CMHC Healthy House 1996
Breathe Architects
Southern Ontario Barn, 1830’s
We have the technology.

-Oscar Goldman
We have the technology.

So what is holding us back?

costs…
“Bad architecture is in the end as much a failure of psychology as of design. It is ... the tendency not to understand who we are and what will satisfy us.”

— Alain de Botton, The Architecture of Happiness
Comfortable Indoor Environment

Thermal Comfort

- Natural/Mechanical Ventilation
- Convective Systems
- Internal Gains
  - Condution
  - Infiltration
  - Solar Gains
- Ceiling Fans
- Intuitive Operation
- Surface Temperature
- Radiant Systems
- Clothing
- Thermal Mass
- Humidity
- Air Velocity
- Psychology
- MET

Air Temperature
<table>
<thead>
<tr>
<th>Operative temperature</th>
<th>Perceived comfort</th>
<th>Thermo Comfort Equivalency</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.5°C</td>
<td>25°C</td>
<td>25°C</td>
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<tr>
<td>25°C</td>
<td>28.3°C</td>
<td>28.3°C</td>
</tr>
<tr>
<td>20 fpm</td>
<td>20 fpm</td>
<td>60 fpm</td>
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<tr>
<td>50 RH</td>
<td>50 RH</td>
<td>trousers &amp; shirt or equivalent</td>
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<td>29.4°C</td>
</tr>
<tr>
<td>160 fpm (ceiling fan on medium speed)</td>
<td>220 fpm (ceiling fan on high speed)</td>
<td>60 RH</td>
</tr>
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Thermal Comfort "Equivalency"
winter heating

natural ventilation

summer cooling

extended natural ventilation
Operative Temperature – Wider Comfort Range
South facing office, 40% radiant slab, 60% WWR, operable exterior shading

Ventilation Mode


54% Natural Ventilation 46% Mechanical Ventilation

Operative Temperature

19 - 21°C, [0%]  21 - 24°C, [52%]  24 - 26°C, [34%]  26 - 28°C, [13%]
Energy Use Intensity (EUI) kWh/m²

- Space Heating
- Ventilation Cooling
- Domestic Hot Water
- Pumps + Fans + Controls
- Ventilation Heating
- Interior + Exterior Lighting
- Space Cooling
- Plug Loads + Elevators

Total EUI: 59 kWh/m²