Presenters

Tracy Blanchard, C.Tech
City of Orillia
Project Manager
Municipal Concrete Liaison Committee Co-Chair

Peter Waisanen, P.Eng.
Exp Services Inc.
Concrete Specialist
## Committee Members - Manual

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
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<tbody>
<tr>
<td>Tracy Blanchard</td>
<td>City of Orillia</td>
</tr>
<tr>
<td>Chris Bradley</td>
<td>County of Peterborough</td>
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<tr>
<td>Peter Bziuk (Chair)</td>
<td>County of Essex</td>
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<tr>
<td>Sean Frye</td>
<td>Danruss Contracting/Ready-mix</td>
</tr>
<tr>
<td>Rico Fung</td>
<td>Cement Association of Canada</td>
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<tr>
<td>Devin Gordon</td>
<td>Miller Group</td>
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<tr>
<td>Neil Johnston</td>
<td>Slip Form Construction</td>
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<tr>
<td>Bart Kanters</td>
<td>Concrete Ontario</td>
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<tr>
<td>Alen Keri</td>
<td>Concrete Ontario</td>
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<tr>
<td>Gerald Kernohan</td>
<td>Dufferin Concrete</td>
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<tr>
<td>Chris McColl</td>
<td>Dufferin Concrete</td>
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<tr>
<td>Matthew Miedema</td>
<td>City of Thunder Bay</td>
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<tr>
<td>Mark Popik</td>
<td>Thurvey Engineering</td>
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<tr>
<td>Mick Prieur</td>
<td>Capital Paving</td>
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<tr>
<td>Eric Saunderson (TE)</td>
<td>Region of Waterloo</td>
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<tr>
<td>Bradley Schmidt</td>
<td>Dillon Consulting</td>
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<tr>
<td>Bryan Schulz</td>
<td>Canada Building Materials</td>
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<tr>
<td>James Smith</td>
<td>Ontario Good Roads Association</td>
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<tr>
<td>Tim Smith</td>
<td>Lafarge North America</td>
</tr>
<tr>
<td>Frank Suppa</td>
<td>City of Vaughan</td>
</tr>
<tr>
<td>Peter Waisanen</td>
<td>exp Services</td>
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**Corresponding Member:** Doug Hooton, University of Toronto
## Current Committee Structure & Members

1. **Municipal - Up to 7 members**
   - Eric Saunderson (Region of Waterloo)
   - Frank Suppa (City of Vaughan) *(Co-chair)*
   - Matthew Miedema (City of Thunder Bay)
   - Peter Bziuk (County of Essex)
   - Robert Lambert (City of Kingston)
   - Tracy Blanchard (City of Orillia) *(Co-chair)*

2. **Producers/contractors - Up to 7 members**
   - Bryan Schulz (CBM)
   - Evan Locke (Miller)
   - Gerald Kernohan (CRH)
   - Tim Smith (Lafarge Holcim)

3. **Consultants/labs - 3 members**
   - Mark Popik (Thurber Engineering)
   - Mick Prieur (Englobe)
   - Peter Waisanen (Exp)

4. **One Corresponding member (resource) from academia**
   - Doug Hooton (University of Toronto)

5. **Each association will appoint 1 staff person to the committee**
   - Alen Keri (Concrete Ontario)
   - James Smith (OGRA)
   - Sherry Sullivan (CAC)
   - Enrico Stradiotto/Paul Imm (OCPA)

**NEW Members**
- Ben McWade (Region of Durham)
- Luca Fiore (Powel/Lecol)

- Released in 2015
- Free document available at:
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Chapter 1 - Introduction

- The “Best Management Practices for Municipal Concrete Infrastructure (BMP-MCI)” manual has been developed by the Ontario Good Roads Association (OGRA), Municipal Concrete Liaison Committee.
- The Committee consists of members from various municipalities all over Ontario; consulting firms; contractors; ready-mix concrete suppliers and associations.
- It is the intention of this guide to provide a resource for municipal staff, consultants, contractors and ready-mix concrete producers for municipal projects and to have a single resource for information on municipal concrete infrastructure across the province of Ontario.
- The Committee recognized the need to have a guide that summarizes the best practices across the province in order to provide consistency for contractors, consultants and ready-mix producers.
- The manual is setup to walk you through a project from the initial concept stage to the identification of future work, material selection, planning, procurement, delivery, inspection, troubleshooting, and project closeout.
Chapter 2 - Sidewalk, Curb & Gutter Evaluation and Inspection

