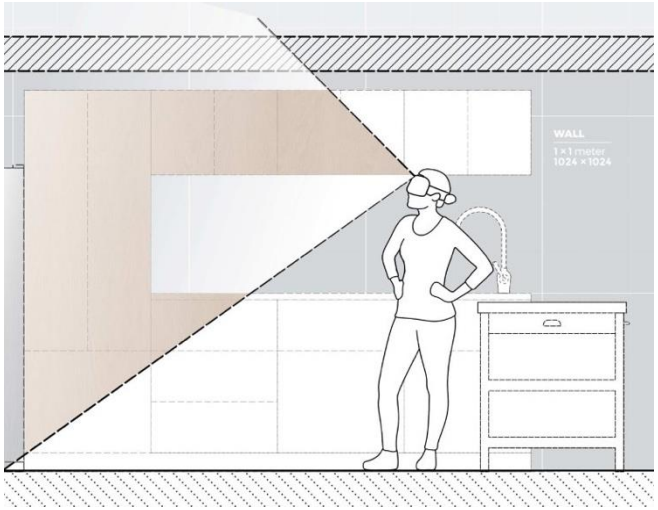
UNIVERSITY OF TORONTO | Building Energy and Indoor Environment (BEIE) Lab

Buildings are in the eye of the beholder: Image-based data collection of resident feedback



Users TCP Academy

October 14, 2026

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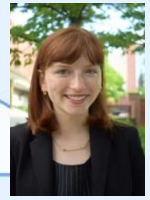
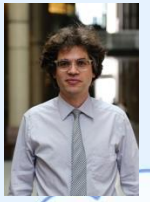
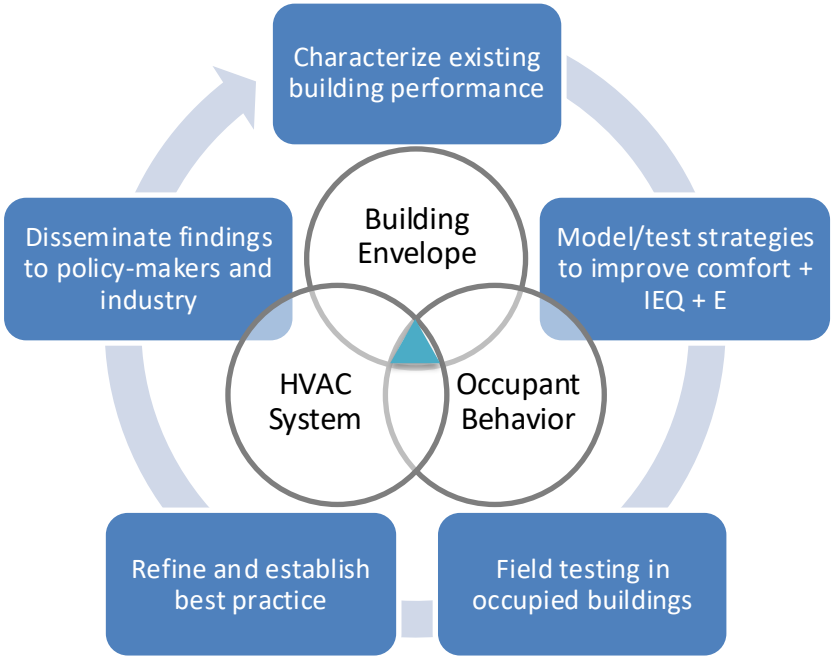
UNIVERSITY OF TORONTO | Hub for Advancing Buildings

The Hub for Advancing Buildings conducts interdisciplinary research to improve human health & comfort, promote equity & resilience and reduce carbon emissions in buildings

Building Energy and Indoor Environment Lab

*Developing strategies to achieve **climate positive** and **people positive** buildings*



