



## Evaluation Report CCMC 13569-R Armadillo Composite Decking

|                           |             |
|---------------------------|-------------|
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### 1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that “Armadillo Composite Decking”, when used as exterior decking in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code 2010:

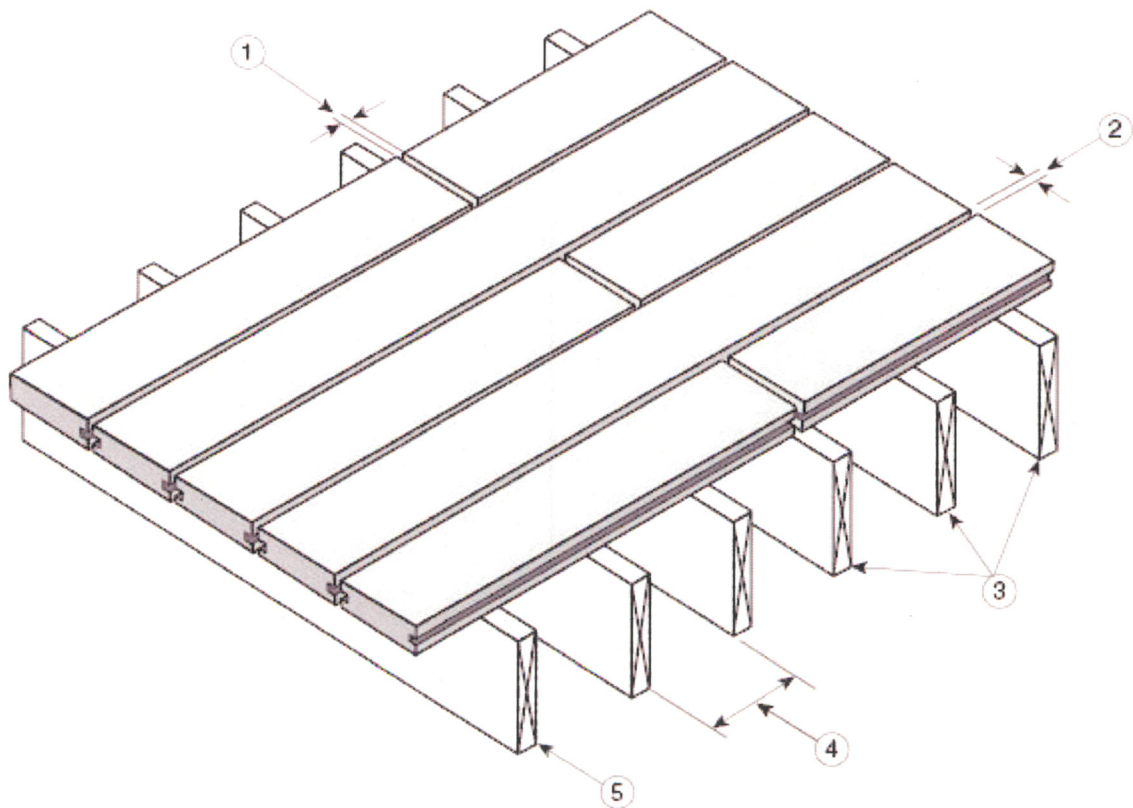
- Clause 1.2.1.1.(1)(b), Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
  - Article 9.3.2.9., Termite and Decay Protection
  - Subsection 9.4.2., Specified Loads
  - Article 9.4.3.1., Deflections
  - Article 9.8.9.1., Loads on Stairs and Ramps
  - Article 9.23.15.5., Subfloor Thickness or Rating

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 wood thermoplastic composite lumber (WTCL) made primarily from equal parts of wood fibre and reclaimed/recycled polyethylene (HDPE) with a UV-protectant capstock. The composite product is manufactured through a continuous extrusion process in planks of solid cross-section. The planks are manufactured in nominal dimensions of 32 mm × 140 mm and are available in 3.66 m and 4.88 m and 6.11 m lengths.

The product is intended to be used as exterior decking installed over traditional structural wood framing spaced at 400 mm on centre (o.c.) and stair treads spaced at 230 mm o.c.



