Designing for Future Reroofing: *Recommendations for Enhanced Sustainability*

By Thomas L. Smith, AIA, RRC

This article discusses design decisions that facilitate reuse and recycling of roofing components at the end of the roof's service life, and it discusses design decisions that minimize waste that is commonly associated with reroofing.

Introduction

Most professionals designing a new roof or reroofing project give very little thought to what happens at the end of its service life. Because of this lack of forward thinking, it is typically difficult to reuse or recycle various components of the roof at the end of its life. Lack of planning for the future also often results in the design of details and system components that do not facilitate future reroofing.

If designers deliberately take into consideration the eventual reroofing of the project that they are currently designing, decisions can be made that will facilitate future reroofing and promote several tenants of sustainable roofing, as discussed in the section below on sustainable roofing. Recommendations and examples of forward thinking planning are presented to inspire creative roof designers to explore this new facet of design.

Sustainable Roofing

At the Sustainable Low-Slope Roofing Workshop at Oak Ridge National Laboratory, Oak Ridge, TN, in 1997, a sustainable roof was defined as "a low-slope roofing system that is designed, constructed, maintained, rehabilitated, or demolished with an emphasis throughout its life-cycle on the efficient use of natural resources and the maintenance of the global environment."[1] In keeping with this definition, the full implementation of the sustainable roofing concept requires consideration of the following: raw materials extraction and processing, material production, material packaging, material transportation, roof system design, installation, maintenance, repair, recover or tear-off at the end of the roof's life, and reuse, recycling, or disposal of the tear-off materials.

In 2000, an international roofing committee working under the auspices of CIB/RILEM published a set of common principles for sustainable roofing. The committee identified 21 tenets that they grouped under three subheadings:

1. Minimize the burden on the environment,
2. Conserve energy, and
3. Extend roof lifespan.

Each tenet is described by a single sentence so that designers can quickly determine the major issues. Accompanying the list of tenets is a description that more thoroughly explains each tenet. Designers interested in emphasizing sustainable roof design are encouraged to review these.[2] Other general information on sustainable roof design considerations may be obtained in *Low-Slope Roofing II*.[3]

This paper focuses on design decisions that facilitate reuse and recycling of roofing components at the end of its service life, and decisions that minimize waste that is commonly associated with reroofing.

Structural Issues

When designing new buildings, the following items pertaining to the structural system are recommended:

- Design the structure with additional dead load carrying capacity so that, when the building needs to be reroofed, the structure can accommodate adding a new roof covering without the need for tearing off the existing roof covering.[4] With reserve structural capacity, the designer of the future reroofing project will have the option of re-covering versus tearing-off, provided the existing roof covering is a suitable candidate for re-covering. (For further general guidance on re-covering versus tearing-off, see *Low-Slope Roofing II*.)[5] A minimum additional allowance of 3 pounds per square foot should be sufficient to accommodate typical re-covering scenarios for low-slope roofs. (*Low-Slope Roofing II* gives the weight of common low-slope roof coverings.)[6]
- Slope the roof structure to provide slope for drainage, rather than specify tapered insulation. By doing so, the more expensive and labor-intensive tapered insulation will be eliminated from both the initial construction and in the future when the insulation is replaced.