Multi-Family Buildings, primarily social housing

Image Sources: ERA Architects, Forum

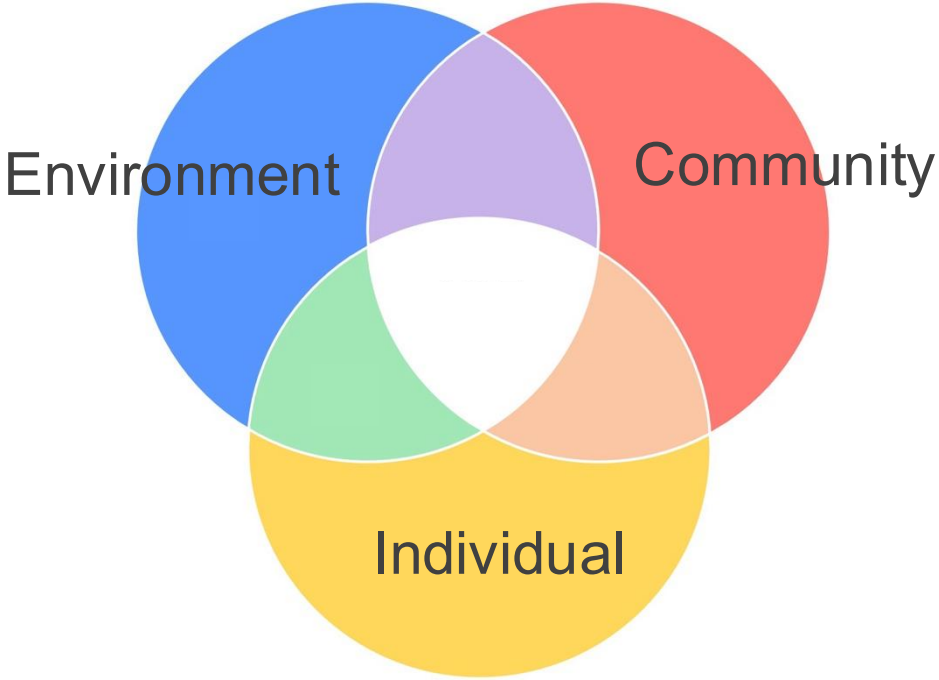
Today's outline

- POE approaches and gaps
- Photovoice POE projects
- Virtual reality Pre-OE project
- Key takeaways

