LINEAR MEASUREMENTS

U.S. Customary Unit	U.S. Equivalent
Inch (In)	1/12 foot
Foot (Ft)	12 In.; 1/3 Yard
Yard (Yd)	36 In.; 3 Ft.
Statute Mile (Mi)	5,280 Ft.; 1,760 Yds.

GUNTER'S OR SURVEYOR'S CHAIN

Chain Unit	U.S. Equivalent
1 Link	7.92 Inches
25 Links	1 Rod (Perch or Pole); 16 ½ Feet
100 Links	1 Chain; 4 Rods; 66 Feet
10 Chains	1 Furlong; 40 Rods; 220 Yds.; 660 Ft.
80 Chains	1 Statute Mile; 320 Rods; 5,280 Feet

AREA MEASUREMENTS

U.S. Customary Unit	U.S. Equivalent
Square Inch (Sq. In.)	1 Inch by 1 Inch; 0.007 Square Feet
Square Foot (Sq. Ft.)	12 Inches by 12 Inches; 144 Sq. In.
Square Yard (Sq. Yd.)	3 Feet by 3 Feet; 9 Sq. Ft.
1 Acre	43,560 Sq. Ft.
1 Standard Section	640 Acres; 1 Sq. Mile

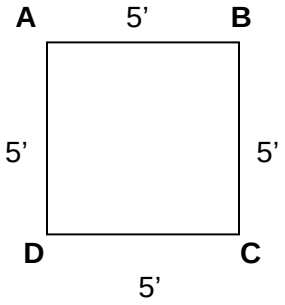
SIDE AND AREA MEASUREMENTS OF VARIOUS SHAPES

SQUARE: Four sides of equal length.

Four angles of 90 degrees.

Perimeter: 4 x AB: 4x5' = 20'

Area: Base (DC) x Height (AD)
5' x 5' = 25 Sq. Ft.



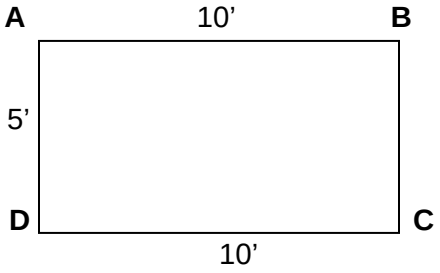
RECTANGLE:

Four sides, opposite sides must be equal to each other.

Four angles of 90 degrees.

Perimeter: 2 (AB + BC)
or 2 (10' + 5')
or 2 x 15' = 30'

Area: Base (AB) x Height (BC)
or 10' x 5' = 50 Sq. Ft.



RIGHT TRIANGLE:

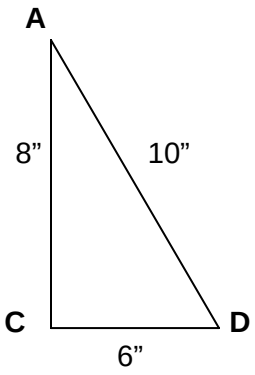
Three sides

Three angles, one of which is 90 degrees

Height: side adjacent to the right angle (AC)
Base: other side adjacent to the right angle (CD)
Hypotenuse: side opposite right angle (AD)

Perimeter: AC + CD + AD = 24 "

Area: ½ Base (CD) x Height (AC)
or ½ (6" x 8") = 24 Sq. In.



OTHER TRIANGLES:

Three sides

Three angles, none of which
Are right angles

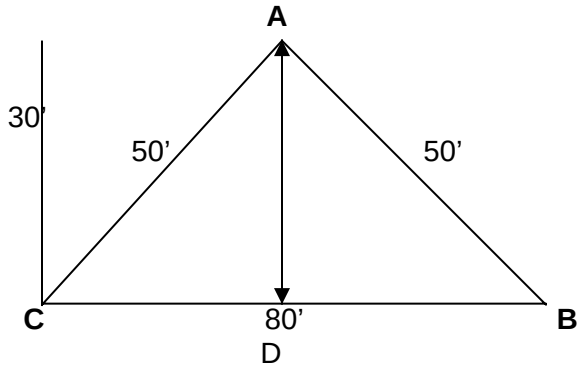
Base: BC

Height: a perpendicular line created at right angles to the Base intersecting the opposite angle. (AD)

Hypotenuse: both AC and AB are "false heights".

