Sustainability Matters: The Need for Reusable Roof Insulation Systems

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Sustainability continues to become a greater focus for the building industry, as more data reveals its impact on the environment with greater clarity. Building materials are responsible for, by some estimates, 40 per cent[1] of all waste generated. Designers and manufacturers are beginning to recognize (or investigate) metrics such as greenhouse gas (GHG) emissions and global warming potential. Lifecycle assessments are gaining traction as a means to ascertain the impact of design choices on the environment. Focusing on these elements of building designs will continue to drive the need for innovative new materials that are reusable or recyclable and have longer functional life spans.

TYPES OF ROOF INSULATION TODAY

Roof insulation requirements have changed significantly over the last 30 years. In some areas of the U.S. and Canada, R-Value requirements for buildings have increased twofold.[2] This increase in R-Value requirements has, in part, been the driver behind the increase in polyisocyanurate (ISO) insulation usage. Other rigid board systems are still used, including perlite, wood fiberboard, and stone wool, but none of these boards provide the insulating properties of ISO. The challenge faced by all of these rigid insulation systems is reusability. Some rigid insulation systems may deliver positively on some attributes but less positively on others. For example, ISO has a current Long Term Thermal Resistance (LTTR) value of 5.6 per inch,[3] while perlite's R-Value is only 2.7 per inch.[4] Some rigid board insulations struggle with other attributes, including dimensional stability, fire resistance, moisture exposure, recyclability, reusability, and compressive strength.

Expanded polystyrene (EPS) and extruded polystyrene (XPS) boards, while having a slightly lower R-Value than ISO, at four per inch, can maintain their R-Value for multiple re-roofing cycles, in some cases. ISO's R-Value is calculated differently than any other insulation board and depends on the LTTR Value mentioned above, which is an average R-Value calculated over a 15-year period. Both EPS and XPS boards are recyclable and reusable, and they have lower impacts on GHG and global warming potential than most ISO and other rigid insulation options.[5]

Lightweight Insulating Concrete (LWIC) is a hybrid insulation / deck system that has been in use for over 80 years. LWIC typically uses an EPS board encapsulated in a base coat and top coat of lightweight concrete that will vary in thickness from one to two inches. This hybrid approach can positively contribute to many variables in building design, as can be seen in Figure 2 on page 24. LWIC, as with all other insulation systems, may be used in both new construction and re-roofing, as shown in Figure 2.

NON-RENEWABLE INSULATION MATERIALS IN THE LANDFILL

Landfill space is a subject of great concern as economies and populations continue to grow. CRC Research currently estimates the annual amount of waste generated in the U.S. and Canada at 285 million tonnes.[6] The building industry is responsible for approximately 40 per cent[1] of that value, which equates to approximately 114 million tonnes. And when it comes to roofing insulation, the Polyisocyanurate Manufacturers Association (PIMA) recently published an article stating that 54 billion board feet of ISO was installed from 2009 to 2019.[7] As Figure 3 on page 25 shows, when these boards reach the end of their service lives and must be removed from the roofs, landfills may be significantly impacted as a result of the low probability of recycling the boards.

GHG, GLOBAL WARMING POTENTIAL, AND EMBODIED CARBON

Insulation systems have begun to adapt to the environmentally focused demands of building design. Insulation manufacturers are moving away from blowing agents such as