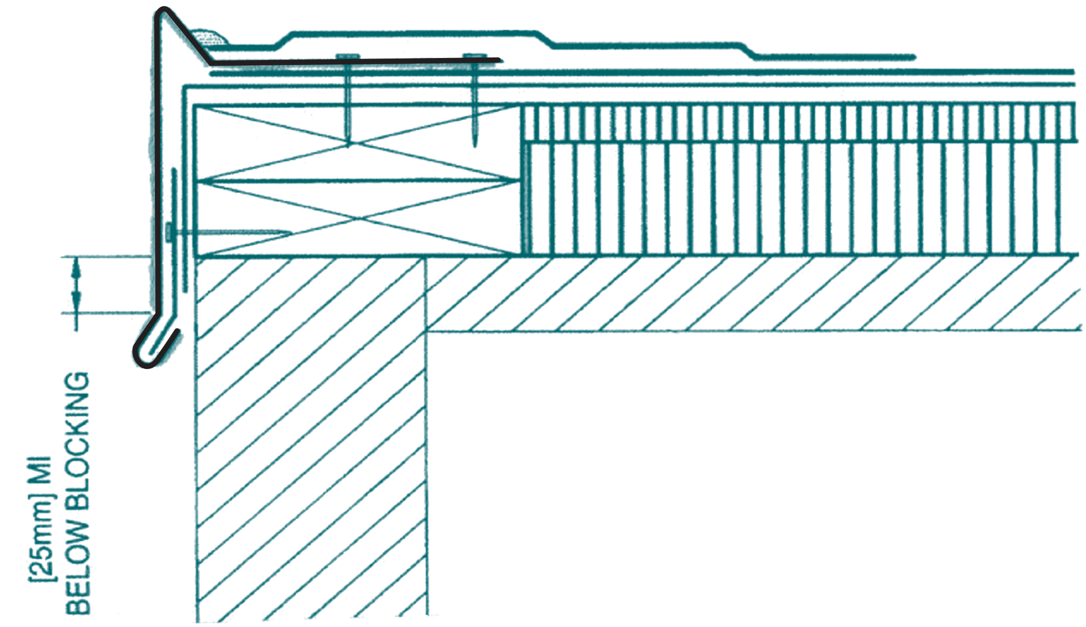


Figure 1: Because typical metal edge flashings are difficult to effectively reuse, they are typically recycled or deposited in a landfill.

Parapets, Reglets, and Weeps

Eight-inch high base flashings are typically recommended. However, by designing the height of parapets, reglets, and weep holes to accommodate an 11-inch minimum high base flashing, a future re-cover can be installed while maintaining a sufficient base flashing height without the need to raise parapets, reglets, or weeps.

Moisture Tolerance

Moisture can be inadvertently induced into the roof system during construction, and water often leaks into the system during its service life. The moisture can be very destructive to roof system components and/or the roof deck. To accommodate the common occurrence of moisture intrusion, the following are recommended:

- Specify moisture tolerant materials to the extent that it is practical and relatively economical.[7] For example, the following are recommended:
  - Specify preservative treatment for wood nailers at copings and edge flashings.
  - When specifying steel decks, specify galvanized G-60 or G-90 coating, or specify an aluminum-zinc alloy finish. G-90 is more conservative than G-60, and aluminum-zinc alloy is more conservative than G-90.
  - Rigid insulation: Plastic foam insulations are more moisture tolerant than perlite and wood fiberboard. Extruded polystyrene is the most moisture tolerant of the plastic foams. In lieu of specifying perlite or wood fiberboard for coverboards, it is recommended that consideration be given to rigid mineral wool (although this is not a common product in North America) or to glass mat gypsum roof board.
- For buildings that don't need a vapor retarder, consider specifying a self-drying roof system. A self-drying system allows for rapid downward dissipation of moisture (hence the roof deck needs to be somewhat permeable). It also needs to be composed of insulation materials that can accommodate some short-term accumulation of moisture without being damaged.

An advantage of a self-drying roof is that it can tolerate a moderate amount of roof leakage. After eliminating the leakage source (such as a puncture or small area of seam failure), the self-drying roof dries naturally, and the system components retain their integrity. In contrast, wet roofing material would have to be removed if a similar leakage occurred on a roof system that was not moisture tolerant or capable of self-drying. Another advantage of a self-drying roof is that when the membrane reaches the end of its service life, this type of system will likely be a suitable candidate for re-covering. For an in-depth discussion on this issue, see André Desjarlais' paper on self-drying roofs.[8]

Copings and Edge Flashings

It is recommended that copings and edge flashings be designed for reuse. While copings may be easily designed for reuse, special consideration needs to be given to edge flashings. Embedded edge flashings *(Figure 1)* typically do not lend themselves to reuse. Therefore, it is recommended that when designing edge flashings, consider designing a raised perimeter *(Figure 2)* or specifying a pre-engineered extruded flashing that can be easily removed and reused.