Perimeter: AC+ BC + AB
or 50' + 80' + 50' = 180'

Area: ½ Base x Height
or ½ (80' x 30') = 1,200 Sq. Ft.



PARALLELOGRAMS:

Four sides; opposite sides are
Parallel to and equal to each other.

No right angles

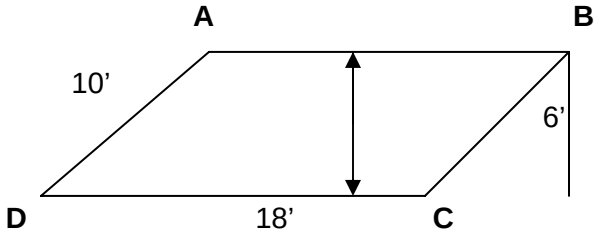
Base: CD or AB

Height: distance between bases at a right angle.

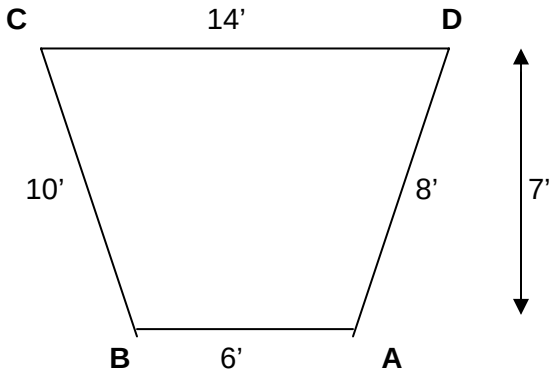
Hypotenuse: angled sides AD and BC

Perimeter: 2 (AB + BC)
or 2 (18' + 10') = 56'

Area: Base x Height
or 18' x 6' = 108 Sq. Ft.



TRAPEZOID:



Four sides of which only 2 of the opposite sides are parallel.

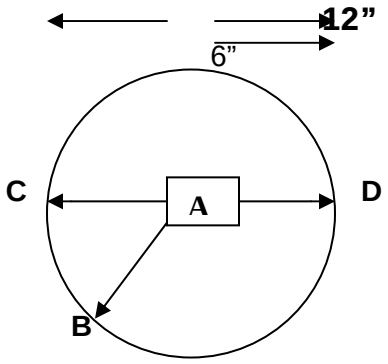
Base: parallel sides (AB and CD)

Height: distance between bases at right angles.

Perimeter: AB + BC + CD + AD
or 6’ + 10’ + 14’ + 8’ = 38 feet

Area: Height x the average of the Bases
or 7’ x (14’ + 6’) / 2 = 70 Sq. Ft.

CIRCLES:



Radius: (AB) distance from center to perimeter; half a diameter

Diameter: (CD) distance from perimeter to perimeter through the center.

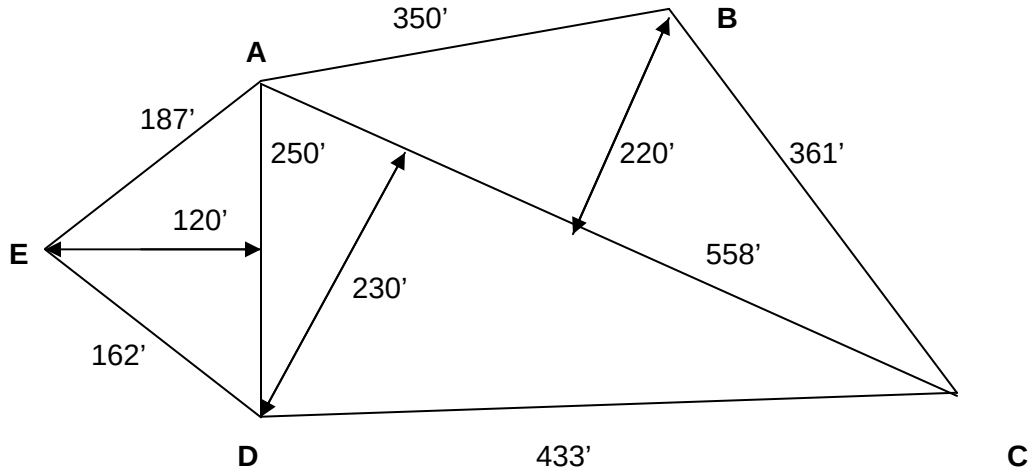
Pi: a standard property of circles: 3.1426

