ENGİNEERİNG SURVEYING

Yildiz Technical University
Faculty of Civil Engineering
Department of Geomatic Engineering

LECTURE NOTES

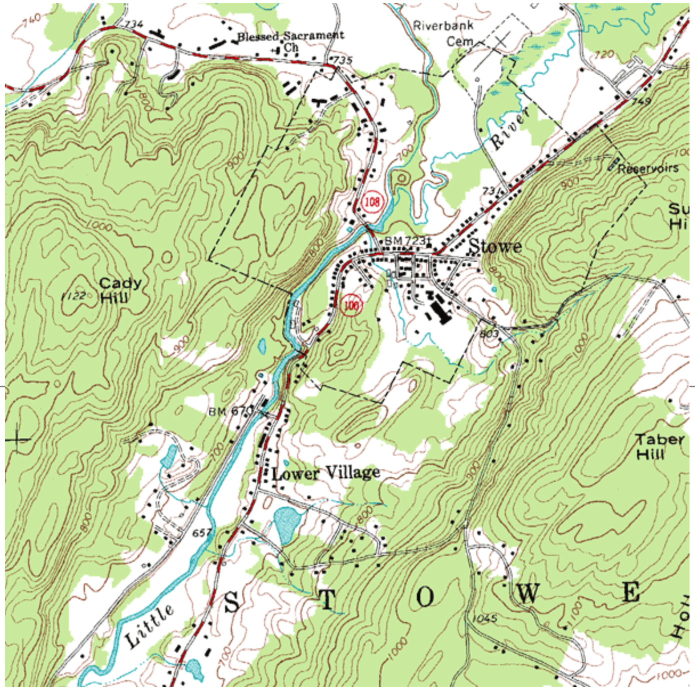
Weekly Subjects and Related Preparation Studies

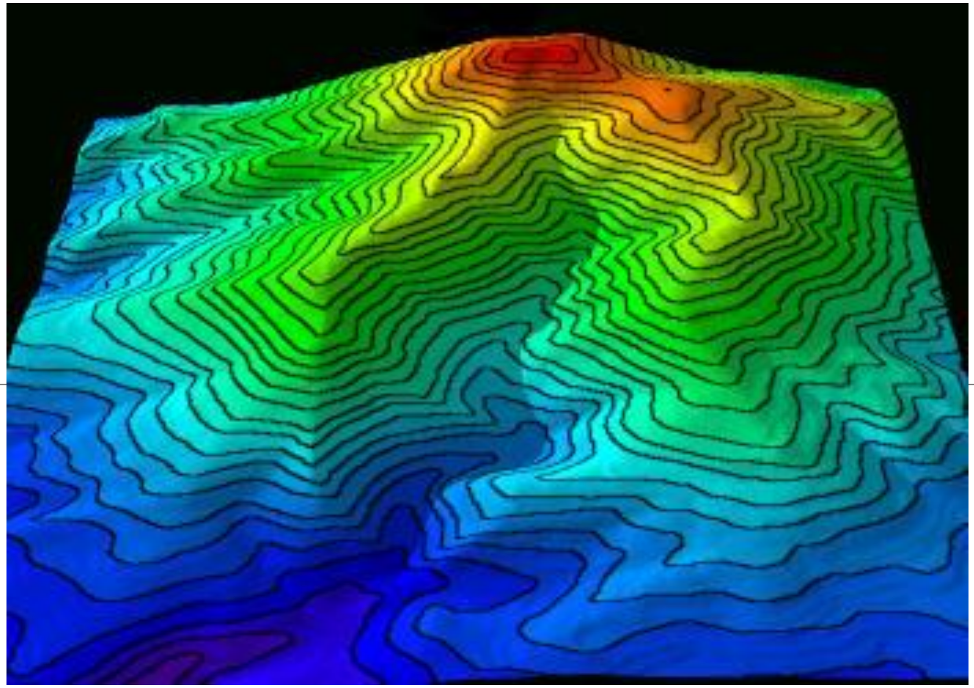
1	The concept of engineering surveying, general principles, application areas	Lecture Notes
2	Processing of engineering measurement data, error calculation and accuracy criterion in engineering measurements	Lecture Notes
3	Measurement, mapping and projecting studies for engineering projects	Lecture Notes
4	Geodetic measurements in engineering constructions	Lecture Notes
5	Stake out, relievo and control measurements	Lecture Notes
6	Line-route survey and calculations	Lecture Notes
7	Line and route stake out ve relievo measurements	Lecture Notes
8	Survey for cadastral and zoning activities	Lecture Notes
9	Midterm 1	
10	Technical infrastructure surveys	Lecture Notes
11	Underground (mine, tunnel, subway vb) surveys	Lecture Notes
12	Midterm Exam 2, Hydrographic survey	Lecture Notes
13	Control and deformation surveys	Lecture Notes
14	Industrial survey	Lecture Notes
15	Final	

Course Objectives	The evaluation of measurements for basic engineering applications in various fields, the identification of surveying engineering in structures and roads, the teaching of calculations and operations related to design, surveying and stake-out applications

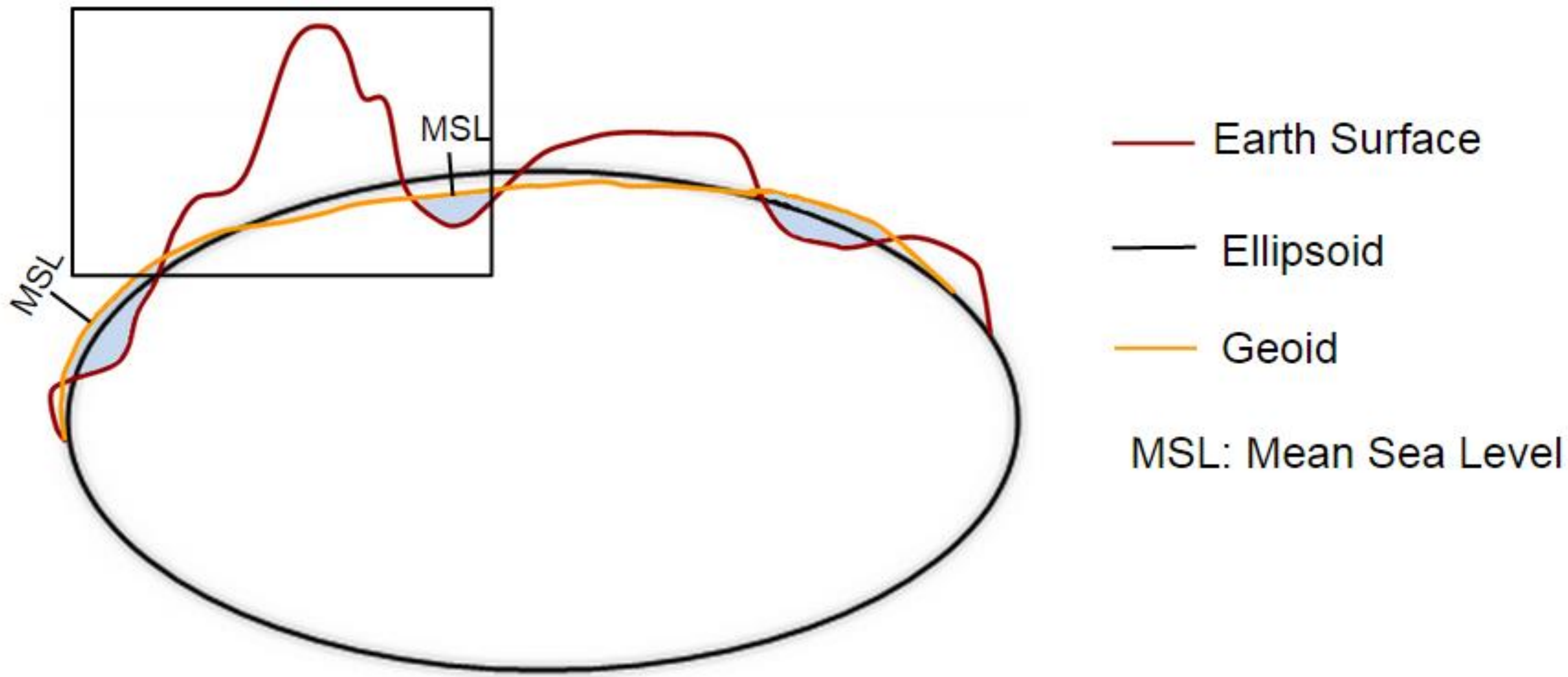
The concept of engineering surveying, general principles, application areas Week_1

