“LOW TEDI GUIDE”

Guide to Low Thermal Energy Demand for Large Buildings

WHAT IS NET ZERO (READY)?

**DEFINITIONS**
- Net Zero Site Energy
- Net Zero Source Energy
- Net Zero Carbon

**RENEWABLE ENERGY SOURCES**
- On Site
- Off Site
- RECS

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WHAT IS NET ZERO (READY)?

1. **Low Thermal Loads**

2. **Low Electrical Loads**

3. **High Efficiency / Low Carbon Supply**
**Net Zero (Ready) Policies**

- **Edmonton**
- **B.C.**
- **Vancouver**
- **National**
- **Toronto**

**Net Zero Policies**

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>kWh/m² (kbtu/sf)</td>
<td>75 (24)</td>
<td>100 (32)</td>
<td>100 (32)</td>
<td>CZ TEDI 4 5 6 7 8 30 32 34 36 40</td>
</tr>
<tr>
<td>TEDI</td>
<td>15 (5)</td>
<td>15 (5)</td>
<td>15 (5)</td>
<td>C.Z TEDI 5 6 7 8 30 32 34 36 40</td>
</tr>
<tr>
<td>kgCO₂/m²</td>
<td>5</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
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</table>
**WHAT IS TEDI?**

THERMAL ENERGY DEMAND INTENSITY
HEATING LOAD PER UNIT AREA
SIMILAR TO PASSIVE HOUSE METRIC

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**CO-BENEFITS OF LOW TEDIs**

- PH Envelope
- Good Envelope
- Bad Envelope

Zone Air Temperature vs. -20 < OAT < -5 Two Weeks
Many roads lead to NZR TEDI

Strategy 1: Optimize Shape

<table>
<thead>
<tr>
<th></th>
<th>Square</th>
<th>Articulated</th>
<th>Narrow</th>
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<tbody>
<tr>
<td>VFAR</td>
<td>0.49</td>
<td>0.59</td>
<td>0.7</td>
</tr>
<tr>
<td>TEDI (kWh/m²)</td>
<td>15.1</td>
<td>20.3</td>
<td>26.1</td>
</tr>
</tbody>
</table>
STRATEGY 2: HIGH EFFICIENCY HEAT RECOVERY

![Graph showing ventilation contribution to TID (kWh/m²-year) for different heat recovery effectiveness (%).]

- Climate Zone 7a
- Climate Zone 6
- Climate Zone 5
- Climate Zone 4

STRATEGY 3: REDUCE HEAT LOSS

![Diagram illustrating reduction in heat loss through improved insulation.]
STRATEGY 3: REDUCE HEAT LOSS

Table 4.2: Wall Thermal Transmittance for Conventional Assemblies and Details

<table>
<thead>
<tr>
<th>Detail</th>
<th>Area or Length</th>
<th>Transmittance Value</th>
<th>Heat Flow (W/K)</th>
<th>Percent of Total Heat Flow (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Stud Wall</td>
<td>610 m²</td>
<td>0.35 W/m²K</td>
<td>2066</td>
<td>36.7%</td>
</tr>
<tr>
<td>Balcony Slab at Door</td>
<td>226 m²</td>
<td>4.72 W/m²K</td>
<td>1048</td>
<td>18.9%</td>
</tr>
<tr>
<td>Parapet at Wall</td>
<td>55 m</td>
<td>0.78 W/m²K</td>
<td>43</td>
<td>0.8%</td>
</tr>
<tr>
<td>Parapet at Glazing</td>
<td>73 m</td>
<td>0.99 W/m²K</td>
<td>73</td>
<td>1.3%</td>
</tr>
<tr>
<td>Intermediate Floor at Wall</td>
<td>616 m²</td>
<td>0.20 W/m²K</td>
<td>123</td>
<td>2.2%</td>
</tr>
<tr>
<td>Intermediate Floor at Balcony</td>
<td>778 m²</td>
<td>1.06 W/m²K</td>
<td>825</td>
<td>14.6%</td>
</tr>
<tr>
<td>Intermediate Floor at Glazing</td>
<td>1536 m²</td>
<td>0.20 W/m²K</td>
<td>307</td>
<td>5.5%</td>
</tr>
<tr>
<td>Window to Wall</td>
<td>5559 m²</td>
<td>0.20 W/m²K</td>
<td>1112</td>
<td>19.7%</td>
</tr>
<tr>
<td>Interior Wall Separation</td>
<td>988 m²</td>
<td>0.20 W/m²K</td>
<td>20</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

Overall Thermal Transmittance (W/m² K): 0.12
Effective R-Value (hr·°F·F/ BTU): 4.2

