

City of Winnipeg Specification - Surface Works

Agenda

- **New Updates to Base Specification – CW 3110-R19 vs. CW 3110-R21**
- **New and Future Updates to Concrete Specification – CW 3310-R17 vs. E-Spec**
- **Future Updates to Asphalt Specification**
- **Future Updates to Standard Details**

- **Why do we update the specifications?**
- **Which distresses are present?**
- **What caused them?**
- **How can they be prevented?**
- **What are the new updates?**
- **What are the benefits?**

The City carried out:

- **Field investigations (field review, coring and testing)**
- **Review of literature and practices of other jurisdictions**
- **Discussions with:**
 - **Other transportation agencies (e.g. Ontario, Minnesota, Edmonton)**
 - **Technical organizations (e.g. ACPA, TAC, TRB)**
 - **Technical experts (Municipal Infrastructure Research Chair, Cementitious Materials and Durability of Concrete Group at U of M, Concrete Pavement Tech Centre, Iowa State, Advanced Concrete Pavement Consultancy)**
 - **Winnipeg industry (Manitoba Heavy Construction Association, Concrete Manitoba, Cement Association of Canada)**

Base Specification

CW 3110 – R21: SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION SPECIFICATION

Introduction: SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION SPECIFICATION

In CW 3110-R19:

Why did we update the specification?

Low-quality materials

Poor practices

Material durability

**Quality and frequency
of testing**

Harmonization with Manitoba Infrastructure

December 2014

DIVISION 4 - CW 3110 – R19

CW 3110 – SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION

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CW 3110-R19:

- had **high dust** (material passing 75 μm) – up to **16%**
 - loose particle packing
 - **low** coefficient of **permeability**

Road Geometry
W 3.8576 m
SR 0.0200 m/m
LR 3.86 m

Materials
 Base - Defined
 Subgrade - Undefined
 Separator - None

Inflow
q_i m³/s/m²
q_m m³/s/m²

Permeable Base
H 0.3 m
U 50. %
t 6598.11 hr
q_d m³/s/m

Edge Drain - Pipe
D m
L_o m
Q m³/s

Roadway Geometry | Sieve Analysis | Inflow | Permeable Base | Separator | Edge Drain |

Analysis Type
☒ Time-to-Drain
☐ Depth-of-flow

n_e 0.011
k 8.525e-004 m/d
SR 0.0200 m/m
LR 3.86 m
S 95.833 % **n** 0.132

U $U = (n - s \cdot h) / n_e$
H 0.3 m
U 50. %

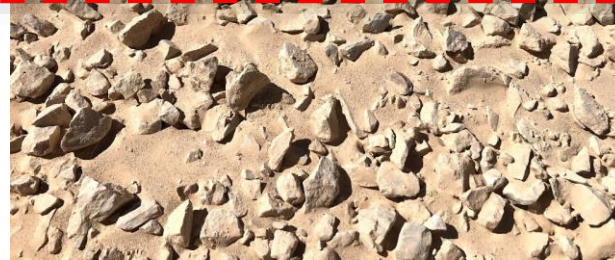
☒ Barber and Sawyer Equation
☐ Casagrande and Shannon Method

t 6598.11 hr

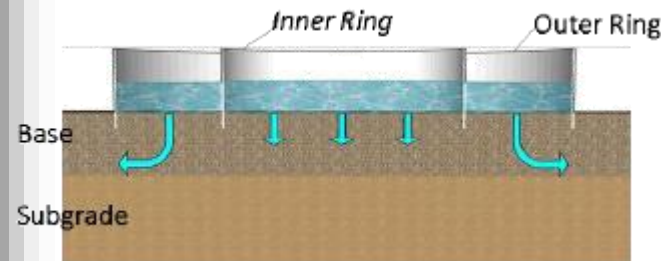
50% Drainage (AASHTO Guide)
 85% Saturation (Pavement Rehabilitation Manual)

Quality of Drainage	Time to Drain
Excellent	2-Hours
Good	1-Day
Fair	7-Day
Poor	1-Month
Very Poor	Does Not Drain

Drainage Quality (DQ)	Water Removed From Layer Within
Excellent	2 hour
Good	1 day
Fair	7 days
Poor	1 month
Very Poor	Water will not drain

