UNIVERSITY OF TORONTO | Building Energy and Indoor Environment (BEIE) Lab

Wintertime Thermal Comfort in Post-War Multi-Unit Residential Buildings

15th Canadian Conference on Building Science and Technology

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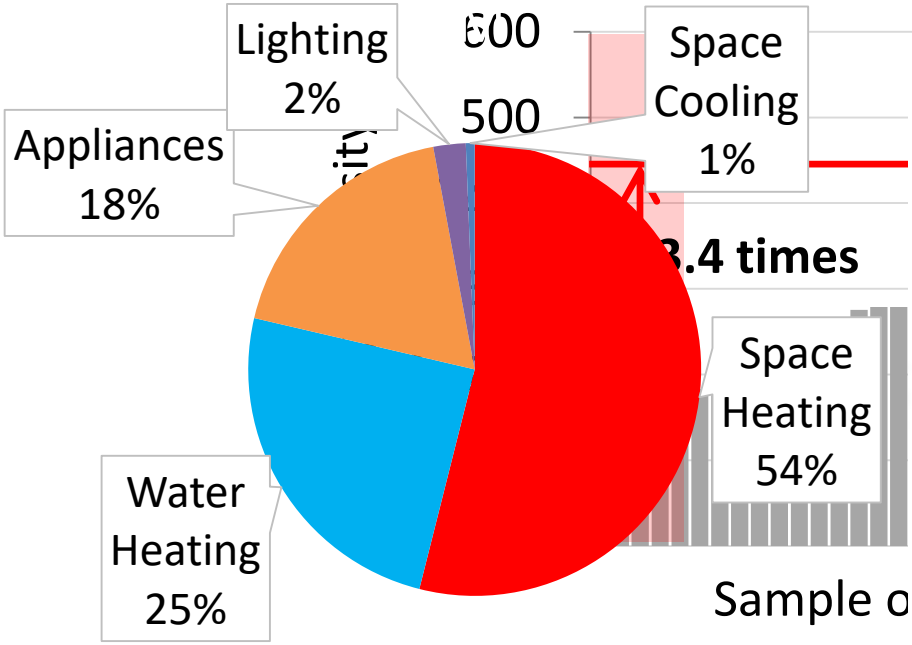
Overview

- Post-War MURBs in Toronto
- Study objectives and methodology
- Results
  - Survey
  - Monitoring
  - Comparison
- Conclusions

Typical Energy use in Ontario MURBs

- High variability between buildings
- Mostly space heating energy use



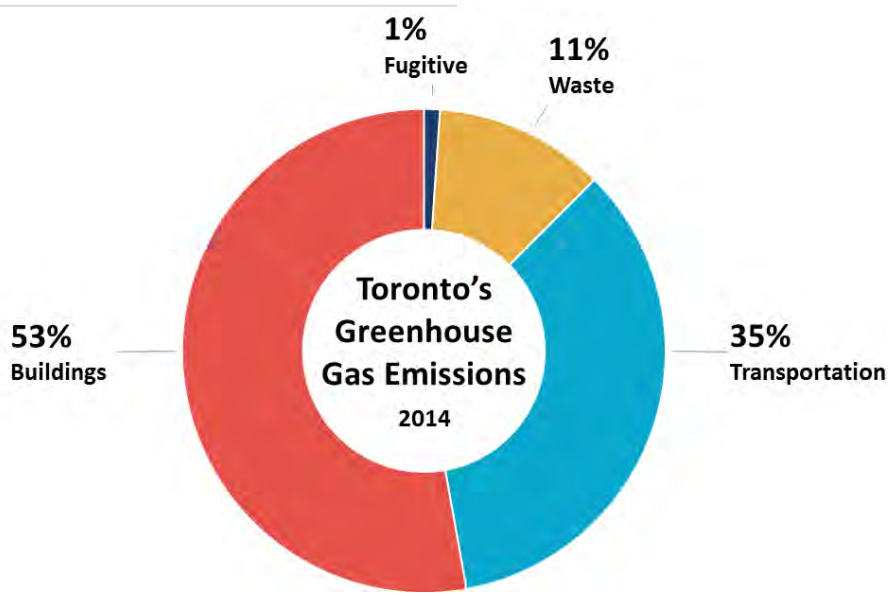
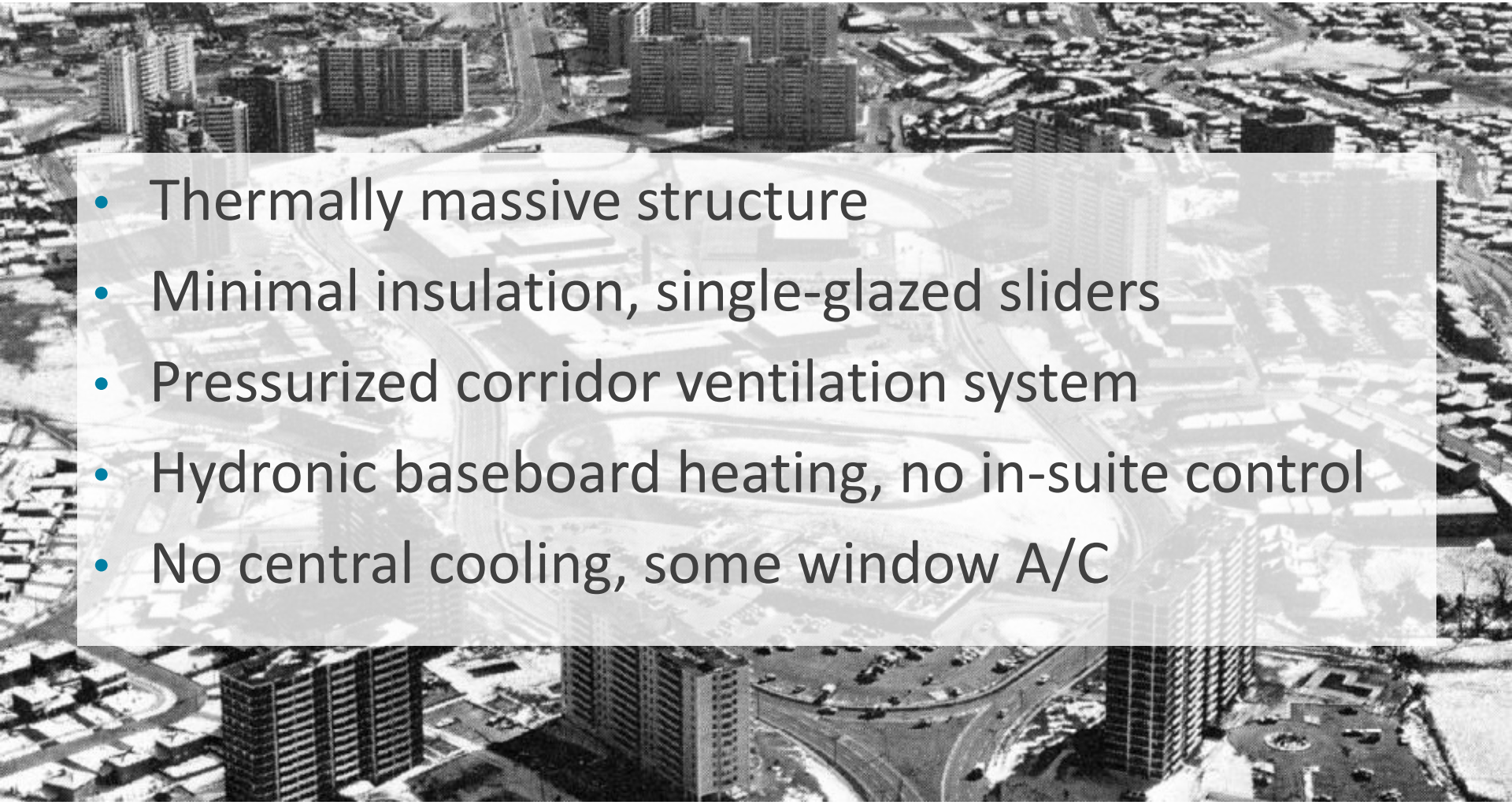