2.1 Sidewalk Inventory and Assessment
2.2 Temporary Sidewalk Restoration
2.3 Sidewalk Replacement
2.4 Sidewalk Condition Index
2.5 Curb / Curb and Gutter Replacement

- In accordance with provincial legislation, municipalities are required to address known sidewalk defects and/or tripping hazards **within a 14-day period**.
- On an on-going basis, municipal staff and/or consulting firms should be able to provide an annual report on the status of sidewalk assets and develop plans to capture their respective City-wide sidewalk condition data for the entire sidewalk network.
Chapter 2 - Sidewalk, Curb & Gutter Evaluation and Inspection

- Sidewalk repairs that present a hazard to Pedestrians (such as trip, slip and fall, etc.) should be promptly addressed.

- Sidewalk Condition Index (SCI). As shown in Table 2.1, the SCI can be based on rankings for segments of streets in terms of low, medium or high priority or can be assigned a numerical value for repair prioritization in the network.
Chapter 3 – Asset Management and Rigid Pavement Selection

3.1 Asset Management
3.2 Economical Assessment
3.3 Subgrade Soil and Traffic Evaluation
3.4 Pavement Selection
3.5 Equivalent Pavement Design
3.6 Components of a Conventional Concrete Pavement
3.7 Types of Concrete Pavement
Common condition ratings contain three major indices or performance indicators; the Structural Adequacy Index (SAI); Surface Distress Index (SDI); and Ride Comfort Index (RCI). Collectively, these indicators create an overall performance rating and Pavement Quality Index (PQI).

When constructing any pavement, it is important to investigate the subsurface conditions to ensure the pavement is designed appropriately to ensure long-term performance and reduce maintenance.
Concrete pavements provide a bridge over the subgrade soils and will exhibit less pressure on the materials below than asphalt pavements.

Figure 3.1: Typical Load Distribution for Rigid and Flexible Pavement Designs (provided by the CAC).
Components of a Conventional Concrete Pavement

1. Longitudinal Joints
2. Transverse Joints
3. Dowel Bars
4. Tie-bars
5. Base and/or Subbase course
6. Subgrade
Chapter 3 – Asset Management and Rigid Pavement Selection
Chapter 3 – Asset Management and Rigid Pavement Selection

➢ Other Types of Concrete Pavements

1. Roller Compacted Concrete (RCC)

Figure 3.5 - Roller Compacted Concrete (RCC) for an industrial facility (provided by Concrete Ontario).
Chapter 3 – Asset Management and Rigid Pavement Selection

➢ Other Types of Concrete Pavements

2. Pervious Concrete

Figure 3.6 - Pervious concrete for a sidewalk application (provided by Concrete Ontario).
Chapter 3 – Asset Management and Rigid Pavement Selection

➢ Other Types of Concrete Pavements

3. Pre-cast Concrete

Figure 3.8 - Installation of Pre-cast Concrete Plan on Highway 427 (C/o super-slab.com).
Chapter 3 – Asset Management and Rigid Pavement Selection

Other Types of Concrete Pavements

4. Interlocking Concrete Pavers (ICP)
Other Types of Concrete Pavements

5. Concrete Overlays

![Diagram showing different types of concrete overlays]

Figure 3.9 - Concrete overlay options (provided by CP Tech Center).
Chapter 4 – Concrete Bridges

4.1 Introduction
4.2 Concrete Bridge Inspection
4.3 Bridge Rehabilitation
4.4 New Technologies
Chapter 4 – Concrete Bridges

- The Ontario Structure Inspection Manual (OSIM) prepared by the MTO provides guidance for engineers and municipalities regarding bridge inspection.
- The Bridge Condition Index (BCI) rating is a planning tool that helps owners schedule maintenance and upkeep of their bridge inventory.
Chapter 4 – Concrete Bridges