Perimeter: Pi x Diameter
or 3.1416 x 12” = 37.7 inches

Area: Pi x Radius squared
or 3.1416 x 6” x 6” = 113.1 Sq. In.

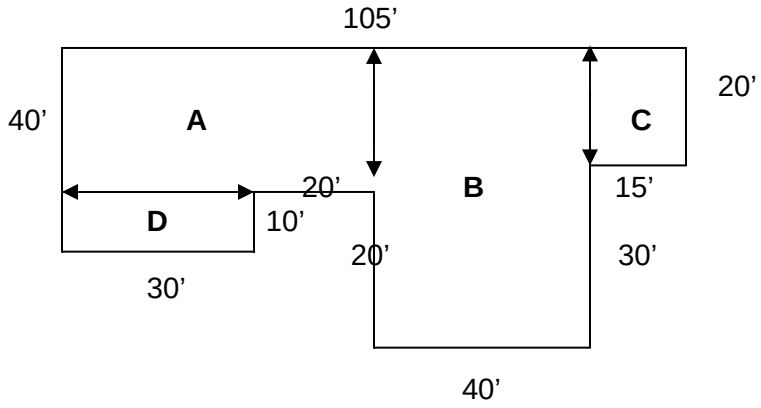
CALCULATING AREAS FOR IRREGULAR SHAPES

Break down the irregular shape into a series of squares, rectangles, and triangles. Simply add together the combined areas of the various shapes that compose the irregular shape to arrive at the total area.



By adding lines AC and AD, irregular shape ABCDE can be broken into three separate triangles. They are ABC, ACD and ADE. Next add the "dashed" height lines for each of the triangles. Measure the resulting heights and bases and you are ready to solve for total area as being the sum of the areas of the three triangles.

Area ADE = ½ (120' x 250") or 15,000 Sq. Ft.: Area ABC = ½ (220' x 558") or 61,380 Sq. Ft.; and Area ACD = ½ (230' x 558') or 64,170 Sq. Ft. Together they total 140,550 Sq. Ft.



Example 2 is a common appraisal problem for calculating the area of irregularly shaped buildings. In this case, the appraiser "breaks" the irregular shape into rectangles A, B, C and D. The area is the sum of their individual areas. "A" = 50' x 30'= 1,500 Sq. Ft. "B" = 50' x 40' = 2,000 Sq. Ft. "C" = 20' x 15' = 300 Sq. Ft. and "D" = 10' x 30' = 300 Sq. Ft. The sum of the four areas is 4,100 Sq. Ft.

MEASUREMENTS IN LEGAL DESCRIPTIONS
METES AND BOUNDS DESCRIPTIONS

This legal description system describes the boundary of a parcel using a series of distances and directions from known initial point or "Point of Beginning".

The method was brought to the original 13 colonies from Europe. Currently, Metes and Bounds descriptions are found when a parcel is irregularly shaped, not situated in a recorded subdivision, or is located in a non-urban area.

The term "metes" means measurements. The term "Bounds" means a limiting line. Together, Metes and Bounds simply means, "measurements and boundaries".

Critical to the system is the starting point or "Point of Beginning". To be effective, the Point of beginning must be long lasting, known to others, not subject to movement, and easily locatable in the future. Surveyed points, such as the intersection of Township and Range Lines, street intersections, or a County corner, are often used.

Natural or man-made points are also used for reference. Landmarks, such as fixed features of the landscape are commonly used. AS custom introduced from Europe and often used in colonial days, was that of the witness or "Flogging Tree". Troublesome lads were taken to Witness Tree to submit to a sound thrashing in the presence of an assembled group. The theory was that during his entire lifetime, the lad would never forget the location of that landmark. Today, occasionally a legal description referring to a Witness Tree is still found. Today, Witness Trees are more likely to be geographically prominent trees and not places of corporal punishment.