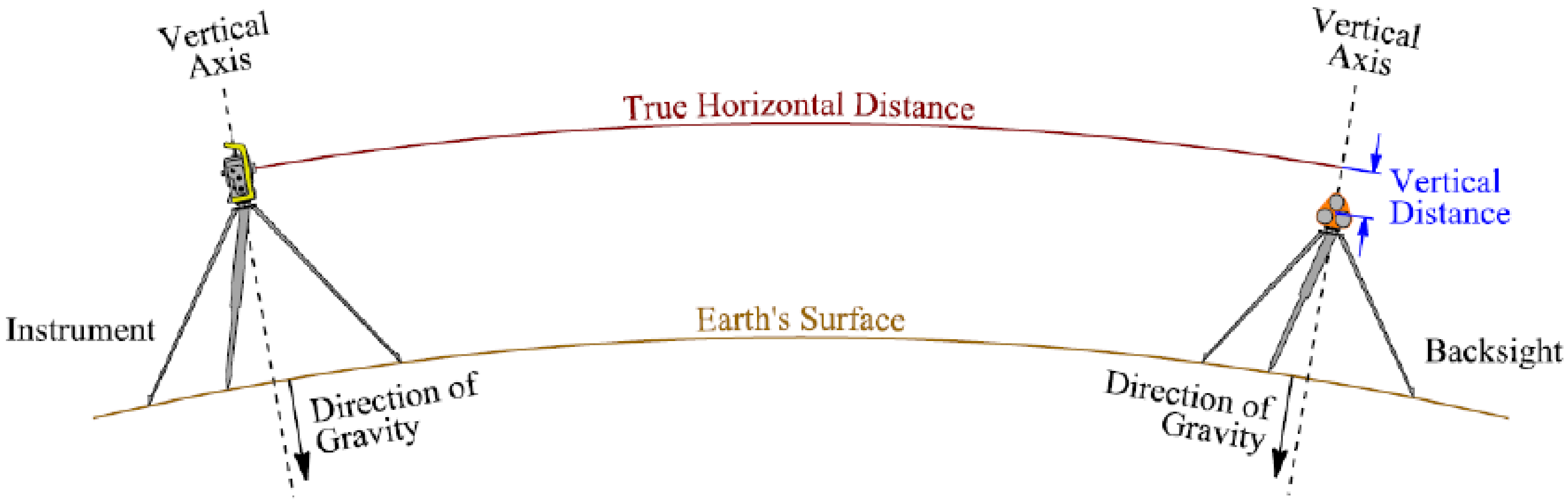
- It is the description of such surface shapes and features (especially their depiction in maps).
- The topography of an area could also mean the surface shape and features themselves.





Topographic Map


MSL
MSL
Earth Surface
Ellipsoid
Geoid
MSL: Mean Sea Level


Vertical Axis
True Horizontal Distance
Vertical Axis
Vertical Distance
Instrument
Earth's Surface
Backsight
Direction of Gravity
Direction of Gravity

What is Engineering Surveying?

Engineering surveying involves:

- Investigating land, using measurement tools and geographic knowledge, to work out the best position to build bridges, tunnels and roads etc.
- Producing up-to-date plans which form the basis for the design of a project
- Setting out a site, so the structure is built in the correct location to the specified parameters
- Monitoring the construction process to make sure that the structure remains in the right position and recording the final built position
- Providing control points by which the future movement of structures such as bridges and dams can be monitored

…

Today, surveying expands beyond traditional surveying and uses many different methods for collecting ***spatial data about the Earth and its environment.*** This data is processed in various formats and are also presented in an assortment of media. Contemporary surveying is now a part of Geomatics or Geoinformatics.

Engineering Survey:

To collect requisite data for planning, design and execution of engineering projects.

Three broad steps are;

1. ***Reconnaissance survey:*** To explore site conditions and availability of infrastructures.
2. ***Preliminary survey:*** To collect adequate data to prepare plan/ map of area to be used for planning and design.
3. ***Location survey:*** To set out work on the ground for actual construction /execution of the project.

Route survey:

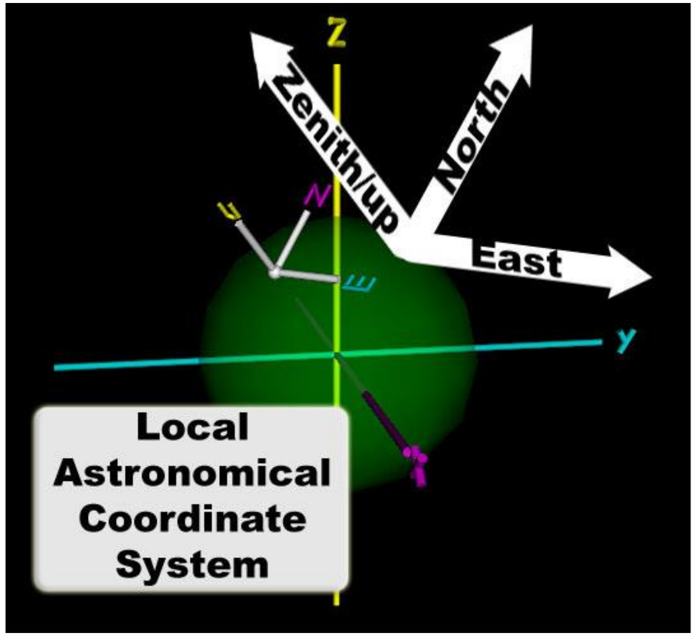
To plan, design, and laying out of route such as highways, railways, canals, pipelines, and other linear projects.

