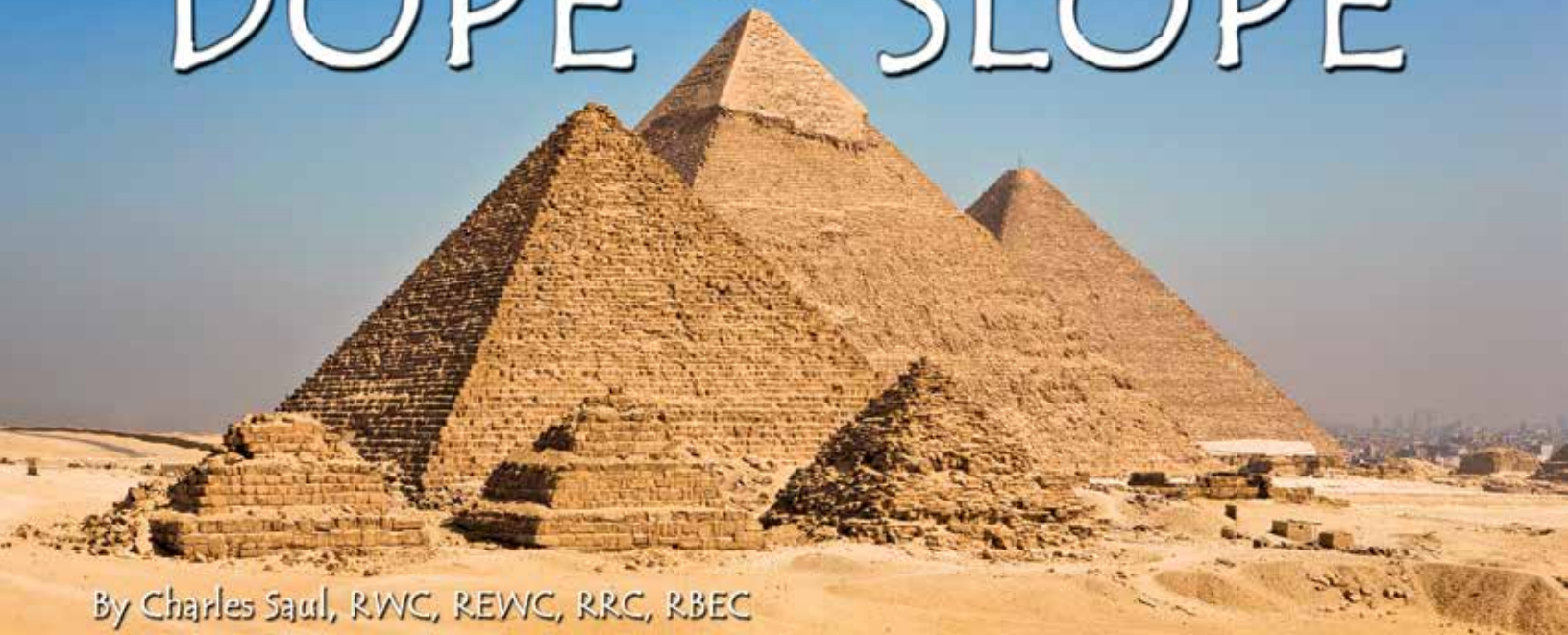


# THE DOPE ON SLOPE



By Charles Saul, RWC, REWC, RRC, RBEC

## INTRODUCTION

We all recognize a 45-degree ( $45^\circ$ ) angle, which is a common diagonal, miter, triangle, or pyramid. But what does one make of a 12 pitch, a 1:1 slope, a vertical slope, or a 100% grade? These are all the same angle, as described in the vernacular of different trades. For the nonmathematician (but math-curious), the author presents a primer regarding slopes, discusses common roof-slope terminology, and has assembled a user-friendly diagram of various construction slopes and their relationships.

## A (VERY) BRIEF HISTORY OF SLOPE

Early units of measurement were, as today, not universal. Any marking stick would do, so long as everyone on the project used a similar stick. When used on angle, a marking stick divides spaces evenly without measurements or math; for example, pickets are spaced evenly using this method. Early buildings may have been built square by pulling a rope the same distance between opposite corners, or the realization that a 3, 4, and 5 triangle provides a square corner. Inevitably, the framing square provided “rise to run”; thus, an angle could be measured and duplicated faithfully without knowing the angle of degree.

Horizontal (from “horizon”) or “level” provides a constant from which slope can be measured and universally duplicated.