Typical POE approaches

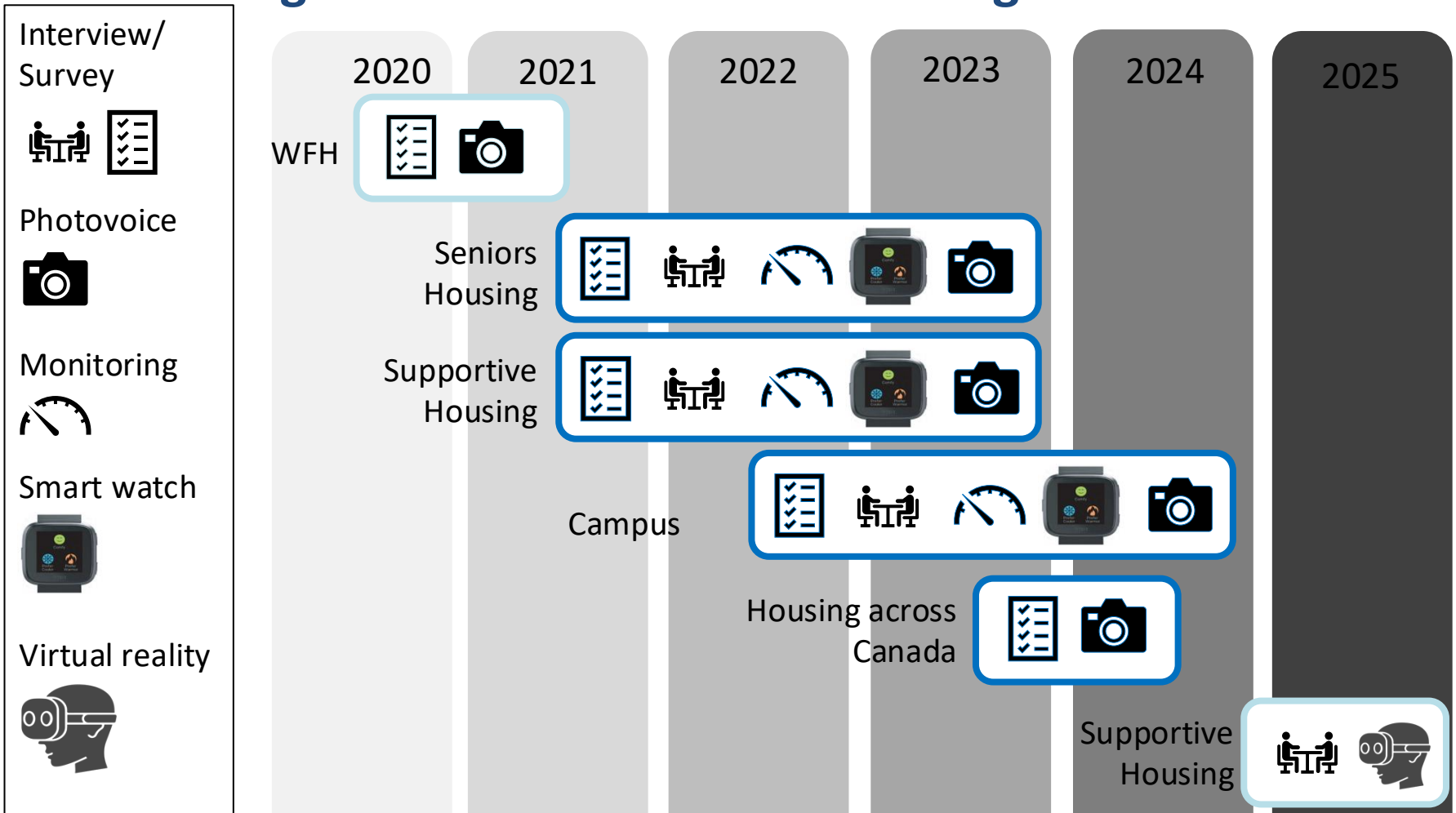
- Occupant surveys
- Indoor environmental quality monitoring
- Energy submetering or utility bill analysis

Well-being in the built environment framework



Makaremi, et al. (2025), *Building and Environment*

Wellbeing in the Built Environment Program Activities



Indoor Environmental Monitoring

- Thermal conditions
- Indoor air quality
- Acoustic conditions
- Visual conditions

Surveys

Topic Areas:

- Demographics (gender, etc.)
- Perceived indoor conditions (air quality, temperature, etc.), comfort and satisfaction
- Architectural and interior design quality
- Self-rated Individual and Community Wellbeing

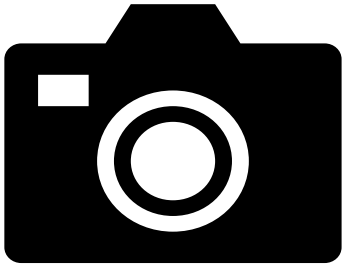
Example Question:

- "Please rate your satisfaction with the overall lighting quality in your classroom/office/etc."

Smartwatch

- The Cozie platform
- Periodic right-here-right-now survey
- Questions on:
  - Perceived comfort
  - Well-being

Photovoice



Individual photos and captioning activity followed by identification common themes as a group.

Photovoice Activity example prompt:

Which areas of the building add to or detract from your wellbeing?

As participants upload the photos, participants:

- label each one with a title (identifying what it is)
- add a comment (how often you use this item; anything about it that enhances or diminishes your day; anything else you'd like to say).

Wellbeing Prompt: Please take 1 or 2 photos of an area, object(s), or activity in your building that you feel has a POSITIVE impact on your wellbeing.