Image credit: Touchie 2014, NRCan 2014, https://www1.toronto.ca/

Typical Post-war MURB Characteristics



- Thermally massive structure
- Minimal insulation, single-glazed sliders
- Pressurized corridor ventilation system
- Hydronic baseboard heating, no in-suite control
- No central cooling, some window A/C

Image Source: Tower Renewal Guidelines

Study Overview

- Seven MURBs undergoing energy retrofits
- Objective: Compare pre- and post-retrofit IEQ

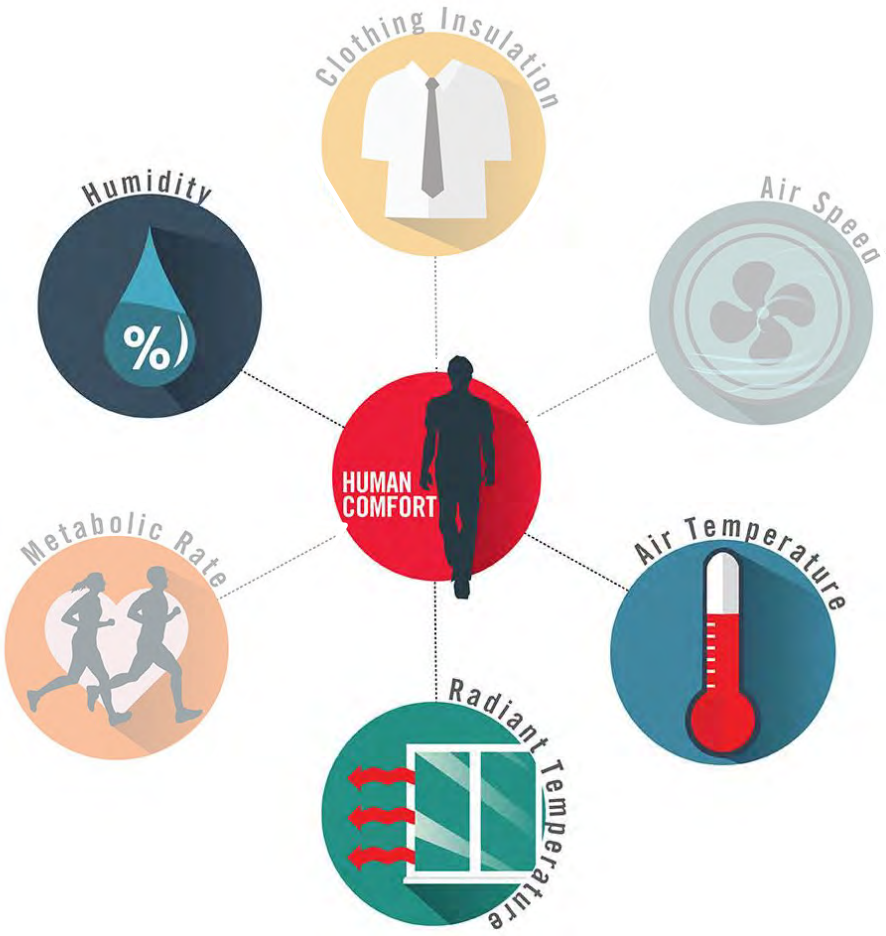


Image Source: http://www.pae-engineers.com/system/uploads/fae/image/asset/786/1430x950_Human_Comfort.jpg

Study Buildings

Site	Buildings	Height	# of suites	Occupant type
1	A,B	4 storeys	397	Senior
2	C,D,E	7-11 storeys	471	Bachelor
3	F,G	18-19 storeys	369	Family