**Figure 1. Installation details for the product with hidden fasteners**

- 1. 3 mm to 6 mm minimum end-to-end gapping, depending on length of plank and temperature at installation**
- 2. 3 mm to 6 mm minimum width-to-width gapping, depending on temperature at installation**
- 3. minimum of 3 joists per plank**
- 4. maximum joist spacing of 400 mm o.c.**
- 5. joist designed to support applicable loads**

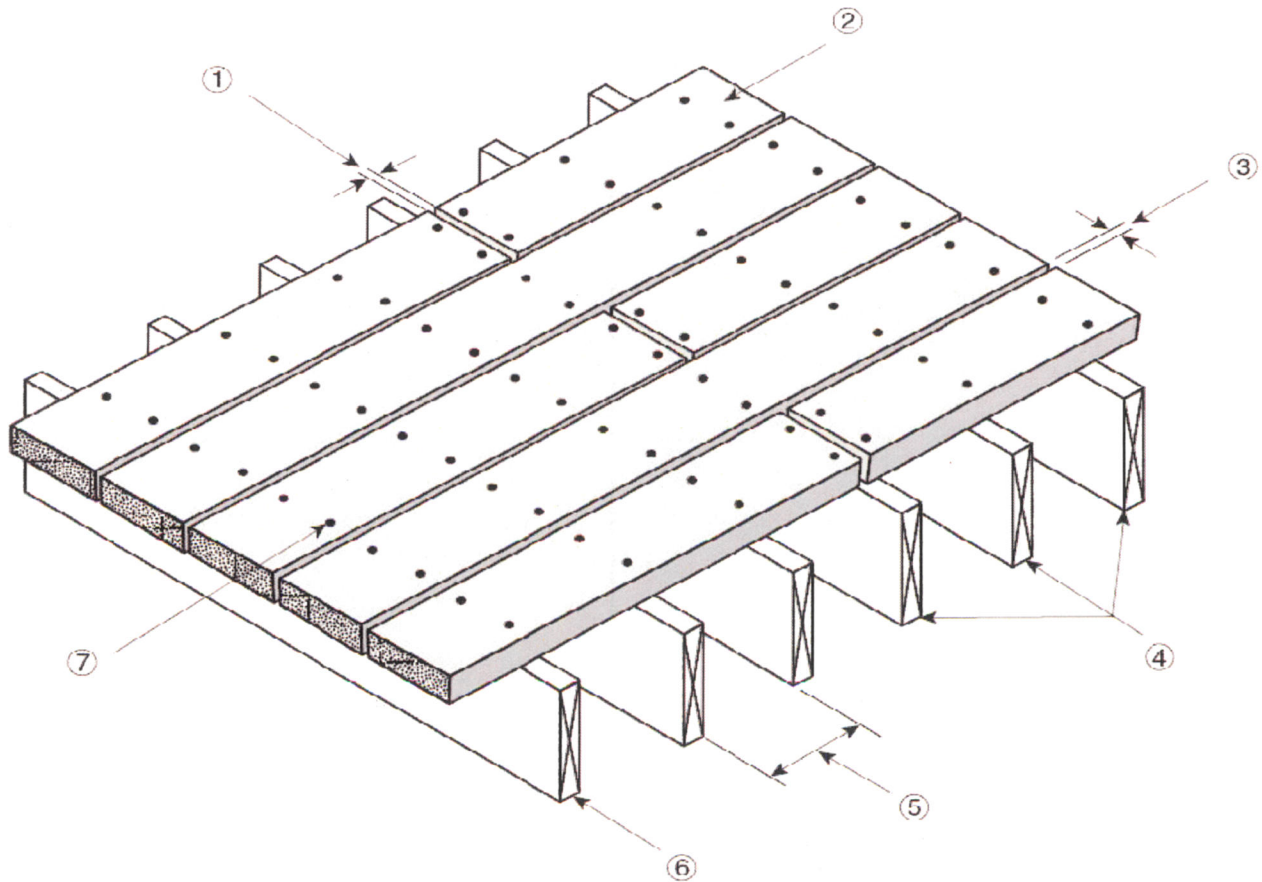


Figure 2. Installation details for the product with exposed fasteners

1. 3 mm to 6 mm minimum end-to-end gapping, depending on length of plank and temperature at installation
2. “Armadillo” deck board
3. 3 mm to 6 mm minimum width-to-width gapping, depending on temperature at installation
4. minimum of 3 joists per plank
5. maximum joist spacing of 400 mm o.c.
6. joist designed to support applicable loads
7. two fasteners, 64 mm long, per support

### 3. Conditions and Limitations

CCMC’s compliance opinion in Section 1 is bound by the “Armadillo” being used in accordance with the conditions and limitations set out below.

