BUILDING FUTURES
Anticipating Tomorrow’s Needs With Future-Ready Strategy

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CSA S478
Durability in Buildings

David De Rose, M.A.Sc., P.Eng.
Synergy Partners
May, 2019
New CSA Standard

CSA S478:19
National Standard of Canada

Durability in buildings

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Durability in Buildings
CSA S478-19

• Supercedes Guideline issued in 1995 that focused on avoiding “Premature Degradation”
• Developed as a standard to be referenced in NBC but can also be used by building owners (e.g. IO)
• Sets minimum requirements in creating durable buildings and elements
• Emphasizes the need to consider initial and long-term costs, maintenance, access & replacement in the selection of building elements
• Applies to Building envelope and structure
Climate Change

• New perspective – introduces climate change and potential effects on building elements – standard will evolve as information on environmental loads evolves
• Loads - look forward as well as at past environmental data
<table>
<thead>
<tr>
<th>Design service life category</th>
<th>Building type</th>
<th>Minimum design service life for building, years</th>
<th>Range of design service life, years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long life</td>
<td>• Single-unit residential</td>
<td>50</td>
<td>50 to 99</td>
</tr>
<tr>
<td></td>
<td>• Multi-unit residential</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Mid- and high-rise commercial and office buildings</td>
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<tr>
<td></td>
<td>• Post-disaster buildings (e.g., hospitals, power generating stations, public water treatment facilities, and emergency response facilities)</td>
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<tr>
<td></td>
<td>• Performing arts buildings, arenas, schools and colleges, and other assembly occupancies</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Detention, care, and treatment occupancy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Table 1, *CSA-S478:19 Durability in Buildings*. © 2019 Canadian Standards Association
<table>
<thead>
<tr>
<th>Category</th>
<th>Consequences of failure</th>
<th>Description of failure</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td>4</td>
<td>Loss of resistance capacity OR High repair cost</td>
<td>Loss of building or building element resistance capacity or function OR Repair to the building or building element is costly because of difficulty in execution or accessibility (e.g., specialized equipment, engineered scaffolding, swing-stage use), or repair requires extensive replacement of materials or components</td>
<td>• Roof or waterproofing replacement • Isolated roof leak in a protected roof membrane system that is difficult to access • Concealed cladding attachments or guard elements that are easily accessible for inspection and repair but where repairs require extensive use of materials • Inner seal of a two-stage joint • Insulating glass unit failure • Protective coatings on unserviceable elements (e.g., long-span roof over a pool)</td>
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## Element DSL & Categories of Failure

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<tr>
<th>Category</th>
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<th>Examples</th>
<th>Minimum design service life of building element</th>
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| 5        | Risk to health and safety of building users | Unacceptable risk of illness for building users or the public (e.g., personal injury, biological growth potentially affecting human health, release of toxic chemical substances) | - Cladding falling hazards  
- Examples shown for categories 6 and 7 that also pose a risk to health | 100% of building design service life |
| 6        | Injury, loss of life, or loss of asset       | Unacceptable risk of injury, loss of human life, or loss of building; building elements are hidden or not readily inspected. | - Cladding primary support members and infill structural wall systems  
- Cladding connectors and secondary support framing members  
- Guard elements that are difficult to access for inspection and repair | |
100% of DSL
## Element DSL & Categories of Failure

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| 7        | Prohibitive repair cost | Extensive reconstruction required to repair or replace the building element | • Waterproofing system below overburden drainage  
• Through-wall flashings and inaccessible drainage  
• Elements of the building or building enclosure that are difficult or costly to access for inspection and repair on mid- and high-rise buildings  
• Concealed sheathing, air barriers, and insulation  
• Foundation wall waterproofing and dampproofing  
• Corrosion of unserviceable elements | 100% of building design service life |

Source: Table 2, *CSA-S478:19 Durability in Buildings*. © 2019 Canadian Standards Association
100% of DSL
Compatibility Issues
## Element DSL & Categories of Failure

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Source: Table 2, *CSA-S478:19 Durability in Buildings*. © 2019 Canadian Standards Association
100% of DSL
100% of DSL
Building Durability Plan

Includes the following:

• A maintenance plan;
• A quality assurance plan (design, construction, operation, etc.)
• An operation and maintenance manual; and
• Documentation required to support predicted service life (demonstrated effectiveness, modelling, testing, life-cycle cost analysis)

Source: Clause 13, CSA-S478:19 Durability in Buildings. © 2019 Canadian Standards Association
Projected Increase in Annual Average Temperature

Source: Figure E.2, CSA-S478:19 Durability in Buildings. © 2019 Canadian Standards Association
Projected Changes in 2.5% Jan. DT

Source: Figure E.4, CSA-S478:19 Durability in Buildings. © 2019 Canadian Standards Association
Projected Changes in 2.5% July DT (wet)

Source: Figure E.6, CSA-S478:19 Durability in Buildings. © 2019 Canadian Standards Association
Projected % Changes in Total Precip.

Source: Figure E.8, CSA-S478:19 Durability in Buildings. © 2019 Canadian Standards Association
Projected changes in avg. wind speed (m/s)

Source: Figure E.9, CSA-S478:19 Durability in Buildings. © 2019 Canadian Standards Association
## Guidance for Climate Change Resilient Design

<table>
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<tr>
<th>Item</th>
<th>Suggestions</th>
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<tr>
<td>Higher temperatures and temperature ranges</td>
<td>- Dimensionally stable products with lower coeff. of thermal expansion</td>
</tr>
<tr>
<td></td>
<td>- Products with enhanced elasticity (e.g. low modulus sealants)</td>
</tr>
<tr>
<td>Higher temperature and exposure to UV</td>
<td>- Products of proven resistance to heat aging and UV</td>
</tr>
<tr>
<td>Increase in Wind-Driven Rain Loads (in concert with higher average</td>
<td>- More robust design approaches that enhance drainage and min. retention</td>
</tr>
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<td>temperature and humidity)</td>
<td>- Products with enhanced resistance to hydrolysis</td>
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<tr>
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<td>- Products with enhanced corrosion resistance</td>
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Source: Table E.1, **CSA-S478:19 Durability in Buildings.** © 2019 Canadian Standards Association
Durability and Climate Change – Selected Studies in Various Countries

- Frost decay of masonry materials
- Concrete Carbonation
- Corrosion of embedded metals in concrete
- Degradation of wood products
- Corrosion of Metals
- Effect of Solar Radiation on plastics

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