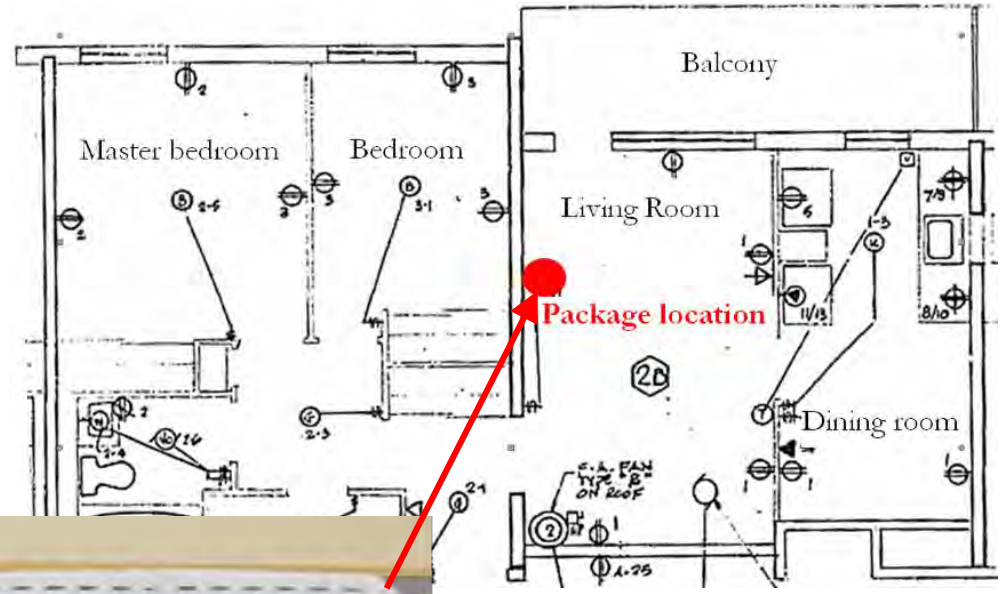
Image Source: Touchie et al., 2016

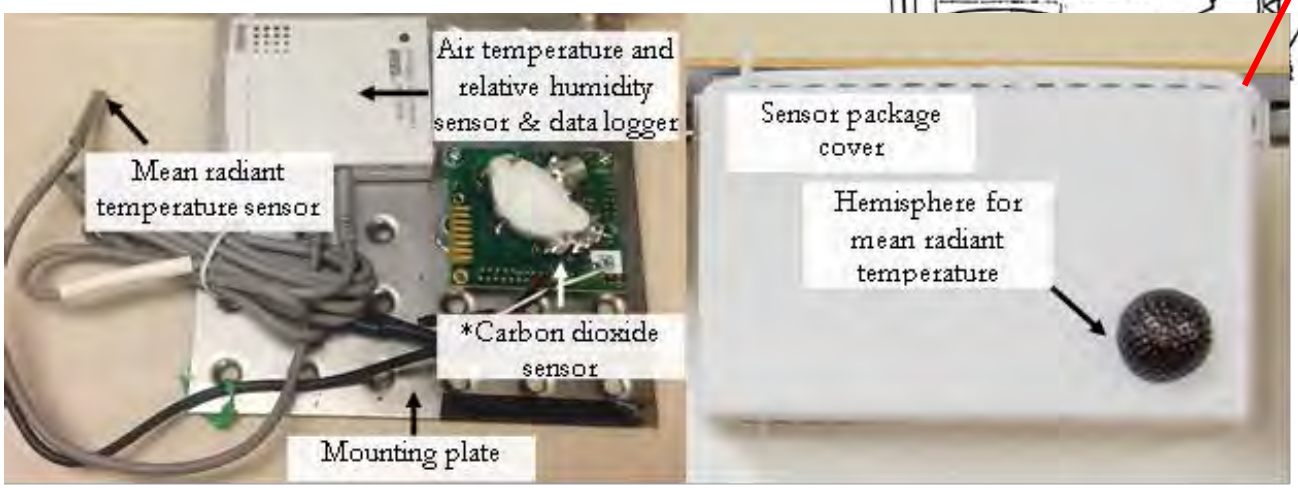
Resident Surveys (180)

- Demographics
- Perceived Comfort
- Behavior in Suite

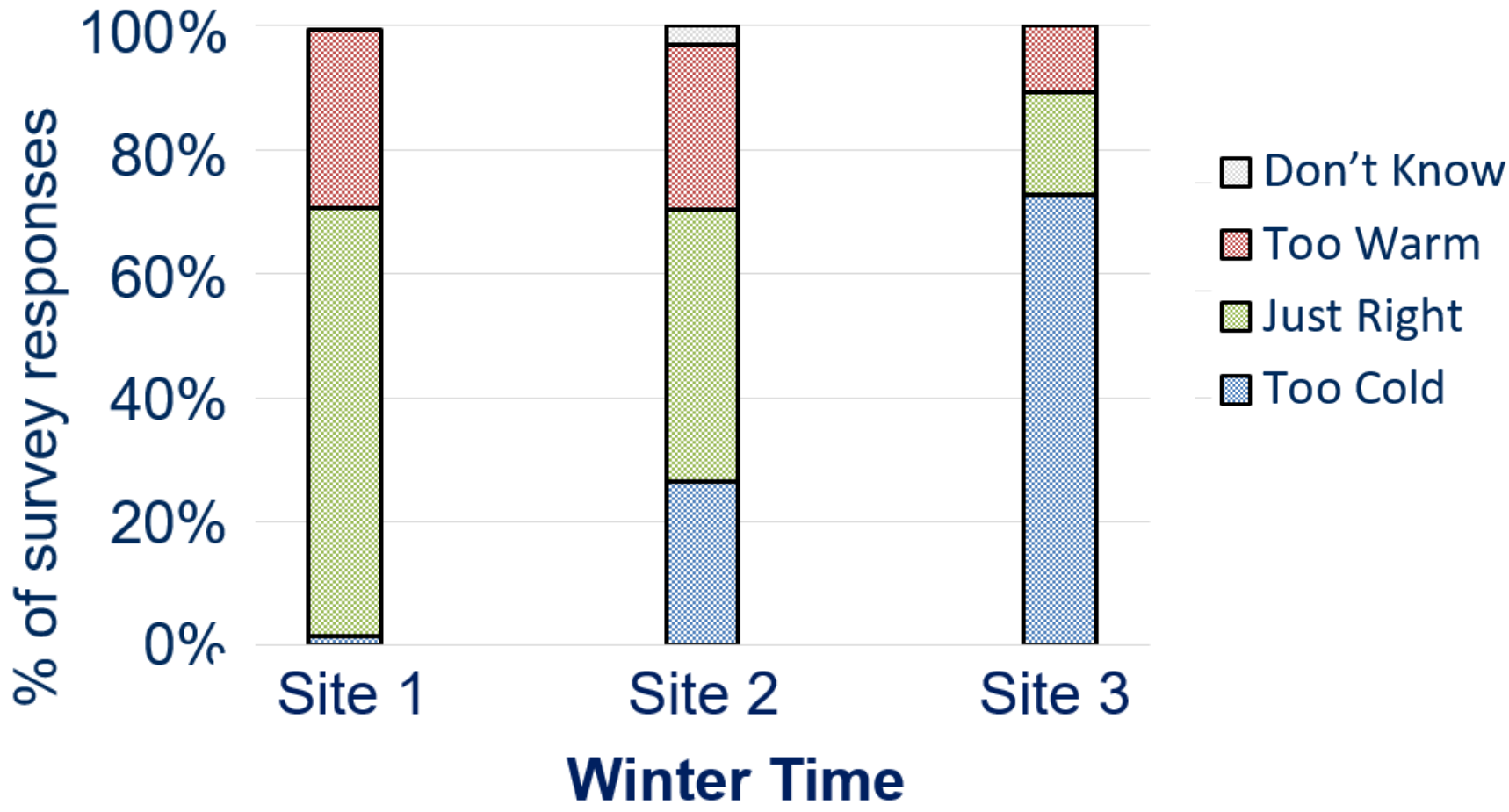
In-Suite Environmental Monitoring (70)