System Selection

At the end of a sustainable roof's life, much of the system should be capable of being reused or recycled; as little material should go to a landfill as possible. The preferred option is to reuse some of the old system in the reroofing project. Ballast, for example, is a component that is easily reused. Extruded expanded polystyrene from protected membrane roofs can also be easily reused, although the moisture content of a few of the boards may be too great to allow reuse.[9]

Various types of products can be recycled, such as metal roof panels, PVC membranes, and molded, expanded polystyrene (MEPS). However, currently some materials cannot be economically recycled if they are contaminated with other materials. For example, if a cover board is adhered to MEPS with asphalt, recycling is currently uneconomical. Therefore, to recycle MEPS, it would need to be loose-laid (such as in a ballasted system) or it would need to be mechanically attached, such as in a mechanically attached single-ply system.[10] MEPS could also be recycled when used in a built-up or modified bitumen system if the MEPS was protected by a mechanically attached cover board.

Other suggestions for design approaches to facilitate future roof system reconstruction and recycling are available.[11]

When selecting a system, in addition to considering future ease of reuse and recycling, it is important to consider system durability. Depending upon climatic conditions, a system that is readily disassembled and reused and/or recycled may compromise the system's durability. For instance, a mechanically attached single-ply membrane with MEPS insulation would be a poor choice for a hospital in a hurricane-prone region.

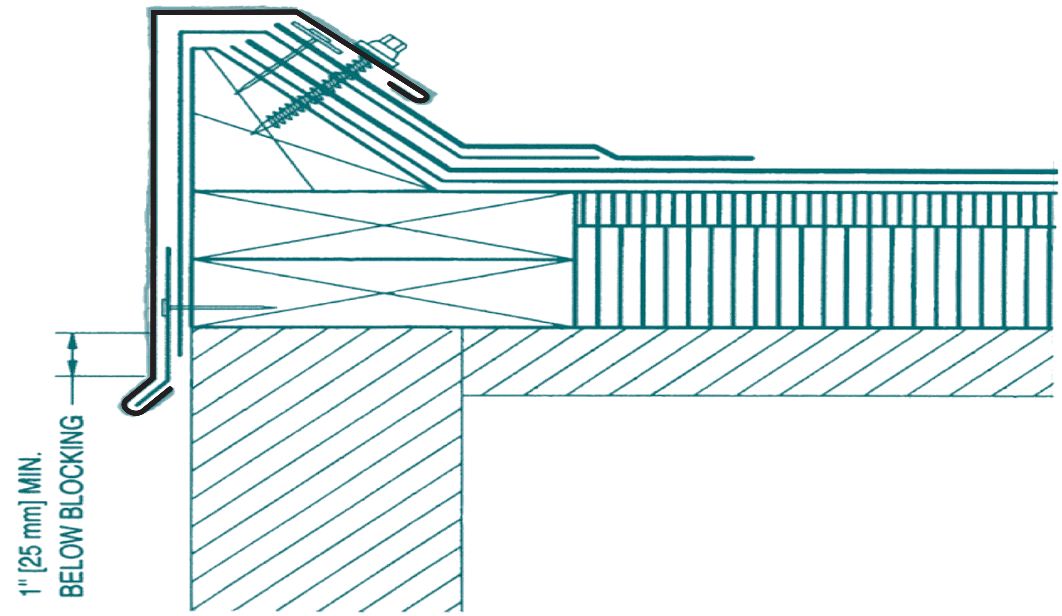


Figure 2: With a raised flashing, the metal edging can be removed and reinstalled during a future reroofing project.

Conclusion

Designers are encouraged to consider the future reuse and recycling of components at the end of the roof's service life and to make decisions that minimize waste that is commonly associated with reroofing. By doing so, future generations will more likely enjoy a friendly environment.

"He who cannot change the very fabric of his thought will never be able to change reality, and will never, therefore, make any progress."

— Anwar Sadat

Editor's Note: This article was adapted from a paper presented in June 2001, in Ottawa, Canada, at the International Conference on Building Envelope Systems and Technologies (ICBEST). The conference was organized by the National Research Council of Canada, Institute for Research in Construction. To purchase the proceedings, call 613-993-0435.

