Annex 69 - Subtask C - BCIT, October 2018

Institution:
British Columbia Institute of Technology (BCIT)
Research Team
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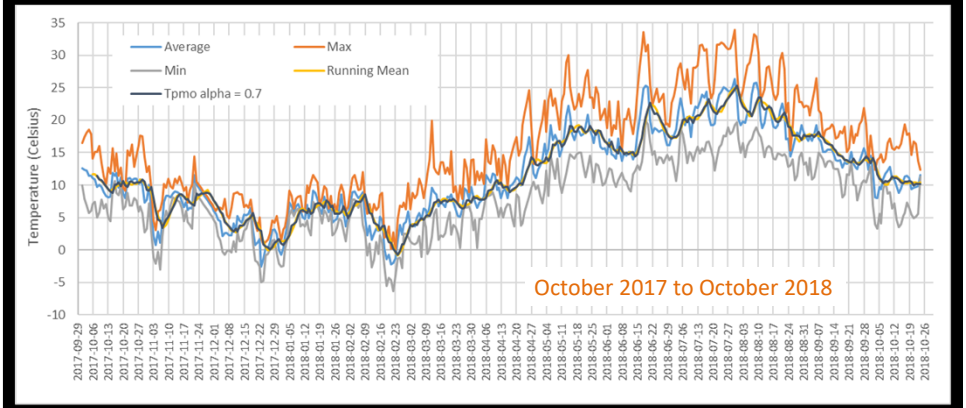
Case study:
BCIT, SW1, Gateway Building
Burnaby, BC, Canada
Climate zone: Csb (warm-summer Mediterranean climate)

Study:
Date started: November of 2017
Scheduled end date: October of 2018

Building information:

- Ground source heat pump: simultaneous heating and cooling
- LEED Gold Certification, completed in 2011
- Site EUI: 217 ekWh/m^2 (approximate)
  - Canadian mean value (offices) = 335 ekWh/m^2
  - Greater Vancouver mean value (offices) = 287 ekWh/m^2
- (HVAC-MM): concurrent, humidity control for ABs
- Administrative building, office-type occupancy
- Individual office climate control via active beams (AB) : cooling & heating
- Operable windows opening to double-skin façade
- Adaptive opportunities: operable windows, interior blinds, individual office & local thermostat control, personal fans, personal heaters

Survey - Ambient Temperature



- Temperature & Relative humidity at 10 minute intervals, two locations at BCIT close to the building
- Solar irradiation & wind speed and direction at 30 minute intervals, two weather stations City of Burnaby

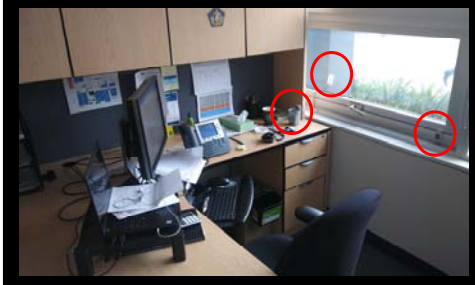
Suvey – Indoor Monitoring

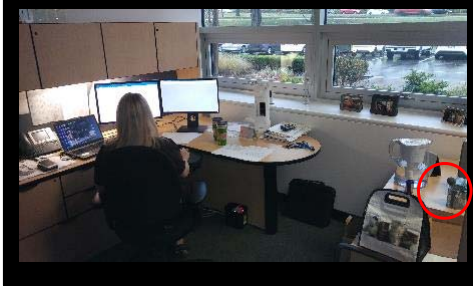
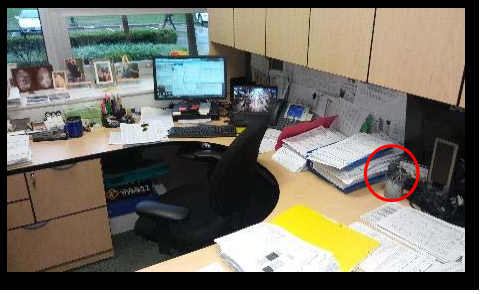
24 Offices Monitored (out of 32 offices at project start)				
Private Perimeter	**Private Interior**	**Cubicle Perimeter**	**Cubicle Interior**	**Meeting rooms**
~~13~~ 11	~~10~~ 9	1	~~8~~ 4	3

Measurements 10 minute logging intervals:

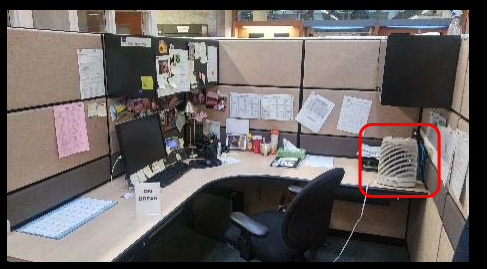
- Air temperature & Relative humidity
- CO2 in private offices
- Operative temperature
- Air speeds: only measured at sample locations
- Window and door state sensors in most private offices

