4.401/4.464 Environmental Technologies in Buildings – Assignment 3

Instructor:	Christoph Reinhart
Due Date:	Friday of week 4
Type:	This is a group assignment (project groups).

Visual and Thermal Comfort

The objectives of this assignment are for you to develop a feeling for indoor environmental variables that have an impact on thermal comfort and to compare your personal sensation to comfort predictions based on thermal and lighting standards. The assignment is split into two components:

- Task A: Using a data logger, measure "your life" on a psychrometric chart over a couple of days.
- Task B: Measure indoor environmental conditions in two spaces that you find comfortable and uncomfortable and compare your assessments to that of current thermal comfort standards.

Task A Psychrometric Chart

A HOBO data logger (photo on the right) collects time series of temperature and relative humidity and comes with a software called HOBOware that allows you to plot the data and/or export it to Excel. This type of data logger is widely used by building commissioning teams as well as in museums or other spaces in which indoor environmental conditions have to be tightly monitored. For this part of the assignment carry one of the school's HOBO data loggers around with you for around 72 hours and collect temperature and relative humidity data pairs in 15-minute time steps. Connect the HOBO data logger to

your computer using the provided USB cable and use the options in HOBOware's Device menu to manage the data logger. (We recommend setting the measurement interval to 5 minutes.) Plot the data using Excel and manually enter extreme points on a psychrometric chart. (A blank chart is provided further below.) 'Extreme' points are e.g. walking outside, cooking and/or laundry, a visit to an indoor pool etc.

Be inventive, go places!

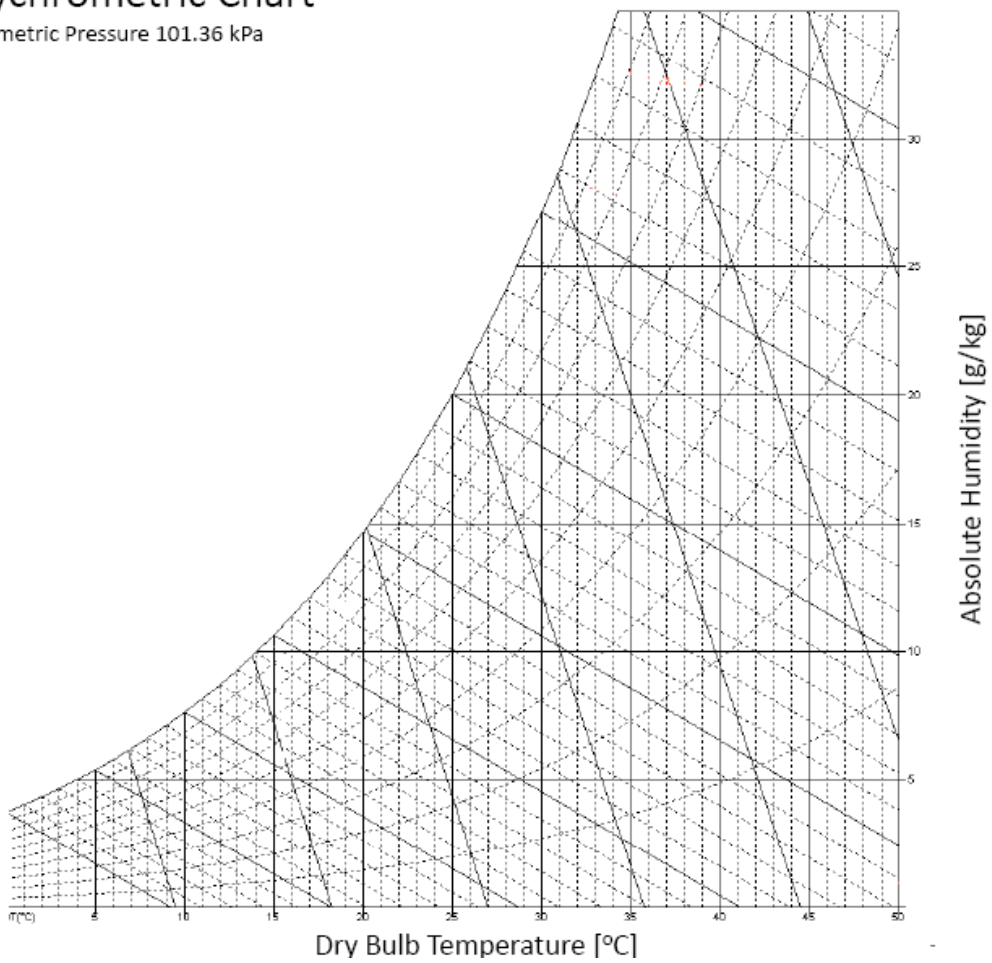
Briefly describe the extreme points on the HOBOware printout. An example is provided on page 3 of this assignment. If you wish, you may use weather data from one of the sources listed on page 4 to explain some of your measurements. For example, if it is a very cold day, the relative humidity in your home will be low unless you have a humidifier.