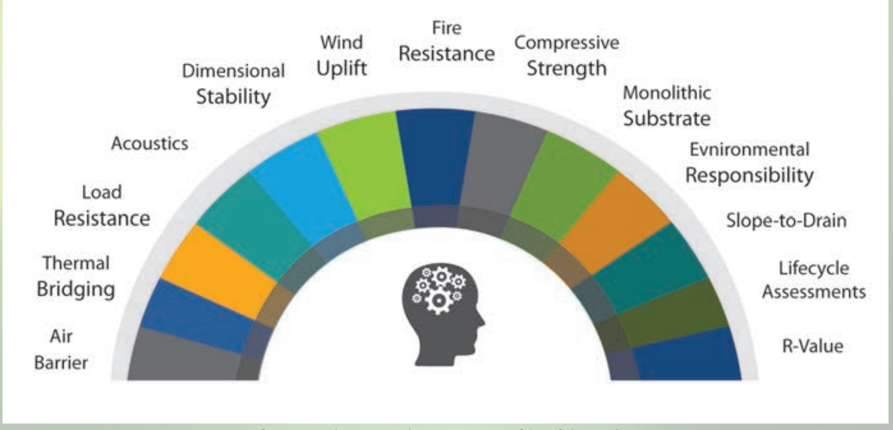

Figure 1. LWIC can positively contribute to these areas of building design.

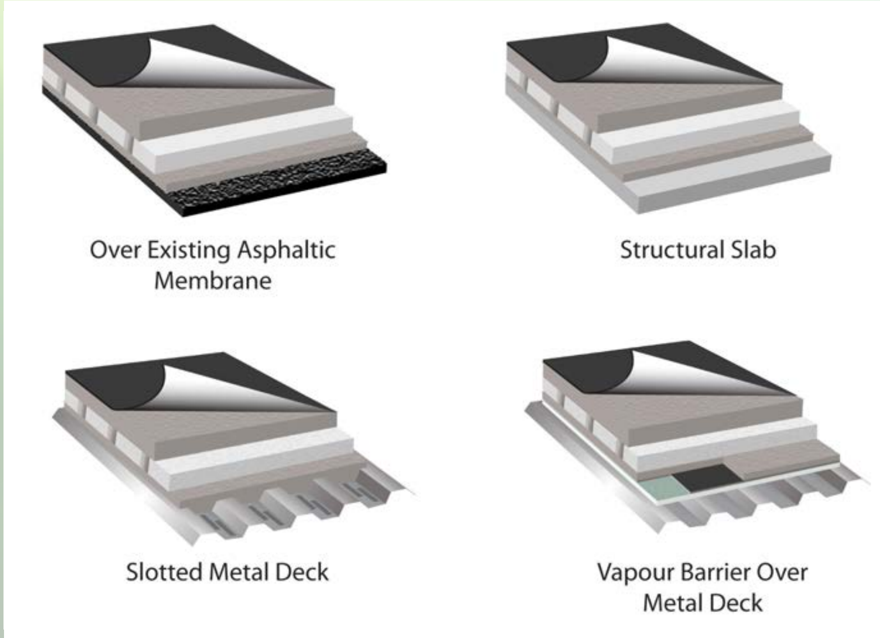

Figure 2. Some common new construction and re-roof LWIC assembly configurations.

hydrofluorocarbons (HFC) to less impactful options.[8] For example, an XPS board using an HFC 134a blowing agent will have a global warming potential value of over 1,400, while an EPS or ISO board using Pentane will have a global warming potential value of 7 or lower. Such changes are being pursued by manufacturers to comply with new regulations such as the Environment and Climate Change Canada regulation,[9] which focuses on the use of products with halocarbons that have a global warming potential value of 150 or more.

Until there is greater adoption of more sustainable roofing insulation, whether driven by regulation or market demand, designers may accelerate increasing use of sound environmental product decisions. Greenhouse gas, global warming potential, reusability, recyclability, environmental product declarations, embodied carbon, and lifecycle assessments are excellent qualifiers that should influence roof insulation product decisions.