Level might have been determined utilizing any rudimentary container; a ditch filled with water could determine level over great distances. Vertical (plummet) or “plumb” could readily be determined using a string and a rock. Such ancient methods may seem primitive by today’s standards, but the beauty is that the results were exact. For example, a spirit level of the modern era is more convenient but less accurate. With rudimentary skills and devices, any angle or slope could be described, constructed, and duplicated with fidelity.

From days immemorial until recently, slope was intuitively constructed in order to shed water. A flat roof then, as now, would puddle and leak; or just as typically, the puddle might grow until the weight of water would burst through. The simple act of providing slope reduced potential load, allowed increased spans, and let our early brethren contractors sleep easy lest they receive the proverbial call in the middle of the storm.

Ideally, slope might be expressed in a universal way—by degree ( $^\circ$ ), for example. Fortunately for experts and unfortunately for laypersons, slopes are expressed in several separate and arcane lingos of the specialty trades.

## SLOPE

Elementally, slope is any surface rise from level. Slope is typically illus-

trated using three lines: vertical, representing rise; horizontal, forming a right ( $90^\circ$ ) angle; while a third connecting line represents the slope; thus, a right triangle is formed. The sloped line is the longest line (see *Figure 1*).

With this simple form, any angle, pitch, grade, ratio, or percentage of slope may be represented.

Even when the amount of slope is not known, visualizing the slope as the angled side of a right triangle is a key concept to describe and determine slopes.

Tradition plays a big part in construction. While it’s possible to learn new ways of doing things, time-honored methods or “trades” are handed down generation to generation. Some of these methods become habitual or common, such as finding square ( $90^\circ$ ) using multiples of 3, 4, and 5 (Pythagorean triples) or drawing an ellipse using two nails and a string.

Locating the rise and run on a framing square provides rafter angles necessary for ridge, seat, and tail cuts.

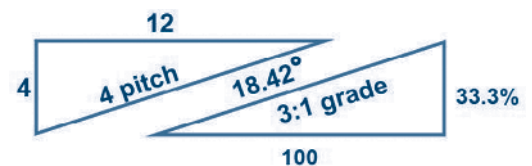


Figure 1

## PITCH: ROOF FRAMING AND ROOFING

Pitch is generally associated with roof slopes, expressed as the vertical inches per 12 inches horizontal (alternately in feet). "Four and twelve," "4 in 12," "4/12," "4:12," or simply "4 pitch" are interchangeable expressions of pitch. Roof pitches are typically expressed in whole numbers such as 1 in 12, 2 in 12, 7 in 12, and so forth. It is atypical to speak of fractions such as a 6½ pitch. However, when it is necessary to duplicate a pitch, the precise rise in 12 is measured.

Sight unseen, even a rough measure of a pitch speaks volumes to a roofer. The difference between a 2 and 12 pitch and a 7 in 12 pitch connotes entirely different materials, tools, skill sets, and safety issues.

Slopes expressed as pitches are 1 in 12 or steeper. A 1:12 pitch is four times steeper than a ¼-in.-per-ft. slope. Roof pitch terminology is further defined below.

### RISE TO RUN

"Rise to run," "rise/run," "rise in run" or the ratio "rise:run" describe the vertical measurement to the horizontal measurement. Rise to run such as 7¼ in.:11½ in. is commonly used in stair construction, where repetition results in the familiar sawtooth pattern. Using rise to run can assure all steps remain consistent, albeit not necessarily plumb and level.

Rise to run describes the sides of any right angle, so rise to run is commonly associated with the framing square. Connecting the two end points produces an angle that can be readily reproduced with fidelity. Thus, the sloped side of a right triangle is determined.

### SLOPE AS A RATIO

A ratio compares one factor to another. "Three parts sand: one part cement," is the same as saying, "one part cement: three parts sand." Either will get the job done. However, various trades use ratio (:) in only one direction. With framing, the rise is given before the run as in 4:12 (four in twelve) pitch, while with grading and landscaping, the run is given before the rise.

A 2:1 slope or "two-to-one slope" (50% or 26.57°) is 2 horizontal to 1 vertical—the typical maximum unretained earthwork. This is not to be reversed, since a 1:2 slope describes a 200% cut slope. Thus, various trades maintain their own vernacular.

In order to avoid confusion, graded slopes, for example, may be expressed as a

percentage or in degrees, which are unambiguous.

### PERCENTAGE (%) OF SLOPE; TANGENT AND GRADES

Similar to roof pitches expressed as the amount of rise in 12, grade is most often expressed as feet of rise per 100 ft. horizontal; or a percentage, as in, "7% grade for the next three miles." Thus, percentage of slope is often used in civil engineering and roadwork, from 1% to 100%.

While vertical or plumb (infinity) is 90° from horizontal, 45° rise from horizontal (or 1:1) is a 100% slope.