- The product must be installed with supports spaced no greater than 400 mm on centre (o.c.). Each plank must be supported by at least three supports.
- The product must be fastened to the wood joists with fasteners specified by the manufacturer and conforming to Article 9.23.3.1., Standards for Nails and Screws, of Division B of the NBC 2010. The fasteners must have a corrosion protection coating or be made of stainless steel. The planks must be fastened with at least two 64-mm-long fasteners per support.  
*Note: As of January 2004, pressure-treated lumber requires specific hot-dipped galvanized fasteners for satisfactory performance.*
- The product must be gapped end-to-end based upon the length of the plank and the temperature at installation. The end-to-end gapping must be 6 mm for installations below 15°C, 3 mm for installations above 15°C. The width-to-width gapping must be 3 mm for installations above 5°C and 6 mm for installation below 5°C.
- The product can be used where termite protection is required as per Article 9.3.2.9. of Division B of the NBC 2010.
- The product can be used as stair treads at 230-mm (9 in.) o.c. spacing.
- The product is **not** to be considered as an equivalent to dimensional lumber.
- The product is permitted where decay resistance is required as per Sentence 9.3.2.9.(3) of Division B of the NBC 2010.

## 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 Results of Testing of Basic Physical and Mechanical Properties for the Product**

| Property                           |                                            | Unit                             | Requirement              | Result <sup>1,2</sup>            |            |       |
|------------------------------------|--------------------------------------------|----------------------------------|--------------------------|----------------------------------|------------|-------|
| Dimensional change                 | Coefficient of linear expansion (thermal)  | Cm/cm/°C                         | $\leq 2 \times 10^{-5}$  | $3 \times 10^{-5}$ <sup>3</sup>  |            |       |
|                                    | Coefficient of linear expansion (swelling) | oven-dry to vacuum pressure soak | %                        | $\geq 0.5$ , by 80% of specimens | 0.00       |       |
| Strength and stiffness             | Modulus of elasticity (MOE)                | span-depth ratio within 18 to 21 | MPa                      | $\geq 750$                       | 1 868      |       |
|                                    | Modulus of rupture (MOR)                   | span-depth ratio within 18 to 21 | MPa                      | $\geq 9$                         | 26.7       |       |
| Creep, recovery and load duration  |                                            | %                                | $\leq 25$ for creep      | 39                               |            |       |
| Strength and stiffness after aging | Weathering                                 | impact resistance                | %                        | $\geq 75$ of non-weathered value | 103        |       |
|                                    | Accelerated aging                          | MOE and MOR                      | %                        | $\geq 50$ of non-aged value      | 140        |       |
|                                    | Fastener holding capacity                  | grooved                          | nail withdrawal strength | N                                | $\geq 600$ | 1 218 |
|                                    |                                            |                                  | lateral nail strength    | N                                | $\geq 720$ | 1 870 |
|                                    |                                            | solid                            | nail withdrawal strength | N                                | $\geq 600$ | 3 646 |
|                                    |                                            |                                  | lateral nail strength    | N                                | $\geq 720$ | 2 039 |

#### Notes to Table 4.1.1:

- <sup>1</sup> Average test results of six specimens, except for the "Creep, recovery and load duration" results that are from three specimens.
- <sup>2</sup> Test results were obtained to classify the product and are not intended to be used as engineering design properties.
- <sup>3</sup> Deemed as an acceptable performance based on manufacturer's gapping installation instructions.

## 4.2 Performance Requirements

**Table 4.2.1 Results of Testing of Performance of the Product Under Both Concentrated Static Loads and Impact Loads**

| Property                    |                 | Requirement                |                                            | Result <sup>1</sup> |                                    |
|-----------------------------|-----------------|----------------------------|--------------------------------------------|---------------------|------------------------------------|
|                             |                 | Minimum Ultimate Load (kN) | Maximum Deflection Under 0.89-kN Load (mm) | Ultimate Load (kN)  | Deflection Under 0.89-kN Load (mm) |
| Concentrated load           | decking at 50°C | 2.45                       | 2.0                                        | 2.35                | 6.34 <sup>2</sup>                  |
|                             | decking at 20°C |                            |                                            | 2.98                | 2.99                               |
| Impact load of 102 N·m (kN) | decking at 50°C | 1.78                       | 2.0                                        | 2.45                | 9.5 <sup>2</sup>                   |

**Notes to Table 4.2.1:**

- <sup>1</sup> Test results for planks with supports at 400 mm o.c.
- <sup>2</sup> Deemed acceptable. Although this result exceeds the 2.0 mm requirement, the additional deflection is not considered significant for material at 50°C.

**Table 4.2.2 Results of Testing of the Durability of the Product**

| Property          | Requirement                                                                                                                                                                             | Result     |                    |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------|
|                   |                                                                                                                                                                                         | SPF Lumber | “Armadillo”        |
| Bending stiffness | Mean percentage loss in bending modulus of elasticity (MOE) after ultraviolet (UV) exposure <sup>1</sup> and accelerated aging <sup>2</sup> must be less than or equal to spruce lumber | 0.2%       | 18.5% <sup>3</sup> |
| Bending strength  | Mean percentage loss in bending stress (MOR) after (UV) exposure <sup>1</sup> and accelerated aging <sup>2</sup> must be less than or equal to spruce lumber                            | 9.2%       | 7.4%               |

**Notes to Table 4.2.2:**

- <sup>1</sup> 4 500 hours of Xenon-Arc exposure following Cycle 1 of ASTM D 2565-99, “Standard Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications.”
- <sup>2</sup> Five cycles of accelerated aging (wetting, freezing, thawing and drying).
- <sup>3</sup> Deemed to be acceptable in comparison to percentage loss of stiffness in lumber after aging.