Table 4.3: Wall Thermal Transmittance for Low TEDI Assemblies and Details

<table>
<thead>
<tr>
<th>Detail</th>
<th>Area or Length</th>
<th>Transmittance Value</th>
<th>Heat Flow (W/K)</th>
<th>Percent of Total Heat Flow (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall with FRP Brackets</td>
<td>612 m²</td>
<td>0.142 W/m²K</td>
<td>870</td>
<td>67.4%</td>
</tr>
<tr>
<td>Delta U for Aluminum Brackets</td>
<td>612 m²</td>
<td>0.041 W/m²K</td>
<td>251</td>
<td>19.5%</td>
</tr>
<tr>
<td>Wall to Roof</td>
<td>128 m²</td>
<td>0.171 W/m²K</td>
<td>22</td>
<td>1.7%</td>
</tr>
<tr>
<td>Intermediate Floor</td>
<td>2930 m²</td>
<td>0.003 W/m²K</td>
<td>10</td>
<td>0.8%</td>
</tr>
<tr>
<td>Window to Wall</td>
<td>5559 m²</td>
<td>0.024 W/m²K</td>
<td>133</td>
<td>10.3%</td>
</tr>
<tr>
<td>Interior Wall Separation</td>
<td>988 m²</td>
<td>0.003 W/m²K</td>
<td>3</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

Overall Thermal Transmittance (W/m² K): 0.21
Effective R-Value (hr·°F·F/ BTU): 27.0

STRATEGY 4: IMPROVE AIR TIGHTNESS

Figure 4.6: Impact of Air Infiltration on TEDI
OTHER STRATEGIES

LOWER WINDOW TO WALL RATIOS

HIGH PERFORMANCE WINDOWS

ORIENTATION AND SOLAR HEAT GAIN

CLIMATE ZONE 5 EXAMPLES

Figure 4.10: Example Paths to Low Energy Buildings in Climate Zone 5
"Net Zero Ready" High Rise Residential

**TEDI:** 16 kWh/m²
(5 kBtu/sf)
**EUI:** 85 kWh/m²
(27 kBtu/sf)

Figure 4.1: End-use Breakdown for a Low Energy MURB in Climate Zone 6

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"Net Zero Ready" High Rise Residential

Figure 4.2: Example Breakdown of Heating Load Components
WHAT NET-ZERO HIGH-RISE LOOK LIKE

MORE THAN THICKER WALLS AND EXTRA INSULATION

All Stakeholders to Recognize:

- The impact of thermal bridging at every junction between building components
- Deviation from conventional practice is required, but it is in everyone’s best interest to minimize disruption and build on local practice
- Success will come from a holistic viewpoint to design specifications and project requirements
- More effort will be required, by everyone, until new norms are established

Design Specification
- Insulation type
- Cladding type
- Glazing type
- Cladding attachment
- Window detailing
- Insulation placement

Requirement
- Fire Protection
- Structural Support
- Environmental Separation
- Durability
- Constructability
**FIRE PROTECTION AND COMBUSTIBILITY**

**Significant differentiator and challenge for high-rise MURBs**
- Many components relied upon to reduce thermal bridging and minimize wall thickness have combustible components.

*Foam Plastic Insulation*

*Combustible Window Frames*

**ENVIRONMENTAL SEPARATION AND DURABILITY**

**Same Minimum Requirements**
- Less energy transfer
- Less forgiveness
**Structural Support**

Some easy and efficient designs are non-starters

- More complex connections, such as required for balconies or overhangs
- More accommodation in structural design for other requirements, such as
  - Cladding attachments with combustible components
  - Thermal breaks
  - Continuity of the thermal insulation across the structure
  - Windows positioned outboard of the structure

**Constructability**

Critical to quality and cost control

- Familiarity and availability
- Engineering and testing for jurisdiction
- Site-built versus pre-fabricated
- Field review and testing
- Sequencing and exterior access
- Crane use
EXPECTATIONS FOR THERMAL BRIDGING

NZE is difficult without high thermal quality details

- Small differences in detailing can be significant
- The wall to window interface demands the greatest attention for thermal transmittance calculations because of the potential variation in values and overall impact

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Low TEDI Guide

<table>
<thead>
<tr>
<th>Performance Category</th>
<th>Linear Transmittance (W/m·K)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Efficient</td>
<td>0.12</td>
<td>0.2</td>
</tr>
<tr>
<td>Regular</td>
<td>0.30</td>
<td>0.33</td>
</tr>
<tr>
<td>Poor</td>
<td>0.28</td>
<td>0.6</td>
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EXCEPTIONS FOR THERMAL BRIDGING

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</tr>
<tr>
<td>Efficient</td>
<td>0.26</td>
<td>0.1</td>
</tr>
<tr>
<td>Marginal</td>
<td>0.13</td>
<td>0.9</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.17</td>
<td>0.3</td>
</tr>
<tr>
<td>Poor</td>
<td>0.21</td>
<td>0.8</td>
</tr>
<tr>
<td>Poor</td>
<td>0.30</td>
<td>1.0</td>
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