Suite Number
Everything inside my apartment is great, everything outside of it is a nightmare

Views and Garden #2
Grounds - my garden

Researcher
Spending time with this researcher makes me happy

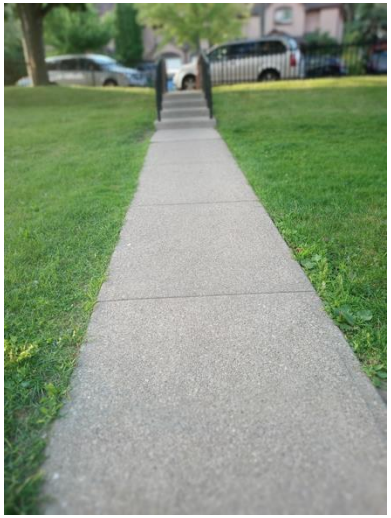
View at night
i have the best view in the building

View during the day
I'm in the 'suite' spot

Wellbeing Prompt 2: Please take 1 or 2 photos of an area, object(s), or activity in your building that you feel has a NEGATIVE impact on your wellbeing.

Unit Door Gap

Lack of privacy, lets in lights, sounds, smells, potential access for rodents/pests

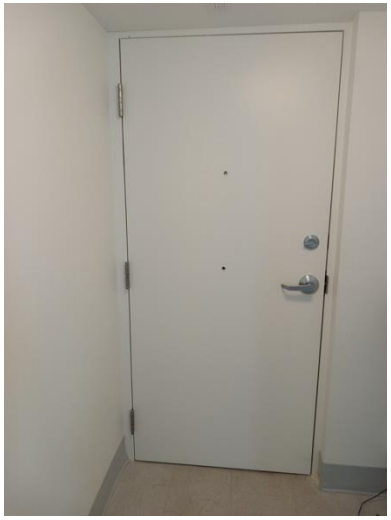


Where is the ramp?

Where is the ramp? How can anyone with a handicap get up there?

'Ring of Fire'

We're trapped. We go next door to get away from the smokers and drug addicts who sit in the disabled parking spots



The door is very heavy and is difficult to open, especially if you have a walker or wheelchair. This is a modified unit for people with disabilities. I put in a request for an automatic door opener 5 months ago. I had to follow up a month ago as nothing was happening. I am still waiting

The importance of Sensemaking

- Researchers analyze photos/captions and develop themes
- Group discussion to:
  - Confirm findings
  - Check what was missed or misinterpreted
  - Learn about new emergent issues/themes

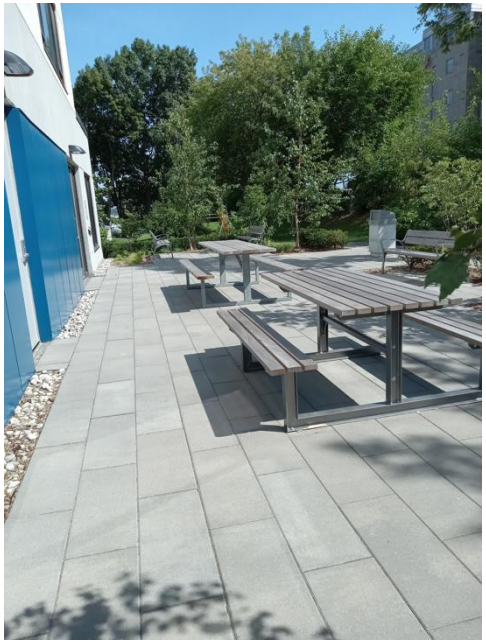
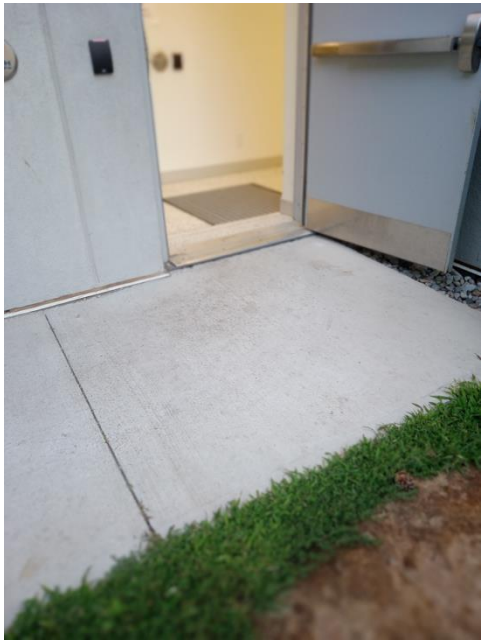
Emergent themes