Any given section of a slope may be measured as a vertical rise to a horizontal run. The rise divided by the run determines the tangent or percentage of slope. Thus, in excavation, 2:1 is a 50% slope and 10:1 is a 10% slope. Tangent is particularly helpful to determine the percentage of driveway grades and transitions: 4 ft. of rise in a 50-ft. driveway is  $4/50 = .08 \times 100 = 8\%$ .

A 20% driveway slope is about the limit, while complex transition slopes are required so that vehicles will not bottom out.

Framers can convert a rise-to-run or a pitch to a percentage, but it's not of much use: 4 and 12 = 33% slope.

### ANGLE OR DEGREES (°) OF SLOPE

Angles of degree (°) are used in construction but are mostly the purview of planners, not so much builders. One of the reasons is that degrees of angle can be drawn on a plan easily; while on site, it is difficult to extend a line from a protractor for any appreciable distance without gaining error. This happens when an angle is defined from only one endpoint.

Another reason is that while a 100% slope is 45° or approximately a 2:1 ratio (a 60% slope is a 31° angle), the relationship between 1 and 45° (1/8 arc of a circle) and 100% of a rise or run is nonlinear; for example, a 20% slope is 11.3° (less than 2:1), while an 80% slope is 38.66° (more than 2:1).

So it is not easy to relate working with angles of degree and percentages, pitches, or ratios of slope, much as working with both metric

and American standards at the same time is difficult.

Rough angles may be transferred with a speed square (carpentry) or with a hickey (electrician), and precise angles may be cut with a chop saw. However, aside from a few common angles such as a miter, degrees are typically the domain of the land surveyor, where degrees (°), minutes ('), and seconds (") are commonplace.

More often, once an angle is found, either a template is made or the angle is simply measured to determine the rise to run.

An acute angle is less than 90°, while an obtuse angle is more than 90°. It would be great if a 60/30-degree angle was a 2 to 1 slope, but it isn't. Also, the math to convert percentage to degrees by hand can be quite a pursuit; it's easier to use arctangent on a calculator.

### X-Y AXES

Slope may also be expressed graphically as a ratio on an X:Y axes chart. Given two measurements, (the X [horizontal] axis and the Y [vertical] axis), one can illustrate the ratio Y over X, or an angle. Given three or more coordinates, the X-Y axes can plot a curve or a progression.

X-Y axes are frequently used in mathematics and science to graphically predict results yet unmeasured.

Rise over run are X-Y axes. A more complex example is a psychrometric chart.

X-Y-Z axes are used to illustrate three dimensions such as architectural renderings or to simply add a third factor such as height; length and depth; or distance, speed, and time.

### LENGTH OF SLOPE

Measuring rise and run, the length of slope (hypotenuse) can be determined. Rafters may be cut with precision. Use the Pythagorean Theorem ( $a^2 + b^2 = c^2$ ) in order

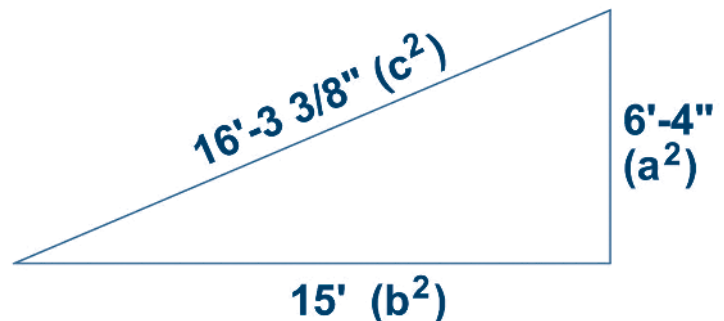
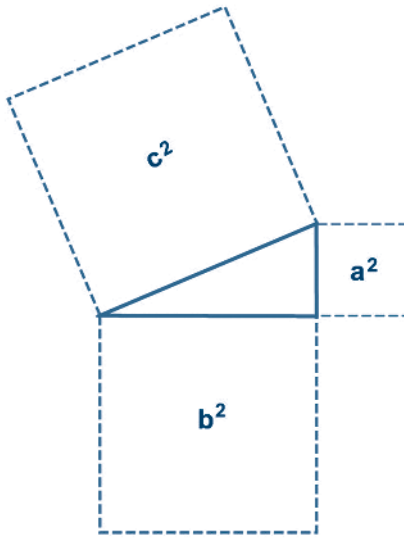


Figure 2



**Figure 3**

to find the length of the hypotenuse (c).  
For example (Figures 2 and 3):

**Take a 6-ft., 4-in. rise in a 15-ft. run**

**Convert to inches:  $76^2 + 180^2 =$   
**hypotenuse<sup>2</sup>:  $5,776 + 32,400 =$   
 $38,176$  (c<sup>2</sup>)****

**The square root of “c” is  
the length of slope.**

**Thus:  $\sqrt{\text{of } 38,176 =}$   
 **$195.386795869117$  in. =  
 $16$  ft.,  $3 \frac{3}{8}$  in.****

Feel free to exercise your long division fantasies. As an alternative, a construction calculator will provide the square root as well as convert to feet, inches, and fractions.