Logistics

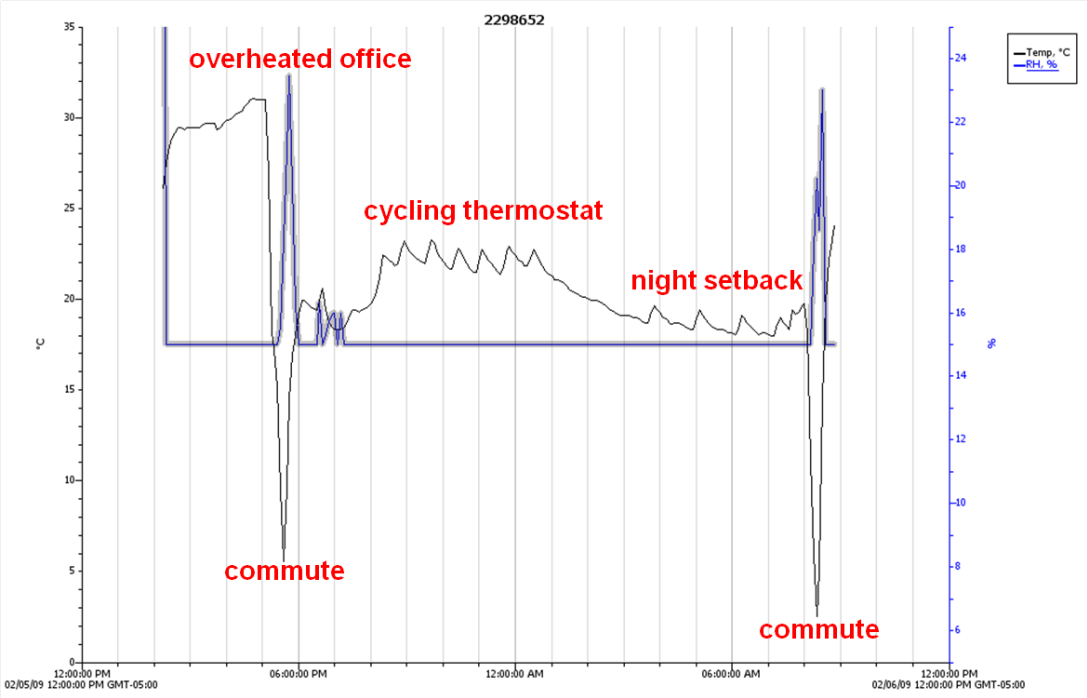
You previously signed up for one of two measurement shifts for Assignment 3, week 3 or week 4. Each group will receive a HOBO data logger, USB cable, and spot thermometer. The first groups to sign up will pick up the equipment during lab on the Friday of week 2 and return the data logger to the Building Technology Suites at 10 am on Friday of week 3. Students in the second shift can pick up their kit after 11am on Friday of week 3. The last groups should return the equipment in class on Monday of week 5.