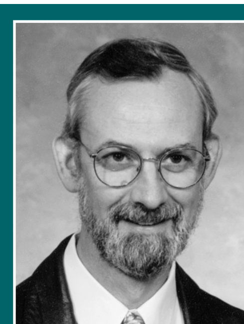
Footnotes

1. *Proceedings of the Sustainable Low-Slope Roofing Workshop,* CONF-9610200, Oak Ridge National Laboratory, Oak Ridge, TN, 1997.
2. Hutchinson, T.W., "Designing Environmentally Responsive Low-Slope Roof Systems to Exceed Anticipated Service Life," In *Proceedings of the International Conference on Building Envelope Systems and Technologies,* National

Research Council of Canada, Ottawa, ON, Canada, 2001.
3. Smith, Thomas L., *Low-Slope Roofing II.* National Council of Architectural Registration Boards. Washington, D.C., USA, 2001.
4 When the roof can be re-covered, energy is not consumed in removing and disposing of the existing roof covering, and the insulation value of the existing insulation is retained, thus saving energy and resources that would otherwise be needed to produce and install new insulation.
5 Smith.
6 Ibid.
7 Materials that are moisture tolerant are typically more expensive than materials that are moisture susceptible. However, moisture tolerant materials typically offer a much longer service life and therefore often offer a low life-cycle cost.
8 Desjarlais, A.O., "Self-Drying Roofs: What! No Dripping!" *Proceedings of the ASHRAE/DOE/BTECC Conference,* ASHRAE, Atlanta, GA, 1995.
9 Extruded polystyrene boards weighing moxre than 8 pounds per cubic foot should not be reused.
10 When using MEPS in a mechanically attached single-ply system without a cover board, a minimum density of 1.35 pounds per cubic foot is recommended. This density is provided by boards complying with ASTM C 578, Type II or IX.
11 Kyle, B., P. Kalinger, C. Boyle, and V. Catalli, "Toward Sustainable Roofs Via Design for Heightened Maintainability and Future Disassembly," *Proceedings of the XITH International Waterproofing & Roofing Congress,* IWA, p. 201, October 2000.

About the Author

Thomas L. Smith is president of TLSmith Consulting Inc. and is a licensed architect and a registered roof consultant. From 1988 to 1998, Tom was the research director for the National Roofing Contractors Association (NRCA). Prior to that, he was in private practice in California and Alaska. He has designed roofs from the arctic to the tropics and is an internationally recognized expert on wind performance of roof systems.



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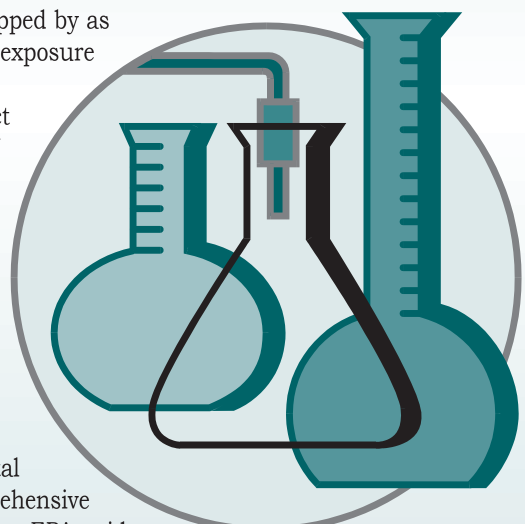
Cool Metal Roofing Coalition Plans Research

The Cool Metal Roofing Coalition is planning a research project aimed at collecting aged reflectance and emittance data from metal roofing materials in comparison to non-metal roofing products. This information will be shared with code officials in an attempt to change the standard degradation factors that are commonly used. Based on a metal roofing study conducted by the Oak Ridge National Laboratory, it has been reported that over a three-year period, pre-painted metal roofing shows less than 5% change in reflectance and emittance. In contrast, the reflectance of membrane roofing and coatings has dropped by as much as 40% over the same exposure time period.



The Coalition is in contact with the National Institute of Building Science, which is working with the General Service Administration (GSA) on a new Building Envelope Design Guide to be used in the selection of building materials and systems for all federal agencies. The Coalition is also working with the EPA to add cool metal roofing to its series of Comprehensive Procurement Guidelines. These EPA guidelines were developed as part of Executive Order 13101, which requires that federal procurement preference be given to products with recycled content.