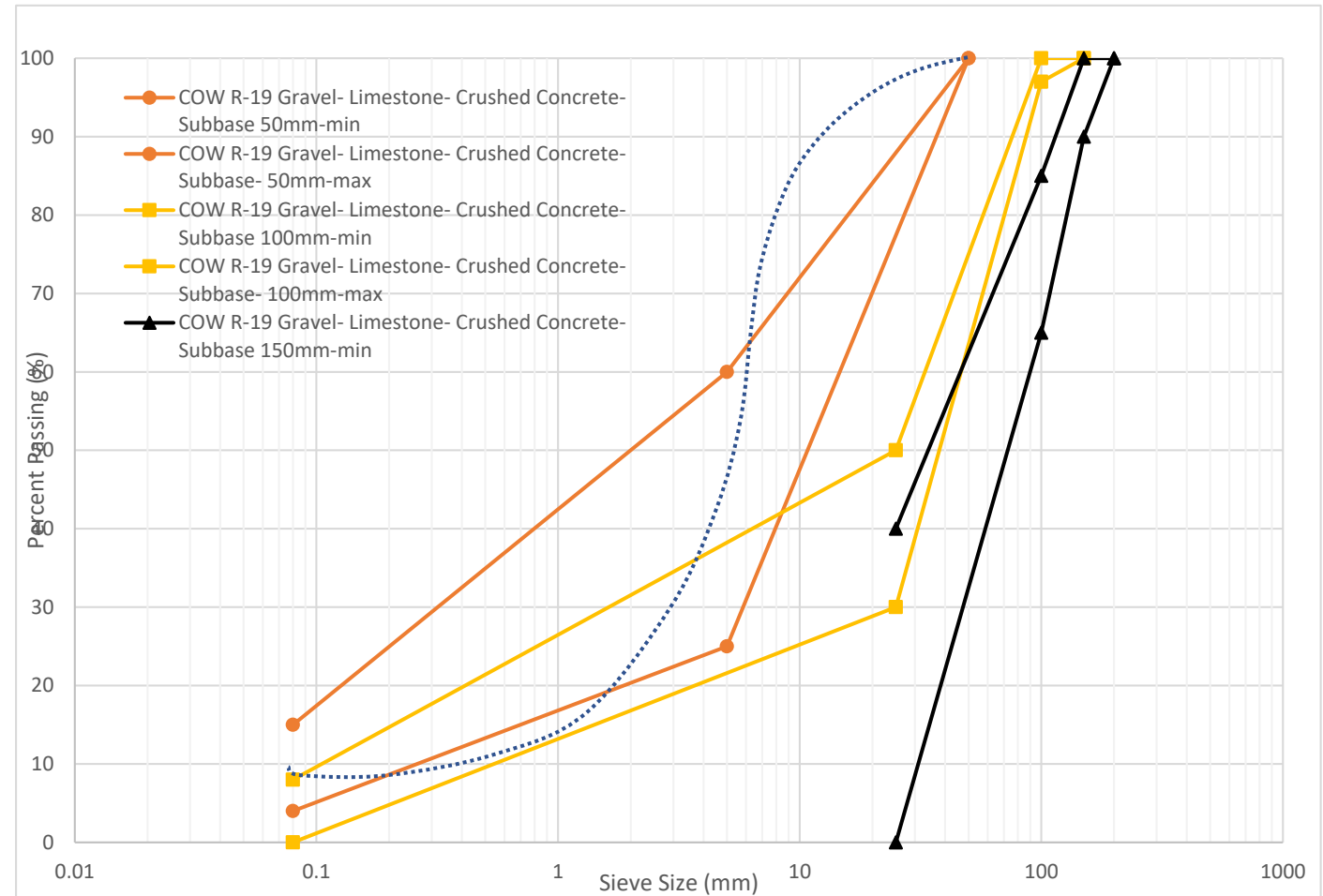


Fair to Very poor



CW 3110-R19:

- had **finer gradation** leading to a significant **reduction in the bearing capacity** of the materials



CW 3110-R19:

- did not differentiate between the base materials
- recycled concrete materials (RCM) **don't provide the same structural value** and **behave differently** than crushed limestone



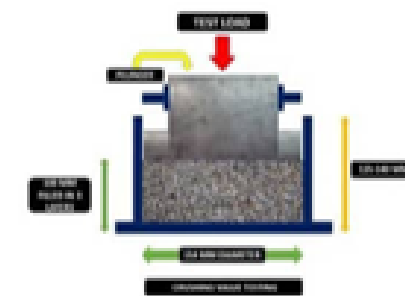
- did not include tests to **identify material durability** and resistance to weathering



Before



After



Micro-Deval
test



Soundness test

CW 3110-R19:

- did not include quality control testing
- did not include adequate **quality assurance** testing



Stockpiling



Loading



Transporting

CW 3110-R19:

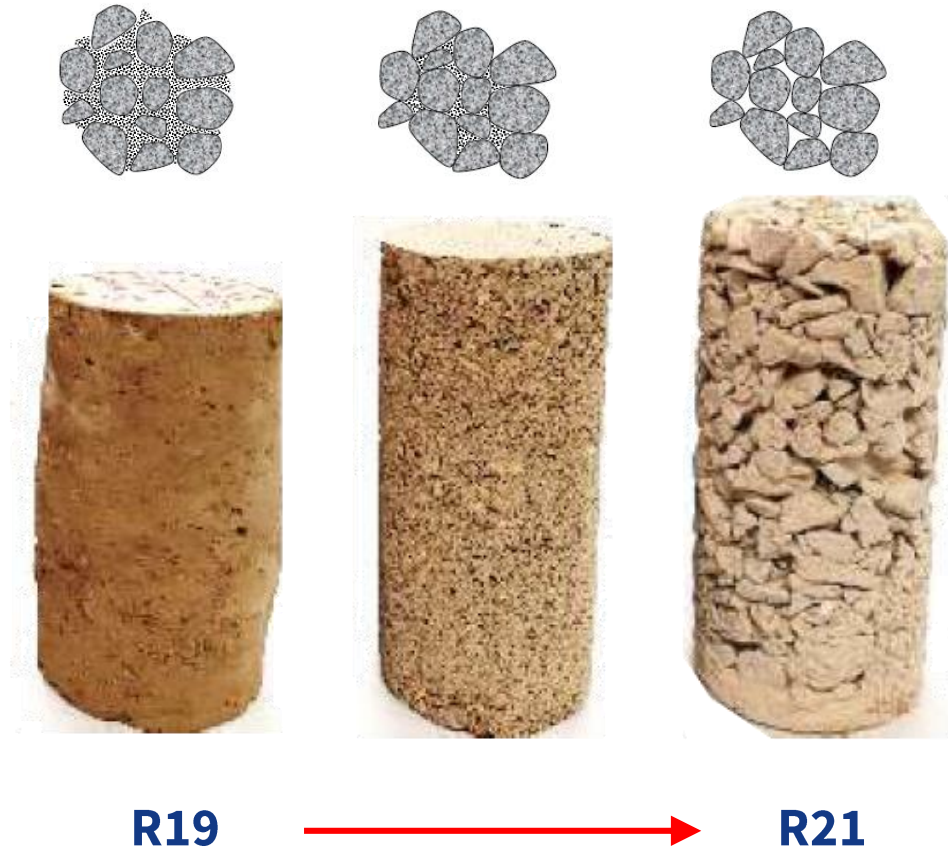
- **allowed** the use of **150 mm materials**
 - we cannot effectively compact lifts that are thicker than 300mm
 - large aggregates maximize segregation and deterioration through stockpiling and construction practices; and
 - testing limitations
- **did not** include criteria for **accepting or rejecting materials** and our Contract Administrators were making inconsistent determinations



