Evaluation Report CCMC 14093-R
NUDURA® Dampproofing Membrane

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "NUDURA® Dampproofing Membrane," when used as a self-adhered modified bituminous membrane for dampproofing below-grade insulated concrete form (ICF) foundation walls in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code (NBC) of Canada 2015:

- Clause 1.2.1.1.(1)(a) of Division A, using the following acceptable solutions from Division B:
  - Clause 9.13.2.1.(1)(b), Required Dampproofing

- Clause 1.2.1.1.(1)(b) of Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
  - Article 9.13.2.2., Dampproofing Materials
  - Article 9.13.2.3., Preparation of Surface
  - Article 9.13.2.4., Application of Dampproofing Material

This opinion is based on CCMC's evaluation of the technical evidence in Section 4 provided by the Report Holder.

2. Description

The product is a self-adhered modified bituminous membrane intended to be used for dampproofing below-grade ICF foundation walls. The membrane consists of a styrene-butadiene-styrene (SBS) modified bitumen to which a tri-laminated woven polyethylene film is laminated. A silicone release film is applied on the other side of the membrane (adhering side) to facilitate installation. The membrane has vertical overlap markings to help installers achieve the minimum overlap at the seams. The membrane is available in two grades, which are made of different modified bituminous blends: the regular grade for the summer (S/E) and the cold-weather grade for the winter (W/H).

The summer and winter grade membranes are manufactured in rolls that measure 22.9 m long × 0.91 m wide. The membrane is 1.0 mm thick for both grades.

3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by the "NUDURA® Dampproofing Membrane" being used in accordance with the conditions and limitations set out below.

- Use of the products has been evaluated for applications falling under the scope of Part 9, Housing and Small Buildings, of Division B of the NBC 2015. The ICF foundation walls must meet the structural requirements of the NBC 2015.
- The membrane rolls must be stored vertically on site at less than the maximum temperature recommended by the manufacturer and must be protected from exposure to ultraviolet (UV) radiation as per the manufacturer's instructions.
- Prior to the application of the membrane, the following conditions and limitations related to the ICF must be followed:
    - The product evaluation is limited for installation over ICFs that comply with the applicable requirements of the NBC 2015, or that are evaluated by CCMC.
    - The ICFs must be made of Type 2 (or greater) moulded expanded polystyrene (EPS) boards that comply with CAN/ULC-S701-11, "Thermal Insulation, Polystyrene, Boards and Pipe Covering," and have a completely flat surface or a flat surface including channels not wider than 4.8 mm and not deeper than 1 mm covering a maximum of 10% of the surface area.
    - The ICFs used to build the foundation wall corners must be of one piece (a prefabricated corner) in order to avoid vertical joints along the foundation wall corners. If prefabricated corners cannot be used, the vertical joints must be finished as per the manufacturer's recommendations with material compatible with the ICF and the membrane.
    - The vertical and horizontal joints between the ICFs must not be larger than 3 mm. The connectors embedded in the ICFs must not be visible on the exterior surface of the EPS.
    - The poured-in-place concrete must reach its 7-day strength prior to application of the membrane.
    - The membrane manufacturer must recommend appropriate material that is compatible with the membrane and the ICF to fill surface irregularities and cracks in the ICFs, gaps between the ICFs, and gaps between the ICFs and the footing.
    - The ICFs must have a smooth surface to prevent air pockets from forming between the ICF and the membrane.
    - The ICF surface must be cleaned and dried prior to the installation of the membrane as per the manufacturer's installation instructions. ICF walls must meet the surface preparation requirements of Article 9.13.2.3., Preparation of Surface, of Division B of the NBC 2015.
    - The ICFs should not be exposed to UV radiation for more than three weeks.
- During the membrane installation, the following conditions and limitations must be followed:
    - The summer grade membrane (S/E) minimum installation temperature is 10°C. The winter grade membrane (W/H) minimum installation temperature is –10°C.
    - The membrane must cover the foundation wall from the top of the footing to the final grade.
    - Lap joint and end lap joints must be sealed as per the manufacturer's instructions. The minimum width of the membrane overlap at the joint must be 75 mm.
    - The membrane installation must stop at grade level. The exposed above-grade portion of the membrane after soil settling must be protected from UV radiation and mechanical impact with additional backfill that would be graded away from the foundation.
    - The thickness of the membrane installed on site must be equivalent to the thickness of the evaluated product, which is 1.0 mm.
    - The top edges (terminations) of the membrane must be sealed with a bead of mastic or an equivalent performing solution in compliance with the manufacturer's instructions. Since the use of a primer is not required for the dampproofing application as opposed to the waterproofing application (see CCMC 14095-R), the top edges of the membrane must be mechanically fixed to the concrete wall using a system recommended by the manufacturer for supporting the membrane weight. Should a primer be used, users must follow the conditions and limitations shown in CCMC 14095-R.
    - The membrane must be protected if its temperature is higher than 40°C.
- Following its application, the entire membrane must be protected from exposure to UV radiation within three weeks of its application and in accordance with the manufacturer's additional recommendations.
- Prior to backfilling, the following conditions and limitations must be followed:
    - The membrane must first be inspected for any defects (holes, tears, etc.), which must be repaired in accordance with the manufacturer's instructions.
    - The membrane must be covered with a protection board, which may consist of a semi- or rigid board with a smooth surface facing the membrane (e.g., mineral fibre boards, EPS/XPS boards or other equivalent boards). The protection boards must not be installed using fasteners in order to avoid penetrations through the membrane. See the manufacturer's recommendations regarding the use of adhesive and tape to secure the protection boards. Clean sand backfill can be used as an alternative solution to protection boards.