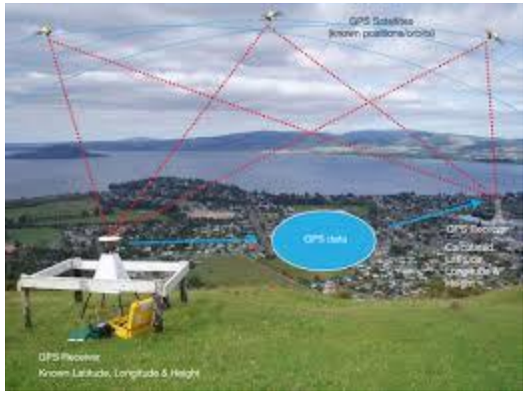
Construction surveys:

Surveys which are required for establishment of points, lines, grades, and for staking out engineering works (after the plans have been prepared and the structural design has been done).

Astronomic Surveys:

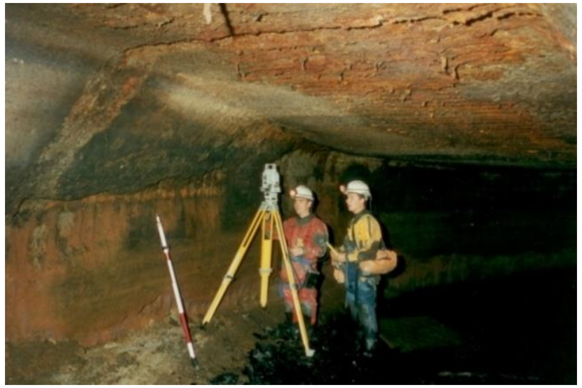
To determine the latitude, longitude (of the observation station) and azimuth (of a line through observation station) from astronomical observation.

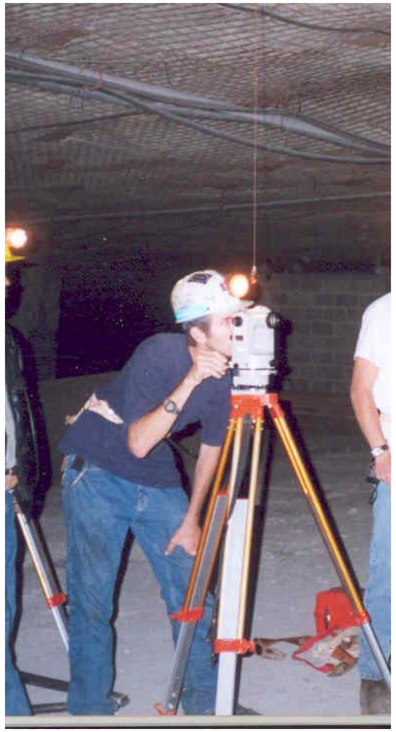


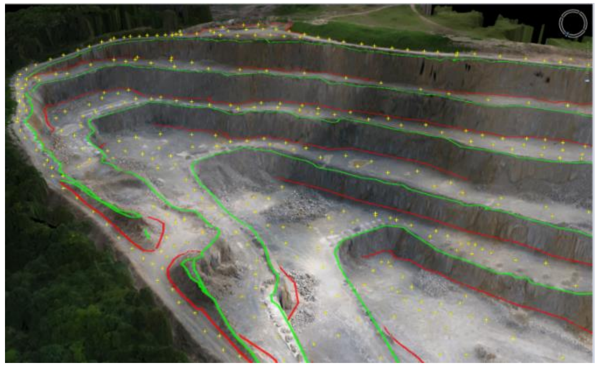


Mine surveys:

To carry out surveying specific for opencast and underground mining purposes.

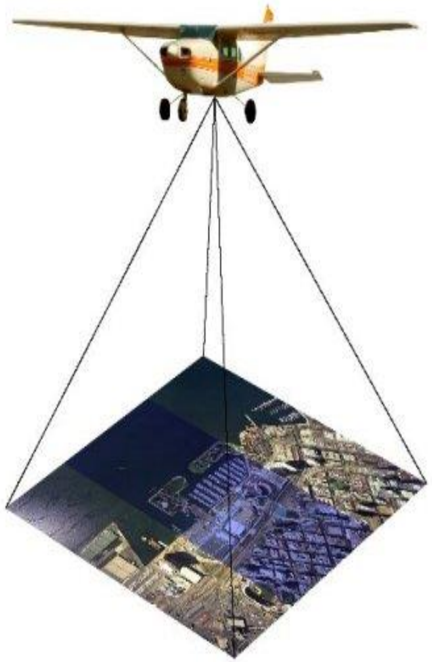


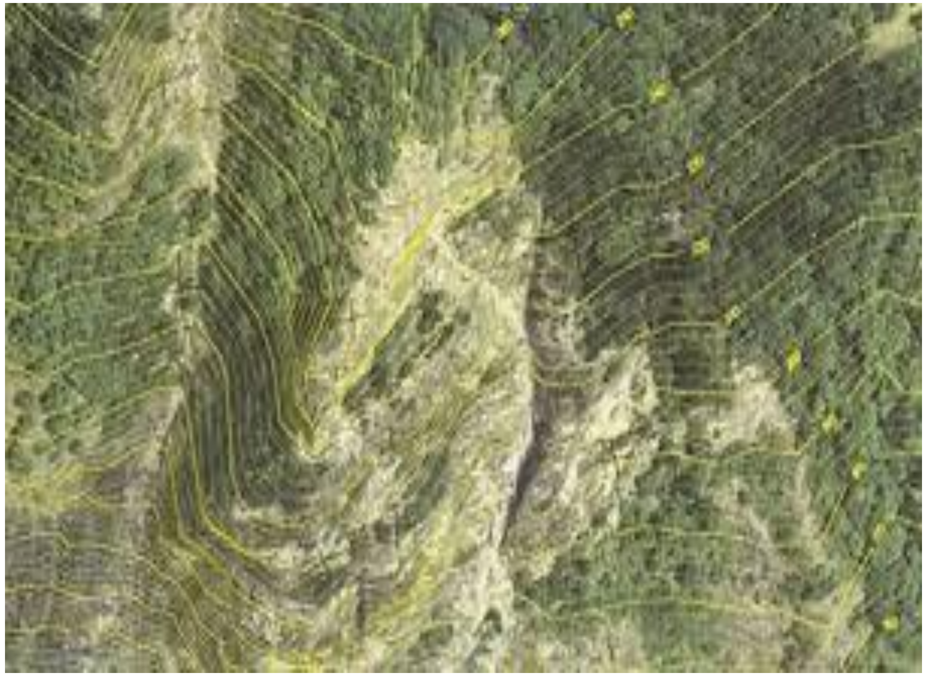




Photogrammetric Surveys

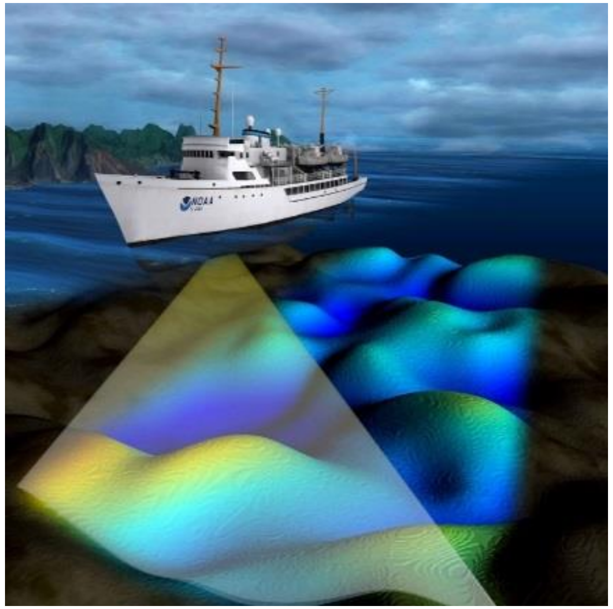
Made to utilize the principle of aerial photogrammetry, in which measurements made on photographs are used to determine the positions of photographed objects.