CW 3110-R21: SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION SPECIFICATION

CW 3110-R21:

- was updated to improve durability and drainage of our streets and prolong the life of our pavements
 - Materials Gradation and Properties
 - Quality Control and Assurance Testing
 - Acceptance criteria



New Updates: SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION SPECIFICATION

The changes include:

1. *New aggregate types based on the materials type and quality (**Granular A, B, and C**);*
2. *Updating the **aggregate gradation** to **limit the fine/dust materials** in the R19 spec and control the grain size distribution to improve the materials permeability;*
3. *Eliminating the **large materials** due to lack of testing and performance;*
4. *Updating the **Physical Requirements** to include tests for material **durability** and resistance to weathering (Micro-Deval);*
5. ***Differentiating** between the **base materials** based on strength and performance (recycled concrete materials (RCM) ≠ crushed limestone);*
6. *Introducing tests to **evaluate the bearing capacity** (Strength) of the materials (CBR)*
7. *Adding new **Aggregate Suppliers Approval** requirements;*
8. ***Updating** the requirements for **aggregate placement** and **compaction** (Proof rolling); and,*
9. *Introducing new testing and frequency for **quality assurance** and **acceptance/rejection criteria** (Payment adjustments will be enforced in 2023).*

New Updates: SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION SPECIFICATION

Changes to material testing include:

QUALITY CONTROL TESTING

Gradation

Los Angeles Abrasion

Micro-Deval Abrasion

California Bearing Ratio

Percentage of Fractured Particles

Liquid Limit and Plasticity Index

Content Composition

QUALITY ASSURANCE TESTING

Gradation

Los Angeles Abrasion

100 mm
Materials

Micro-Deval Abrasion

Percentage of Fractured Particles

Liquid Limit and Plasticity Index

Content Composition

Standard
Proctor

Field
Density

Nuclear
Methods

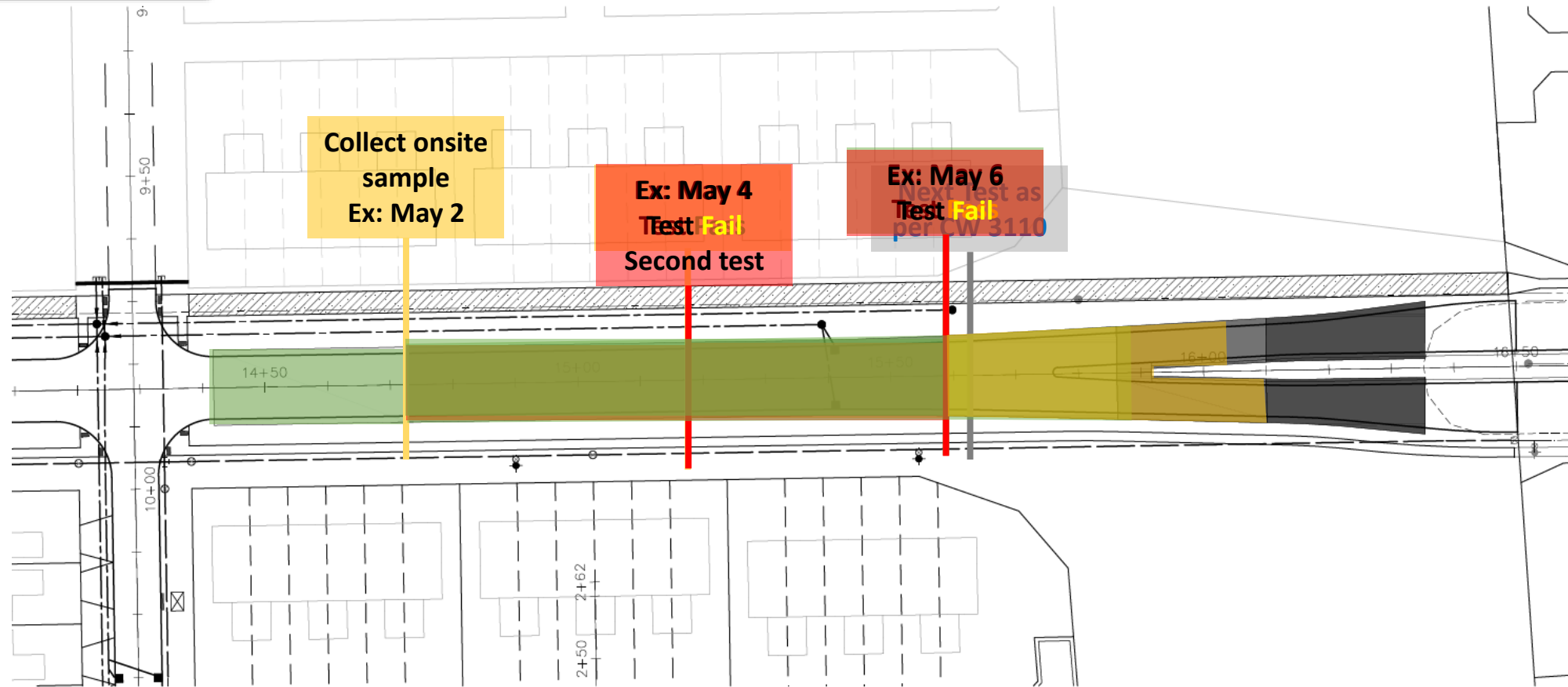
Proof
rolling

New Updates: SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION SPECIFICATION

QUALITY ASSURANCE TESTING



Prior to starting
construction
(In the quarry)



Concrete Specification

CW 3310 – R18: PORTLAND CEMENT CONCRETE PAVEMENT WORKS

Introduction: PORTLAND CEMENT CONCRETE PAVEMENT WORKS

Why did we update the specification?

