An Overview of Steep-Sloped Asphalt Shingle Roofing

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Roofs are the building component most exposed to the elements and are, consequently, the building's first line of defense against rain and other environmental loads. While low-sloped roofing systems are more frequently discussed and have considerable market share in the industrial, commercial, and institutional building sectors, steep-sloped roofing systems are the dominant force in smaller and low-rise residential buildings.

Many different types of sloped roofing systems have been adopted and used throughout recent history. These roofing systems (e.g., tile, slate, metal, wood, asphalt, etc.) were constructed from different materials with varying installation methods. However, much of the hydrokinetic physics on how these systems work to keep water out of the building, and their design intent, have remained consistent. Let's look at the performance of steep-sloped roofing and the most common type of steep-sloped roof installed in North America today: asphalt shingles.

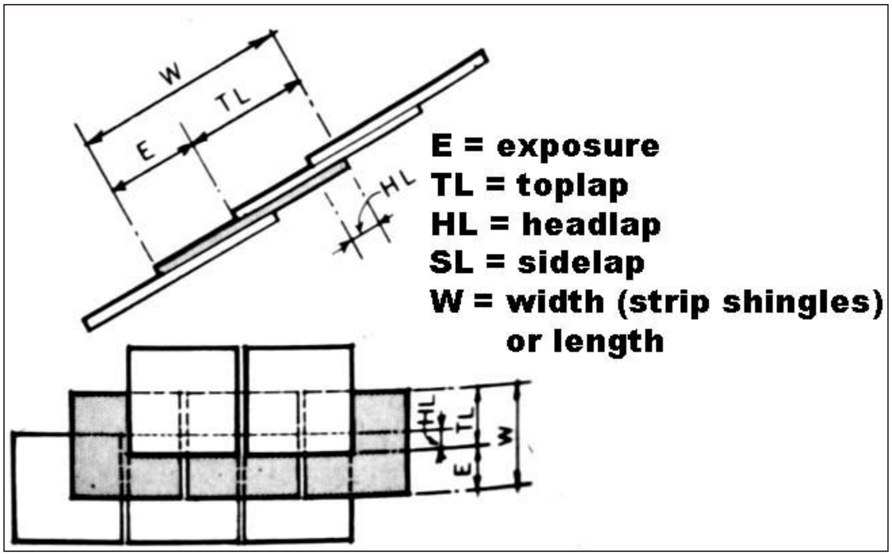
Roofs with slopes greater than a 3:12 pitch (14 degrees) are generally considered steep-sloped roofs. Steep-sloped roofing is a constantly evolving market, and many new(er) roofing systems are being developed and improved upon. Countless types of steep-sloped roofing systems exist in the market today, including tile roofing (clay and concrete), slate, wood shingles and shakes, standard asphalt laminated fiberglass, and styrene-butadiene-styrene (SBS) asphalt laminated fiberglass shingles, various types of metal roofing, and more.

These sloped roofing systems commonly incorporate the use of materials installed in a shingle fashion, with a headlap to shed water away from the building and minimize water entry. Contrary to low-sloped roofing systems, steep-sloped roofs generally function on the principle of water shedding (hydrokinetic) as opposed to being waterproof (hydrostatic). For this reason, most sloped roofing systems today employ the use of some form of underlayment membrane for any water that bypasses the primary shingled units. Different roofing systems have varying requirements and recommendations, in terms of the type and installation of underlayment, depending on the jurisdiction, roof pitch, and other factors.

ASPHALT SHINGLE BASICS

The history of asphalt shingles dates all the way back to the 1840s, when coal tar pitch was used to saturate layers of rag felts to produce a cheap and reliable composite waterproofing material. In the 1860s, the growth of the petroleum industry created an abundance of asphalt, which replaced coal tar pitch in roofing systems. The creation of the first true "asphalt shingle" is often attributed to the H.M. Reynolds Company, which started hand-cutting individual shingles in 1903 to make the installation process easier. Today, asphalt shingles are, by far, the most common roofing material used in steep-sloped applications, and they dominate the residential market in North America.

