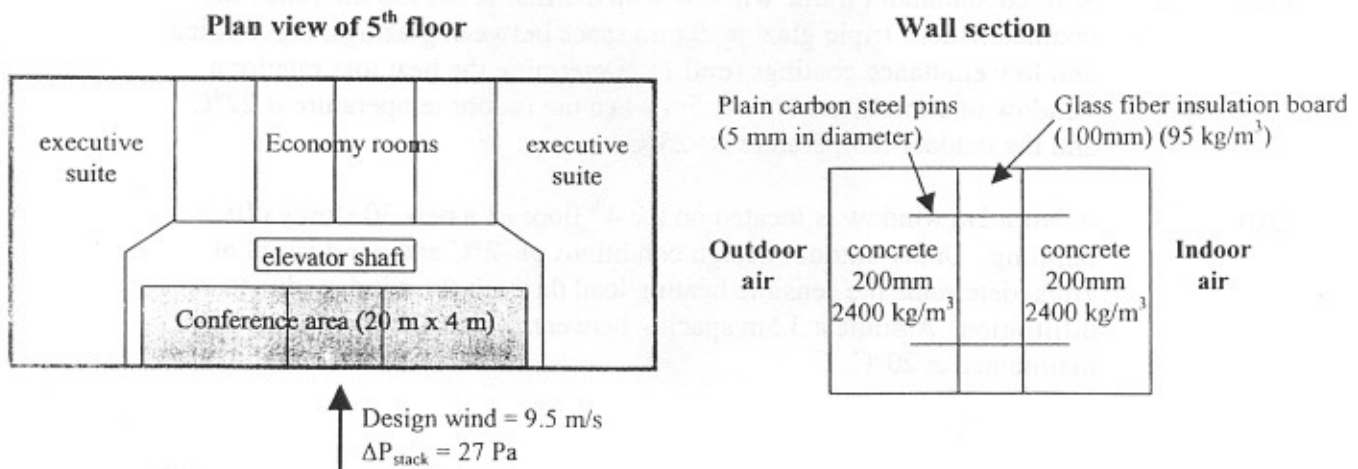
1. Indicate by circling the correct response whether the following statements are true or false (T – True or F – False).
  - (2) a) The chilled mirror hygrometer operates by cooling the sample air to the wet bulb temperature determined when a reflected beam from a mirror is interrupted. **T or F ?**
  - (2) b) VAV systems offer the advantage of better room air distribution than other air distribution system types. **T or F ?**
  - (2) c) Low emissivity coatings on the glazing reduce the space cooling load by reflecting some of the radiation in the solar spectrum. **T or F ?**
  - (2) d) North Battleford, Saskatchewan has a greater potential for evaporative cooling than Greensboro, North Carolina. **T or F ?**
  - (2) e) Energy from a fan in the air supply line to a building would increase the cooling coil size but decrease the heating coil size. **T or F ?**
- (15) 2. A fixed aluminum frame window with thermal break has the following characteristics: triple glazing, 9 mm space between glazings, argon filled and low emittance coatings ( $e=0.1$ ). Determine the heat loss rate for a window of dimensions 2m x 1.5m when the indoor temperature is 22°C and the outdoor temperature is -25°C.
- (20) 3. A 2m x 2m window is located on the 4<sup>th</sup> floor of a new 30 storey office building. Under outdoor design conditions of -2°C and wind speed of 7m/s, determine the sensible heating load through the window due to infiltration. Assume a 3.5m spacing between floors and that the space is maintained at 20°C.

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airflow rates to be the same for each room (1000 L/s of which 50% is outdoor air). The consultant has also measured the temperature and humidity data as shown below. As a last resort, the action committee has hired you to evaluate the situation because they have heard that ME 491 students at the U of S are excellent HVAC specialists. Do you agree with the U of R's position that the consultants measurements prove there is no difference between the air quality and comfort in the two rooms. Explain. What is the minimum outdoor ventilation rate you would recommend for Room 150 when it is used as a lecture room?

	Room 140	Room 150
floor area	40m x 40m	20m x 20m
air temperature	23°C	21°C
mean radiant temperature	21°C	23°C
relative humidity	80%	40%
supply airflow rate	1000 L/s	1000 L/s

5. Calculate the design heating load (including ventilation) for an area of conference rooms (80m<sup>2</sup>) on the 5<sup>th</sup> floor of a hotel in Montreal (see figure). The exterior wall of the conference room area is 3 m high and has an average pressure difference of 27 Pa due to the stack effect. The exterior wall is on the windward side of the building and the design wind speed is 9.5 m/s in Montreal. The conference room has fixed, double-pane windows with a 12.7 mm air space and a vinyl frame. The windows are average-fitting and make up 50% of the exterior surface area and have a perimeter of 90m. The envelope of the building is a concrete sandwich envelope made of 100 mm of rigid board insulation with a density of 95 kg/m<sup>3</sup> sandwiched between 200 mm of normal density concrete (2400 kg/m<sup>3</sup>). The wall construction also includes steel pins (5 mm in diameter). These pins are spaced at intervals of 10 m in the horizontal direction and 5m in the vertical direction.



TOTAL 50