The Canadian Precast Industry’s Journey to Sustainable Product Labelling

Robert Burak, P.Eng., President CPCI
The Athena Sustainable Materials Institute (ASMI) and the engineering firm Morrison Hershfield conducted a life cycle assessment (LCA) of a typical commercial building in two Canadian locations – Vancouver (cool climate) and Toronto (cold climate).

The LCA compared the performance of three structural framing systems as well as a typical curtain wall design against different concrete building envelopes.
LCA of Precast Concrete Buildings

- Looking at 60- and 73-year occupancy scenarios (CSA and ISO lifecycles), the best performing buildings in terms of global warming potential (GWP) and total primary energy (TPE), regardless of service life or location, were those with a precast concrete envelope and cast-in-place concrete structure.

- Energy simulation revealed that the interior thermal mass inherent in cast-in-place concrete and precast concrete floors reduced annual heating energy by 6-15% — and that was without any specific thermal mass based heating strategies since the functional unit was the same for each scenario.

- For more info: Life Cycle Assessment of Precast Concrete Commercial Buildings
Challenge the conventional: “End-of-Life”? Reuse Sensitivity Analysis

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Unit</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming</td>
<td>kg CO₂ eq.</td>
<td>34,104</td>
<td>54,567</td>
<td>68,208</td>
<td>135,402</td>
<td><strong>169,253</strong></td>
<td>193,432</td>
<td>124,951</td>
<td>156,189</td>
<td>178,501</td>
<td><strong>314,920</strong></td>
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<tr>
<td>Acidification</td>
<td>H+ moles eq.</td>
<td>9,399</td>
<td>15,029</td>
<td>18,787</td>
<td>37,294</td>
<td>466,18</td>
<td>53,277</td>
<td><strong>34,597</strong></td>
<td>42,969</td>
<td>49,139</td>
<td>86,721</td>
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<tr>
<td>Respiratory effects</td>
<td>kg PM2.5 eq.</td>
<td>53</td>
<td>84</td>
<td>105</td>
<td>209</td>
<td>261</td>
<td>298</td>
<td>188</td>
<td>235</td>
<td>269</td>
<td>481</td>
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<tr>
<td>Eutrophication</td>
<td>kg N eq.</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>23</td>
<td>29</td>
<td>33</td>
<td>22</td>
<td>27</td>
<td>31</td>
<td>54</td>
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<tr>
<td>Photochemical smog</td>
<td>kg NO₂ eq.</td>
<td>76</td>
<td>121</td>
<td>151</td>
<td>301</td>
<td>376</td>
<td>429</td>
<td>295</td>
<td>368</td>
<td>421</td>
<td>716</td>
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<tr>
<td>Solid waste</td>
<td>kg</td>
<td>5,306</td>
<td>8,489</td>
<td>10,612</td>
<td>21,065</td>
<td><strong>26,332</strong></td>
<td>30,093</td>
<td>20,210</td>
<td>25,263</td>
<td>28,871</td>
<td><strong>49,765</strong></td>
</tr>
<tr>
<td>Wateruse</td>
<td>m³</td>
<td>52</td>
<td>83</td>
<td>103</td>
<td>205</td>
<td>257</td>
<td>293</td>
<td>181</td>
<td>226</td>
<td>258</td>
<td>469</td>
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<tr>
<td>Abiotic resource depletion</td>
<td>kg Sb eq.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Ozone depletion</td>
<td>CFC-11 eq.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total primary energy</td>
<td>MJ</td>
<td>395,967</td>
<td>633,580</td>
<td>791,975</td>
<td>1,572,175</td>
<td><strong>1,965,219</strong></td>
<td>2,245,964</td>
<td>1,450,011</td>
<td>1,812,514</td>
<td>2,071,444</td>
<td><strong>3,655,765</strong></td>
</tr>
<tr>
<td>Non renewable, fossil</td>
<td>MJ</td>
<td>340,625</td>
<td>545,000</td>
<td>681,250</td>
<td>1,352,371</td>
<td>1,690,464</td>
<td><strong>1,931,959</strong></td>
<td>1,247,198</td>
<td>1,558,997</td>
<td>1,781,711</td>
<td><strong>3,144,569</strong></td>
</tr>
<tr>
<td>Non renewable, nuclear</td>
<td>MJ</td>
<td>46,653</td>
<td>74,644</td>
<td>93,305</td>
<td>185,223</td>
<td>231,529</td>
<td>264,605</td>
<td>170,676</td>
<td>213,345</td>
<td>243,823</td>
<td>430,544</td>
</tr>
<tr>
<td>Renewable (SWHC)</td>
<td>MJ</td>
<td>7,964</td>
<td>12,742</td>
<td>15,928</td>
<td>31,619</td>
<td>39,523</td>
<td>45,169</td>
<td>29,329</td>
<td>36,661</td>
<td>41,898</td>
<td>73,689</td>
</tr>
<tr>
<td>Feedstock, fossil</td>
<td>MJ</td>
<td>746</td>
<td>1,193</td>
<td>1,492</td>
<td>2,962</td>
<td>3,702</td>
<td>4,231</td>
<td>2,808</td>
<td>3,510</td>
<td>4,011</td>
<td>6963</td>
</tr>
</tbody>
</table>