Figure 4.2 - Inspection of concrete frame bridge

Figure 4.3 - Below-deck inspection and steel corrosion deficiency
Chapter 5 – Sustainability

5.1 Cement
5.2 Long Life Pavement
5.3 Traffic Delays
5.4 Heat Island Reduction and Cooling Effects
5.5 Lighting and Electricity Use
5.6 CO$_2$ Sequestering
5.7 Reduction in Virgin Aggregate Usage
5.8 Pavement-Vehicle Interaction
5.9 Two-lift Concrete pavements
5.10 Thin pavements
5.11 Diamond Grinding/Grooving
5.12 Concrete Recycling
5.13 ECO Certified Plants
5.14 Enhanced Aesthetics and Societal Benefits
6.1 Equivalent Pavement Design Example

For this example, a 50-year analysis period for the construction and maintenance of 1km of 4-lane roadway was considered for comparable concrete and asphalt pavement designs. The existing subgrade is assumed to be in the medium category (low plasticity /silt = 40MPa and/or CBR=4) and the Annual Average Daily Truck Traffic (AADT) is 2,500 vehicles.

For these design conditions, the proposed sections consist of:
1. 200 mm of concrete; and 200 mm Granular “A” base.
2. 140 mm of hot-mix asphalt (HMA); 150 mm of Granular “A” base; and 450 mm of Granular “B” sub-base.
Chapter 6 – Life-Cycle Cost Analysis (LCCA)

Concrete
$980,100
+$136,916
$1,117,016

Present Worth value

Table 6.3 - Initial and long-term maintenance costs for a concrete pavement with 2,500 AADTT and 40MPa subgrade (provided by CAC – Street Smart Report, ARA).
# Chapter 6 – Life-Cycle Cost Analysis (LCCA)

Asphalt

$991,620

+$200,051

$1,191,671

Present Worth value

<table>
<thead>
<tr>
<th>Initial Pavement Structure</th>
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<tbody>
<tr>
<td>Pavement layer</td>
<td>Description of pavement layer, Amount (Quantity)</td>
<td>Amount</td>
<td>Quantity</td>
<td>Price per unit of quantity</td>
<td>Cost</td>
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<tr>
<td>Surface</td>
<td>Superpave 12.5FC1, mm (t)</td>
<td>40</td>
<td>1,512</td>
<td>$115.00</td>
<td>$173,880</td>
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<tr>
<td>Binder</td>
<td>Superpave 19, mm (t)</td>
<td>100</td>
<td>3,690</td>
<td>$96.00</td>
<td>$354,240</td>
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<tr>
<td>Base</td>
<td>Granular A, mm (t)</td>
<td>150</td>
<td>5,400</td>
<td>$18.00</td>
<td>$97,200</td>
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<tr>
<td>Subbase</td>
<td>Granular B, mm (t)</td>
<td>400</td>
<td>12,000</td>
<td>$15.00</td>
<td>$180,000</td>
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<tr>
<td>Excavation</td>
<td>Earth excavation (m³)</td>
<td>690</td>
<td>10,350</td>
<td>$18.00</td>
<td>$186,300</td>
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<td><strong>Total Initial Cost</strong></td>
<td></td>
<td></td>
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<td>$ 991,620</td>
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<tr>
<th>Urban Pavement Maintenance and Rehabilitation Action Plan</th>
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<tr>
<td><strong>Years after initial construction</strong></td>
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<td>5</td>
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<td>10</td>
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<td>50</td>
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<tr>
<td><strong>Total M&amp;R Cost</strong></td>
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$ 200,051
Chapter 6 – Life-Cycle Cost Analysis (LCCA)

- Present Worth Value
  - Concrete: $1,117,016
  - Asphalt: $1,191,671

$74,655

And the winner is... CONCRETE!
Chapter 7 – Unshrinkable Fill (U-Fill)

- U-Fill is a controlled, low strength, self-compacted, backfill material (or CLSM - Controlled Low-Strength Materials) used in utility cuts and trenches. (Max. 0.7MPa)

Figure 7.1 – Utility cut restoration with U-Fill (provided by CAC).
Chapter 8 – Architectural Concrete