1. Meet the new **Exposure conditions** and **Code requirements**
2. Improve concrete **durability** to produce long lasting concrete
3. Improve the **Long-Term** Performance
4. Minimize the risk of **premature deterioration**, especially at the **joints**
5. Use more **sustainable materials**
6. Deal with current and expected **climate**
7. Improve **quality assurance** efficiency
8. Reduce safety hazards

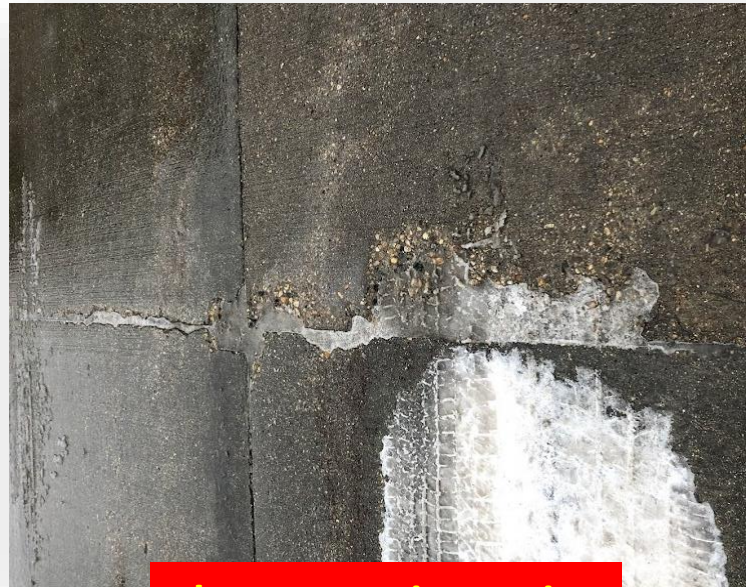


Introduction: PORTLAND CEMENT CONCRETE PAVEMENT WORKS

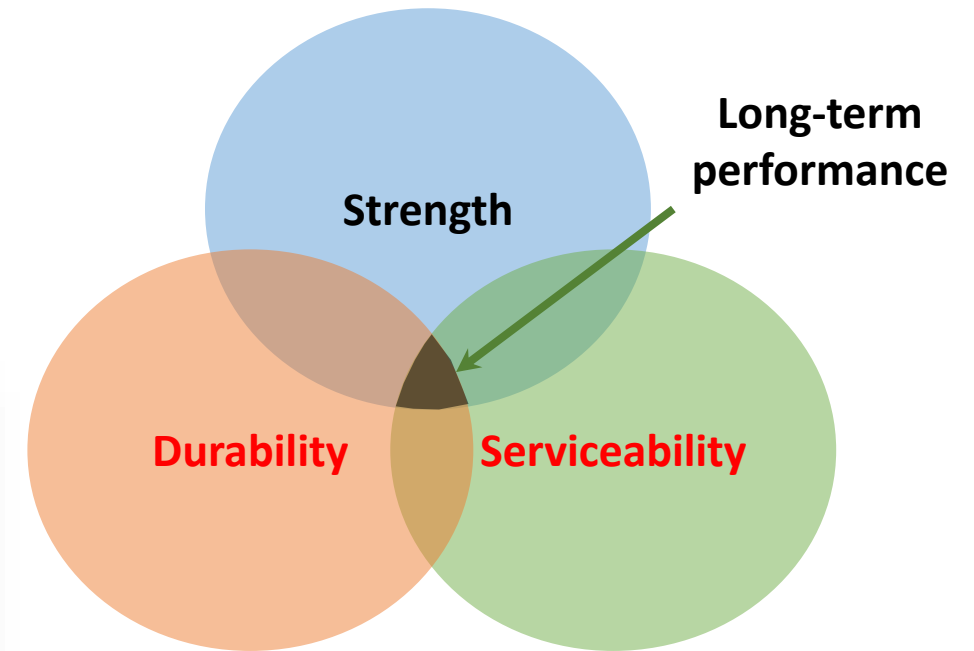
Concrete pavements are typically designed for long-term performance (**initial service life of 30 to 50 years**); however, they are vulnerable to premature deterioration during service (**Multiple Damage Mechanisms**).



One year in service



Three years in service



Low-quality materials

Poor practices

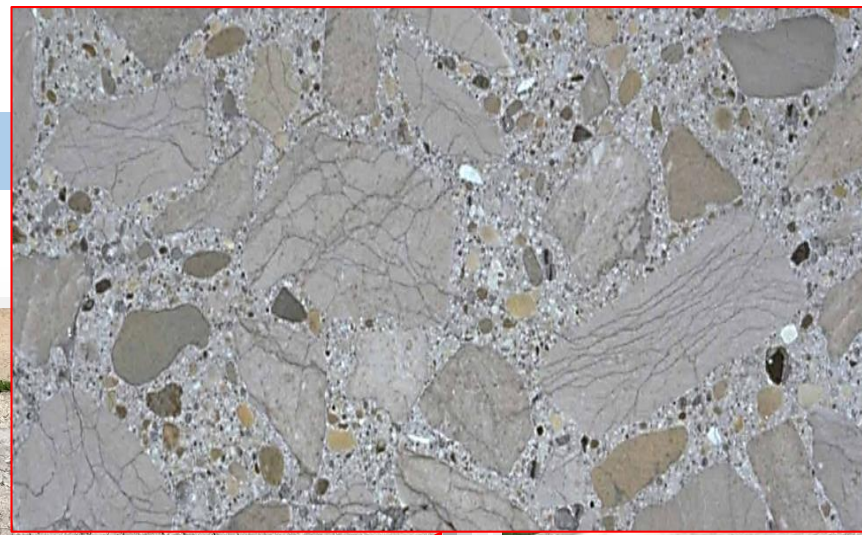
Low-quality Materials

What caused it?

