Form vs Function?

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What form? What function?

• Form:
  – Shape, layers

• Function:
  – Durability
  – Energy
  – Comfort
  – Cost
Keep it simple

• Cost, durability, energy all benefit from simple shape
• Balance aesthetics and program
Two - 12 ft. stories
45' x 222'
Floor area: enclosure = 0.88

Two - 12 ft. stories
100' x 100'
Floor area: enclosure = 1.02

Six - 12 ft. stories
50' x 200'
Floor area: enclosure = 1.30

Six - 12 ft. stories
100' x 100'
Floor area: enclosure = 1.55
Expanded Plans

- Better daylight, easier ventilation but more enclosure heat loss and gain and air leaks
• **Head height** of window is primary determinant of daylighting
• Windows below desk are essentially useless
Building Shape?

\[ \frac{V}{S} = \frac{432}{348} = 1.24 \]
\[ \frac{V}{S} = \frac{432}{368} = 0.92 \]
\[ \frac{V}{S} = \frac{432}{516} = 0.84 \]

Figure 2.6: Impact of building shape on annual heating energy for a small 144 m² (1500 ft²) building in a cold climate. [Gratia & De Herde 2003]
Barbara Ross M.Arch. Study

160,000 sf 8-storey

50,000 sf 4-storey

12,000 sf 2-storey

LG**HE

MD**HE

LG**NS

MD**NS

LG**SQ

MD**SQ

SM**SQ
FIGURE 3: Office building: Medium H-shaped plan form, 4 stories (MD**HE-*)
(footprint 12,537 sf; gross floor area 50,148 sf)
### H plan form

<table>
<thead>
<tr>
<th>Plan</th>
<th>kWh/m²/year</th>
<th>Skin %</th>
<th>Internal %</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD40HN-A</td>
<td>173</td>
<td>39%</td>
<td>61%</td>
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<tr>
<td>MD40HN-C</td>
<td>216</td>
<td>49%</td>
<td>51%</td>
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<tr>
<td>MD40HN-D</td>
<td>263</td>
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<td>44%</td>
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### Long plan form

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<td>MD40EW-A</td>
<td>168</td>
<td>38%</td>
<td>62%</td>
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<tr>
<td>MD40EW-C</td>
<td>210</td>
<td>18%</td>
<td>52%</td>
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<tr>
<td>MD40EW-D</td>
<td>256</td>
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### Square plan form

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<th>Internal %</th>
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</thead>
<tbody>
<tr>
<td>MD40SQ-A</td>
<td>164</td>
<td>37%</td>
<td>63%</td>
</tr>
<tr>
<td>MD40SQ-C</td>
<td>207</td>
<td>48%</td>
<td>52%</td>
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<tr>
<td>MD40SQ-D</td>
<td>251</td>
<td>55%</td>
<td>45%</td>
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40,000 GFA 4-storey office in Toronto, Ont.
For a 65% WWR Medium sized office

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Energy Intensity (kWhr/m²/yr)</th>
<th>Difference (% of high)</th>
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</thead>
<tbody>
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<td></td>
<td>spine NS玻璃 E&amp;W</td>
<td>spine EW玻璃 N&amp;S</td>
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<tr>
<td>Regina</td>
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<tr>
<td>Seattle</td>
<td>47°N</td>
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<tr>
<td>Toronto</td>
<td>44°N</td>
<td>219</td>
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<td>Phoenix</td>
<td>33°N</td>
<td>219</td>
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<tr>
<td>Miami</td>
<td>26°N</td>
<td>221</td>
</tr>
</tbody>
</table>
Cold climate/ hot climate

- Enclosure matters in both cold and sunny climes, just in different ways

**MD65EW-C**

**Toronto**

213 kWh/m²/year

**MD65EW-C**

**Miami**

221 kWh/m²/year

Long building form, glass facing North-South
Enclosure Form

• Improving the enclosure has a major impact

**FIGURE 6:** Load profiles for square buildings with varied enclosure type
Skin Dominated Building

- "Skin-dominated": Perimeter Zone over most of floor area
- Excellent daylighting and cross ventilation opportunities
- Best massing for many commercial buildings
- **Demands good building enclosure because of increased enclosure area**

≈ 18 m / 60 ft

Building Science
Enclosure form

Choose a simple high-performance option

1. Water control layer
2. Air control layer
3. Thermal control layer
4. Vapor control layer

Structure

Service

Interior finish