Length of slope is also important when doing an estimate or plan takeoff, because the quantity of material needed increases with pitch. Low slopes may require little more material while steep slopes will require considerably more. Roof elevation plans may indicate the pitch or measure the rise and run to determine the pitch.

The roof pitch chart in Table 1 provides the multiplier to convert flat roof footage to the sloped footage.

**ROOF PITCH MULTIPLIER  
(HYPOTENUSE DIVIDED BY 12)**

See Table 1.

Note: A hip roof may calculate to a bit less area than a gable, but hip roofs typically require more material due to hip overlap, waste, and continuous gutters.

**DEFLECTION AND CREEP**

Roofs are sloped to shed water and/or snow. A low-sloped roof exerts little outward force (rotation) against the top of walls, while pitched roofs develop increasing pressure up until 12:12 (100% or 45°), generally requiring stronger and/or more frequent tie beams. Conversely, pitches steeper than 12:12 develop decreasingly less outward force. Historically, very steep roofs were used to create relatively open and airy structures such as stone cathedrals.

Today, wide spans are readily achieved without steep roofs, which can be prohibitively tall and impractical. Mechanical equipment may be consolidated above the valuable conditioned spaces in penthouses, but large structures often require multiple mechanical platforms. Thus, placing equipment on low-slope roofing allows easy access for periodic maintenance that would be difficult and potentially dangerous on a steep roof.

In addition, as buildings have become islands unto themselves, outdoor spaces are increasingly built within the building footprint, creating flat surfaces such as roof decks and plazas. Simply applying waterproofing to flat structural decks is risking leaks, because puddles increase hydrostatic pressure with depth. One inch of water column presses against a membrane equivalent to a 45-mph wind pressure difference. Water pressure will challenge any imperfection in the membrane or the installation. Thus, even the most durable waterproofing materials benefit from slope to drain, which can eliminate hydrostatic pressure. Dampproofing applied to a slope to drain can easily outperform sophisticated waterproofing applied to a flat surface.

Water is heavy. One inch of water weighs 5.2 lbs. per sq. ft. If water is allowed

to accumulate, the weight can exceed the design loads and the structure can break. Thus, throughout history, almost all substantial buildings were constructed with liberally sloped surfaces to ensure that water would not accumulate.

Slope generally directs drainage off the edge or into a drainage system. Providing ¼-in.-per-ft. slope moves water while preventing hydrostatic pressure (in nonshow/ice environments). However, even a ¼-in. slope will puddle due to overlaps and cross slopes and because construction is not perfect. Horizontal building surfaces experience sag or “deflection” under their own weight or when added loads are imposed. Often, puddles grow or “creep” over time, turning into ponds, particularly on low-slope roofs and decks. Cycles of sag can increase creep, resulting in tremendous water weight and hydrostatic pressure, a recipe for disaster. Codes recognize this potential, so ¼-in. slope, properly sized drains, and failsafe overflow drains are required. A good practice is to provide a ½-in. sloped membrane where possible. Surface slope may be ¼ in. per ft.; or, in the case of pavers on pedestals, no surface slope is required.

A structural engineer may design a deck or roof structure to accommodate deflection to L/360—“L” being 1 in. deflection in the middle of a 360-in. span. Thus, a 15-ft. span is allowed to sag up to ½ in. Obviously with these numbers, camber should be built such that the allowed sag will not defeat the required slope.

Often, slope is added on top of a flat substrate in order to accommodate drainage. However, the original design loads can easily be exceeded. Thus, a structural engineer should be consulted when considering adding any weight to a structure.

All roofs in snow regions must be calculated to account for snow weight as well as snow turned to ice. In addition, ice can prevent meltwater from reaching drains, resulting in a dangerous accumulation of ice and water weight. Water is approx. 62 lbs./ft.<sup>3</sup>; ice, about 57 lbs./ft.<sup>3</sup>; and snow, about 15 lbs./ft.<sup>3</sup>.