- Low quality and reactive aggregate
- Freezing and thawing after absorbing moisture
- Inadequate concrete mix design

To prevent or minimize these issues, we will:

- Use high quality durable aggregate
- Test and Select aggregates that resist F/T cycles
- Reduce maximum aggregate size
- Install effective drainage systems



D-cracking



ASR or ACR

Low-quality Materials

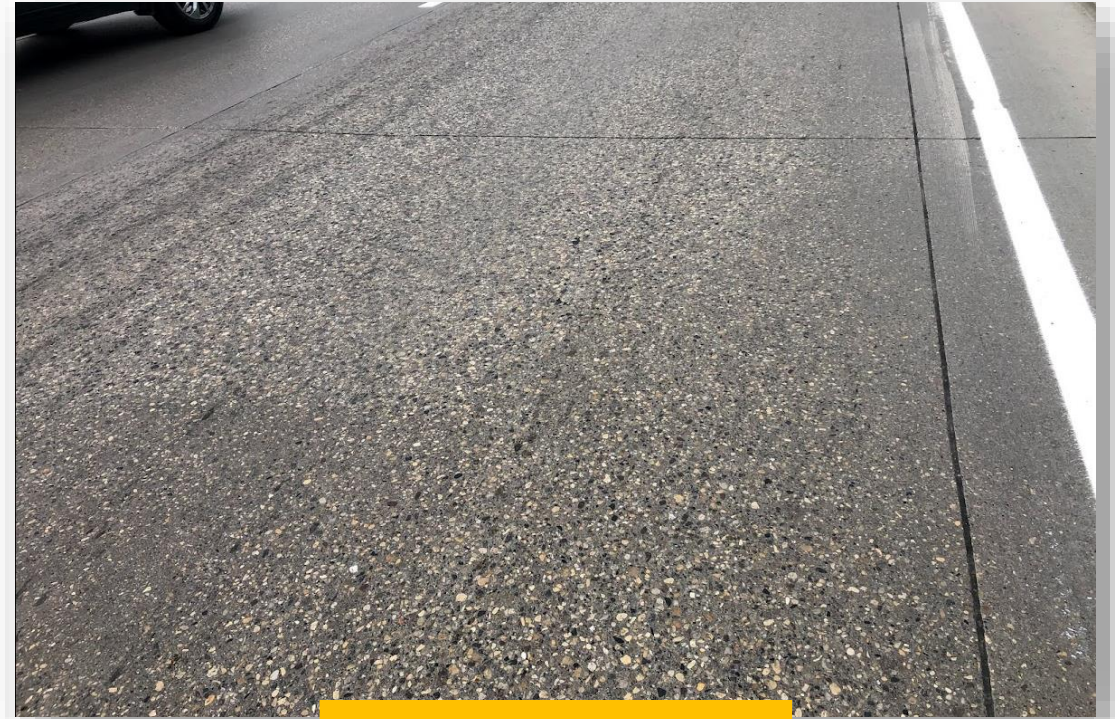
Surface Scaling



One year in service



Two years in service



Three years in service

Low-quality Materials

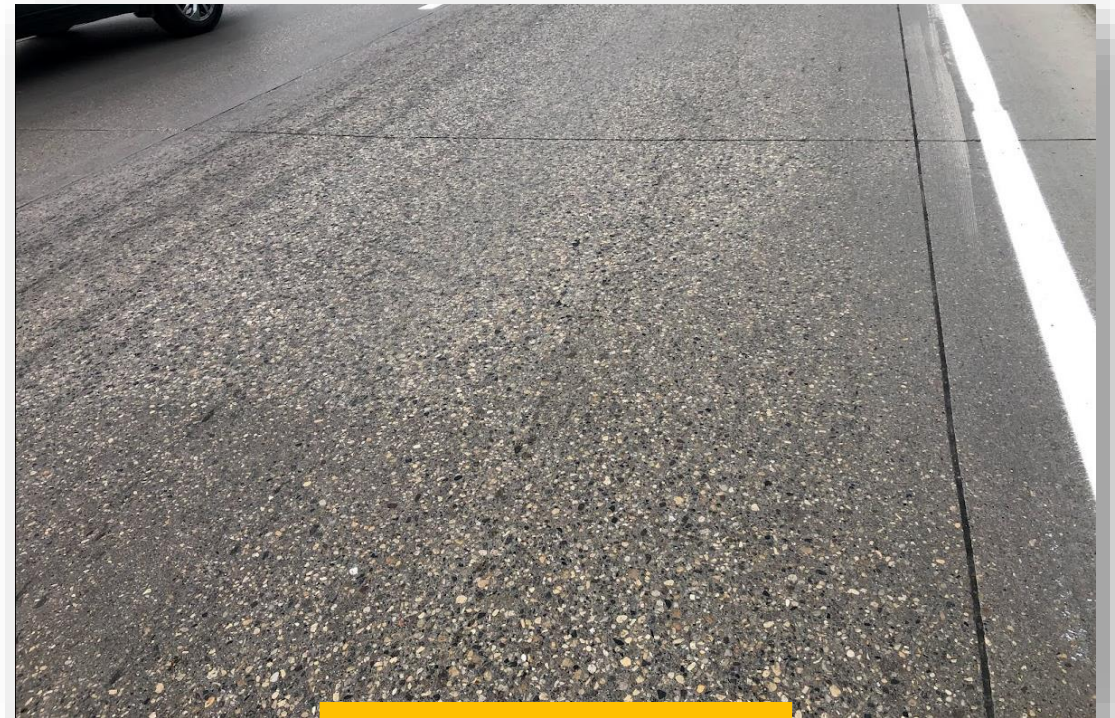
Surface Scaling

What caused it?

