Yildiz Technical University
Faculty of Civil Engineering
Department of Geomatic Engineering

TOPOGRAPHY (HRT3351)

Lecture Notes

Prof. Dr. Burak AKPINAR

Title	Code	Local Credit	ECTS	Lecture (hour/week)	Practical (hour/week)	Laboratory (hour/week)
Topography	HRT3351	3	4	3	0	0

Course Objectives	The aim of this course, gains required skills of basic of surveying techniques, mathematical definitions using for large scale map production.

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WEEKLY SUBJECTS

Week	Subject
1	Introduction to Topography
2	Measurement Units and Sources of Measurement Errors
3	Types of Errors
4	Coordinate Systems and Map Projections
5	Geodetic Network Points and Distance Measurements
6	Direction Measurements
7	Traverse Computations
8	Height Measurements
9	Midterm exam 1
10	Area and Volume Computations
11	Field work
12	Field work
13	Geographic Information System, GIS
14	Midterm exam 2
15	GNSS Global Positioning Systems
16	Final exam

Week-2
Measurement Units and Sources of Measurement Errors

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Measurement Units

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Units of Length

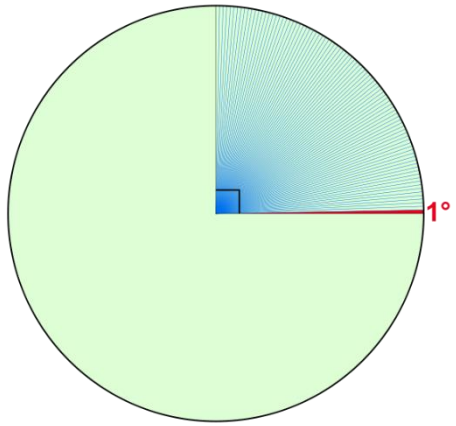
LINEER MEASUREMENT	METRIC UNITS
1 Kilometer	1000 meters
1 Hectometer	100 meters
1 Decameter	10 meters
1 Meter	100 centimeters
1 Decimeter	10 centimeters
1 Centimeter	10 milimeters
1 Milimeter	0,001 meter
1 Decimilimeter	0,1 milimeter
1 Centimilimeter	0,01 milimeter
1 Micrometer-micron	0,001 milimeter

Units of Area (Land) Measurement

1 ar	100 m^2
1 dekar (dönüm)	1000 m^2
1 hectare	10000 m^2
1 km^2 (100 hectare)	1000000 m^2
1 square decimeter	0,01m^2
1 square centimeter	0,0001 m^2
1 square milimeter	0,000001 m^2

Units of Angular Measurement

1- Degree: A degree usually denoted by ° (the degree symbol), is a measurement of plane angle, representing 1/360 of a full rotation.



1 Degree	1^0	60 minutes	3600 seconds
1 Minute	1 '	1/60 degree	60 seconds
1 Second	1 "	1/360 degree	1/60 minute

1° = 60'= 3600" 1' = 60"

As an example of preferred notation of angles with sexagesimal system;

$$180^0\ 28'\ 43".6$$

Notice that minutes and seconds equal to or greater than 60 are carried over to the next larger unit and that degrees and minutes do not have decimals. decimal seconds are acceptable.

For performing certain mathematical operations with angles, it is sometimes easier to convert to decimal degrees first, perform the necessary math, then convert back to degrees, minutes, and seconds.

degrees - minutes - seconds	decimal degrees
87° 58 '48"	87.98^0

$$1° = 60' = 3600" \qquad 1' = 60"$$

$$87° + (58/60) + (48/3600) = 87.98\ °$$

15° 14' 51"

15° + (14/60) + (51/3600) = 15°.2475

86°.9382

$X^o = 86^o.9382$ (Decimal degrees)

$X^o = 86^o + (0.9382 * 60') = 86^o\ 56'.292$

$X^o = 86^o\ 56' + (0.292 * 60'') = 86^o\ 56'\ 17''.52$

$45^o\ 17'\ 58'' + 15^o\ 45'\ 17'' = ?$

$45^o\ 17'\ 58'' + 15^o\ 45'\ 17'' = 61^o\ 03'\ 15''$

Units of Angular Measurement

2- Grad (gon, gradian): The gradian is a unit of plane angle, equivalent to 1⁄400 of a turn.

A grad is defined as 1/400 of a circle. A grad is dividing into 100 centigrad, centigrad into 100 centicentigrad.