BETTER USE OF CAPITAL TO BENEFIT THE COMMUNITY

Capital savings from reusable insulation systems in re-roofing scenarios, whether it is EPS, XPS or LWIC, are easily calculated and well-reported. For example, a major hospital in the southeastern U.S. had a pre-existing LWIC deck with a ballasted ethylene propylene diene monomer roof that needed to be replaced. During the re-roofing process, they diverted 718 tonnes of waste from landfills, reused 297,000 board feet of insulation, and saved over $200,000, earning recognition in the 2007 Environmental Protection Agency's Lifecycle Building Challenge.[10]

Another excellent example is a 44-storey, 13,700 square-foot roof in Toronto. A reusable lightweight insulating concrete deck system was installed on the project in 1975. When the roof reached its full life expectancy at 36 years of age, the re-roofing process began. Had this project used rigid insulation originally, the re-roofing process may have required removing the roof and board, bagging the discarded materials, and taking them off-site via a freight elevator, chute, or crane. None of these options come without significant cost implications. Thanks to the initial decision in 1975 to go with LWIC, only removal of the existing roof membrane was required. The LWIC system could be re-used and, therefore, may have saved nearly 209 cubic metres of waste from going to a landfill. The capital savings from diverting that waste and the labour savings related to tearing off rigid insulation was over $300,000, as can be seen in the chart on this page.

Stories about savings that result from reusable and / or renewable materials

SAVINGS OVER THE LIFE OF THE BUILDING USING LWIC

Location	Toronto
Year of initial installation	1975
Year of replacement	2011
Lifespan of roof membrane	36 Years
Initial installation cost (1975)	$ 134,543.00
Cost of replacement (2011)	$ 236,873.00
The 1975 installation costs by 2011 prices $ (4.1% inflation)	$ 571,593.60
Real cost of replacement as a percentage of initial installation	41%

are common, but the farther-reaching effects of choosing these materials are often overlooked. In addition to environmental benefits, capital savings can translate into much-needed supplies, equipment, and salaries for companies and institutions.

CALL TO ACTION

The notion of a circular economy is a good goal, wherein every part of the system focuses on the ability to recycle and reuse everything in the supply chain to the utmost efficiency. A great step toward this in building design includes ensuring the materials you are using can be recycled or reused. This regenerative approach can help reduce construction waste going to landfills and the impact of such landfills on our environment.

Roof insulation systems that cannot be reused or recycled can contribute to landfill waste. We now have opportunities to choose insulation systems that are designed to last more than 40 years and that are reusable and recyclable. These insulation systems, coupled with the added benefits of depolluting roof membranes, can create roof assemblies that play an active role in improving our environment. ■

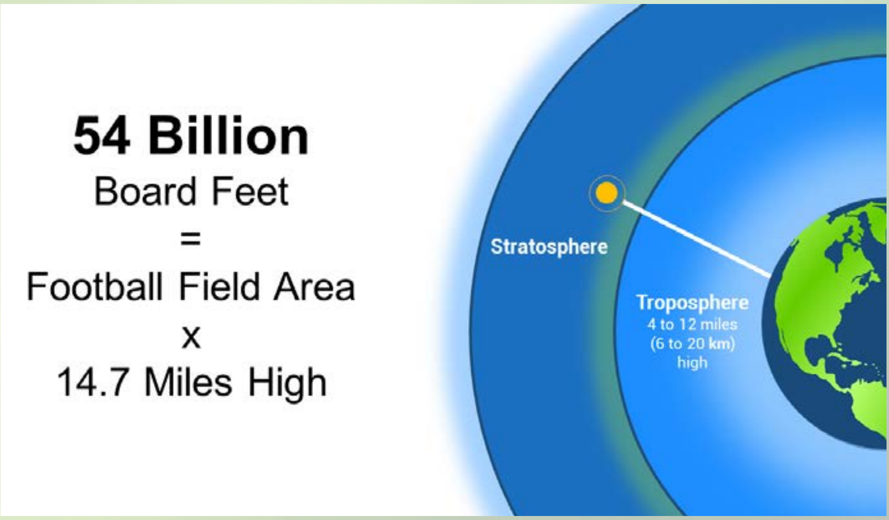

Figure 3. The amount of ISO roof insulation used in a 10-year period that could ultimately end up in landfills.

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REFERENCES

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