Often, surveyors have placed a permanent marker, called a monument, to locate these Points of Beginning. From the Point of Beginning (POB), a "call" is made in the form of a distance and direction to the first corner of the property to be surveyed. This first property corner is the "True Point of Beginning".

The description will then "call" direction and distance to each of the succeeding property corners. These "calls" will continue until the survey returns to the "True Point of Beginning". Tracing out the boundary of the property is called a "traverse". It is imperative that the last leg returns exactly to the POB. If it does not, the description is invalid as it did not "close". Without "closing", the parcel is not truly separated from all other property. The entire point of a legal description is to separate that one property from all other properties.

GOVERNMENT OR RECTANGULAR SURVEY SYSTEM

Shortly after the Revolutionary War, America was acquiring large tracts of the North American continent. The existing Metes and Bounds description system would be, at best, extremely cumbersome. A fast and simple way of surveying vast areas of the "Manifest Destiny" would need to be created.

In 1785 a committee of the Continental Congress, headed by Thomas Jefferson, developed a plan that would divide land into a series of squares. The original plan only provided for 6 mile by 6 mile squares of land called Townships. Subsequent Congressional acts refined the system and provided for the actual smaller divisions of the standard Township.

This survey system is the predominant land description methodology for all States west of the Mississippi River, other than Texas. Texas has a "Spanish based" land description system similar to Metes and Bounds.

The system first requires that a large land area is selected. The area may be a part of a state or several states depending on physical and political constraints. For example, all of Oregon and Washington fall into one measurement area.

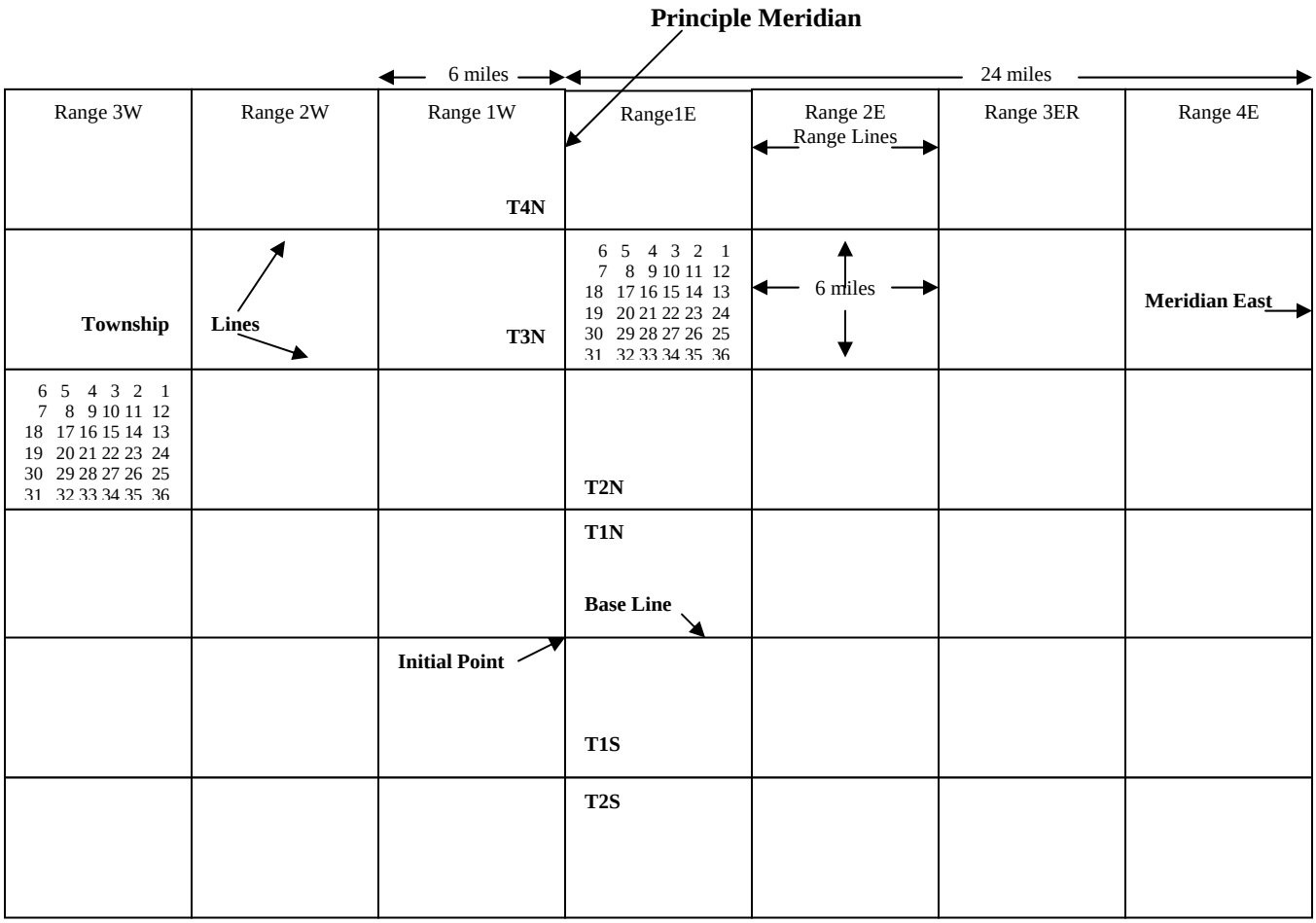
Once the area to be surveyed is selected, a Principal Meridian, a due north-south line is established. In Oregon and Washington, the Principal Meridian is called the Willamette Meridian. The Willamette Meridian lies just west of Portland.