- 15-min interval
- Temp, RH, ~MRT
- Dec 2015-Feb 2016

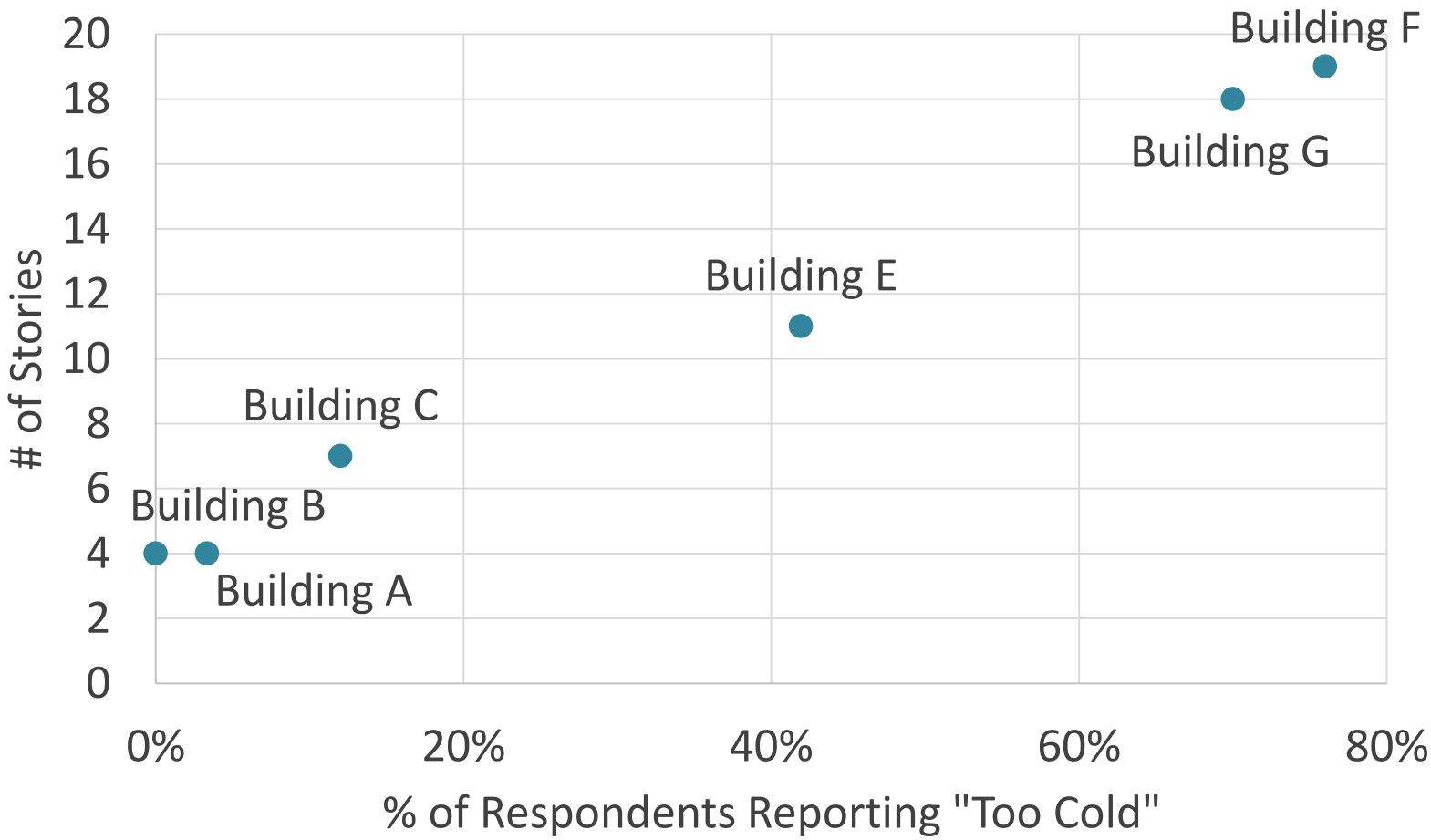




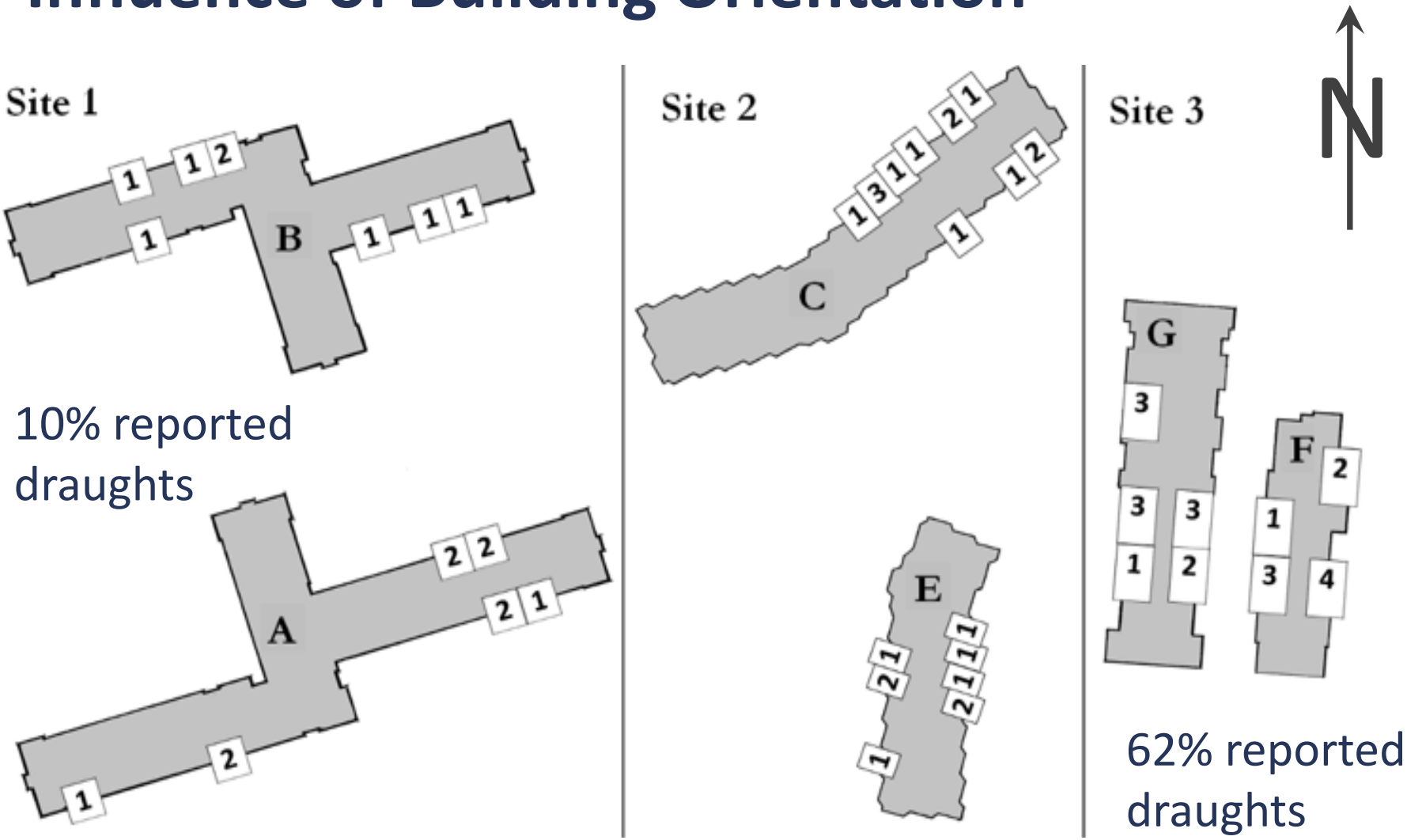
Reported Thermal Comfort



Influence of Building Height



Influence of Building Orientation



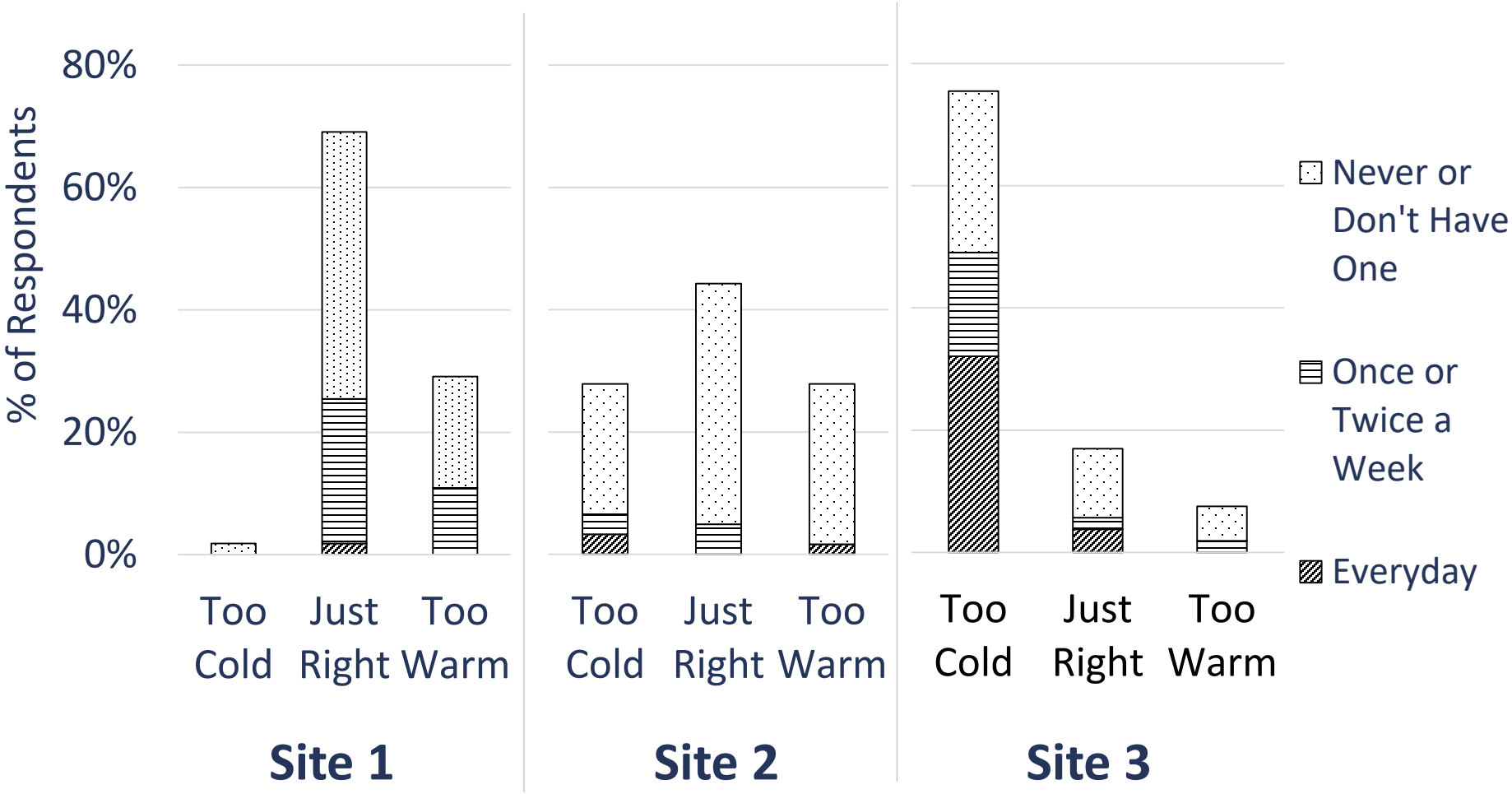
10% reported draughts

