FACILITIES BUILDING ENVELOPE STANDARD – LOW-SLOPE ROOFING

MX-FAE-STD-C011

Facilities Architecture & Engineering
Revision 00
October 2025

METROLINX

Facilities Building Envelope Standard – Low-Slope Roofing

MX-FAE-STD-C011

Publication Date: October 2025
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Preface

This is the first edition of the Facilities Building Envelope Standard – Low-Slope Roofing (MX-FAE-STD-C011). This standard is to provide minimum civil engineering requirements and design guidance to designers for Metrolinx-owned assets.

This standard is to be followed by Engineering and Design Consultants working on Metrolinx projects and internal Metrolinx staff.

The technical content within the Facilities Building Envelope Standard – Low-Slope Roofing (MX-FAE-STD-011) was developed by the Metrolinx Facilities, Architecture, and Engineering's Civil Engineering Team within the Asset Management and Maintenance Division, which includes specialized subject matter experts.

This Standard is available for external users to download via the Metrolinx public download site at https://www.metrolinx.com/en/metrolinx-technical-standards

Suggestions for revision or improvements can be sent to Metrolinx Facilities, Architecture, and Engineering (FAE) Civil Engineering Team, Attention: Senior Manager, FAE Civil Engineering, who will introduce the proposed changes to Metrolinx FAE Civil Engineering. The Senior Manager, FAE Civil Engineering, ultimately authorizes the changes. A description of the proposed change shall be included along with information on the background of the application and any other useful rationale or justification. Proposals for revisions or improvements shall include your name, company affiliation (if applicable), email address, and phone number.

October 2025

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1. General

1.1 Purpose

1.1.1 This standard outlines the design requirements for low-slope (flat) roofing systems in new construction projects.

1.2 Scope

1.2.1 Low-slope roofing is defined as roofing with a slope less than or equal to 1:6 pitch (1 unit vertical and 6 units horizontal).

1.2.2 This standard excludes steep-slope roofing systems (greater than 1:6 pitch), roofing repairs, temporary roofing solutions, tensile membrane structures, and roofs for small accessory structures, such as shelters, canopies, and similar categories of roofs.

1.2.3 This document shall be read in conjunction with the Metrolinx Facilities Civil Engineering and Building Envelope Standard – General (MX-FAE-STD-C001).

2. Definitions & Abbreviations

2.1 Definitions

2.1.1 The capitalized terms used in this standard shall have the meaning prescribed in Table 1.

Table 1: List of Definitions

Term	Definition
Ballasted Roofing	A system where the roof membrane is held in place by heavy gravel or pavers instead of adhesives.
Blue Roof	A roofing system that stores stormwater on the roof (e.g., retention and detention) and gradually drains it.
Built-Up Roofing (BUR)	A multi-layered roofing system composed of asphalt or bitumen sheets with reinforcing layers.
Cool Roofs	Roofing designed with high solar reflectivity to minimize heat absorption and reduce cooling loads.
Electronic Leak Detection	A method using low-voltage or high-voltage electrical currents to identify breaches in the roofing membrane.
Green Roof	A roofing system that is partially or completely covered with vegetation to provide insulation and manage stormwater.
Liquid-Applied Roofing	A seamless, monolithic, fully bonded roofing membrane that is achieved using fluid-based coatings.
Low-Slope Roofing	A roofing system with a slope of 1:6 or less (1 unit vertical per 6 units horizontal).
Modified Bitumen Roofing	A roofing system using reinforced bitumen sheets for increased flexibility and durability.
Roof Access Hatch	A secure entry point for maintenance personnel to access the roof.
Roof Drainage System	A system of drains, scuppers, and downspouts that directs rainwater off the roof.
Single-Ply Roofing	A single-layer synthetic membrane roofing system, fully adhered and reinforced for strength.

Term	Definition
Tapered Insulation	A sloped insulation layer used to direct water toward drains and prevent ponding.
Thermographic Scan	A heat-detecting scan used to inspect roofing for moisture intrusion and insulation defects.
Vapour Barrier	A moisture-resistant layer that prevents water vapour from entering and damaging insulation.
Wind Uplift Resistance	The ability of a roofing system to withstand a net upward wind force without detaching or debonding.

2.2 Abbreviations

2.2.1 The abbreviations used in this standard shall have the meaning prescribed in Table 2.

Table 2: List of Abbreviations

Abbreviation	Definition
BUR	Built-Up Roofing
CSA	Canadian Standards Association
MOL	Ministry of Labour
OBC	Ontario Building Code
OHSA	Occupational Health and Safety Act
PMMA	Polymethyl Methacrylate
PUMA	Polyurethane-Methacrylate
SRI	Solar Reflectance Index

3. Low Slope Roofing

3.1 General Design Requirements

3.1.1 The roofing design shall include design specifications and drawings with project-specific details. These details shall include, but are not limited to, the following typical and atypical conditions:

a) Penetration details, parapet details, details of curb tie-ins and drains;

b) Base flashings and membrane terminations and attachments to other work;

c) Orientation of steel roof deck (if applicable) and orientation of membrane roofing;

d) Tapered insulation, including slopes;

e) Insulation adhesive and mechanical fastening patterns for corner, perimeter, and field-of-roof locations;

f) Leak detection system (if applicable);

g) Roof walkway system and roof accessories; and

h) Wind uplift requirements (designer to confirm if building is considered post-disaster).