- Exposure of concrete to freezing and thawing cycles before the concrete gains the required strength
- Increased w/c in the surface
- Poor air void system
- Inadequate concrete mix design
- Improper curing
- Lack of adequate concrete protection after placement
- Improper finishing

To prevent or minimize these issues, we will:

- Avoid the above



Three years in service

Poor practices

Lack of adequate concrete protection



Poor practices

Inadequate concrete mix design and Placement



Poor practices

Inadequate Tie Bar installation

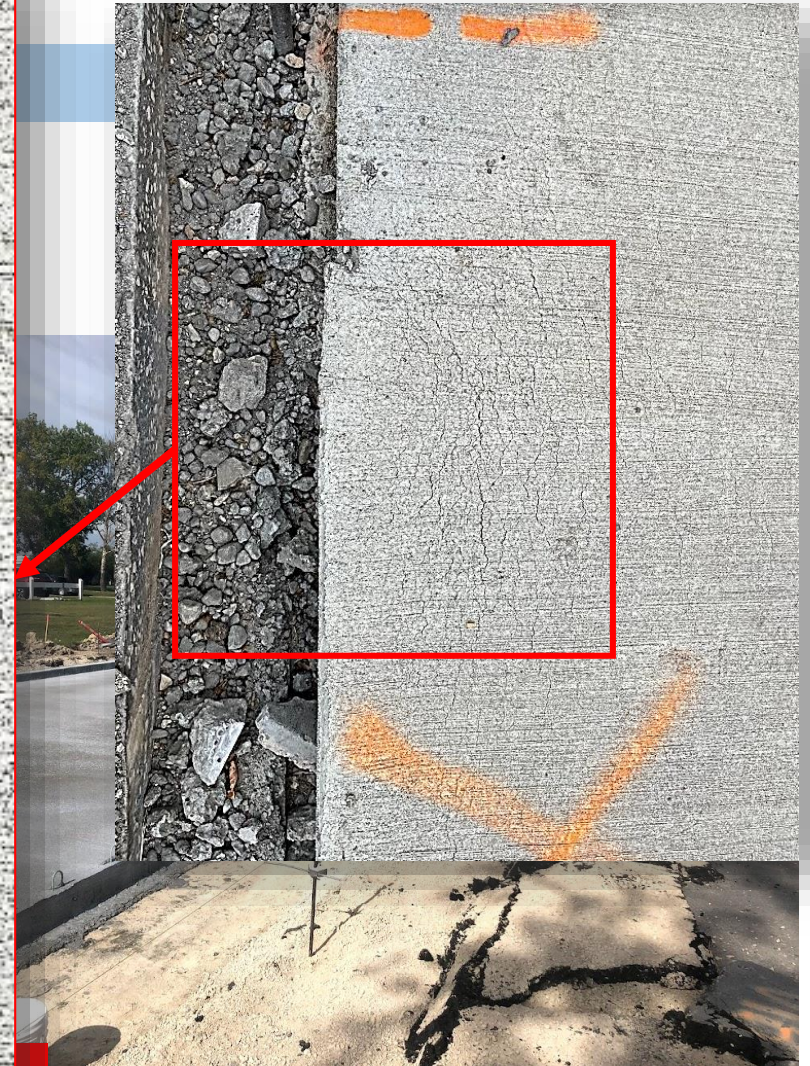


Three years in service

Poor practices



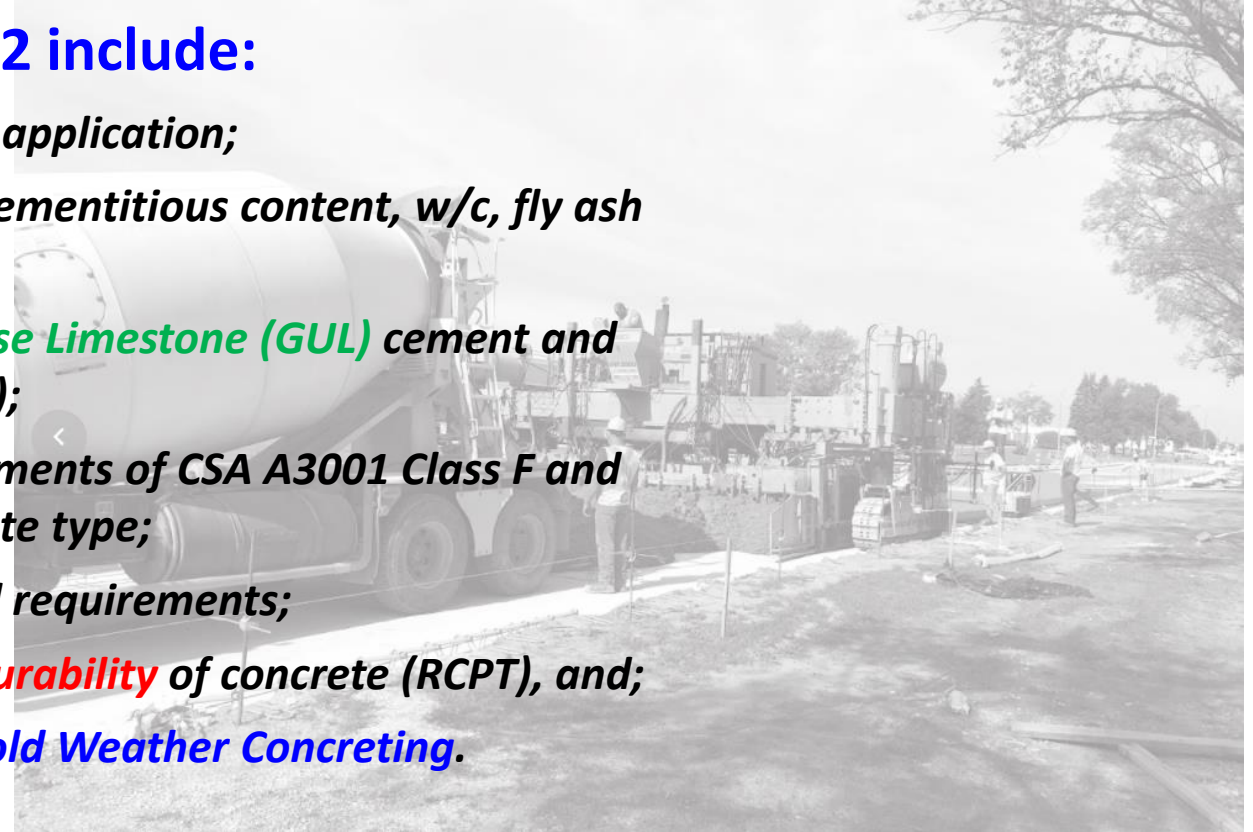
No curing



New Updates: PORTLAND CEMENT CONCRETE PAVEMENT WORKS

The changes to Capital Projects in 2022 include:

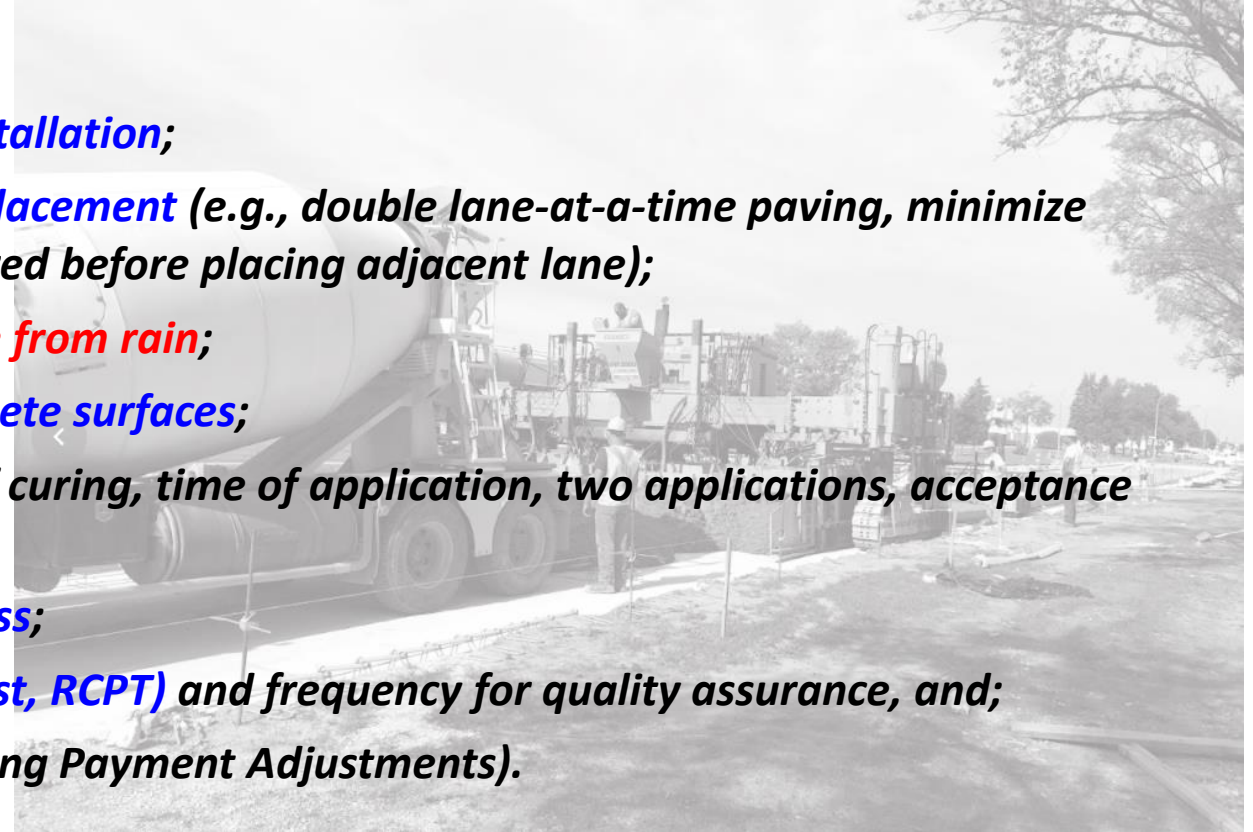
1. New **concrete categories** (eight) based on application;
2. New **concrete mix design** requirements (Cementitious content, w/c, fly ash dosage, etc.);
3. Allowing **new types of cement** (**General Use Limestone (GUL)** cement and High-early-strength Portland cement (HE));
4. Updating fly ash type to meet the requirements of CSA A3001 Class F and **increasing fly ash dosage** based on concrete type;
5. Updating the Concrete Suppliers Approval requirements;
6. Introducing new **testing to evaluate the durability** of concrete (RCPT), and;