- The foundation wall must be backfilled in accordance with the requirements of the Subsection 9.12.3., Backfill, of Division B of the NBC 2015.
- When used in soils containing high levels of organic matter, chemicals and microbiological activity that will affect the product's performance, the manufacturer must be consulted to determine suitability.
- The product must be applied by qualified installers who will follow the CCMC conditions and limitations on the product and the manufacturer's installation instructions.
- The product must be identified with the phrase "CCMC 14093-R."

4. Technical Evidence

The proposed product has already been qualified for use as a waterproofing membrane under CCMC 14095-R. The Report Holder had previously submitted technical documentation for CCMC 14095-R and the related technical evidence for demonstrating waterproofing performance is summarized below.

Testing was conducted at laboratories recognized by CCMC.

Since "NUDURA® Dampproofing Membrane" is the same product as the one evaluated under CCMC 14095-R, it is deemed to possess the required material properties to perform as a dampproofing material.

4.1 Material Requirements

Table 4.1.1 Material Properties of the Membrane

Property		Unit	Requirement	Result	
				Summer Grade	Winter Grade
Thickness variation		mm	Maximum 1.1 mm Minimum 0.9 mm (±10% of the manufacturer's declared value)(1)	0.93	0.92
Hardness (Type 00 hardness gauge)		n/a	Report value	89.8	95.4
Water vapour permeance, Procedure B		ng/(Pa·s·m^2)	Report value	1.45	1.65
Tensile strength at break:	**machine direction**	kN/m(2)	Report value	12.40	12.85
	cross-machine direction			13.67	12.69

Notes to Table 4.1.1:

1. The manufacturer's claimed thickness of the membrane is 1.0 mm.
2. The tensile strength is expressed as a force per metre width of the specimen due to the particular behaviour of the multi-layered membrane.

4.2 Performance Requirements

Table 4.2.1 Watertightness Performance of the Membrane

Property[1][2]	Requirement	Result	
		Summer Grade	Winter Grade
Watertightness	No leakage	Passed	
Water immersion/watertightness	No leakage	Passed	
Heat aging/watertightness	No leakage	Passed	
Chemical aging (NaoH)/watertightness	No leakage	Passed	
Chemical aging (acetic acid)/watertightness	No leakage	Passed	
UV aging/watertightness	No leakage	Passed	
Low temperature flexibility at –20°C/watertightness	No leakage	Passed	

Notes to Table 4.2.1:

1. The "/" under "Property" indicates that a test sequence was performed (e.g., a water immersion test was performed followed by a watertightness test).
2. The specimens passed the watertightness test at 60 kPa of water pressure.

Table 4.2.2 Crack Bridging Resistance of the Membrane

Property[1]		Requirement	Result[2]	
			Summer Grade	Winter Grade
Crack bridging	**30 cycles at –20°C**	No visible cracking, blistering, peeling or other defects visible to the naked eye when lit with a 60-watt incandescent light at a 300-mm distance	Passed	
	30 cycles at 30°C			
Water immersion/crack bridging	**30 cycles at –20°C**	No visible cracking, blistering, peeling or other defects visible to the naked eye when lit with a 60-watt incandescent light at a 300-mm distance	Passed	
	30 cycles at 30°C			
Heat aging/crack bridging	**30 cycles at –20°C**	No visible cracking, blistering, peeling or other defects visible to the naked eye when lit with a 60-watt incandescent light at a 300-mm distance	Passed	
	30 cycles at 30°C			
Chemical aging (NaOH)/crack bridging	**10 cycles at –20°C**	No visible cracking, blistering, peeling or other defects visible to the naked eye when lit with a 60-watt incandescent light at a 300-mm distance	Passed	
	10 cycles at 30°C			
Chemical aging (acetic acid)/crack bridging	**10 cycles at –20°C**	No visible cracking, blistering, peeling or other defects visible to the naked eye when lit with a 60-watt incandescent light at a 300-mm distance	Passed	
	10 cycles at 30°C			
UV aging/crack bridging	**10 cycles at –20°C**	No visible cracking, blistering, peeling or other defects visible to the naked eye when lit with a 60-watt incandescent light at a 300-mm distance	Passed	
	10 cycles at 30°C			

Notes to Table 4.2.2:

1. The "/" under "Property" indicates that a test sequence was performed (e.g., a water immersion test was performed followed by a crack bridging test).
2. The results are valid for the machine and cross-machine directions of the membrane.

