

The Poetry of Roof Failures



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What do engineers do for fun? I can't speak for them all, but this one occasionally reads poetry about roofing. Carl G. Cash, a well-respected roofing consultant who practiced in the Boston area, wrote a snappy little book simply titled, *Roofing Failures*. Now out of print, the book describes nearly 40 case studies Cash encountered over his career of 1500 roof failure investigations. It is part technical paper and part professional memoir with homework questions at the end of each chapter. The most charming part of the book are the interspersed haiku poems that Cash wrote to distill his lifetime of roofing observations to a mere 17 syllables each. He begins:

*Roofing is joyous
Always remember: it is
On top of us all!*

With that level of enthusiasm in mind, understanding your roof and its construction, expected life span, and maintenance requirements will reduce the chances that your roof becomes a future case study. In Carl's own words:

*Roofing is simple
Slope all surfaces to drains
Or they will leak.*

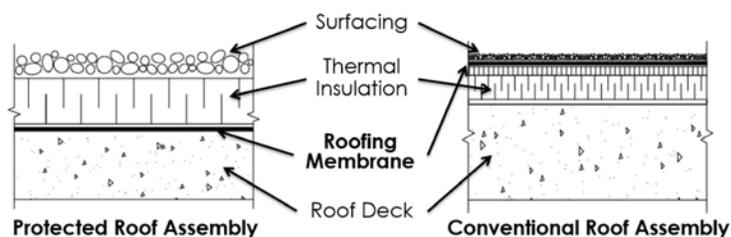
There are two broad categories of roofing: steep slope and low slope. Steep slope roofs have slopes of 25% (3 in 12) or greater. The exposed surface of these roofs may not be completely watertight, but rely on gravity and multiple layers to promote water shedding and drainage. They may be clad in asphalt or wood shingles, metal, slate, or tiles made of concrete or clay. These materials can have life spans from 15 years (asphalt shingles) to 60 years or more (slate). If roof leaks

occur during the roof's service life, it is generally due to flaws in the flashings at penetrations like vent pipes and chimneys, and at slope transitions like valleys and dormers. Rain runoff must be managed with properly designed eavestroughs and downspouts.

Low slope roofs are sometimes called flat roofs, but in fact, they should have at least a 2% slope towards roof drains to prevent accumulation of water or "ponding". Low slope roofs contain continuous membranes that must be welded, glued or taped at seams to keep them watertight. Think of the membrane as being in a bathtub configuration with roof drains at the lowest points on the roof. Life spans of membrane-type roofs are in the 15-20 year range, but can be longer if using enhanced materials and detailing or shorter due to weathering, abuse and neglect.

*Holes and gravity
Are the primary sources
Of all roofing leaks.*

There are two main types of low slope roof assemblies: conventional and protected. The diagram below shows the two types of low slope roofing assemblies:



The membrane of a conventional roof assembly is visible when you stand on the roof. You may see a white, grey, black or coloured granulated surface which likely means you have a modified bitumen-based membrane of two or more layers. A roof covered with dime-sized gravel embedded into a black asphalt-based membrane is likely a built-up roof (known as a BUR) consisting of multiple layers of asphalt and felt. Or you may see a black, rubbery surface, which is likely a single-ply EPDM membrane. There are many other membrane possibilities, but these systems are a few of the most common assemblies we see in the Eastern Ontario market.

On conventional low slope roofs, it is common to see puddles of water collecting in unintentional depressions on the roof surface. The rule of thumb is that if the water evaporates within 48 hours, it is of no concern. If the water lingers and keeps the roofing membrane saturated, the membrane can experience premature aging and failure. Owners can perform preventative maintenance by ensuring roof drains are regularly checked and cleaned to reduce ponding.

If you can't see the roofing membrane because it is covered in a layer of rocks or concrete pavers, you likely have a protected assembly, sometimes called an inverted roof. The membrane is applied directly to the structural roof deck (concrete, fluted steel, or in some cases wood sheathing) and then covered with insulation boards (usually extruded polystyrene foam) held in place with rocks or paving stones to anchor them against movement from wind uplift.

As the name implies, the membrane is protected by the insulation and ballast which can extend its lifespan if it is well-designed, installed and maintained.

*All insulation
 Requires firm adhesion
 Or it will go bye.*

The September tornados in the National Capital Region resulted in a number of roofing failures across the city. Though most systems are unable to withstand a direct hit from a storm of this magnitude, several failures in areas outlying the storms' centres brought to light the importance of detailed design and quality control to resist increasingly severe weather events. Even if damages are covered under insurance policies (not all are), upgrades that improve performance or energy efficiency are not covered. The re-roofing phase is a good time to look closely at the design and function of the roof and see if it is worthwhile to pay a little more to increase the lifespan of the roof with higher quality membranes or to reduce heating and cooling costs with higher insulation levels. Roofing consultants can help determine which is the best option for your project.

To sum up the book and one of Carl's best observations regarding roofing failures and how to avoid them:

*Materials don't fail
 They obey physical laws
 We don't use them right.*

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