1 pitch – 1.003	2 pitch – 1.014	3 pitch – 1.03	4 pitch – 1.06	5 pitch – 1.085	6 pitch – 1.12
7 pitch – 1.16	8 pitch – 1.21	9 pitch – 1.25	10 pitch – 1.31	11 pitch – 1.36	12 pitch – 1.42
13 pitch – 1.47	14 pitch – 1.54	15 pitch – 1.60	16 pitch – 1.67	17 pitch – 1.73	18 pitch – 1.80
19 pitch – 1.87	20 pitch – 1.94	21 pitch – 2.02	22 pitch – 2.09	23 pitch – 2.16	24 pitch – 2.24

**Table 1**

## CREATING SLOPE

In wood construction, low-sloped roofs and decks are often created by setting rafters to the slope required and adding level-ceiling falsework below. Alternative methods involve adding tapers or sistering sloped joists. Roof features are often added “California style” by framing over the main roof sheathing. Consider providing ventilation for these and similar confined spaces. As an alternative to constructing slopes, tapered rigid insulation, lightweight insulated concrete, polymerized cement, or epoxy topping compounds may be used to create slopes and cross slopes.

Ordinary concrete toppings over structural concrete will not bond and will likely crack if under 2 in. thick. Special topping compounds and/or bonders are used to slope to a feather edge and adhere to the substrate. Structural concrete roof decks or decks supported by corrugated metal decking may be poured flat, with a sloped topping added; but decks are best built with slope, poured one thickness to drains and overflows.

## SLOPE CONCEPTS AND CONSIDERATIONS

- **Maintenance.** Tenant improvements, debris, and lack of monitoring or maintenance can undo the advantages of slope. A warranty never stopped a leak. However, a warranty or extra insurance may be required for low-pitched roofs. An uninformed, well-meaning improvement contractor can swiftly negate a roof's worthiness and warranty.
- **The elements.** Exposed roofing and membranes degrade from sun, heat, and ultraviolet light (UV). Membranes may crack under freezing conditions. Wind uplift can flutter or destroy ballasted or mechanically fastened membranes. Condensation can deteriorate substrate materials.
- **Daylight drainage.** Always provide drainage sloped to daylight when it is available. An effective drainage system will likely outperform waterproofing. Gravity drainage can be permanent. Slope and gravity are generally free, and together they can be permanent. Therefore, slope is smart and slope is “green.”
  - The author observed a damp crawlspace served by a sump

pump. Reportedly, the electric bill was out of sight. The request was to design a dampproofing system to cover the soil. In fact, the pump was actually dewatering the entire neighborhood; all the while, daylight drainage was available.

- **Drainage is two-way.** Frequently, there is a failure to realize that water that can drain out may also drain in. This is often the case with foundation drainage.
- **Drainage versus capillarity.** Drainage composites, gravel, perforated pipe, weep holes, cavity wall construction, through-wall flashings, and rainscreens are all designed to provide a path for drainage so that water cannot accumulate. They all provide a capillary break and eliminate hydrostatic pressure. Sand, road base, soils, and concrete provide capillarity and a water reservoir.
- **Ventilation.** Drying potential is an important consideration to mitigate condensation damage.
- **Air barrier.** An air barrier is an assembly or material that resists bulk air infiltration and exfiltration. Air barriers may be vapor barriers; but more typically, they breathe, allowing vapor diffusion on the order of 10 perms or more. Usually, air barriers are an exterior continuous sheet, liquid, or adhered materials or sheathing.
- **Vapor barrier.** A vapor barrier is continuous material that prevents air and vapor diffusion on the order of .1 perm or less. Typical vapor barriers are polyethylene sheeting, epoxies, dampproofing, or waterproofing.
- **WRB (weather-resistant barrier/water-resistant barrier).** This is material with a water resistance of 10 minutes or more (commonly 60 minutes). WRBs are meant to manage incidental water only.
- **Flashings.** Material that deflects or redirects water and is weather-lapped or sealed. Typically, a component material that has a minimum water resistance of 24 hours.
- **Dampproofing.** A material or system resistant to water intrusion in the absence of hydrostatic pressure.

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Therefore, damp-proofing is often paired with a drainage system. At times, damp-proofing is employed to reduce the incidence of efflorescence.

- **Waterproofing.** A material or system that allows hydrostatic pressure on one side while remaining dry on the other. Manufacturers rightfully tout the quality of their waterproof materials. However, waterproofing consultants advocate redundancy. Almost any redundant system offers advantages to stand-alone membranes. This “belt and suspenders” approach is a response to the historic evidence of failures, which are more often flawed installations than product failures. Thus, sheet membranes are often paired with bentonite or concrete admixtures in order to provide redundancy. With waterproofing, longevity is a measure of value. Often, waterproofing cannot readily be accessed to repair it. Slope and waterproofing are distinctly different concepts; slope eliminates water pressure, while waterproofing resists it.
- **Leaks.** There are numerous definitions that attempt to qualify a leak: a certain quantity, duration, or damage sustained from uncontrolled water. Perhaps a universal definition is water being present where it’s not supposed to be.