Table 4.2.3 Peel Adhesion Performance of the Membrane over ICF

Property[1]		Unit[2]	Requirement	Result[3]	
				Summer Grade	Winter Grade
Peel adhesion at 23°C		N/m	≥ 193	1 028	632
Peel adhesion at maximum interface temperature:[4][5]	**40°C**	N/m		332	216
Peel adhesion at lowest interface temperature:[4]	**5°C for the winter grade**	N/m		n/a	770
	10°C for the summer grade	N/m		771	n/a
UV exposure on ICF substrate/rasping and cleaning of the ICF/peel adhesion with interface at 40°C[4][6]		N/m	≥ 174 (90% of 193)	361	242
Heat aging on specimen/peel adhesion at 23°C[7]		N/m		617	588
UV exposure on specimen/peel adhesion with interface at 40°C[4][7]		N/m		467	434

Notes to Table 4.2.3:

1. The "/" under "Property" indicates that a test sequence was performed (e.g., a heat aging test was performed followed by a peel adhesion test).
2. The peel adhesion is expressed as a force unit per metre width of the specimen.
3. All specimens were prepared with the NUDURA® Membrane Primer applied over the ICF substrates.
4. The interface consists of the separated surface between the ICF substrate and the membrane.
5. The results show that the peel adhesion of the membrane can be maintained greater than 193 N/m if the interface temperature does not exceed 40°C. The maximum interface temperature of 40°C was established through a research project conducted by the National Research Council.
6. Rasping was conducted using a 12-grit sandpaper in a hand sander. Five passes (back and forth) across the surface were performed on each sample. Cleaning was done using a whisk to remove dust and particles left behind.
7. The specimen consists of the membrane installed on an ICF substrate.

Table 4.2.4 Peel Adhesion Performance of the Membrane over Concrete

Property[1]	Unit[2]	Requirement	Result	
			Summer Grade	Winter Grade
Peel adhesion at 23°C	N/m	≥ 175	673	750
Water immersion/peel adhesion at 23°C	N/m	≥ 158 (90% of 175)	1 575	247
Heat aging/peel adhesion at 23°C	N/m		367	452
UV aging/peel adhesion at 23°C	N/m		1 292	749

Notes to Table 4.2.4:

1. The "/" under "Property" indicates that a test sequence was performed (e.g., a water immersion test was performed followed by a peel adhesion test).
2. The peel adhesion is expressed as a force unit per metre width of the specimen.

Table 4.2.5 Tensile Strength Performance of the Membrane

Property[1]	Unit[2]	Requirement	Result[4]	
			Summer Grade	Winter Grade
Heat aging/tensile strength	kN/m	Summer grade ≥ 11.16 Winter grade ≥ 11.42 (90% of original value)[3]	13.74	13.57
Chemical aging (NaOH)/tensile strength			12.97	14.02
Chemical aging (acetic acid)/tensile strength			12.83	13.65
UV aging/tensile strength			11.57	12.45

Notes to Table 4.2.5:

1. The "/" under "Property" indicates that a test sequence was performed (e.g., a heat aging test was performed followed by a tensile strength test).
2. The tensile strength is expressed as a force unit per metre width of the specimen due to the particular behaviour of the multi-layered membrane.
3. The original values for tensile strength are shown in Table 4.1.1.
4. The aging test sequences were conducted with specimens that showed the weakest tensile test results prior to aging either in the machine or cross-machine direction.

Table 4.2.6 Performance Properties of the Lap Joint

Property[1][2]	Unit[3]	Requirement	Result	
			Summer Grade	Winter Grade
Water immersion/watertightness	n/a	No leakage	Passed[4]	
Heat aging/watertightness	n/a	No leakage	Passed[4]	
Water immersion/peel adhesion at 23°C	N/m	≥ 174 (90% of 193)[3]	676	401
Heat aging/peel adhesion at 23°C			546	384
UV aging/peel adhesion at 23°C			532	575

Property[1][2]	Unit[3]	Requirement	Result	
			Summer Grade	Winter Grade
UV aging/peel adhesion with lap joint interface at 40°C			333	254
Lap joint shear at 23°C	kN/m	Summer grade ≥ 6.2 Winter grade ≥ 6.3 (50% of original tensile strength of the membrane)[5]	10.67	9.88
Heat aging/lap joint shear at 23°C			8.27	8.19
Lap joint shear at 10°C			8.76	n/a
Lap shear at –10°C			n/a	8.76
Peel adhesion at 10°C	N/m	193	3 22	n/a
Peel adhesion at –10°C	N/m		n/a	3 555

Notes to Table 4.2.6:

1. The "/" under "Property" indicates that a test sequence was performed (e.g., a water immersion test was performed followed by watertightness test).
2. The overlap joint width is 75 mm.
3. The peel adhesion is expressed as a force unit per metre width of the specimen.
4. The lap joint specimens passed the watertightness test at 60 kPa of water pressure.
5. The original value for the tensile strength of the membrane is shown in Table 4.1.1.

Report Holder

NUDURA Inc.
27 Hooper Road, Unit 10
Barrie, ON
L4N 9S3

Telephone: 866-468-629

Email: info@nudura.com

Web: www.nudura.com

Plant(s)

Drummondville, QC

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