CONSTRUCTION FORMULAS

These are formulas that I refer to almost daily. Some are extremely complicated, most are not. I explain in the CB (Carpenters Book) extensively about formulas and calculations. They are essential for proper construction. If you are in construction you need to print these out and carry them in your billfold for reference. I do.

When I show a formula such as πr^2=area (area of a circle) and you see the pi symbol, π, (3.14) [pi is calculated by dividing the circumference of a circle by its diameter] next to the r^2, this means you multiply the radiusxradiusx3.14.

Squared (^{2})means to multiply the factor (radius) times itself.

Third power ^{3} means to multiply the factorxfactorxfactor.

If you have a 6" radius you would multiply 3.14x36=113.04, the 12" diameter circle has 113.04 square inches in its area.

You may need to study these formulas for they are probably simple for some of you and not so simple for some of us carpenters.

First, some abbreviations:
π=3.14, a=area, d=diameter, c=circumference, w=width, h=height, l=length, Rs=rise, Rk=rake (hypotenuse), Rn=run.

To learn these formulas you willneed to do them a few times withyour own measurements.

The formulas are:

Circle:

$\pi r2$=area of a circle, πd=circumference of a circle

Let me explain this next one to you again until you get use to these formulas. The surface area of a ball is calculated by multiplying 4 times π times the radius of ball squared equals the area.

Example, an 8" diameter ball: 4π times 16 (4x4) = 201 square inches of surface area on an 8" ball. Painters would use this to figure how much surface area a ball shaped water storage tank has.

Ball:

$4\pi r^2$=a

$4\pi r^3 \div 3$=volume (r^3 is the radius to the third power. If you have a radius of 4, r^3 would calculate 4x4x4, third power is 64. 4x4=16, 16x4=64.

Cone:

LC÷2=a

$\pi r^2 L \div 3$=volume

Cylinder:

CL=a

$\pi r^2 L$=volume

Ellipse: (Egg) h÷2 times the w÷2xπ=area, h÷2 plus w÷2 times π= circumference

These are the most common shapes in construction, probably the ones you will be dealing with. Now, with this information let's go onto some more common formulas that you will actually use on the job.

I have had some engineers and architects tell me that there is no way to calculate the angle of

a triangle by only knowing two factors of the triangle. Read on.
We are going to use the most commonly known triangle in carpentry, the 3-4-5, 3"rise-4"run- 5"rake. These two formulas are from the Magic Circles in the Carpenters Book. Using the Magic Circles you can calculate distances using a transit level, calculate heights of buildings and structures without ever leaving the ground and find any factor in a triangle. It would take me 3 pages to explain the Magic Circles, so I am going to give you the two main formulas only. There are 16 of these in the CB, but these are the most common.
You need a "scientific calculator" to do these formulas with.
I use Casio scientific calculators (model fx 260), yours may be different, and these are only $9.
If you want the know the angle/rake of a right triangle (hypotenuse), enter the rise 5, then, shift, then R-P, (it's the plus button) then the run, 12, then equals, gives you 13, the rake, then click the, shift X-Y button (on the top in yellow markings) and this gives you the rise/rake angle 67.38°. To get the bottom angle, enter run first, 12, shift R-P [this is Radial-Polar] then enter 5, gives you 13 again, the rake, then hit shift X-Y, 22.61°.
Rn"÷12xpitch'=rise in inches
Rs'x12÷pitch'=run in feet
Rs"÷rn'=pitch in feet

Let's do a formula to get the pitch, like a common 5/12, five is the inches of rise per foot, 12 is the run.
We have a rise of 4', a run of 16'. 48"÷16=3, we have a 3/12 pitch.
One thing here, if you have a rise of 91" and you want to know how many feet this is, simply divide 91 by 12 and you will get 7.58 feet, now read below and learn how to turn this .58 into inches and sixteenths.
Now something that I covered in the CB again and again, if you take a regular calculator and you are calculating the diagonal (rake length of the footprint) [footprint is the overhead view of a building laid out on the ground] of a building such as a building 30'x50' and you enter 30x30=900 and then 50x50=2500, add these two sums, and then you get the square root of 3400 you will get 58.3. This is not 58' and 3". The .3 is three tenths of a foot. To change tenths of a foot to inches you multiply the tenths .3 times 12 and you get 3.6". Three inches and six tenths of an inch. To change the .6 tenths of an inch to sixteenths you multiply the .6 times 16 and you get 9.6, the answer is 58' 3" and 9. sixteenths.
This is one of the most common mistakes in laying out buildings. Something you don't want to forget. Some say this is trivial and doesn't have that big of an effect on a slab or footing.

It does to me, and should to you. If my calculator says the diagonal is 34.5', I am going to mark 34' 6". I am a carpenter not an estimator of heights and lengths.
One more calculation and this is the one that everyone needs to learn.
You nearly always know the run of structure or truss or triangle you are working with. The tread on a stair is the tread run; total run is the bottom measurement you calculated your treads with.
The run on this calculation is 12 and the angle we are using is 20. We need to know the rise of this angle.
Enter the angle (20) then push tan (tangent), push times (x) then enter the run (12) then equal and this gives you 4.37 rise.
>tan x run=rise
You will forget these formulas; I do, so I keep them on a card in my billfold.
It is a little embarrassing for someone to ask a carpenter to calculate a rise and he doesn't even know where to start.
I know these formulas and this article will help.

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