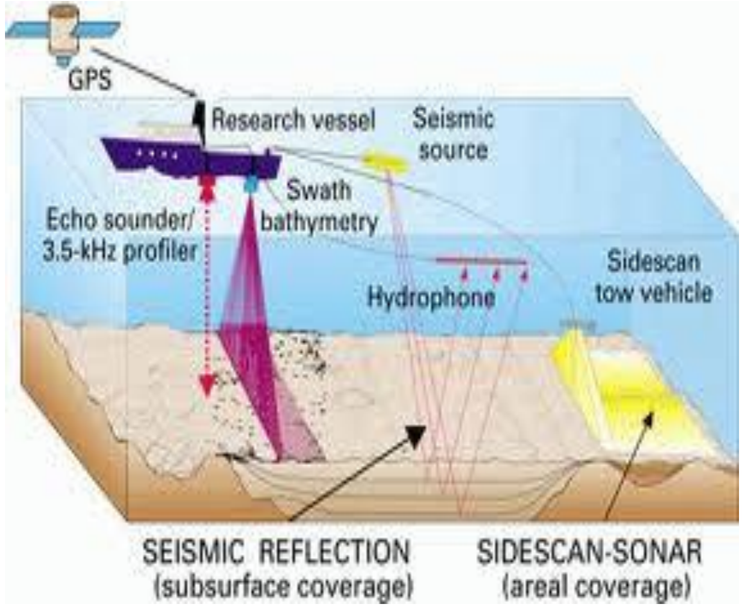


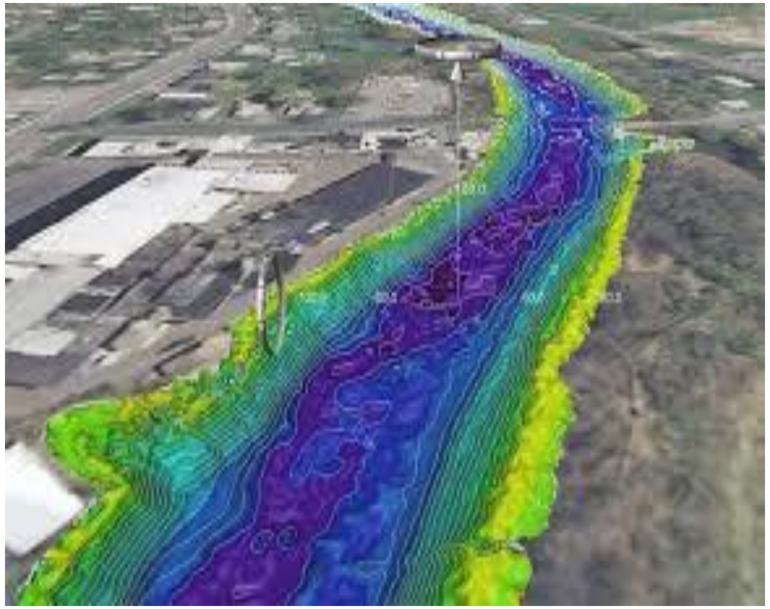


Hydrographic Surveys

The surveys of bodies of water made for the purpose of navigation, water supply, or subaqueous construction.