Grad is represented by the symbol (^{g}) , centigrad by (^{c}) , centicentigrad by (^{cc})

1 Grad	1^{g}	100 centigrad	1000miligrad	10000centicentigrad
1 Centigrad	1^{c}	0,01 grad	10 miligrad	100 centicentigrad
1 Centicentigrad	1^{cc}	0,0001 grad		

$1^{g} = 100^{c}$

$1^{c} = 100^{cc}$

133.1932^{g} (133.1932 grad) $133^{g}\ 19^{c}\ 32^{cc}$

$56^{g}.7284 = 56^{g}\ 72^{c}\ 84^{cc}$

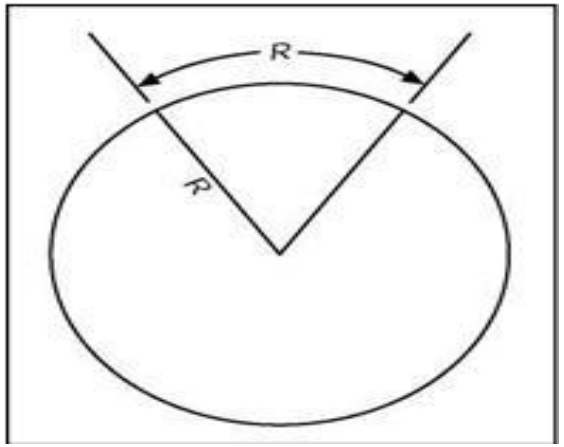
$105^{g}\ 36^{c}\ 89^{cc} = 105^{g}.3689$

$45^{g}\ 6075 + 25^{g}\ 1522 = ?$

$45^{g}\ 6075 + 25^{g}\ 1522 = 70^{g}\ 7597$

Units of Angular Measurement

3- Radian: Radian describes the plane angle subtended by a circular arc as the length of the arc divided by the radius of the arc. One radian is the angle subtended at the center of a circle by an arc that is equal in length to the radius of the circle.



The circumference of a circle is twice the radius length times π, or C = 2πr. Therefore, 1 circle = 2π radians

Conversion Between Angular Units

$$360^{o} = 400^{g} = 2\pi \qquad \frac{D}{180} = \frac{G}{200} = \frac{R}{\pi}$$

Please transform 45º 17’ 58’’ in to grad.

$$\alpha(decimal) = 45^{0} + \frac{17'}{60} + \frac{58''}{3600} = 45^{0}.29944$$

$$\frac{45^{0}.29944}{180} = \frac{G}{200} \qquad G = \frac{45^{0}.29944x200}{180} = 50^{g}.3327$$

Conversion Between Angular Units

$$360^o = 400^g = 2\pi$$

$$\frac{D}{180} = \frac{G}{200} = \frac{R}{\pi}$$

Please transform $60^g\,2735$ in to degree.

$$\frac{D}{180} = \frac{60^g.2735}{200}$$

$$D = \frac{60^g.2735x180}{200} = 54^o.24615$$

$X^o = 54^o.24615$ (Decimal degrees)
$X^o = 54^o + (0.24615 * 60') = 54^o\ 14'.\ 769$
$X^o = 54^o\ 14' + (0.769 * 60'') = 54^o\ 14'\ 46''.14$

Conversion Between Angular Units

$$360^o = 400^g = 2\pi \qquad \frac{D}{180} = \frac{G}{200} = \frac{R}{\pi}$$

Please transform 1.055221 radian to degree.

$$\frac{D}{180} = \frac{1.055221}{3.14159265} \qquad D = \frac{1.055221x180}{3.14159265} = 60^o.45970974$$

$X^o = 60^o.45970974$ (Decimal degrees)
$X^o = 60^o + (0.45970974 * 60') = 60^o\ 27'.\ 5825844$
$X^o = 60^o\ 27' + (0.5825844 * 60'') = 60^o\ 27'\ 34''.96$

Conversion Between Angular Units

$$360^{o} = 400^{g} = 2\pi \qquad \frac{D}{180} = \frac{G}{200} = \frac{R}{\pi}$$

Please transform 149ᵍ.5824 grad to radian.