From prompts about:

- well-being
- comfort
- health
- control
- socialization

Participant-driven themes

Common areas access and programming

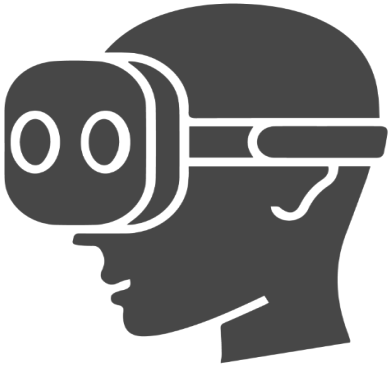
Lessons learned from PV studies

- Some residents were not comfortable with taking photos (visual impairments, health issues) or with the technology
- Images and captions together enhanced understanding
- Multiple researchers tagging photos and captions, then reach consensus before frequency analysis
- Online PV study required significant quality control (only 54 of 1261 responses were legitimate, *Nikam et al., 2025*)

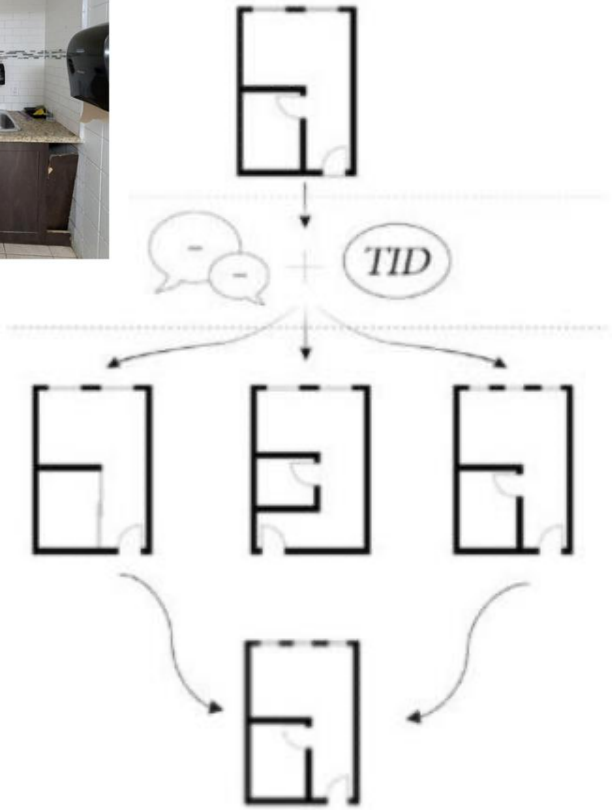
Virtual Reality Study

The study addresses two important gaps in the literature:

- Supportive housing residents and frontline staff are rarely involved in building design decisions before construction. (Baharetha et al. 2025; Maslova & Burgess, 2023)
- Evaluations of trauma-informed housing environments typically occur only *after* occupancy (Furman & Hadjri, 2025; Wingler et al. 2020)