7. Updating the requirements for **Hot and Cold Weather Concreting**.



Next Updates: PORTLAND CEMENT CONCRETE PAVEMENT WORKS

Additional updates in 2023 include:

1. *Updating the requirements for **Tie Bar installation**;*
2. *Updating the requirements for **concrete placement** (e.g., double lane-at-a-time paving, minimize hand placement, time and strength required before placing adjacent lane);*
3. *New requirements for **protecting concrete from rain**;*
4. *Updating requirements for **finishing concrete surfaces**;*
5. *New **requirements for curing** (e.g., rate of curing, time of application, two applications, acceptance criteria);*
6. *New requirements for **pavement roughness**;*
7. *Introducing **new testing** (e.g., **Maturity test, RCPT**) and frequency for quality assurance, and;*
8. *New acceptance/rejection criteria (including Payment Adjustments).*



Next Updates: PORTLAND CEMENT CONCRETE PAVEMENT WORKS

Changes to testing include:

QUALITY CONTROL TESTING

Concrete Temperature

Slump

Fresh Air Content

Harden Air Content

Penetrability

Concrete Strength

QUALITY ASSURANCE TESTING

Concrete Temperature

Slump

Fresh Air Content

Concrete Thickness

Penetrability

Concrete Scaling

Concrete Pavement Roughness

Concrete Strength

Cylinders

Maturity
test

Asphalt Specification

CW 3410 – R13: ASPHALTIC CONCRETE PAVEMENT WORKS

Why does the specification need updating?