### ROOF SLOPE TERMINOLOGY (LOWEST SLOPE TO STEEPEST)

**Roof.** From tents to palaces, the primary function of a roof is to provide shelter from the direct elements, weather, and pests. Secondary functions provide a controlled environment, privacy, and durability.

**Water retention systems.** Purposeful water collection is often associated with garden roof systems that detain water runoff and conserve storm drainage capacity. Water containment systems must be waterproof in order to resist hydrostatic pressure.

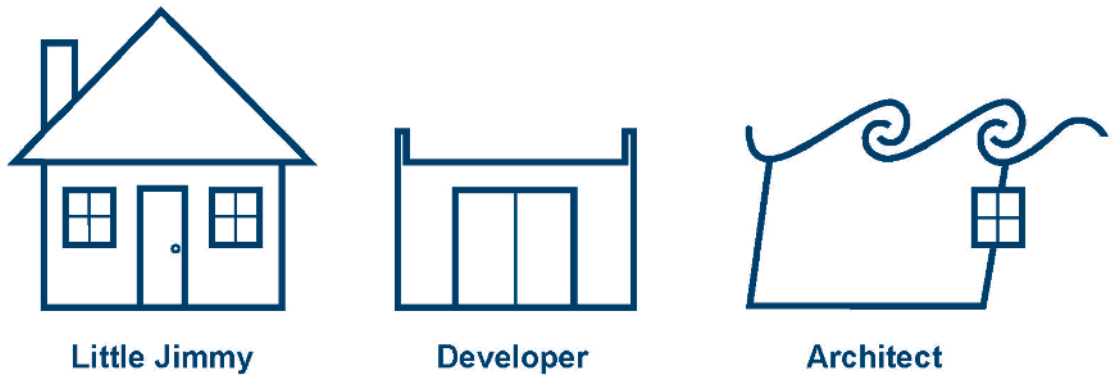


Figure 4 – In grade school, little Jimmy invariably will draw a house with a triangular-shaped roof. He has instinctually grasped the purpose of slope in “form-follows-function design.” Throughout life, Jimmy may hold such values close. But in alternate realities, Jim the accountant-turned-developer may value-engineer the design to the nth degree. Or perhaps James the architect’s fantasies come true.

**Puddle.** Surface that lacks drainage slope, resulting in puddles less than ¼-in. deep or that dry within 48 hours during drying conditions.

**Ponding.** Lacks slope to drain, leaving standing water more than ¼-in. deep for more than 48 hours during drying conditions, which is a code violation.

**Flat.** Zero slope to ¼ in./ft. slope. Some membranes function without slope, but most benefit from it.

**Low slope.** Sometimes referred to as “flat” but is meant to be sloped to drain.

**2% slope.** 1 unit rise in 50 or 1:50 slope. A 2% slope (1:50) is the most commonly specified hardscape slope; the Americans with Disabilities Act (ADA) maximum and minimum field slopes.

**¼-in. slope.** ¼ in. rise per running foot; 1 in. rise in 48 in. or 1:48 slope. One-quarter-in. is the typically specified minimum slope for pedestrian traffic coatings, split-slab waterproofing, and built-up roof (BUR) systems. In practice, surfaces undulate somewhat, so even a ¼-in. slope will likely puddle.

The terms “¼ in. in 12” or simply “¼-in. slope” are often interchanged with 2% slope. However, it should be noted that a ¼-in. slope or 1:48 is a bit steeper than a 1:50 slope, which is a true 2% slope ( $\frac{1}{4} \text{ in.} \div 12 = .021$ , or slightly more than 2% slope).

Code requires ¼-in.-per-ft. slope unless signed off by an engineer, or per ADA requirements.

One-quarter-in. slope is the min-

imum drainpipe slope for properly sized pipes. Under certain conditions, 1/8-in. slope may be used with oversized drainpipes.

One-quarter-in. slope is commonly referred to as “slope to drain.” Most deck and roof membranes fall into this category. As a result, cross slopes such as those formed by valleys or crickets are less sloped. Fire-rated assemblies are available.

This is a bit confusing, as 1:48 and 1:50 describe ratios, while in grading, the first number is the horizontal measure.

**½-in. slope.** One-half-in. per running ft. is a common maximum slope for a BUR, because fires spread faster on steeper slopes. Slopes greater than ½ in. carry additional fire rating restrictions. As compared with a ¼-in. sloped roof membrane, a ½-in. sloped membrane is likely to serve longer because it more positively sheds water. As a result, failed seams are less likely to leak.

