Integration of humans and their environment in building design and operation

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Sponsor: Alcoa Foundation

Existing work spaces –inefficient, uncomfortable, unproductive

Indoor environments tuned for occupant satisfaction, productivity and energy efficiency
Living Labs at CHPB

• 4 side-by-side occupied open plan office spaces
  Fully modular design – configurable envelope, lighting and comfort delivery elements
• Monitoring energy use and indoor environmental conditions

Portable measurement station for monitoring indoor environment with simultaneous occupant surveys under different conditions
Visual comfort measurements – HDR camera and image processing

Occupant surveys and preferences

Reasons for lack of satisfaction
- Too dark: 13%
- Too bright: 20%
- Electric light flickering: 13%
- Too much daylight: 20%
- Not enough electric light: 7%
- Reflections on screen: 7%
- Not enough light for task: 13%
- Not enough daylight: 7%

What would you prefer?
- More natural light: 53%
- Less natural light: 20%
- More electric lighting: 27%
- Less electric lighting: 0%
- No change: 7%

Correlations with existing comfort indices

- DGP correlation - 4x Average threshold: $R^2 = 0.8193$
- DGP correlation - 6x Average threshold: $R^2 = 0.8549$
- DGP correlation - 500 cd/m² Absolute threshold: $R^2 = 0.7967$
- DGP correlation - 1000 cd/m² Absolute threshold: $R^2 = 0.8193$

Relative frequency histogram for satisfaction and work plane illuminance

- Satisfied
- Unsatisfied

Work plane illuminance ranges [lx]:
- Satisfied
- Unsatisfied
Ongoing work

• Experiments in 4 identical private offices with different shading, lighting and thermal controls

• Detailed monitoring of indoor environmental conditions and occupant actions under variable exterior and interior conditions

• Development of occupant interaction models, comfort models, adaptive controls