Reusing 50% of hollow-core slabs for another 60 years on another building (scenario #5) reduces GWP by 169 tonnes CO₂ eq., primary energy by 2.0 million MJ, and solid waste by 26 tonnes.

Reusing 60% of all precast elements for another 40 years on another building (scenario #10) reduces GWP by 315 tonnes CO₂ eq., primary energy by 3.7 million MJ, and solid waste by 50 tonnes.
Challenge the conventional: Wall Panel Thermal Performance Sensitivity Analysis

Increase the Wall Performance beyond minimum code:

A 61% increase in overall effective wall RSI-value for these scenarios results in **7% decrease in annual heating energy**, 1% decrease in fan use, 2% decrease in annual energy use, 2% decrease in electricity use, and 1-2% decrease in natural gas use. Conversely, a 61% increase in overall wall RSI-value does not affect cooling energy use, and nor does it affect interior loads (lights and equipment).
CPCI Sustainable Plant Program

CPCI officially launched the Sustainable Plant Program in 2012

Sustainable Plant Software:
Developed By the Athena Sustainable Materials Institute (ASMI)
Performance Markers: Global Warming Potential, Total Primary Energy, Water
CPCI Sustainable Plant Performance Report

CPCI SUSTAINABLE PLANT PERFORMANCE REPORT

Second QUARTER 2014

CPCI spp 14 – 02
Next Steps for the Precast Industry

The Sustainable Plant software will be used to provide credible, timely, and up to date data for Precast Product EPD’s - in 2015

Launch of the North American Precast Concrete Sustainable Plant Program - in 2015:

The industry will collectively use the same software tracking program developed by ASMI
Where does the conversation go from here?

- Development of **Responsible Sourcing Requirements** to Ensure **Resilient Infrastructure**:
  - Increased Longevity
  - Increased Robustness
  - Improved Sustainability
  - Improved Life Safety
  - Increased Durability
  - Increased Adaptability for Reuse
  - Increased Resistance to Disasters
For More Information

Publications available for download

www.cpci.ca/?sc=publications

- Life Cycle Assessment of Precast Concrete Commercial Buildings Technical Brochure
- LCA Product Transparency Guide
- Sustainable Plant Program Guide
- Sustainable Plant Performance Report
- **CSCE 2012** Paper - LCA for Sustainable Design of Precast Concrete Commercial Buildings in Canada
- **TAC 2013** Paper - Implementation of GHG Tracking Software for Sustainable Transportation Infrastructure Projects
Thank you

For more information on CPCI Sustainability Initiatives
www.sustainableprecast.ca
Visit at Booth #1014 at IIDEX Canada

For more information on Athena Sustainable Materials Institute
www.athenasmi.org