**Lowpitch.** One-half-in. to 2:12 slope. Low-pitched roofs, typically 2:12 or less, generally have sealed membranes. However, some are simply water-resistant and not waterproof. Such roofs rely on consistent slopes without ponding.

2:12 is the limit for gravel ballast; wind scour can leave patches of roofing bare to UV degradation. As a result, fire resistance ratings are affected.

**3 pitch, 3 and 12, 3/12, which is also 4:1 grade (4 horizontal to 1 rise), 15°, or 25%.** A pitched roof traditionally has a 15° minimum

slope. However, 15° is only a 3¼ pitch. Roof pitches between 2 and 4 pitch are commonly referred to as “bastard” roofs, because they are too steep for gravel ballast to remain in place and too shallow for weather-lapped underlayments to resist leaks from wind-driven rains. This is the realm of membranes with granulated cap sheets, membranes covered with roof claddings, and metal roofs.

**4 pitch, 4 and 12, 4/12, which is also 3:1 grade, 33.3%, or 18.42°.** The ubiquitous 4 and 12 roof pitch meets most standard roofing applications. It is 4 inches of vertical “rise” for each horizontal “run” of 12 inches. Roofers recognize a 4 and 12 pitch as a comfortable roof to work on. Traditionally, such a roof was skip-sheathed and shingled, which was generally sufficient to shed water and to resist wind-driven rains. Such overlapping is referred to as “in shingle fashion” or “weather lapping.”

Valleys that intersect these pitches slope less, while directing the largest volume of water. Long valleys may need to widen towards the bottom to accommodate the volume. Therefore, consideration should be given to provide extra underlayment protection in valleys.

A 4:12 roof typically becomes a visible part of the structure, often rising several feet. Thus, curb appeal is often a consideration.

A 3:1 grade is the typical maximum slope for unrestrained landscaping, good moisture retention, and mowing.

The range 4:12 to 6:12 pitch is commonly called “standard pitch.”

**6 pitch, 6 and 12, 6/12, which is also 2:1 grade, 50% slope, or 26.57°.** Six and twelve is about the steepest pitch that can be comfortably walked or knelt on. Most roofing is applied shingle-style over a weather-lapped underlayment within this range. 6 pitch is generally the minimum slope required to shed snow. 2:1 slope is typically the maximum unretained cut slope.

**Steep-pitched.** 6 pitch is the typical minimum-required roof slope in snow regions to shed snow, thereby reducing the potential of collapse under the weight of snow and ice.

In nonsnow regions, steep pitches are all about appearance, status, even godliness. Imagine the Great Pyramids a more practical 4:12 pitch; they wouldn't be so great! With less than ½ in. of rain a year and very low humidity, shedding water evidently wasn't the point!

Steep-sloped roofs on the inverse create space. Often the slight difference between a 6:12 pitch and an 8:12 pitch is a functional attic.

Because steep roofs are so challenging to maintain, they are typically clad with the most durable and expensive materials, which also imbue quality.

Rainwater abrades as it washes down a roof, which accelerates wear at the eave. This is why slate roofs are traditionally crafted with thicker slates and/or narrower exposures near the eave.

**12:12 pitch.** In plumbing, 1:1 slope



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of the varied and often unique conditions: carpenters, sheet metal workers, plasterers, waterproofers, and roofers. Roofers in particular are specialized, and few, if any, can properly install every available type of roofing.

In some regards, it would be great if one material and one trade could accommodate all roof slope conditions, from flat to steep. In fact, there are a few. Copper and other dear metals have long served for gutters and roofing alike, but long expanses of flat metal roofing are problematic. Some liquid-applied materials (LAM) are ultraviolet (UV)-resistant and may be used from gutters to hog valleys to domes to spires. Single-ply thermoplastics are also used. Some are available in colors and even available with simulated standing seams. A downside may be color fastness.

In the chart in *Figure 5*, each trade will recognize its own familiar slopes and language. The chart makes the slopes and language of less familiar trades easy to translate and compare. For example, a 6:12 pitch familiar to one trade is a 50% slope, a 27° angle, or a 2:1 grade familiar to others.

### SUMMARY

Unlike nature, in construction, slopes do not occur by themselves. Typically, slopes are designed to shed water, create space, or for aesthetics. This article was an attempt to explain the different ways slopes are measured and defined among the various trades and to present a means to compare these differences. The ruminations herein are not comprehensive or conclusive. They are the general opinion of the author and are not advice for a specific project. Information is presented solely to spark the reader's curiosity for further evaluation. 