62% reported draughts

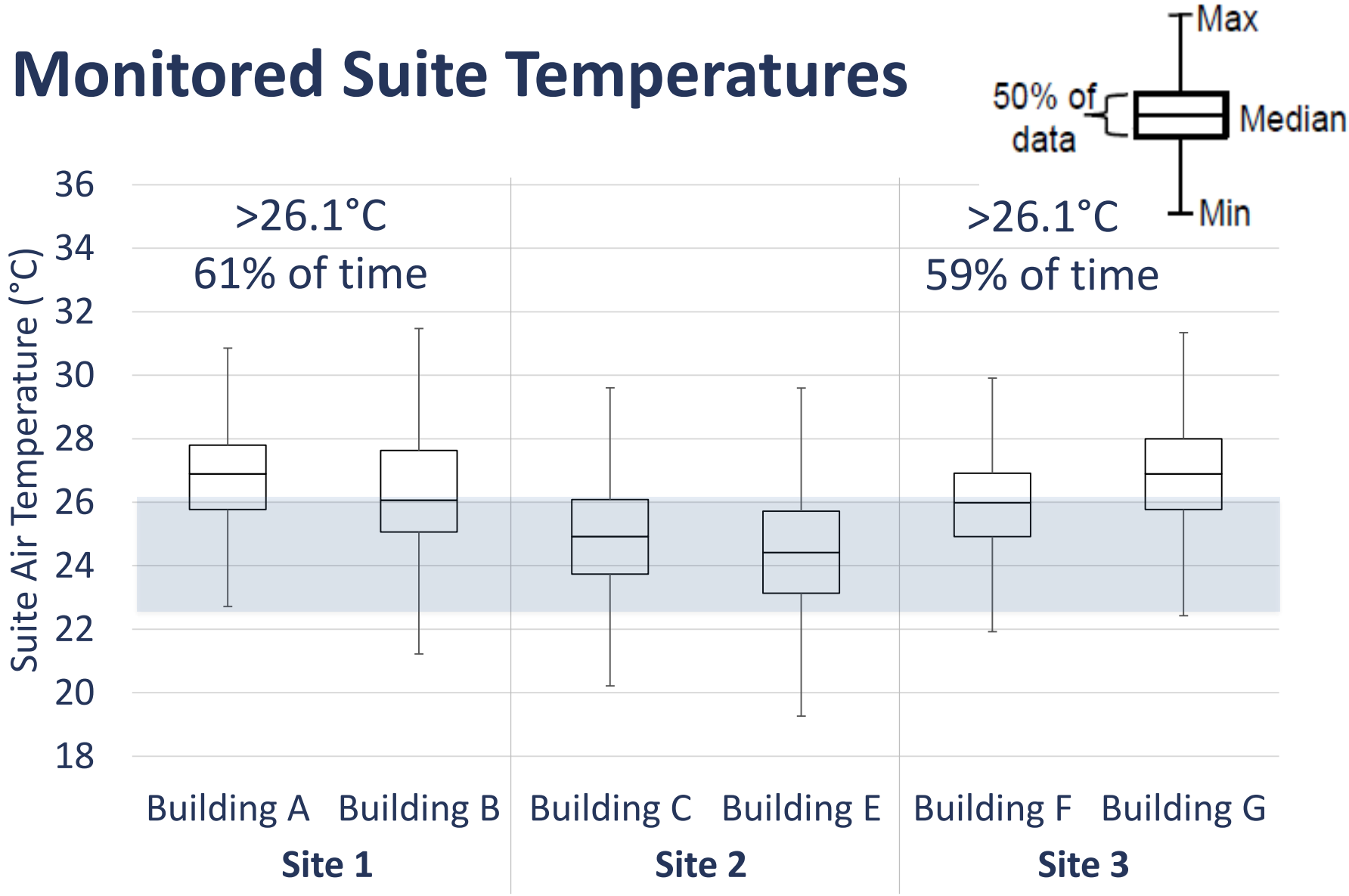
Image Source: Touchie et al., 2016

Window/Door Operation, Smoking and Odour Detection

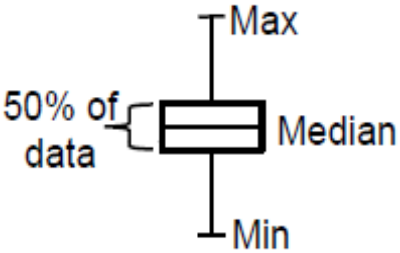
Use of Supplementary Heaters

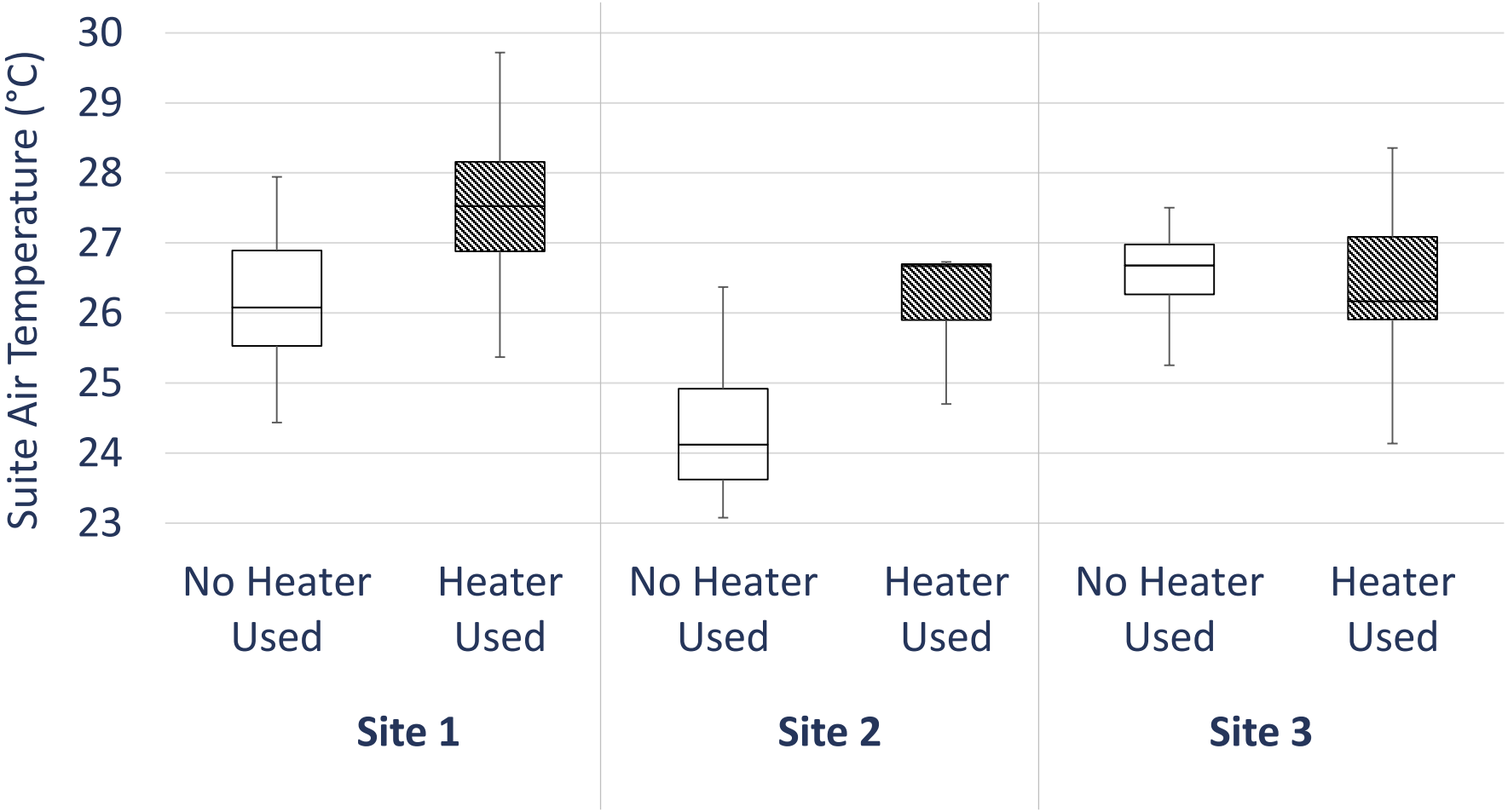


Monitored Suite Temperatures