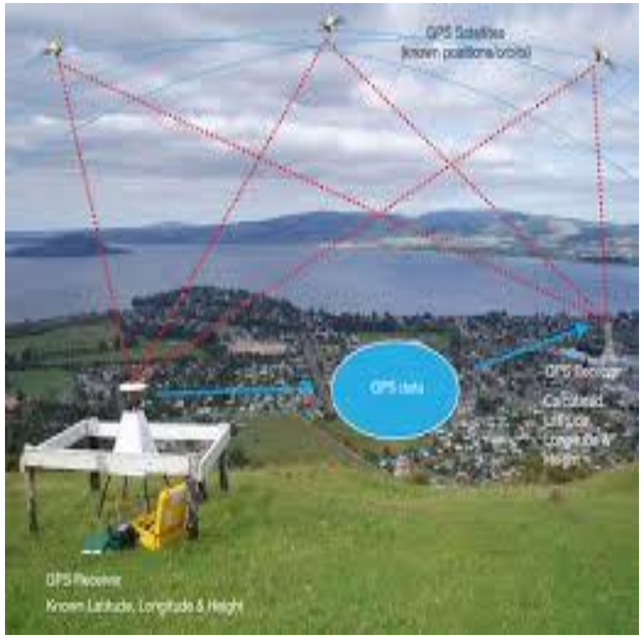


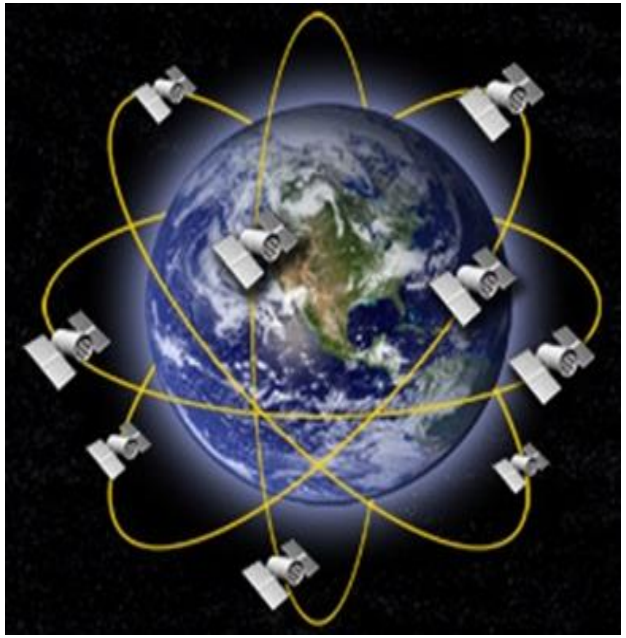


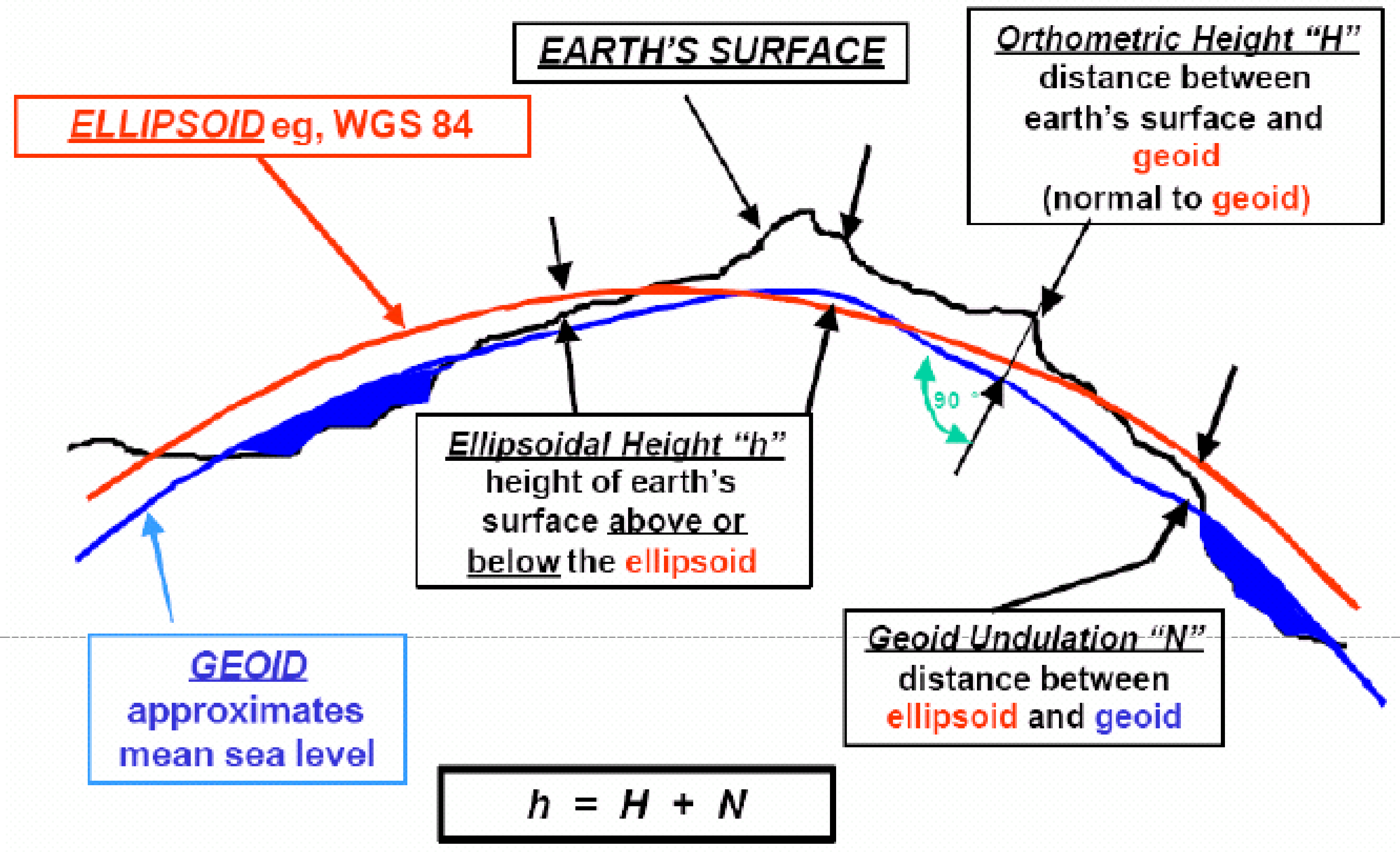


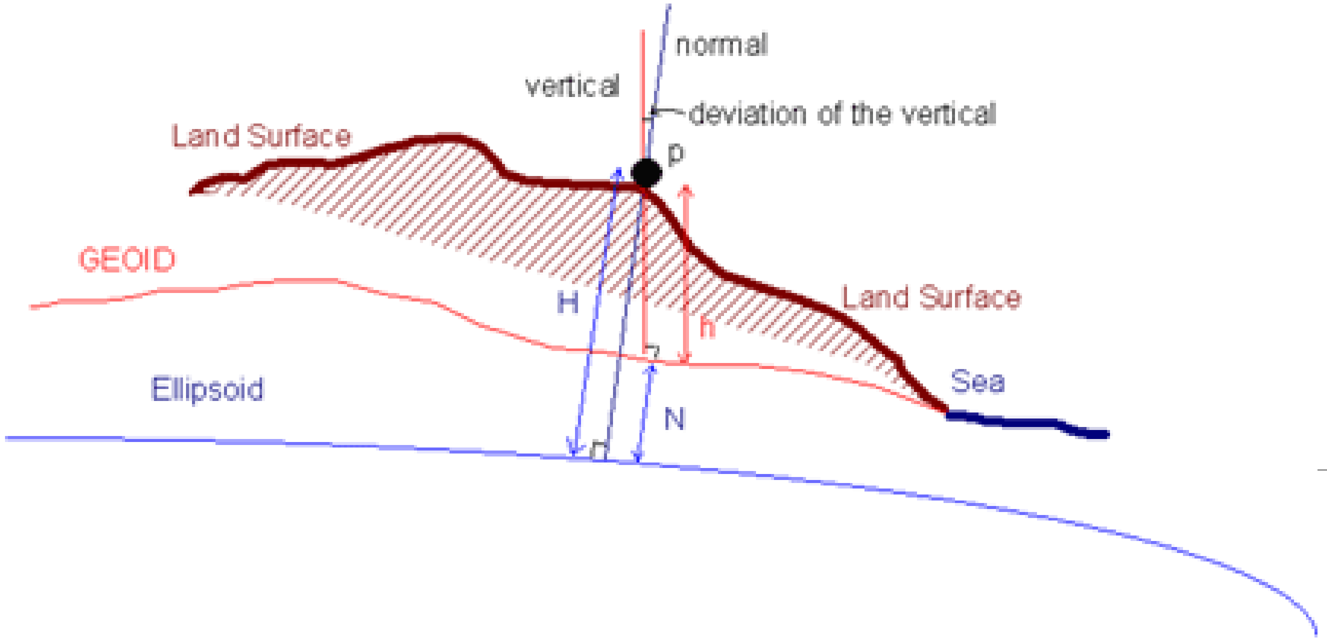
Satellite Surveys

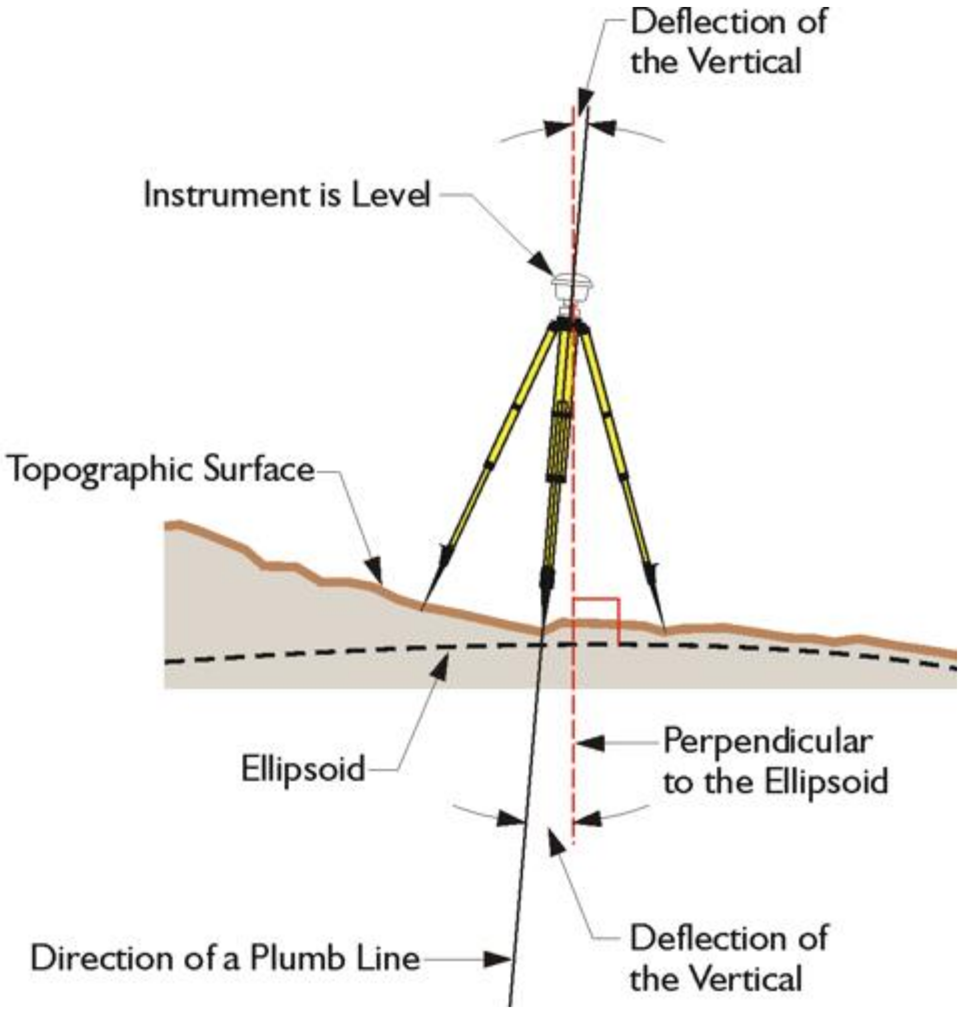
They include the determination of ground locations from measurements made to satellites using GPS receivers, or the use of satellite images for mapping and monitoring large region of the earth.



