Evaluation Report CCMC 14095-R
NUDURA® Waterproofing Membrane

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1. Opinion

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

- Clause 1.2.1.1.(1)(a), Division A, using the following acceptable solutions from Division B:
  - Clause 9.13.3.1.(1)(b), Required Waterproofing

- Clause 1.2.1.1.(1)(b), 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 9.13.3.2., Waterproofing Materials
  - Article 9.13.3.3., Preparation of Surface
  - Article 9.13.3.4., Application of Waterproofing Membranes

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

2. Description

The products are self-adhered modified bituminous membranes intended to be used for waterproofing 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 to facilitate installation. The membrane has vertical overlap markings to help installers achieve the required 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 membrane is installed after applying the manufacturer's recommended primer over the foundation wall (ICF substrate).

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® Waterproofing 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 of Division B of the NBC 2015. The ICF foundation walls must meet the structural requirements of the NBC 2015.
- While the waterproofing continuity of the membrane to other parts of the wall (slabs, footing, etc.) is beyond the scope of this Report, the installer must follow engineer-approved solutions to provide the waterproofing continuity (i.e., an overall waterproofing system that will perform under the building site conditions).

- The maximum hydrostatic pressure that the membrane and seams can sustain is 60 kPa.
- 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 ICF must be made of Type 2 (or greater) moulded expanded polystyrene (EPS) boards having a complete 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 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 ICF must have a smooth surface to prevent air pockets from forming between the ICF and the membrane.
    - The ICF surface must be cleaned, dried and primed with NUDURA® Membrane Primer prior to the installation of the membrane as per the manufacturer's installation instructions. ICF walls must meet the surface preparation requirements of Article 9.13.3.4., Preparation of Surface, of Division B of the NBC 2015.
    - If the surface of the ICF is damaged (e.g., discoloured, chalked) by UV radiation, it must be rasped and cleaned in order to bring it back to its original condition.
    - 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 minimum outdoor air temperature during installation of the membrane is 5°C for the winter grade and 10°C for the summer grade. When the membrane is subjected to cold temperatures, the outdoor air temperature is similar to the membrane surface temperature (which is equivalent to the temperature at the interface between the membrane and ICF). For installation of the membrane in temperatures colder than 5°C for the winter grade and 10°C for the summer grade, proper and good techniques such as protection of materials, enclosing work areas, etc., must be followed to ensure the evaluated performances.
    - When the membrane is subjected to hot temperatures, the membrane interface temperature does not necessarily correspond to the outdoor air temperature especially where the sun hits the membrane. On construction sites during hot summer days, the interface temperature can reach 70°C while the outdoor air temperature is only around 35°C. For proper adhesion of the membrane during these summer conditions, measures must be taken on site to ensure that the surface temperature (which is equivalent to the interface temperature) of both grades of the membrane is maintained below 40°C. The approximate temperature of the membrane surface can be determined using an infrared thermometer held at about 600 mm from the wall. Temperature measurements must be taken on all sides of the building since wind and sun exposure will vary and, thus, influence the temperature. Where the membrane is exposed to the sun, the operator of the thermometer should cast a shadow in front of the membrane and quickly take a measurement in the shaded area at about 600 mm from the wall. The membrane must be protected if the temperature is higher than 40°C.
    - A minimum 5-kg force must be applied with a roller over the entire membrane surface including the seams to ensure full contact and adhesion of the membrane with the ICFs. A minimum of two passes must be performed.
    - 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.
- The peel adhesion performance of the membrane was assessed only over two substrates: ICF and concrete. See Tables 4.2.2 and 4.2.3 of this Report.
- 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 matters, chemicals and microbiological activity that will affect the products' performance, the manufacturer must be consulted to determine suitability.
- The products must be applied by qualified installers who will follow the CCMC conditions and limitations on the products and the manufacturer's installation instructions.
- The products must be identified with the phrase "CCMC 14095-R."

4. Technical Evidence

The Report Holder has submitted technical documentation for CCMC's evaluation. Testing was conducted at laboratories recognized by CCMC. The corresponding technical evidence for this product is summarized below.

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)	1575	247
Heat aging/peel adhesion at 23°C	N/m		367	452
UV aging/peel adhesion at 23°C	N/m		1292	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[3]	Result[4]	
			Summer grade	Winter grade
Heat aging/tensile strength	kN/m	Summer grade ≥ 11.16 Winter grade ≥ 11.42 (90% of original value)	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)	676	401
Heat aging/peel adhesion at 23°C			546	384
UV aging/peel adhesion at 23°C			532	575
UV aging/peel adhesion with lap joint interface at 40°C			333	254
Lap joint shear test 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 test at 23°C			8.27	8.19

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.

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