As with many other steep-sloped roofing systems, asphalt shingles rely primarily on water shedding. The shingle installations start at the eaves (i.e., the bottom of the roof) and progress upward, so there are positive laps (headlaps) to shed water. While asphalt shingles are generally manufactured



A diagram of the typical geometry of roof shingles.

A view of the adhesive strip between three-tab shingles not engaged and properly bonded.

with asphalt adhesive strips to help provide wind uplift resistance and a seal against moisture intrusion, it's not a watertight barrier. Therefore, a membrane underlayment is generally recommended below the shingles to provide an additional waterproofing layer for any incidental water that bypasses the shingles.

The basic construction of a modern asphalt shingle is essentially a reinforcing fiberglass mat saturated and sandwiched between coatings of asphalt. Various volatiles, admixtures, and fillers are added into the asphalt mix to enhance flexibility, durability, and waterproofing properties to the shingles. Surface granules are embedded into the asphalt weather-facing surface of the shingle to add ultraviolet and weathering protection, enhance fire resistance, and allow the shingle to be manufactured with varying appearances and colours.

In the past, organic reinforcing mats made of cellulose (paper) were commonly used as an evolution from rag felts. This material was gradually phased out over the years in favour of glass fiber reinforcing mats, due to their increased resistance to heat and humidity and their better stability. Standard asphalt laminated fiberglass shingles don't absorb as much moisture, and they deform less over time compared to organic shingles.

Asphalt shingles come in various types, with the most common being the three-tab and standard asphalt laminated fiberglass shingles. In recent years, three-tab shingles have become increasingly less common and are being phased out. Nowadays, standard asphalt laminated fiberglass shingles are generally preferred, due to their extra laminate layer (increased thickness and durability) and less unsightly deterioration from their more "three-dimensional" appearance.

LONGEVITY OF ASPHALT SHINGLE ROOFS

As with most products, the quality and type of raw materials used, along with the manufacturing process, play a significant role in the lifespan of the standard asphalt laminated fiberglass shingle. There are difficulties for specifiers in this regard, as most manufacturers don't publish the make-up of their asphalt shingle products for proprietary reasons. This makes for a difficult comparison of the various products available in the market. It's generally advisable to opt for manufacturers with a good reputation and proven performance, and / or to enlist the help of knowledgeable professionals.

Regardless of the type of product, asphalt shingles will deteriorate over time. This generally involves the shingles losing surface granules from weathering, exposing more of the underlying asphalt to ultraviolet degradation. As the asphalt dries by sun exposure, the shingles lose their essential oils and flexibility, becoming more brittle as the roof is exposed to changing temperatures. This leads to cracking and failure in the shingle.

A standard asphalt laminated fiberglass shingle can generally be expected to last around 15 to 20 years. Most manufacturers today also offer the option of an SBS polymer-modified shingle, which comes at a higher cost but can be expected to last 20 to 25 years or longer. The SBS rubber mixed with the asphalt emulsion improves the shingle's cold-weather flexibility, thermal shock

A three-tab asphalt shingle (left) versus an asphalt laminated fiberglass shingle (right).

resistance, and blow-off resistance in high winds. It also provides better adhesion to hold the surface granules in place and offers superior ultraviolet resistance.

A roof failure isn't necessarily related to the roofing product. In fact, an improperly / poorly manufactured shingle with a proper installation generally takes many years to result in a roof leak. By comparison, a good quality shingle with an improper installation can cause a roof to leak during the very first rainstorm. Some common contributors to non-product related shingle failures include inadequate attic ventilation, ice damming, improper nailing location and technique, and poor detailing around penetrations, walls, and other vulnerable transition areas.

Asphalt shingles can be a quality, well-performing steep-sloped roofing system. However, its performance depends on the design of the system, the products used, and their installation. A well-designed, quality asphalt laminated fiberglass asphalt shingle installed by a qualified roofing professional cannot only protect your building for years to come—it can also enhance the health of the building, its aesthetics and curb appeal, and increase the property value. ■

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