Survey – Indoor Monitoring



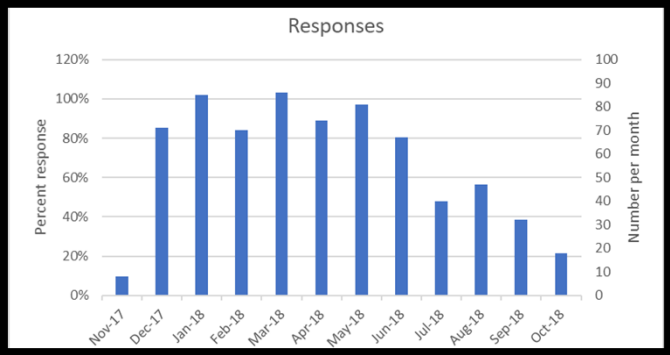



Adaptive Opportunities

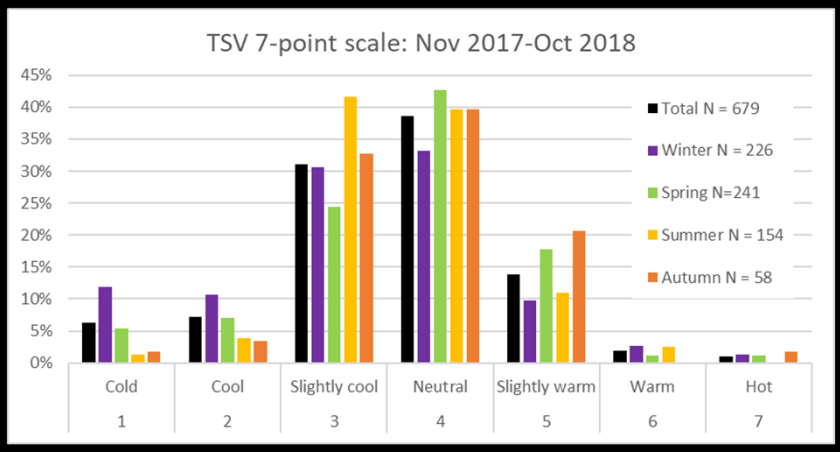



Survey – Weekly Questionnaires

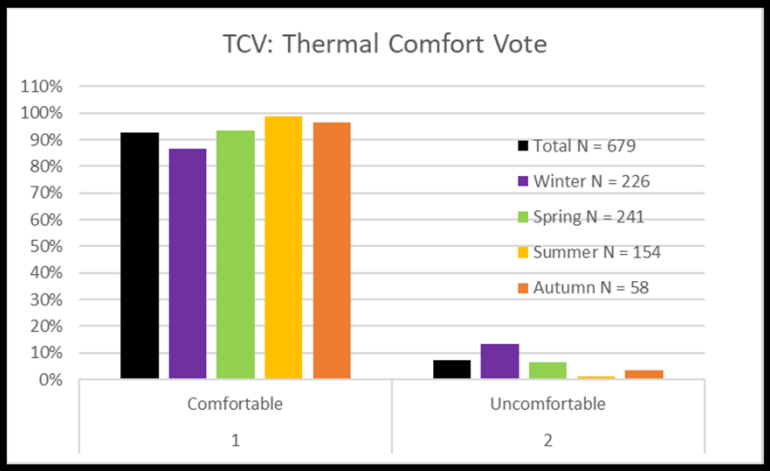
- Administered by email
- 44 surveys in total (November 2017 – October 2018)
- Response rate declined over time
- Total responses = 860
- Number of responses per month:



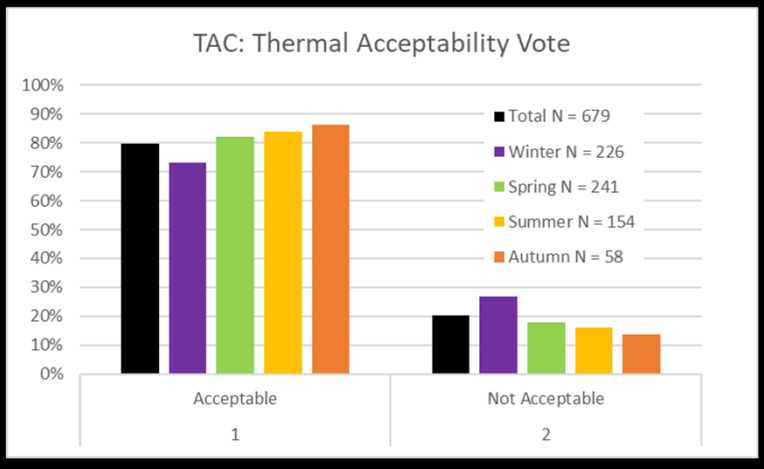
Thermal Sensation Vote



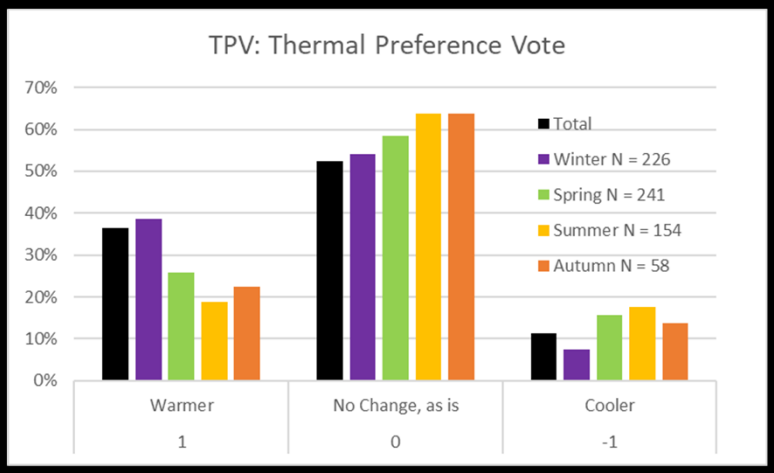
Thermal Comfort Vote



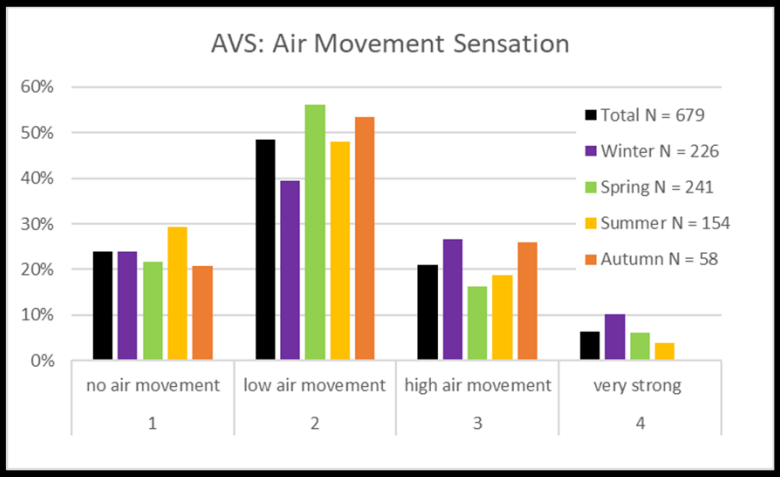
Thermal Acceptability Vote



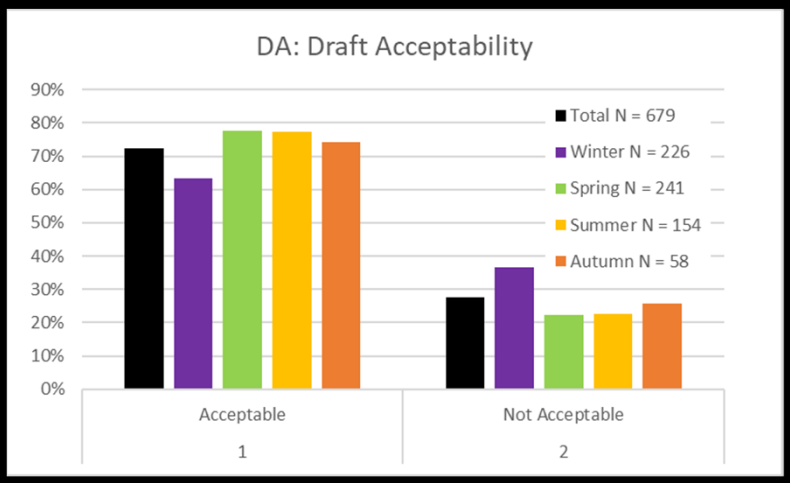
Thermal Preference Vote



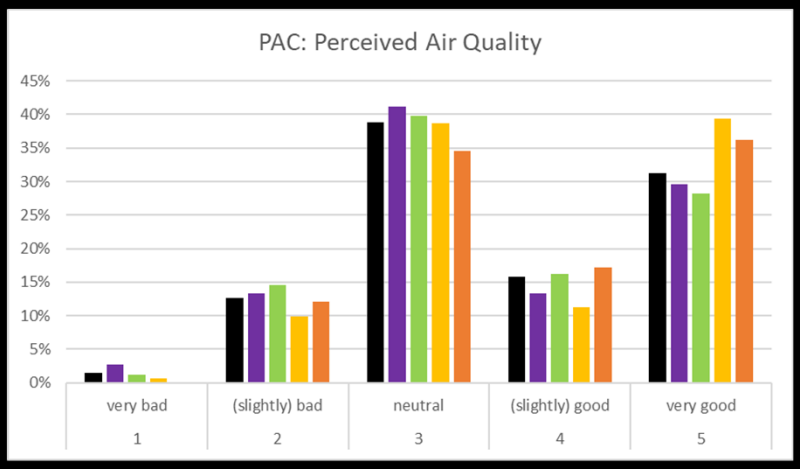
AMS: Air Movement Sensation



DA: Draft Acceptability

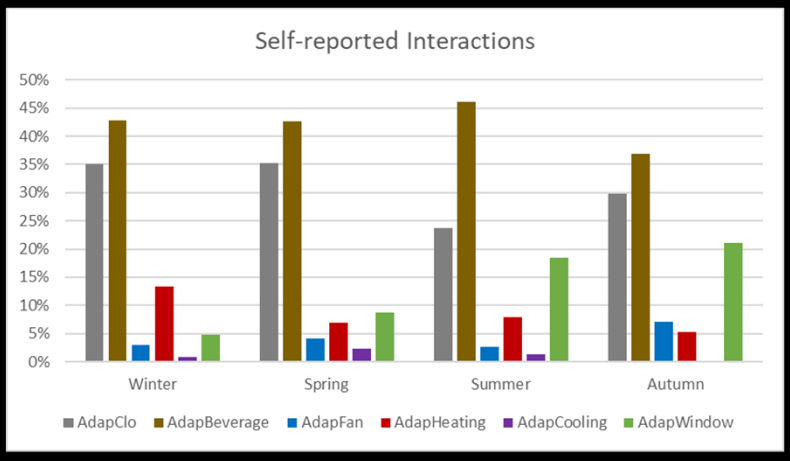


PAQ: Perceived Air Quality

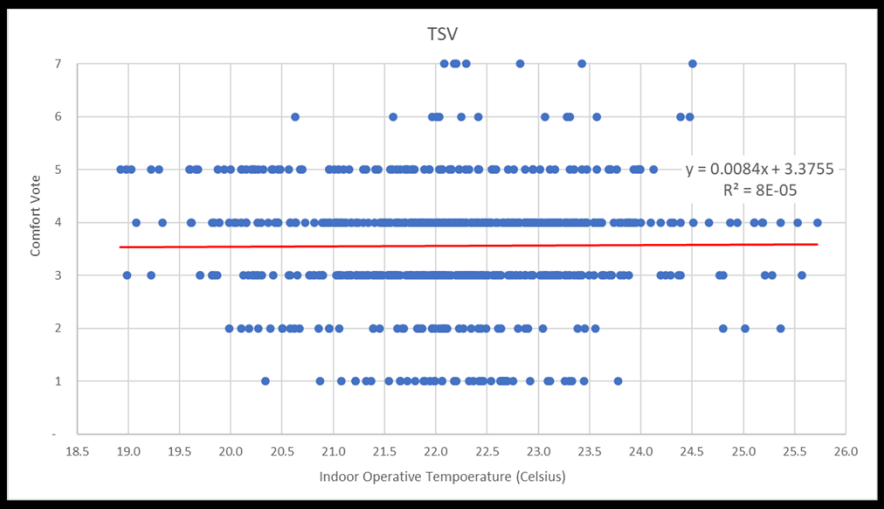


CLO: Clothing

Self-reported Interactions



Comfort Votes against Operative Temperature Regression line



Lessons Learned

- Focus on private offices, having proper individual temperature control. Few open offices surveyed.
- Anecdotally, during data collection people complained about discomfort in open offices only.
- Analysis of responses seem to provide reasonable results
- However, the responses from "Beverage adaptation" question seem wrong (unreasonably high):
  - *Question asked: in your office, right here and now, what strategies have you used to maintain comfort? (please select all that apply):*
    - *Change clothing, Drink hot/cold beverage, etc.*
- It would have been interesting to conduct analysis by office type. However, there were no sufficient number of open offices surveyed
- Extent of mixed-mode operation? Windows were not opened as usual as expected (given the double façade)

List of Sensors/Loggers

Type			Image	
a-	MX1102	CO2/RH/T Bluetooth		RH/T/CO2
b-	U12-013	HOBO RH/T + 2 external channels		RH/T/Top external channel
b-1	TMC1-HD (1') TMC6-HD (6')	External air temperature for U12 (operative)		External sensor for Top
b-2	TMC6-HE (6')	External air temperature for U13 (surface)		External sensor for window temperature
c-	UX90-001M	State/pulse/runtime sensors		Window and door open/close sensors
d-	MX1101	HOBO RH/T Bluetooth		Chilled beam RH/T sensor