Figure 8.7 – Decorative coloured concrete with micro etched and brick stencil finish (provided by Concrete Ontario).
Chapter 9 – Jointing

9.1 Construction Joints
9.2 Contraction Joints
9.3 Isolation Joints
9.4 Expansion Joints
9.5 Joint Sealant
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10.5 Contract Closure
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Chapter 12 – Concrete Ordering Procedures

12.1 Concrete Order Entry
12.2 Directions to the Jobsite
12.3 Dispatch Process
12.4 Specialty Concrete Products
Chapter 13 – Transportation and Receiving Concrete

➢ Ready-mix Trucks
Chapter 13 – Transportation and Receiving Concrete

- Volumetric Mixer
Chapter 13 – Transportation and Receiving Concrete

- Dump Trucks
Chapter 14 – Convey, Placing, Consolidating and Finishing Concrete

➢ After the pre-planning, ordering and transportation of the concrete has occurred successfully, it is then the responsibility of the contractor to take the concrete from the delivery truck to its final placement position.

➢ This includes: **Subgrade grading and compaction, formwork, steel reinforcing, placement, consolidation and finishing.**
Chapter 14 – Convey, Placing, Consolidating and Finishing Concrete
In this last stage, contractors install curing protection systems and maintain an optimal environment for the concrete resulting in a finished concrete product that has achieved the desired strength and durability for its intended use.

Greatest benefit for the concrete, for the least amount of cost!
Figure 15.3 – (Left / middle) Insufficient curing examples and (right) adequate curing compound application (provided by Concrete Ontario).
The concrete laboratory should be both certified to CSA A283 – Qualification Code for Concrete Testing Laboratories; and also have Canadian Council of Independent Laboratories (CCIL) Type H certification.

The concrete field testing technician performing the onsite testing of the concrete must be either CSA or American Concrete Institute (ACI) certified and must have a valid CCIL Type J certification in order to test the concrete.
Chapter 16 – Measurement, Testing and Acceptance of Concrete

- The standard concrete test methods that can be used on all projects include:
  - CSA A23.2-1C Sampling Plastic Concrete
  - CSA A23.1-3C Making and Curing Concrete
  - CSA A23.2-4C Air Content of Plastic Concrete by the Pressure Method
  - CSA A23.2-5C Slump and Slump Flow of Concrete
  - CSA A23.1-9C Compressive Strength of Cylindrical Concrete Specimens
Chapter 16 – Measurement, Testing and Acceptance of Concrete

Specialty Testing Requirements:

- Non-standard test methods such as Hardened Air Void System (AVS) and Rapid Chloride Permeability (RCP) shall be identified in the contract documents and specifically addressed during the pre-construction meeting.
Chapter 17 – Project Closeout and Continuous Improvement

1. Deficiency Identification and Rectification Work
2. Substantial Completion and Contract Maintenance Period
3. Continuous Improvement and Lessons Learned
4. Contractor and Consultant Performance Evaluation
Chapter 18 – Troubleshooting

- The troubleshooting section addresses the causes of a problem, goes into a discussion, prevention and finally repair and maintenance.

- As new problems are being encountered in the industry, this section will continue to evolve and will become an invaluable tool.
Chapter 18 – Troubleshooting

Air Loss – Concrete Pumping

Air Loss – Excessive Vibration
Chapter 18 – Troubleshooting

- Excessive Bleeding
- Plastic Shrinkage Cracking
Chapter 18 – Troubleshooting

Blistering

Segregation
Chapter 18 – Troubleshooting

Honeycombing

Cold Joints
Chapter 18 – Troubleshooting

Bugholes

Popouts
Chapter 18 – Troubleshooting

Crazing

Curling
Chapter 18 – Troubleshooting

Mortar Flaking

Joint Lockup
Potential Revision Topics

1. Concrete Pipe
2. AODA Tactile Plates
3. Project Responsibilities (Owner, contractor, supplier, etc.)

- Feedback is appreciated as the Committee would like to address any issues the industry is experiencing!
- Additional webinars and workshops can be provided by the Committee upon request!
Thank you!