Next, a due east-west line called the Base Line is selected. The point where the Baseline intersects the Willamette Meridian is the starting point for this legal description system. The intersection point for Oregon and Washington is marked with a monument called the Willamette Stone. It is located south of NW Skyline Blvd. at about NW 63" Avenue, or about 1mile NNW of the Sylvan area of Portland.

Township lines are then surveyed at 6 mile intervals north and south of the Baseline. Range lines are surveyed at 6 mile intervals east and west of the Willamette Meridian. A "checkerboard" of 6 mile by 6 mile squares is the result. Each of these squares is a Township. The Townships are numbered based on how many "tiers" of Townships north or south it lies from the Willamette Baseline and how many rows of Ranges it lies east or west of the Willamette Meridian. On the next page is an illustration where two of the Townships are subdivided into their 36 Sections. The upper one would be numbered T2N, R2W. The lower one would be numbered T3S, R2E.

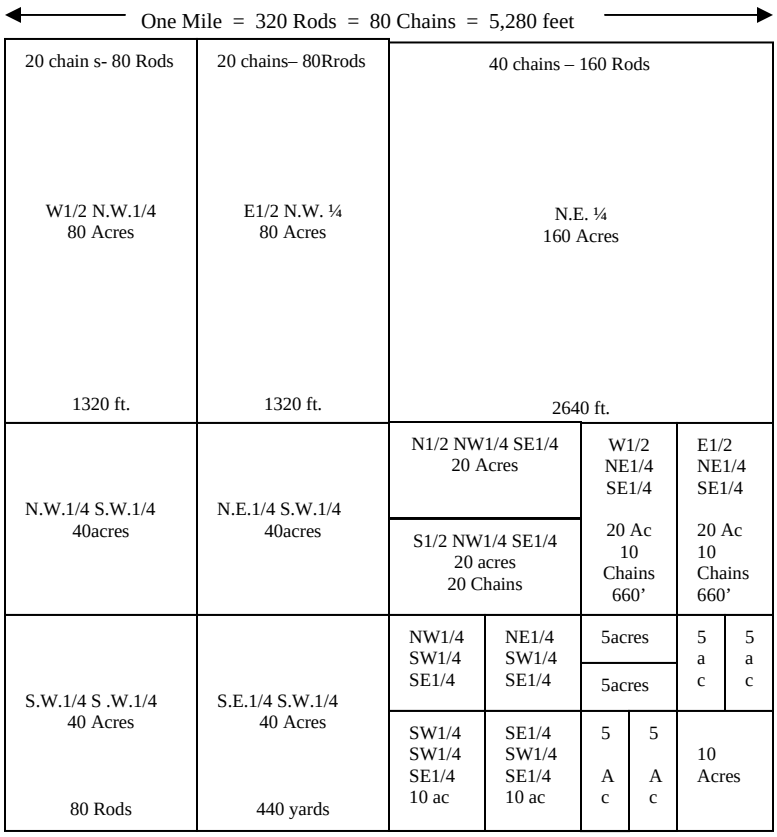
The system works perfectly on a flat surface, but these straight lines are being applied to a world that is round. The east-west Base line and Township lines stay parallel to each other, but the north-south Range lines converge as they approach the North and South Pole. The farther you move away from the Equator, the greater the rate of convergence.

