ConEd Session
The Great Material Debate
Cement & Concrete

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CEMENT ASSOCIATION OF CANADA
About Cement and Concrete

Cement is

- A very fine, dry powder
- Manufactured and shipped globally
- Sold in bulk or bags
- 7% - 11% of a concrete mix
- The glue that holds concrete together

Concrete is

- Created by mixing cement, aggregate (sand & gravel), water
- Produced locally, mixed and hauled over short distances, typically less than 150 km from a project site
- The 2nd most used substance on the planet, after water
Our Industry and Sustainability

• Sustainability is a collective challenge that requires a collective solution.
Our Commitment to Sustainability

• Producing cement and concrete in an environmentally and socially responsible manner
• Continuous significant investment in reducing our operational footprint
• Cement manufacturers are signatories to World Business Council for Sustainable Development Cement Sustainability Initiative
• Community Engagement
• Being a proactive partner in driving a societal shift to a more sustainable economy
Reducing our Carbon Footprint – Examples

• Reduced CO₂ emissions per tonne of cement by about 10% in past 10 years
  – Improvements in operating energy efficiency
  – Use of alternative and renewable energy sources
  – Use of Supplementary Cementing Materials (SCMs)
• Introduced Contempra, a new lower carbon cement that reduces CO₂ by an additional 10%
  – Will decrease CO₂ by 900,000 tonnes a year
  – Equivalent to taking 172,000 cars off the road
  – Equivalent to planting 23 million trees
  – Produces concrete of equivalent strength to that produced with regular Portland cement
Contempra™

Place Victoria, Gatineau, built with Contempra-based concrete

The Trump Tower, Vancouver, to be built with Contempra-based concrete
A Proven Track Record

• Contempra is a brand name used by the cement industry
• Contempra is identified as Portland-Limestone Cement (PLC) in Canadian codes and standards
• PLC has been used successfully for over 28 years in Europe in a variety of applications and exposure conditions
• Up to 35% limestone content allowed by European cement standards
• Most popular cement sold in Europe today has a limestone content of up to 20%
Portland-limestone cement – a product obtained by:

• Inter-grinding portland cement clinker and limestone, to which the various forms of calcium sulphate, water, and processing additions may be added at the option of the manufacturer.

Notes:

• (1) Limestone is designated with the suffix L. Its proportion is indicated in Clause 4.3.1.

• (2) Portland-limestone cement is by itself a cementitious material and is not considered to be a blended hydraulic cement.
How Is PLC Different?

- PLC is made by intergrinding regular clinker with up to 15% limestone while regular Portland cement contains no more than 5% limestone.
- PLC is a finer ground product than regular Portland cement.
Extensive Research and Testing

• Extensive research and testing verified PLC’s adequacy for the Canadian environment and construction industry

• Field trials in the harsh climates of Quebec, Nova Scotia, Alberta and Ontario over 6 winters verified that PLC produces concrete with a level of durability comparable to that produced with regular Portland cement
Table 6
Types of hydraulic cement
(See Clauses 4.2.1.1.2 and 4.2.1.4.1.)

<table>
<thead>
<tr>
<th>Name</th>
<th>Portland cement</th>
<th>Portland-limestone cement (PLC)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>General use hydraulic cement</td>
<td>GU</td>
<td>GUL</td>
<td>For use in general concrete construction when the special properties of the other types are not required.</td>
</tr>
<tr>
<td>High-early-strength hydraulic cement</td>
<td>HE</td>
<td>HEL</td>
<td>For use when high-early-strength is required.</td>
</tr>
<tr>
<td>Moderate sulphate-resistant hydraulic cement</td>
<td>MS</td>
<td>—</td>
<td>For use in general concrete construction exposed to moderate sulphate action.</td>
</tr>
<tr>
<td>High sulphate-resistant hydraulic cement</td>
<td>HS</td>
<td>—</td>
<td>For use when high sulphate resistance is required.</td>
</tr>
<tr>
<td>Moderate heat of hydration hydraulic cement</td>
<td>MH</td>
<td>MHL</td>
<td>For use in general concrete construction when moderate heat of hydration is required.</td>
</tr>
<tr>
<td>Low heat of hydration hydraulic cement</td>
<td>LH</td>
<td>LHL</td>
<td>For use when low heat of hydration is required.</td>
</tr>
</tbody>
</table>

Notes:
(1) A detailed guideline to the naming practice is provided in Annex C of CSA A3001.
(2) There is no type of sulphate resisting Portland-limestone cement (see Clause 4.1.1.6.2).
(3) HS cement shall not be used in reinforced concrete exposed to both chlorides and sulphates. See Clauses 4.1.1.5 and 4.1.1.6.3.
Adopted In Canadian Building Codes, Standards and MTO

- Included in CSA A3001 and A23.1 standards, now referenced in the 2010 and the upcoming 2015 National Building Code of Canada, under its technical name Portland-Limestone Cement
- Approved for use in British Columbia, Manitoba, Ontario, Quebec and Nova Scotia
- Permitted to be used in MTO structures and PLC is listed in the Designated Materials Source List since August, 2014, also recently adopted by City of Toronto in TS1350 Specification
- Is widely available from cement manufacturers across Canada
Concrete’s Sustainability Attributes