3.1.2 The designer shall conduct a feasibility study to determine the necessity of a leak detection system for the project.

3.1.3 Designer to use discretion to select the most suitable roofing system for the project, considering performance criteria, environmental conditions, and maintenance requirements. The following are types of acceptable roofing systems:

a) Built-Up Roofing (BUR): This system shall be a conventional four or five-ply built-up roofing system.

b) Modified Bitumen Roofing: This system shall consist of a base sheet and cap sheet, both of which shall include composite reinforcement sheets.

c) Single-Ply Roofing: This system shall be fully adhered with adhesive, reinforced, and have a minimum uniform thickness of 1.5 mm (60 mils); "average thickness" will not be accepted. Seams shall be dual (two-stage) heat-welded.

d) Liquid-Applied: This system shall consist of Polymethyl Methacrylate (PMMA) and Polyurethane-Methacrylate (PUMA) liquid-applied roofing systems.

3.1.4 Modified Bitumen Roofing and Single-Ply Roofing systems are generally compatible with green roof assemblies, subject to verification of material compatibility and

load-bearing capacity. The suitability of the roofing system for green roof applications shall be confirmed with the green roof system manufacturer.

3.1.5 All roof systems shall include, at a minimum, the following components: a roof membrane, cover board, base and tapered rigid insulation, and a continuous air and vapour barrier membrane (excluding polyethylene sheets).

3.1.6 Mechanical fastening of the single-ply membrane itself will not be accepted.

3.1.7 The use of metal roofing on low-slope roofs is prohibited.

3.1.8 Where green or blue roofs are required as part of the project, the following considerations shall be addressed to ensure compliance with structural, waterproofing, and water management requirements:

a) Structural Load: Ensure the roof structure supports the combined load of media, vegetation (green roofs), and water retention or detention (blue roofs), including maximum saturation and live loads, per OBC;

b) Waterproofing and Drainage: Specify a multi-layered waterproofing system to prevent leaks and root penetration. Design drainage to handle water retention and flow control;

c) Vegetation and Media (Green Roofs): Select appropriate, low-maintenance vegetation and growing media that balance water retention and structural load, suited to the project's environmental conditions; and

d) Refer to Sustainable Design Standard (DS-05) for sustainable requirements on green and blue roofs, including guidance on plant selection, energy efficiency, ecological considerations, and stormwater detention.

3.2 Performance Requirements

3.2.1 Roof systems shall be designed to achieve a minimum service life of 30 years, per CSA S478 and ensure compliance with all applicable building codes and standards.

3.2.2 Membranes shall be durable and accommodate the building's structural movement or deflection, thermal expansion, and avoid thermal bridging, particularly at penetrations. They shall prevent water ingress into the building interior and be UV-resistant.

3.2.3 Roof areas designed to receive rooftop equipment or fall protection anchors shall have the primary roofing membrane protected by a durable, walkable surface to protect membrane from incidental damage from building maintenance practices.

3.2.4 All non-green roof systems shall be designed as cool roofs, with high solar reflectivity and thermal emissivity.

3.2.4.1 Inverted roof membranes shall be protected by light-coloured ballast. Refer to Sustainable Design Standard (DS-05) for minimum Solar Reflectance Index (SRI) values required for cool roofs.

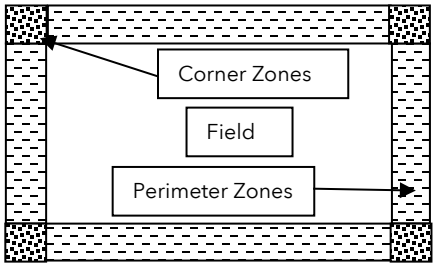
3.2.4.2 Cap sheets on multi-ply modified bitumen roofing systems shall have a high albedo rating and incorporate white reflective granules on the top surface to enhance energy efficiency and provide slip resistance under wet conditions.

3.2.5 All roof systems shall meet fire rating requirements as required by the OBC.

3.2.6 Minimum Slope to Drain: Low-slope roof systems shall be designed with a minimum 2% slope towards drains or exterior scuppers, achieved via tapered insulation. Roof drains should be positioned at the lowest points, with overflow scuppers placed 25 mm above the roof line, and provisions shall be made to prevent standing water for more than 48 hours.

3.2.7 Wind uplift resistance shall account for both Unfactored and Factored wind loads, which should be clearly detailed on roof plans for the Corner Zone, Perimeter Zone, and Field of the Roof, per Figure 1. These zones shall be precisely dimensioned and identified to ensure structural integrity.

Figure 1: Wind Uplift Zones



3.2.8 Conventional roofing system: Design a system that complies with the OBC and has been tested in accordance with CSA A123.21 to meet the required wind uplift resistance.