To compensate for curvature convergence, a correction is made every 24 miles as you move away from the initial point. 24 miles is every 4th township. This 24 mile by 24 mile area is called a "Check". As you can see, a "Check" contains a block of 16 Townships. The east, south and west sides of the "Check" will be exactly 24 miles. The north side of a "Check" will be less than 24 miles.



The Townships are divided into 36 Sections. Each Section is 1 mile square. The Sections are numbered consecutively beginning in the NE corner of each Township. The numbering continues east to west, drops down a row and continues opposite from west to east. The back and forth numbering continues until the SE corner, Section 36, is reached. The corner Sections of a Township are always 1-6-3 1-36.

DIVISION OF A SECTION OF LAND



A Standard Section is exactly one mile on each side. It contains 640 acres of land. The eleven sections that are located on the west and north edges of a Township are slightly less than one square mile. They are where corrections for errors in measurements and alignment corrections for curvature of the Earth are shared. The other 25 Sections are normally Standard Sections.

A quick and easy check for the proper acreage contained in a division of a Standard Section is to multiply the denominators (the lower number in a fraction) and divide into 640 acres. For example, W112, NE114, SE 114 = ????? acres. 2 x 4 x 4 = 32 640/32 = 20 acres

Be careful when reading these descriptions. A comma means "of the", or a division of, while a semi-colon means "and the", or a second parcel. For example: NW ¼ SW ¼; SE ¼ NW ¼ SE ¼ should be read "The Northwest quarter OF THE Southeast quarter AND THE Southeast quarter OF THE Northwest quarter OF THE Southeast Quarter". This describes a 40acre parcel and a 10 acre parcel. The total is 50 acres. But if the reader were to miss the semi-colon, they could wrongfully conclude that the description is for one parcel of only 0.625 acres.

LOT AND BLOCK SYSTEM

This system of legal descriptions derived from the Rectangular Survey system and usually is found in urban settings. It originated as the community grew. Land developers had their tract surveyed and platted into blocks and lots. The Plat Map provides for streets and possibly public areas such as open space or parks. Each Block and Lot is numbered for identification on the Plat Map. The Plat Map is filed with the County Recorder. This recorded Plat Map becomes the official permanent reference. The Lot and Block system is simple and convenient. An example might read:

"Lot 6 and Lot 7 in Block 12 in Spangler Ridge Estates, a subdivision of the Southwest Quarter of the Northwest Quarter of Section 18, Township 4 South, Range 1East of the Willamette Meridian in Clackamas County, Oregon."

CENTERLINE DESCRIPTIONS

The Right of Way maps that we use at Oregon Department of Transportation base the legal description on the surveyed centerline of the highway. It starts from known monuments, and then describes the centerline much like a Metes and Bounds description. It is quite common to have several centerlines in a given stretch of highway. Each one will relate back to a different project that has taken place in that area. Be sure you know which centerline is the basis for your current descriptions.

Once the centerline is established, it is given "stations" every 100 feet down the length of the centerline. Fee takings and easements are described perpendicularly to given station points. An example would be: "A strip of land lying 40 feet to 50 feet west of the ABCD Centerline".

The two most common math errors concerning centerline descriptions involve "project related improvements" and "remainder parcels".