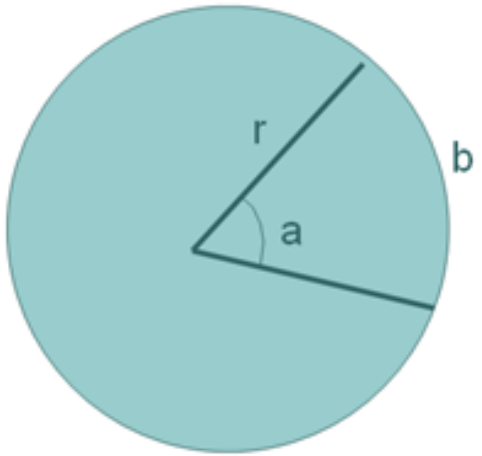
$$\frac{R}{\pi} = \frac{149^{g}.5824}{200} \qquad R = \frac{149^{g}.5824x3.14159265}{200} = 2.349634rad$$

Conversion Between Angular Units

$$360^o = 400^g = 2\pi$$

$$\frac{D}{180} = \frac{G}{200} = \frac{R}{\pi}$$

Please calculate the arc length determined by central angle with 25^g in a circle with radius of 700m.



$$r = 700m$$

$$a = 25^g$$
$$b = ?$$

$$\frac{2.\pi.r}{400^g} = \frac{x}{25^g}$$

$$x = \frac{25x2x3.14159265}{400} = 274.89m$$

Measurement Errors

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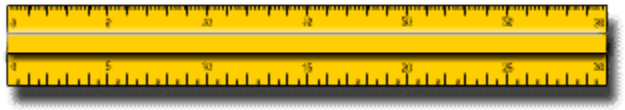
Errors in Measurement



Any measurement made with a measuring device is approximate. If you measure the same object two different times, the two measurements may not be exactly the same. The difference between two measurements is called a **variation** in the measurements.

Another word for this variation - or uncertainty in measurement - is "**error**." This "error" is not the same as a "mistake." It does not mean that you got the wrong answer.

The error in measurement is a mathematical way to show the uncertainty in the measurement. It is the difference between the result of the measurement and the true value of what you were measuring.

MEASUREMENT ERROR

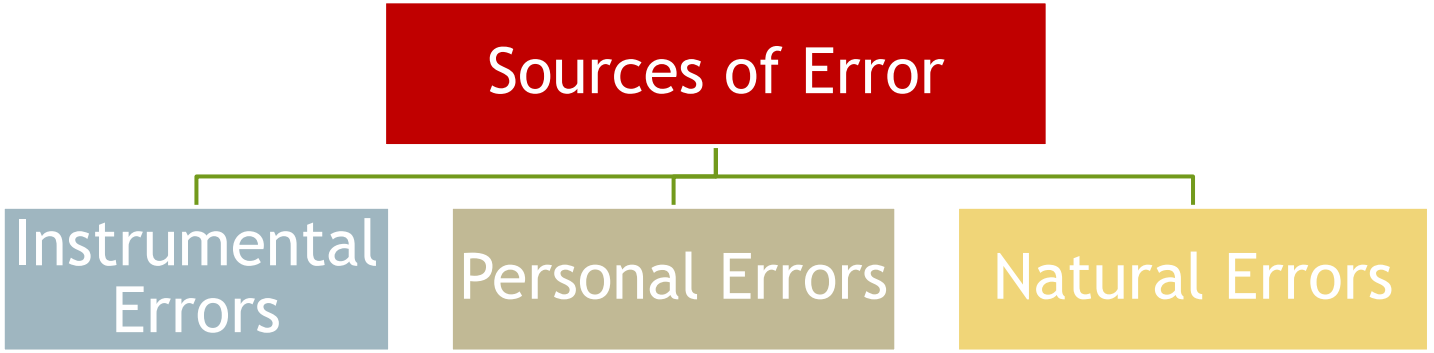
Difference between the actual value of a quantity and the value obtained by a measurement.

$\varepsilon_i = y_i - \mu$
ε_i = the error of an observation
y_i = the observed value
μ = the true value

True value: a quantity's theoretically correct or exact value.
(True value can never be determined!)
True value is the simply the population's arithmetic mean if all repeated measurements have equal precision.

- no observation is exact
- every observation contains error
- the true value of an observation is never known

Sources of Error



Instrumental Errors

Instrument error refers to the combined accuracy and precision of a measuring instrument, or the difference between the actual value and the value indicated by the instrument.

Personal Errors

Personal errors arise principally from limitation of the human senses. As an example; a small error occurs in the observed value of a horizontal angle if the vertical crosshair in a theodolite is not aligned perfectly on the target.

Natural Errors

Natural errors are caused by variations in wind, temperature, humidity, atmospheric pressure, atmospheric refraction, etc.

An example is a steel tape whose length varies with the changes in temperature..

Week-3
Types of Errors

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