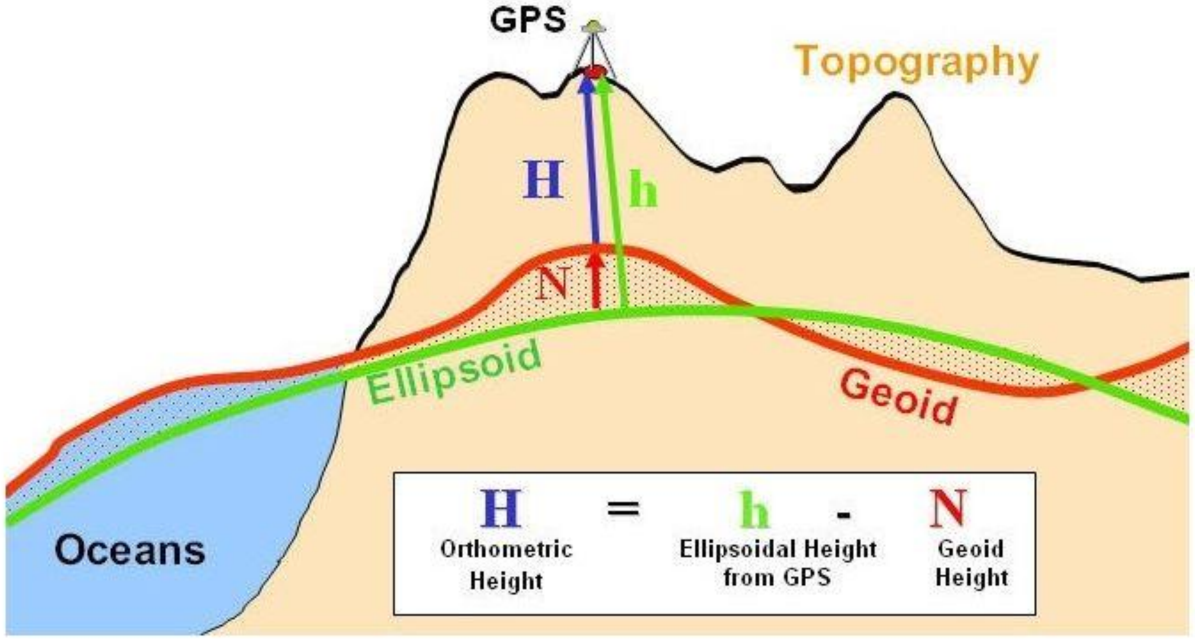



EARTH'S SURFACE
Orthometric Height "H"
distance between
earth's surface and
geoid
(normal to geoid)
ELLIPSOID eg, WGS 84
90 °
Ellipsoidal Height "h"
height of earth's
surface above or
below the ellipsoid
GEOID
approximates
mean sea level
Geoid Undulation "N"
distance between
ellipsoid and geoid
h = H + N

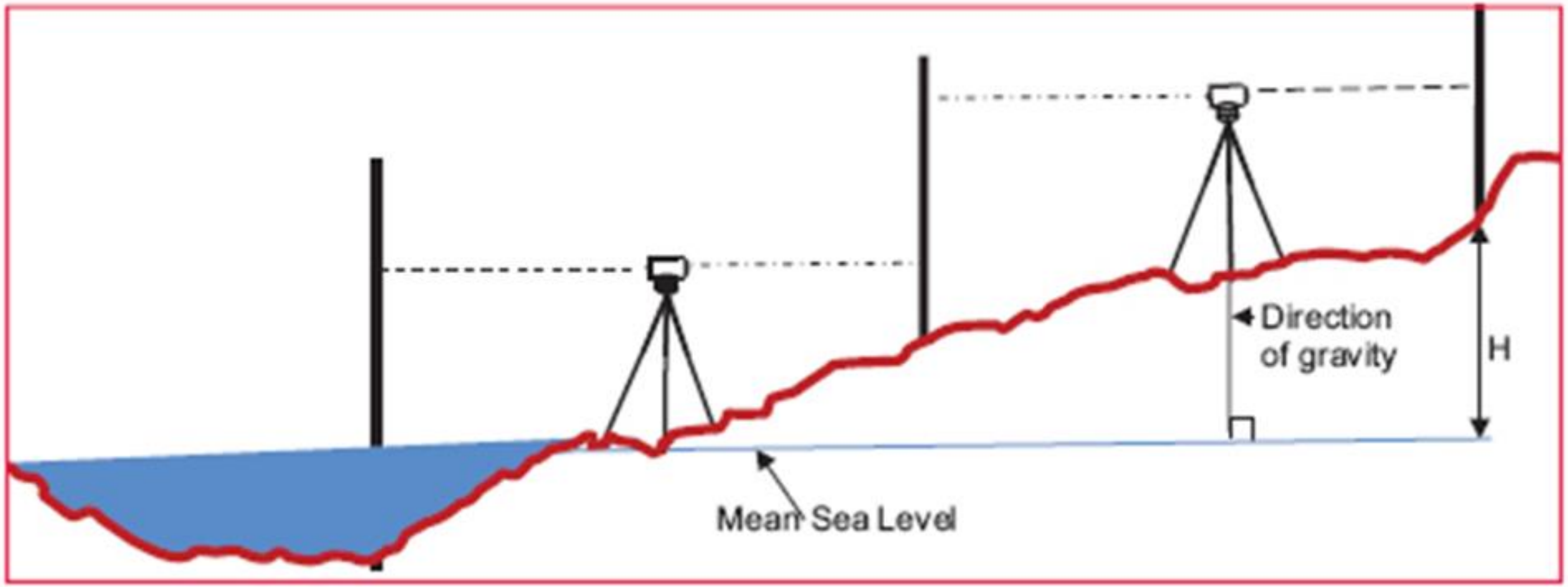

normal
vertical
deviation of the vertical
P
Land Surface
GEOID
H
h
Land Surface
Ellipsoid
Sea
N


Deflection of the Vertical
Instrument is Level
Topographic Surface
Ellipsoid
Perpendicular to the Ellipsoid
Direction of a Plumb Line
Deflection of the Vertical

Equipotential surface, geoid and reference ellipsoid



Geoid is an equipotential surface of gravitational field. It coincides in open ocean with the mean sea level. Deviation of the geoid from a reference ellipsoid (geoid's height) is called geoid's undulation. Determination of the geoid on land requires 1) a precise gravimetric survey of the entire land, and 2) the knowledge of the mass distribution in the Earth's interior.