**Table 4.2.3 Results of Testing of Decay and Termite Resistance of the Product**

| Property           |                      | Requirement                                                                                                                                                                                                                                                    | Result              |
|--------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Decay resistance   | % loss in weight     | Mean percentage loss in weight and compressive strength after exposure to decay-causing fungi must be equal to or better than preservative-treated wood conforming to CAN/CSA-O80.1-M97, “Preservative Treatment of All Timber Products by Pressure Processes” | Passed <sup>1</sup> |
|                    | compressive strength |                                                                                                                                                                                                                                                                |                     |
| Termite resistance |                      | Rating must be equal to or better than preservative-treated wood conforming to CAN/CSA-O80.1                                                                                                                                                                   | Passed <sup>1</sup> |

**Note to Table 4.2.3:**

- <sup>1</sup> Data presented was not in accordance with CCMC’s evaluation requirements, however the test results submitted demonstrated a resistance to decay-causing fungi that was deemed to meet the intent of CCMC’s requirements.

**Table 4.2.4 Results of Testing of the Product Performance Under Concentrated Static Load – Stair Tread**

| Property          |                    | Requirement                |                                    | Result <sup>1</sup>        |                            |
|-------------------|--------------------|----------------------------|------------------------------------|----------------------------|----------------------------|
|                   |                    | Minimum Ultimate Load (kN) | Maximum Deflection Under 1 kN (mm) | Applied Ultimate Load (kN) | Deflection Under 1 kN (mm) |
| Concentrated load | stair tread        | 5 <sup>2</sup>             | 13.5                               | 6.3                        | 0.67                       |
|                   | stair tread nosing | 5 <sup>3</sup>             |                                    | 8.3                        |                            |

**Notes to Table 4.2.4:**

- <sup>1</sup> Test results are for stair stringers spaced at 230 mm o.c. at a test condition of 50°C and 80% RH. Three specimens were tested for each test.
- <sup>2</sup> Applied through a 75-mm-diameter disk positioned at the centreline of the plank and midway between stringers.
- <sup>3</sup> Applied through a 38-mm-diameter disk positioned along the outside edge of the nosing at the stringer location.

**4.3 Additional Performance Data**

Data in this section does not form part of CCMC’s opinion in Section 1.

**Table 4.3.1 Results of Testing of Additional Performance Properties of the Product<sup>1</sup>**

| Property                                  |                                          | Unit                                                                                                            | Reference value         | Result                            |
|-------------------------------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------------|
| Coefficient of linear expansion (thermal) | longitudinal                             | cm/cm/°C                                                                                                        | $\leq 2 \times 10^{-5}$ | $3 \times 10^{-5}$ <sup>2</sup>   |
|                                           | Impact resistance (Izod impact, notched) | J/m                                                                                                             | $\geq 53.4$             | 37.0 <sup>3</sup>                 |
| Hardness (11.28-mm-diameter ball)         |                                          | kN                                                                                                              | $\geq 1.8$              | 8.1                               |
| Slip resistance                           | dry condition                            | ASTM D2394 -05(2011), Standard Test Methods for Simulated Service Testing of wood and Wood Base Finish Flooring | $\geq 0.5$              | 0.22 (with grain)                 |
|                                           |                                          |                                                                                                                 |                         | 0.26 (against grain)              |
|                                           | wet condition                            |                                                                                                                 |                         | 0.43 (with grain)                 |
|                                           |                                          |                                                                                                                 |                         | 0.54 (against grain) <sup>4</sup> |

**Notes to Table 4.3.1:**

- <sup>1</sup> Results provided in this Table do not invalidate CCMC’s opinion concerning the product’s compliance with the NBC 2010.
- <sup>2</sup> The manufacturer’s gapping installation instructions must address the linear expansion values.
- <sup>3</sup> The Izod impact is a small-scale test used to characterize the material. Very low performance values show a sensitivity to a loss of impact strength when the product is significantly damaged by a notch, cut or split. The results of the large-scale impact floor tests are the primary performance indicator with respect to floor impact loads.
- <sup>4</sup> Having fallen to 0.22 under the dry condition and 0.43 under the wet condition with grain, only the wet condition against grain met the 0.5 criterion. This criterion may not meet all occupant expectations. The manufacturer may be contacted for further information.

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