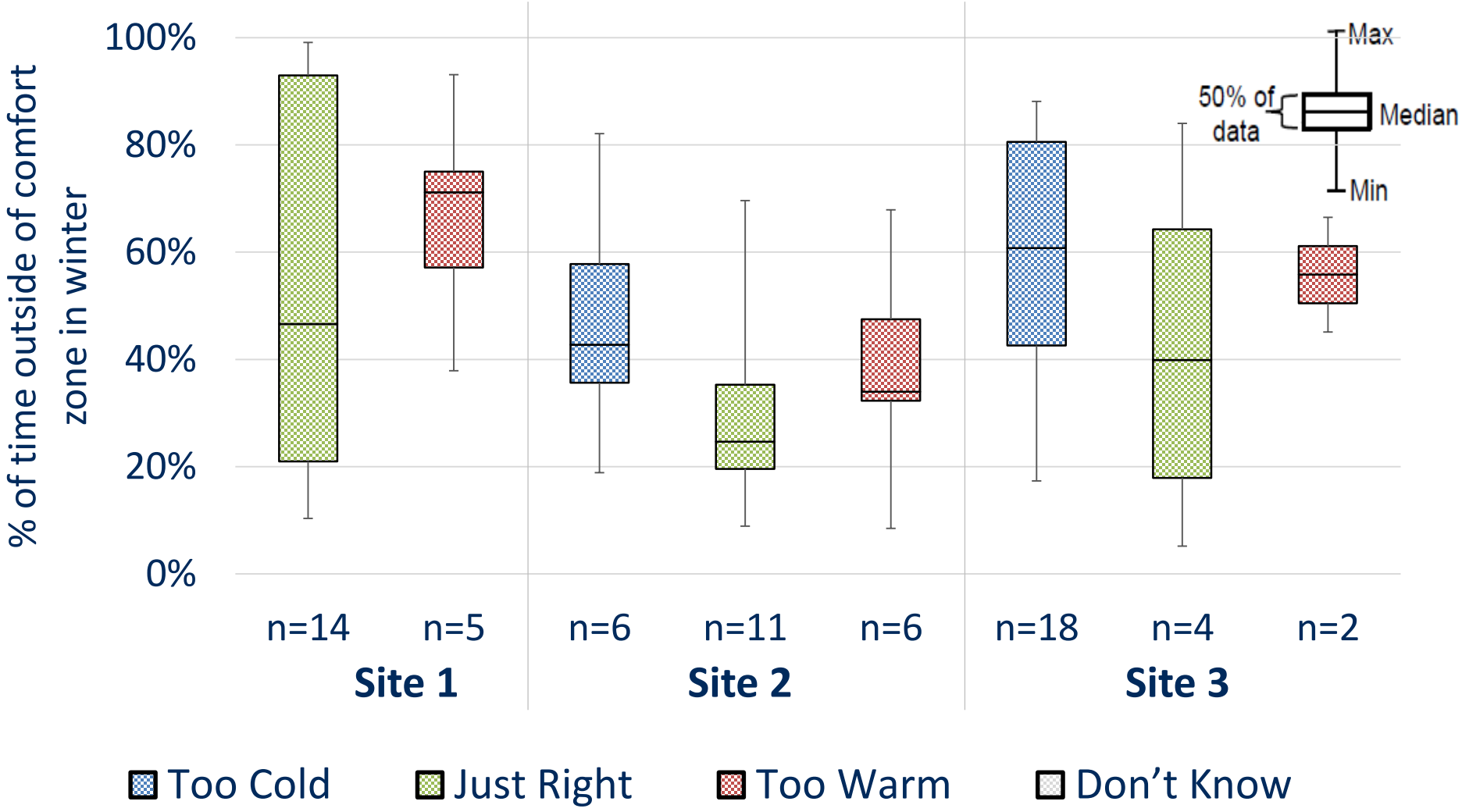


Heater Use and Suite Temperatures

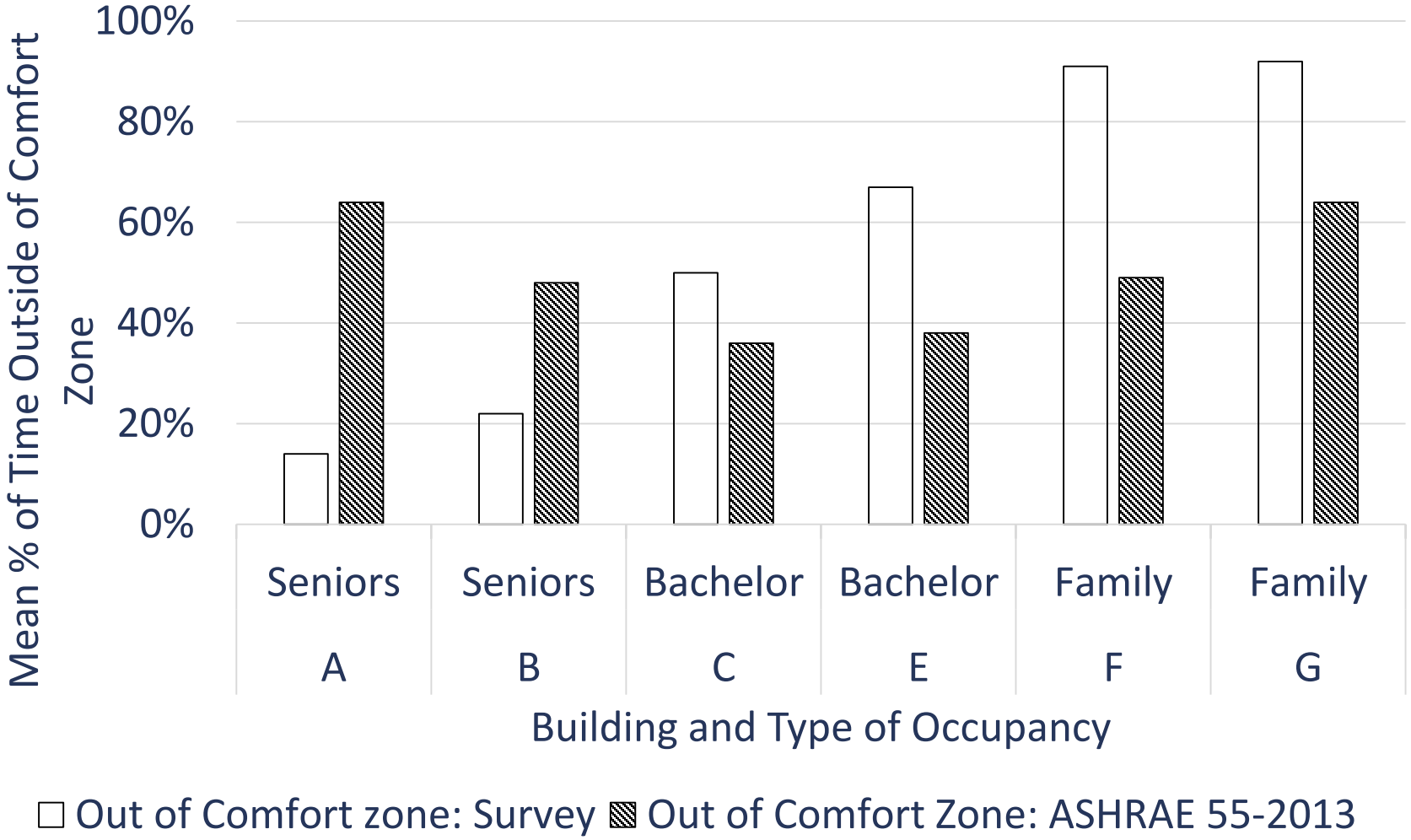




Comparison of Monitored and Survey Data



Comfort Perceptions



Survey Conclusions

- Taller, family-occupied, East-West facing buildings reported “Too Cold” conditions
- No evidence of stack effect
- High frequency of window/door operation during winter

Monitoring Conclusions

- Sites 1 and 3 outside of comfort zone more than half the time
- Observable stack effect in Sites 2 and 3

Comparing Monitoring and Survey Data

- Window/door opening driven by different factors (smoke, odours or thermal comfort)
- Uncomfortable residents more likely to use supplementary heaters
- Elderly residents report greatest thermal comfort, least time in comfort zone
- Poor agreement between survey and monitoring data

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