Psychrometric Chart

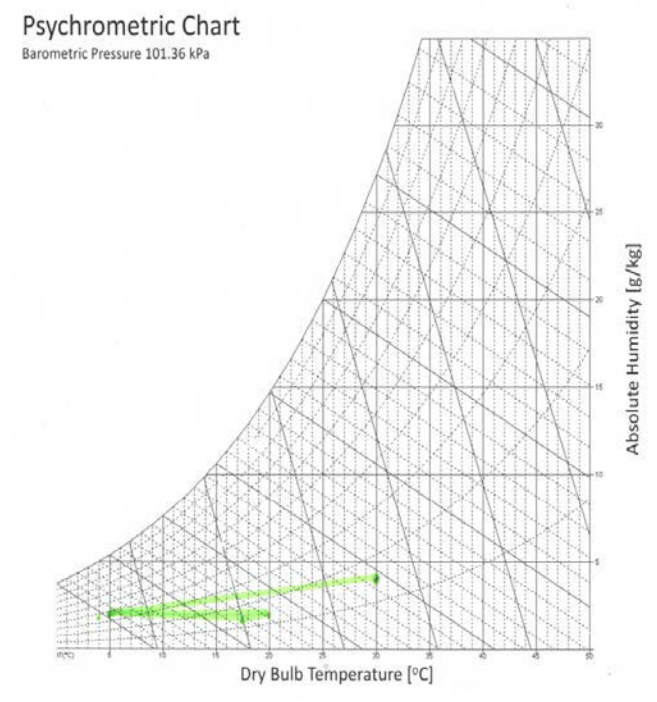
Barometric Pressure 101.36 kPa



Example Printout using HOBOware



Psychrometric Chart



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Task B Thermal and Visual Comfort Analysis of Two Daylit Spaces

Measure a series of indoor environmental variables in two situations, one of which you consider to be comfortable and the other uncomfortable. You may either pick the same space at two different times or two different spaces. Translate your measurements into thermal comfort predictions according to ASHRAE 55 (PMV and adaptive method) and compare those predictions against your initial, personal comfort assessment. Collect the following information for each situation:

- Submit a photo that provides a general sense of the space
- Record the time, date, dry bulb temperature and relative humidity (HOBO data logger) and mean radiant temperature (spot thermometer). Go to the nearest weather station and mark down ambient temperature, relative humidity, wind and solar radiation.
- Describe why you picked the space and your general thermal sensations at the time when you took the measurements.
- Derive Predicted Mean Vote and Adaptive Comfort from your measurements using the CBE Thermal Comfort Tool and discuss on your earlier observations vis-a-vis these two comfort indices.

The figures below show an example comfort evaluation for a dry bulb temperature of 25.8°C, relative humidity of 44.8% and mean radiation temperature of 27.3° C for Predicted Mean Vote and Adaptive Thermal Comfort.

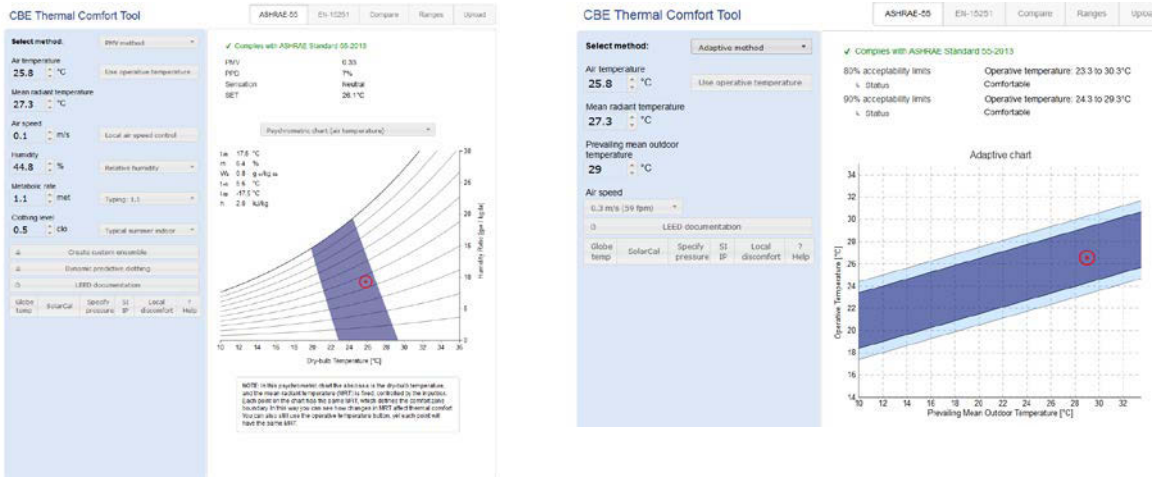

Figure: Thermal comfort conditions according to PMV (top) and Adaptive Comfort theory (bottom)

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