1. Meet the new *Exposure conditions* and benefit from new *Asphalt Technology*
2. Improve *durability* to produce long lasting asphalt
3. Improve *Long-Term* Performance
4. Minimize the risk of *premature deterioration*, especially at the longitudinal *joints*
5. Harmonize with *Manitoba Infrastructure*
6. Use more *sustainable materials*
7. Deal with current and expected *climate*
8. Improve *quality assurance* efficiency
9. Reduce safety hazards

Low-quality materials

What caused it?

- Low quality asphalt mix
- Improper or low asphalt cement
- Improper aggregate size
- Improper practice

To prevent or minimize these issues, we will:

- Avoid the above



Early Cracking



Improper Joint



Segregation



Potholes



Flaking

Poor practices

What caused it?

- Improper Prime/Tack Coating
- Improper finishing
- Low density

To prevent or minimize these issues, we will:

- Avoid the above



Prime/Tack Coating



Improper finishing

Expected updates for 2024 include:

1. New **asphalt types** based on the application (**SUPERPAVE, Hot Mix Asphalt, Warm Mix Asphalt, High Rutting Resistance Mixes, Cold Mix**);
2. Updating asphalt mix design requirements (aggregate, asphalt cement, asphalt content);
3. New asphalt cement requirement (**Asphalt Cement PG Grades**);
4. Updating the Physical Requirements for Asphaltic Mix (Asphalt content, VMA, Air Voids, Stability, Flow Index);
5. Adding new **Asphalt Suppliers Approval** requirements;
6. Updating the requirements for **asphalt placement**;
7. Updating the requirement for **Prime/Tack Coating**;
8. **Weather Limitations** (Time of Paving, Limitations for Paving later in the season);
9. New testing for **quality assurance** (acceptance/rejection criteria), and;
10. New requirements for **Pavement Roughness**.



Standard Details

April 2015

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DIVISION 4 - STANDARD DETAILS - SURFACE WORKS

<u>DETAIL NO.</u>	<u>TITLE</u>
SD-200	CURB AND GUTTER
SD-201	MOUNTABLE CURB
SD-202A	75 mm LIP CURB
SD-202B	40 mm LIP CURB
SD-202C	MODIFIED LIP CURB
SD-203A	BARRIER CURB (SEPARATE)
SD-203B	MODIFIED BARRIER CURB
SD-204	BARRIER CURB (INTEGRAL)
SD-205	BARRIER CURB (DOWELLED)
SD-206A	BARRIER CURB REPLACEMENT
SD-206B	SAFETY CURB
SD-207	CONCRETE PAVEMENT WIDENING
SD-208	PAVEMENT WIDENING (CONCRETE PAVEMENT c/w ASPHALT OVERLAY)
SD-210A	LONGITUDINAL JOINT FOR CONCRETE PAVEMENT
SD-210B	TIE BAR INSTALLATION FOR LANE-AT-A-TIME PAVING
SD-211A	CONSTRUCTION JOINT AND CONTRACTION JOINT FOR REINFORCED CONCRETE PAVEMENT
SD-211B	CONSTRUCTION JOINT AND CONTRACTION JOINT FOR PLAIN-DOWELLED PAVEMENTS
SD-212	SAWN JOINT AND BUTT JOINT FOR REINFORCED AND PLAIN-DOWELLED PAVEMENTS
SD-213A	TYPICAL FULL-DEPTH PATCHES ON EXISTING PAVEMENT SLABS AND JOINTS
SD-213B	FULL-DEPTH PATCHES DETAILS OF MOVING AND TIED JOINTS
SD-214A	LONGITUDINAL JOINT REPAIR DETAILS FULL-WIDTH PATCH (BOTH SIDES AT THE SAME TIME)
SD-214B	LONGITUDINAL JOINT REPAIR DETAILS LANE-AT-A-TIME PATCH
SD-214C	LONGITUDINAL JOINT PATCH DETAILS - ONE SIDE ONLY
SD-215	PLACEMENT OF STEEL IN PLAIN-DOWELLED CONCRETE PAVEMENT
SD-216	PLACEMENT OF STEEL REINFORCEMENT IN REINFORCED CONCRETE PAVEMENTS, 5000mm JOINT SPACING
SD-217	LAYOUT FOR TYPE "A" AND "B" BAR MAT REINFORCEMENT, 5000 mm JOINT SPACING
SD-218A	TYPICAL JOINT DETAILS FOR PORTLAND CEMENT CONCRETE PAVEMENTS
SD-218B	LOCATION OF LONGITUDINAL JOINTS IN CONCRETE PAVEMENTS
SD-219	TYPICAL PUBLIC LANE DETAILS
SD-220A	CATCHBASIN AND MANHOLE ISOLATION DETAIL (NEW PAVEMENTS)

Expected updates for 2023 include:

- 1. New Barrier Curb for Asphalt Pavements;***
- 2. New Expansion Joint requirements for Sidewalks, Median slabs, etc.;***
- 3. Updating Dowel and Tie Bar Sizes and embedded depth based on concrete thickness;***
- 4. Updating Transverse Saw Cut Spacing;***
- 5. Updating Saw Cut Depth for Longitudinal joints; and,***
- 6. Updating the Typical Joint Layout for Concrete Pavement in accordance with ACPA.***

Thank You