• Durability
• Resiliency
• Energy efficiency
• Versatility
• 100% Recyclable
• Produced locally
Concrete’s Sustainability Benefits

• Maximizes buildings’ service life
• Allows greater, safer urban density
• Reduces operating costs and CO₂ emissions
• Offers limitless architectural possibilities
• Benefits local economies
Economy of Concrete Structures
Versatility of Concrete Structures

• Design Flexibility—On Site Adjustment

• Aesthetic Appeal:
  ▪ Color
  ▪ Texture
  ▪ Shape

Toronto City Hall:
Viljo Revell, Architect
John B Parkin & Associates, Associated Architects
More Floor Per Structure

• Shallower floor systems, flat slab and flat plate, are an important structural advantage of concrete. There is no additional fireproofing or finishes required.
• On average, the construction of concrete buildings will allow one additional floor to be created for each 10 stories of traditional building height, resulting in more rentable space for buildings of similar size.
• When faced with height restrictions, concrete construction is a key consideration and could represent initial construction cost savings and additional income generation.
FLAT PLATE FLOORS ALLOW REDUCED BUILDING HEIGHT
Early Start Up and No Delay

• Concrete is readily available from over 1,100 locations across Canada, with a great many in urban centres.

• NO pre-ordering of materials is required, a concrete structure can be well underway before final plans are complete if partial building permit will be issued. In general, ready-mixed concrete will be delivered within a few hours once ordered.

• Earlier start-up means better cash flow for owners and developers.

• Due to short construction season, an earlier start could mean getting the jump on the summer construction season, in particular completing all below grade work before winter temperatures set in.
Faster Finish Time

• Precast/prestressed concrete can help reduce construction time and on-site labour costs by taking advantage of prefabrication of standard and custom structure segments

• Advanced construction techniques, in particular the formwork systems such as ‘flying forms’ started in the 60s, increase the speed of floor construction and reducing formwork cost

• As a concrete frame progresses upward, workers on the completed floors below can proceed with interior partitions, exterior finishing, electrical, mechanical and plumbing systems

• There is minimal fire hazard during the construction of a concrete frame
Lower Material/Energy Cost

• The operating energy efficiency of a structure is the major consideration in the life cycle analysis. The construction phase is a minor component of the full LCA, typically less than 10%

• Concrete construction minimizes the overall building height. This shortens vertical runs of mechanical and electrical systems and reduces the exterior surface area to be enclosed and insulated, precast cladding or glazing, thus reduced the material use, energy and COST
Long Span

• Due to its high strength and load-carrying properties, concrete allows for longer floor spans with fewer supporting columns/shear walls.

• This offers flexibility in architectural layout and even more usable space for tenants’ requirements, increasing the rentability of office space and sales of condo units.
Regional/Local Materials

Impact of Cement/Concrete Usage on Ontario Economy

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Cement/Concrete</th>
<th>Lumber</th>
<th>Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontario Provincial Distribution of GDP</td>
<td>0.74</td>
<td>0.61</td>
<td>0.40</td>
</tr>
<tr>
<td>(Direct &amp; Indirect)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>per $1 by Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct &amp; Indirect Labour</td>
<td>0.35</td>
<td>0.37</td>
<td>0.25</td>
</tr>
<tr>
<td>Wages &amp; salary per $1 by Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Input-Output Multipliers L97 Statistics Canada (2010)
Lower Life-cycle Cost/High Durability

- Concrete products work well in harsh environments (docks, bridges & heavy industry)
  - Unaffected by wide temperature extremes
  - Resistant to water, wind and fire
  - Will not rot, rust or support the growth of mould
  - Insect resistant
  - High impact resistance
  - Very forgiving during construction

- The high durability of concrete is a benefit to “Green Building”, reducing environmental impacts over the life of a building, minimizing maintenance and repair resulting in a lower LCC
Quiet and Safe

• The inherent mass of concrete provides effective sound isolation for quiet residential and work place environments, as well as superior fire safety

• Concrete is inert, no toxic fumes, off-gassing or VOCs
Fire Resistance
Energy Efficiency with Concrete’s Thermal Mass – Use Phase

• Concerns about global warming and climate change have led to an unprecedented societal call to minimize energy demand and reduce CO₂ emissions.

• In 2009, buildings consumed 31% of all secondary energy use in Canada¹.

• Buildings generated 28% of all GHGs in Canada² and these emissions are expected to grow by 8% by 2020³.
Thermal Mass Moderates Indoor Climate

• Acts as a heat sink, absorbing and storing heat gains during the day, and releasing heat back to interior space during the night
• Reduces and delays peak load demands
• Helps reduce heating and cooling energy demands

Time Lag and Temperature Damping – from ASHRAE Standard 90.1
Energy Efficiency with Concrete’s Thermal Mass

Session 53CE
May 8, 2:00 to 5:30 pm

Thank You
Q&A