Levelling procedure for acquiring data for orthometric height

UNITS of LENGTH

The basic unit of length is meter and represented as m.

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

SI-unit of AREA is equal to 1 squaremeter and represented as m^2.

1 are	100 m^2
1 decare	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

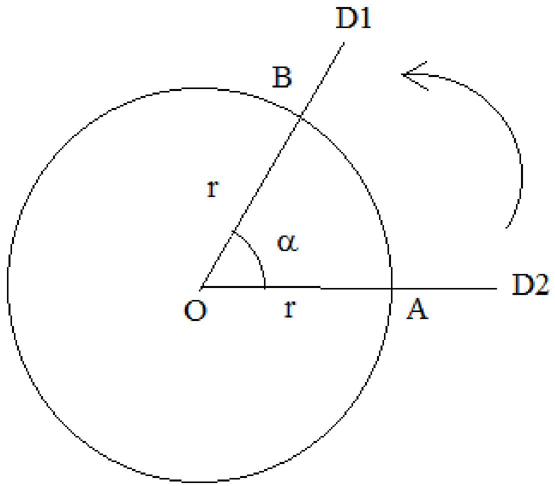
UNITS of VOLUME

The unit of volume is cubic meter and represented as m^3.

Conversion	
1 m^3	1000 dm^3
1 dm^3	1000 cm^3
1 cm^3	1000 mm^3
1 lt=1 dm^3	1000 cm^3

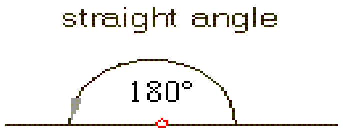
Units of Angular Measures

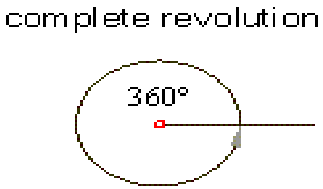
What is an angle: An angle is a combination of two rays (half-lines) with a common endpoint. The latter is known as the *vertex* of the angle and the rays as the *sides*, sometimes as the *legs* and sometimes the *arms* of the angle.



UNITS of ANGULAR MEASUREMENTS

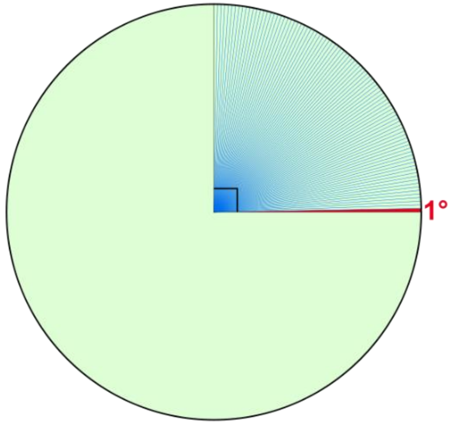
<u>1- Degree:</u> A degree usually denoted by ° (the degree symbol), is a measurement of plane angle, representing 1/360 of a full rotation.





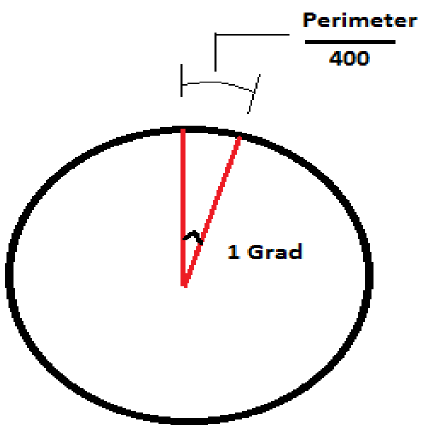
$1^\circ = 60' = 3600''$

$1' = 60''$



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

UNITS of ANGLE



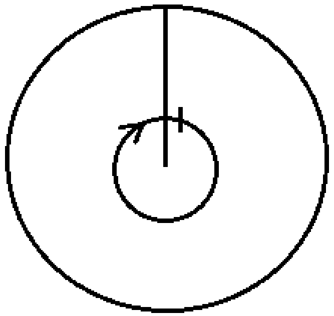
Definition of 1 Grad

2-Gradian (Grad/ Gon): 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)

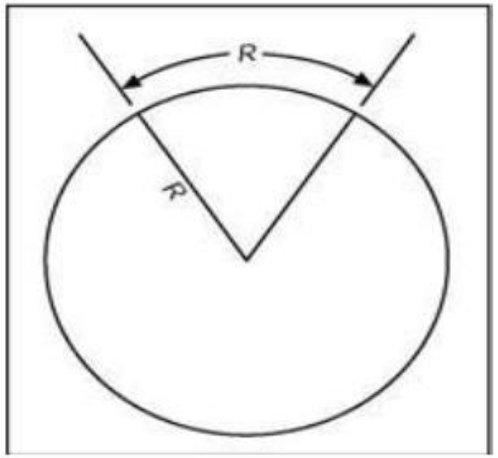

1 full rotation= 400 grad

1^{g}	Grad	100 centigrad	100^{c}
1^{c}	Centigrad	100 centicentigrad	100^{cc}
1^{cc}	Centicentigrad	0.0001 grad	

$$58^{g}\,62^{c}\,73^{cc} = 58^{g}\,62{,}73^{c} = 58{,}6273^{g}$$

UNITS OF ANGLE

<u>3-Radian:</u> The radian is the standard unit of angular measure, used in many areas of mathematics. An angle's measurement in radians is numerically equal to the length of a corresponding arc of a unit circle, one radian is just under 57.3 degrees (when the arc length is equal to the radius).



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

CONVERSION BETWEEN ANGULAR UNITS

Conversion of units is the conversion between different units of measurement for the same quantity, typically through multiplicative conversion factors.