3.2.9 Inverted Membrane Roofing: Design a system to OBC requirements and Dupont Tech Solutions 508.3 Ballast Design Guide for PMR System.

3.3 Component Specific Requirements

3.3.1 All components of the roofing system shall be fully compatible and sourced from a single manufacturer whenever possible.

3.3.1.1 Drainage:

a) Design: Roof drainage shall comply with the requirements of the Ontario Building Code (OBC) and municipal requirements. The location of roof drains shall consider maintenance access, Ministry of Labour (MOL) requirements, and fall protection requirements;

b) Blockage Prevention: The roof system shall be designed to prevent blockages of drainage channels and outlets, and include an overflow system in case of blockages; and

c) Scuppers / Downspouts: primary and overflow scuppers to be a minimum of 100 mm high x 200 mm wide. All downspouts to be a minimum of 100 mm x 100 mm. Ensure they are not positioned above doorways, gathering areas, paved walkways, or any locations where water runoff could create hazards.

3.3.1.2 Vapour Barriers:

a) Design a fully adhered vapour barrier on the warm side of the roof insulation, providing separation from heated spaces, with detailed sealing requirements for joints and penetrations. Select vapour barriers with self-sealing properties for areas where mechanical fastening is required.

3.3.1.3 Supports for Rooftop Units:

a) Design curbs and sleepers, to be positioned at least 200 mm above the finished height of the roof. For Inverted Membrane Roofing, specify that the height measurement starts from the gravel ballast.

3.3.1.4 Access Ladders:

a) Wall-mounted access ladders for reaching multiple roof levels shall be designed in compliance with the Ministry of Labour's Fixed Access Ladders: Engineering Data Sheet 2-04, and include a lockable gate at the lower section to prevent unauthorized access.

3.3.1.5 Roof Access Hatches:

a) Size: Roof access hatches shall be serviced by fixed ladders and measure at least 550 mm by 900 mm;

b) Location**:** Roof access hatches shall not be permitted within 3 m from the edge of a roof or near areas of different heights; and

c) Features**:** Roof hatches shall include spring operators, hold-open arms, stainless steel spring latches with turn handles, stainless hinge systems, and lockable systems inside and outside.

3.3.1.6 Walkways:

a) Design walkways from roof access points to all rooftop mechanical equipment, consisting of two rows of 600 mm x 600 mm x 50 mm pavers on adequately sized (i.e. 100 mm x 100 mm x 25 mm) pads or adjustable pedestals, ensuring that the placement of pavers does not obstruct roof drainage.

3.3.1.7 Ballasted Guard Rails:

a) Design ballasted guard rails at all areas where rooftop equipment, drains, and other roof accessories are located within 3 m from the edge of a roof.

b) Design guard railing systems in accordance with OBC, CSA S16 and CAN/CSA S136 to withstand live, snow, dead, lateral, wind, seismic, handling, transportation, and erection loads. Comply with requirements of OBC Part 3, OBC Part 4 and OHSA Reg. 851 S.14.

c) Design live loads in accordance with OBC Part 4 Article 4.1.5.14 Loads on Guards.

3.3.1.8 Leak detection system:

a) An electronic leak detection system is recommended for conventional roof systems, where the membrane is on the exterior side of the structure and insulation, exposed to the elements.

3.4 Quality Assurance and Quality Control (QA/QC)

3.4.1 The following QA/QC activities shall be included in the project agreement to ensure proper documentation and certification by the Professional Engineer responsible for the design throughout construction. At project completion, all QA/QC documentation shall be submitted to the Owner of this Standard for review and approval.

a) Mock-ups: Documentation confirming that mock-ups were included in the design to validate the suitability of materials, products, and designs, and to establish performance and execution standards. This includes mock-ups for parapet upturns, metal cap and counter flashing, curb upturns, typical penetration detailing, ballast edging, fall arrest anchor penetration, insulation installation, and typical drain assembly;

b) Experience and Qualification of Applicators: Documentation demonstrating that only qualified applicators with a minimum of ten years of experience with the proposed roofing membrane type, certified by OIRCA and CRCA, executed the installation. Include details of training and certification requirements fulfilled by the applicators;

c) Inspection and Testing: Documentation of manufacturer's field services, providing product use recommendations, and conducting periodic site visits in accordance with their instructions. The frequency of these tests and the criteria for acceptable results shall be clearly defined in the design specifications. Additionally, incorporate water testing procedures to verify roof membrane performance, including localized hose testing or other appropriate methods to confirm the watertightness of the membrane;

d) Leak Detection Systems: If leak detection systems are part of the roof design, documentation of tests conducted post-installation but before final acceptance, to identify any breaches in the roofing membrane;

e) Thermographic Scan: Documentation of a thermographic scan of the roof conducted after installation and before final acceptance, including a comprehensive report with colour images; and

f) Roof Drain Protection: Documentation confirming that measures were taken to protect roof drains during construction to prevent debris blockage and ensure proper function. This includes temporary protection measures and post-installation inspections to verify that drains are clear and operational.