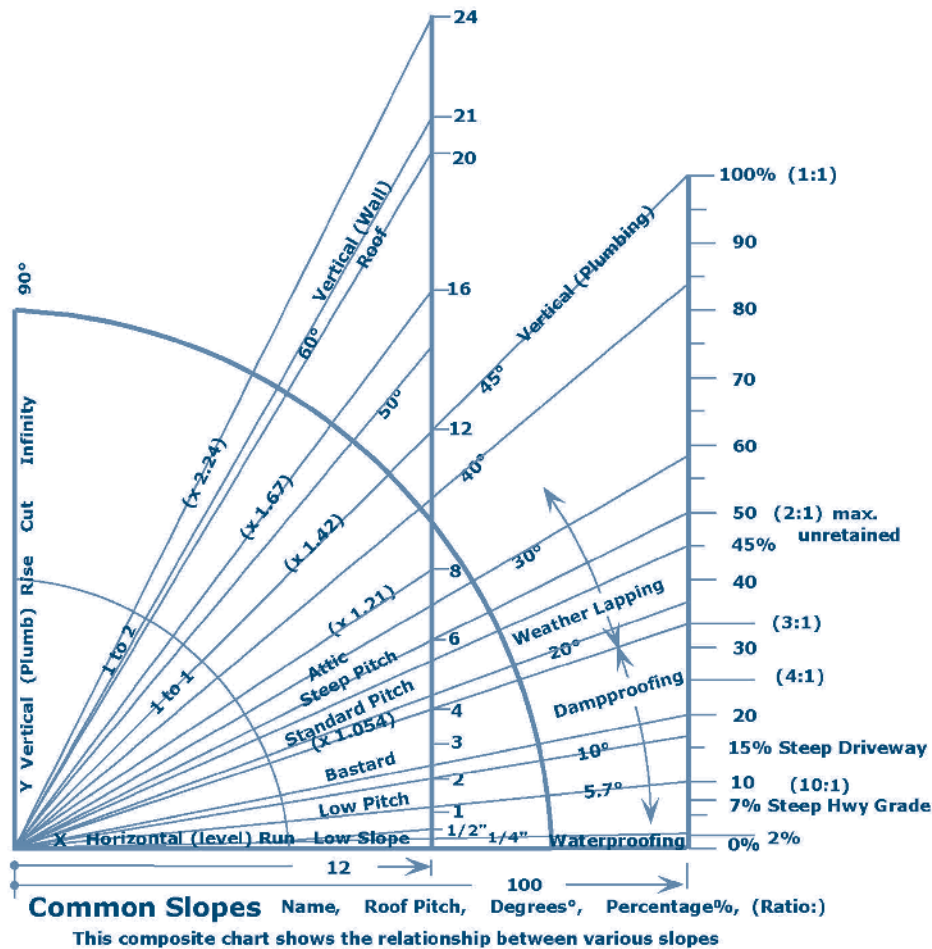


Figure 5

or a 45-degree angle is considered vertical.

- **Comparing low-slope to steep-sloped roofs.** A low-slope roof may leak or cause damage the moment a defect occurs. A roof with a standard or greater pitch typically provides longer protection with fewer inspections and less maintenance. Roof longevity is traditionally measured against a 20-year bar. However, a roof will wear based upon numerous factors. For example, a steep roof may be worn in 20 years but may continue to serve for many more years. **Multipitched roofing.** Design consideration should be given to running differing roof pitches into a hip or valley, as the roofing butt lines will misalign.

**Wall.** In roofing, a 21:12 pitch is considered vertical, or the point at which a roof becomes a wall. A 20:12 pitch is a 60° slope.

**Parapet.** Perimeter walls that contin-

ue above the roofline. Parapets can reduce wind uplift and roof scour, reduce the spread of flames from wall to roof and from adjacent structures, and can serve as safety guardrails for rooftop maintenance workers.

**Roof materials and labor.** Traditionally, roof slopes and associated roof conditions have been clad in an orchestration of diverse tradesmen utilizing a broad variety of materials for each

Charlie Saul, RWC, REWC, RRC, RBEC

Charlie Saul is a building envelope consultant and principal partner with Aquatech Consultancy, Inc., Novato, CA, specialists in waterproofing design and remediation. Saul has been a licensed general contractor since 1974 and spent the first 30 years of his career as a hands-on designer/builder specializing in high-end residential construction and renovation. He segued into consulting in 2004. In addition to being an RBEC, Charlie's other trade titles include AAMA Certified Window Installation Master, AWCI EIFS Inspector, and WESTCON past board member. Being a building envelope consultant, says Charlie, "Every day is a light bulb moment."