Methods



Part A – User Feedback

- Interview about current building

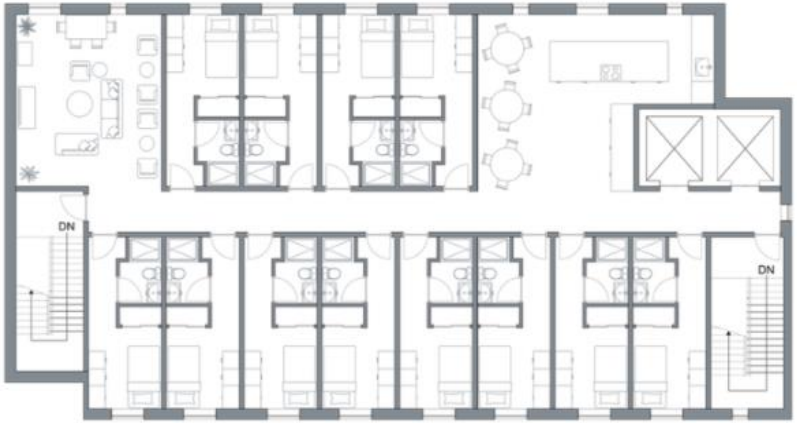
Part B – VR Baseline Design

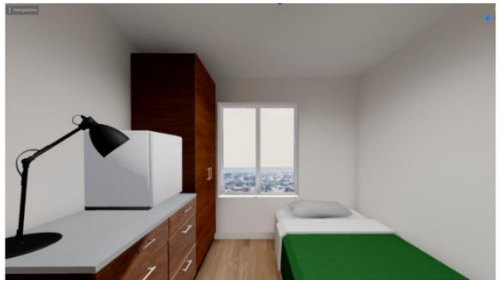
- Freeform exploration
- Task-based observation
- Guided Interview

Part C – Alternative Design Iterations

- Informed by Part B feedback
- Informed by Trauma Informed Design Principles

Baseline Design





Design alternatives

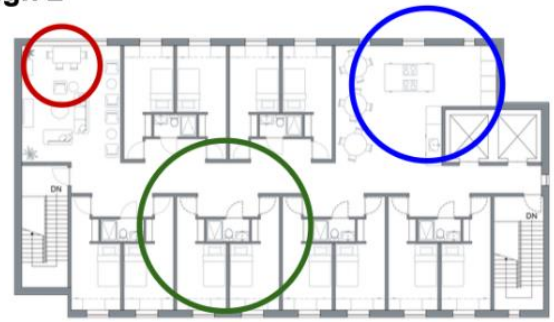
Design 1

Common Area Revisions
- Furniture layout roasted 180°
- Privacy screen added near hallway

Kitchen Revisions
- Second stovetop added
- Second sink added

Suite Revisions
- Modifications to built-in cabinetry to expand desk space

Design 2



Common Area Revisions
- Larger windows

Kitchen Revisions
- Additional stovetop added
- Smaller kitchen island
- Laundry space behind elevators
- Sink moved closer to hallway

Suite Revisions
- Built-in closet removed
- Cabinetry moved against window
- En-suite bathrooms replaced with shared bathroom added between paired units
- Built-in shelving added to suite entryway

Design 3

Kitchen Revisions
- Split kitchen islands
- Cabinetry moved to SW wall
- Banquette seating replaces tables
- Laundry added behind elevators
- Privacy screen added near hallway and between laundry & kitchen

Suite Revisions
- Built-in closet removed
- Cabinetry moved further into suite, bed moved against window
- Shared washroom between pair units made to meet accessibility standards

Participants & Data

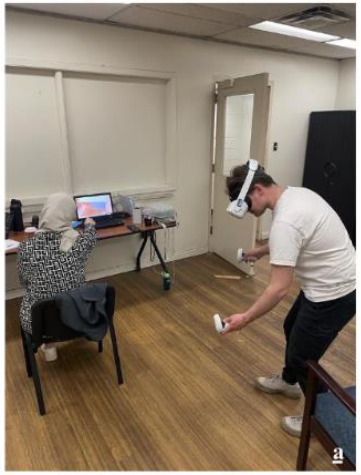
12 site-visits

12 participants

4 design iterations

19 Interview & VR sessions

20+ hours of audio



Results

- TID design elements well received (aesthetics and materials; improved sense of safety; less 'institutional' or 'prison-like' atmosphere)
- Both groups favoured separated kitchen and communal areas, hallway alcoves, locked personal storage, and neutral, warm material palettes
- Divergent design priorities about washrooms
- The role of building operations and management is critical

Recommended Design

Discussion and Lessons Learned

- There were tensions between residents and staff:
  - balance resident privacy and independence with the responsibilities of staff to maintain resident safety and provide oversight
- Provide alternative ways for participants to engage with VR
- Interactive elements not critical for immersion in this study

Key takeaways

- Photovoice methods can yield new insights, beyond survey responses, and lead to a clearer understanding of how inhabitants engage with building elements
- Iterative, participatory VR sessions can reveal critical design and operational insights early in the design process
- Trauma informed design dimensions appear to support inhabitant experience
- Need to integrate flexibility to ensure these methods are accessible to all participants

Acknowledgements

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Thank you!

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