

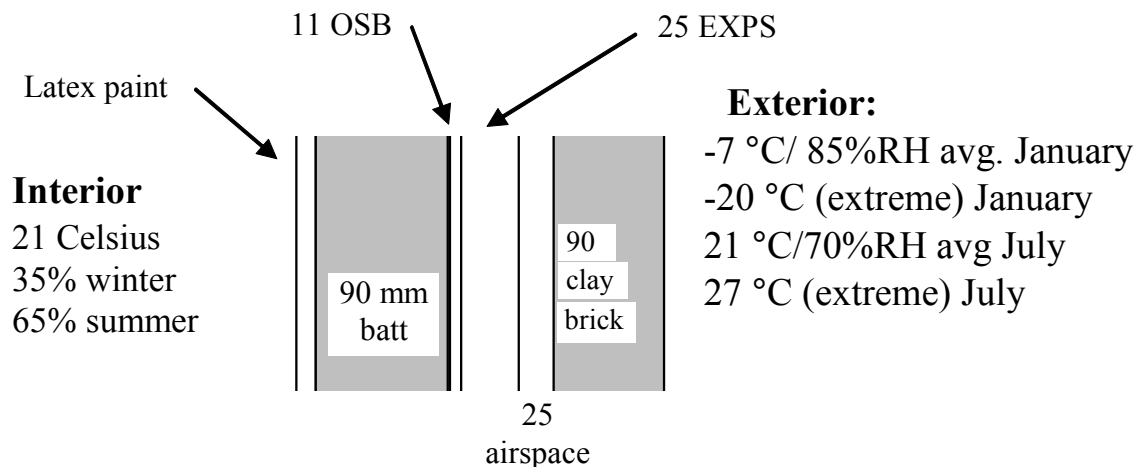
CE 507: Building Science and Technology

Assignment # 3

Groups of four.

1. Using the simplified psychrometric equations given in the text, create a psychrometric chart (using a spreadsheet) with temperature (in Celsius) along the bottom axis and vapour pressure (in Pa) along the vertical axis. Plot saturation (100%RH) and several other RH lines on the chart. This is a tool for this assignments and for your future.
2. Extend your heat flow spreadsheet from Assignment 2 to calculate the temperature and vapour flow through a drywall finished, 90 mm wood frame wall with 11 mm OSB sheathing and 25 mm EXPS insulation, a 25 mm airspace, and 90 mm clay brick veneer (Figure 1).

The enclosure wall is intended for a local grad student town house project at UW. Your spreadsheet should calculate the vapour pressure and RH conditions at each interface and calculate both the occurrence and severity of condensation.



Note: Use average material properties from the notes. Extreme conditions occur for at least 86 hours/yr.

Figure 1: Wall Assembly

3. Plot the (temperature, vapour pressure) co-ordinates of each interface on a full page psychrometric chart for average summer and winter conditions.
4. Write a report, and cover the following topics in a logical and professional manner.
 - (a) How do the temperature/vapour/RH conditions inside the wall vary between winter and summer, average and extreme conditions? The occurrence of condensation is, of itself, not a concern – if it occurs, calculate or estimate its magnitude and judge its significance by considering where and how much is occurring.

- (b) What is the effect of sun on the heat and moisture flow through the wall? Assess what happens if the brick is wet (e.g., from a previous days' rainstorm) and it is sunny. (see notes).
- (c) If the OSB were installed wet, how many days would it take for it to lose 100 g/m² of moisture during average April weather conditions (5.8 C/84% RH).
- (d) Qualitatively, what is the effect of the studs on energy consumption? What is the effect on the temperatures in the wall (see text).
- (e) What would be the effect on moisture transport of 0.5 litres/second/m² of air leaking outward? Plot the results on the psych chart of Question #3. What assumptions have you made in your plot? Compare and contrast the impacts of air leakage with vapour diffusion. How would your answers change if the air flow was inward.
- (f) Describe what the results of your analysis means about the performance of the wall.
- (g) What changes/improvements to the wall would you suggest?
- (h) If this wall were proposed for a museum in which conditions must be maintained at 50%RH year round, how would this change your assessment of the walls performance? Attempt to answer without any *detailed* calculations.

Note: This is a group project that typically requires about 40 person. Please provide concise and clear answers (quantify if possible, describe if not), stating all assumptions. The explanation and meaning of your work is important, not the spreadsheets and/or graphs. Consider the accuracy of what you are calculating. Hand in relevant spreadsheets as an appendix to your report. Use your spreadsheet to consider the many "what if" analyses but don't print out dozens of combinations, just the three or four important ones to your report's discussion.