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

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

Processing of engineering measurement data, error calculation and accuracy criterion in engineering measurements – Week_2

Deformation Measurements on Dams

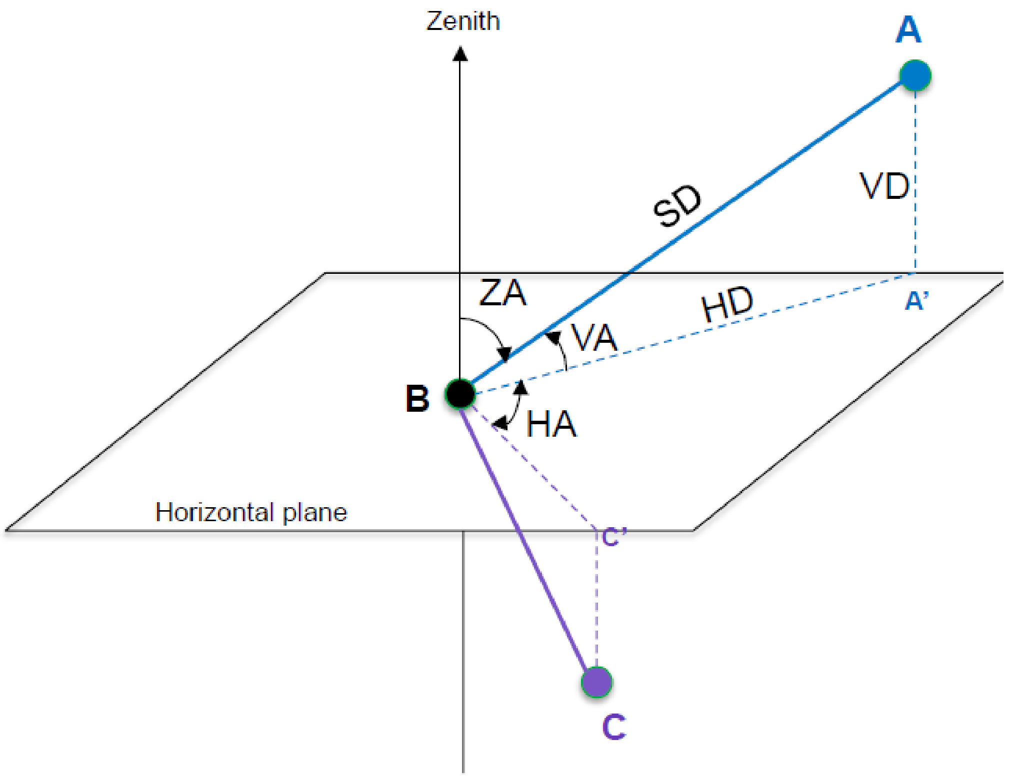
Engineering Measurements on Highways

Deformation Measurements on Tunnels

Distances
- Slope (SD)
- Horizontal (HD)
- Vertical (VD)

Directions & angles
- Horizontal (HA)
- Vertical (VA)
- Zenital (ZA)

Positions




Digital level and rod
AL24
1870's Surveyor's Steel Tape
PRECISION TOOLS
... others
Total station
Electronic theodolite
FARO
Laser scanner
Satellite receiver

www.leica-geosystems.com

http://www.trimble.com

www.topconpositioning.com

http://www.railway-technology.com

NNo	Geri(mm)	İleri(mm)	Δh	H(m)
RS1	2.546^{+1}			**162.245**
P1	2.780^{+1}	1.056	**1.491**	**163.736**
P2	3.245^{+1}	1.956	**0.825**	**164.561**
P3	2.678^{+1}	0.976	**2.270**	**166.831**
	2.087	1.876	**0.803**	**167.634**
P4	3.002	2.045	**0.042**	**167.676**
RS2		1.879	**1.123**	**168.799**

[g] = 16.338

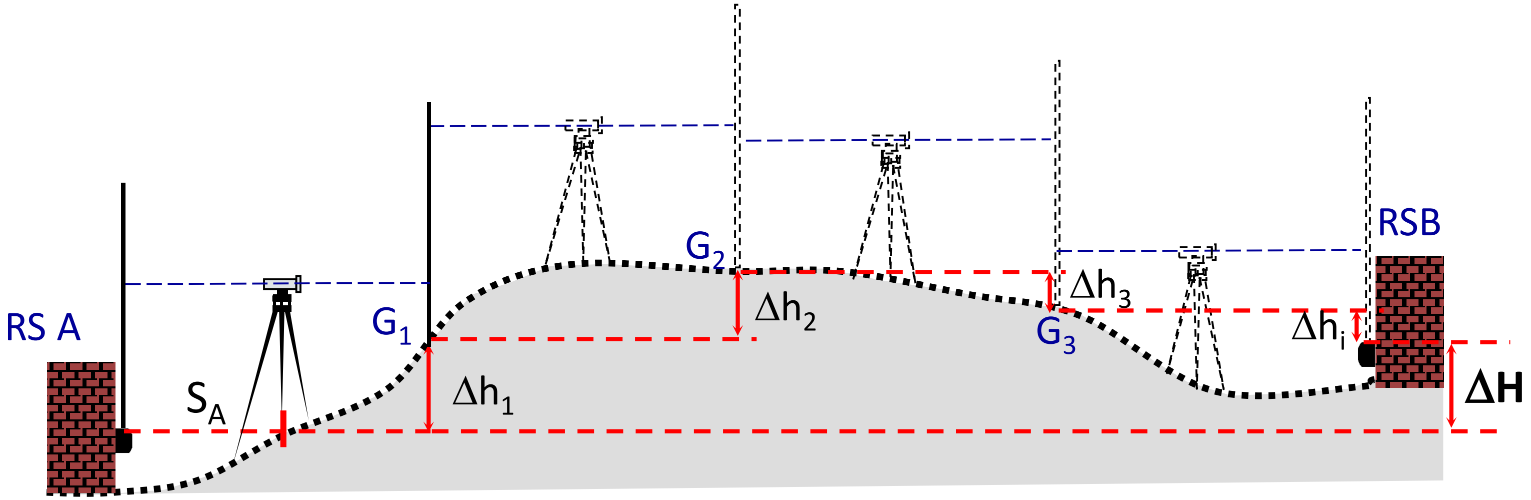
DH = 6.554

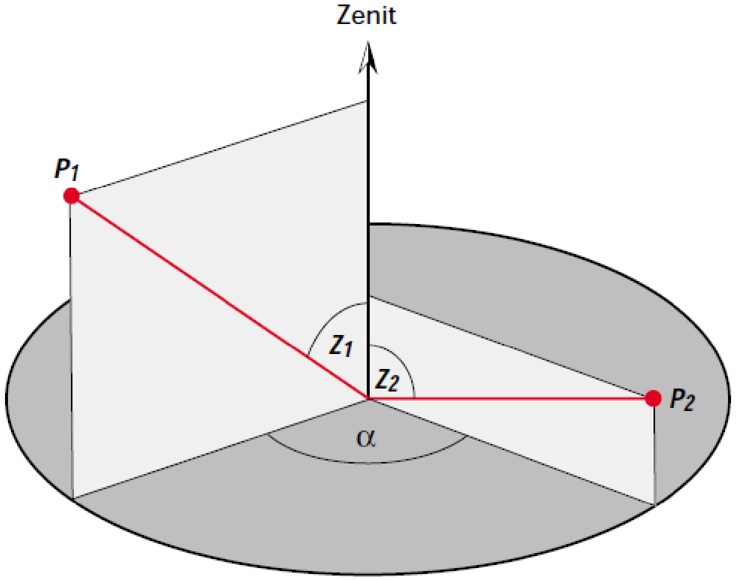
[i] = 9.788

[g] – [i] = 6.550

Kapanma hatası = 6.550 – 6.554 = -0.004 m = -4mm

Hata Sınırı = $d = 0{,}002\sqrt{[S]} + 0{,}0003\ \Delta h$ = 0.036 m = 36mm



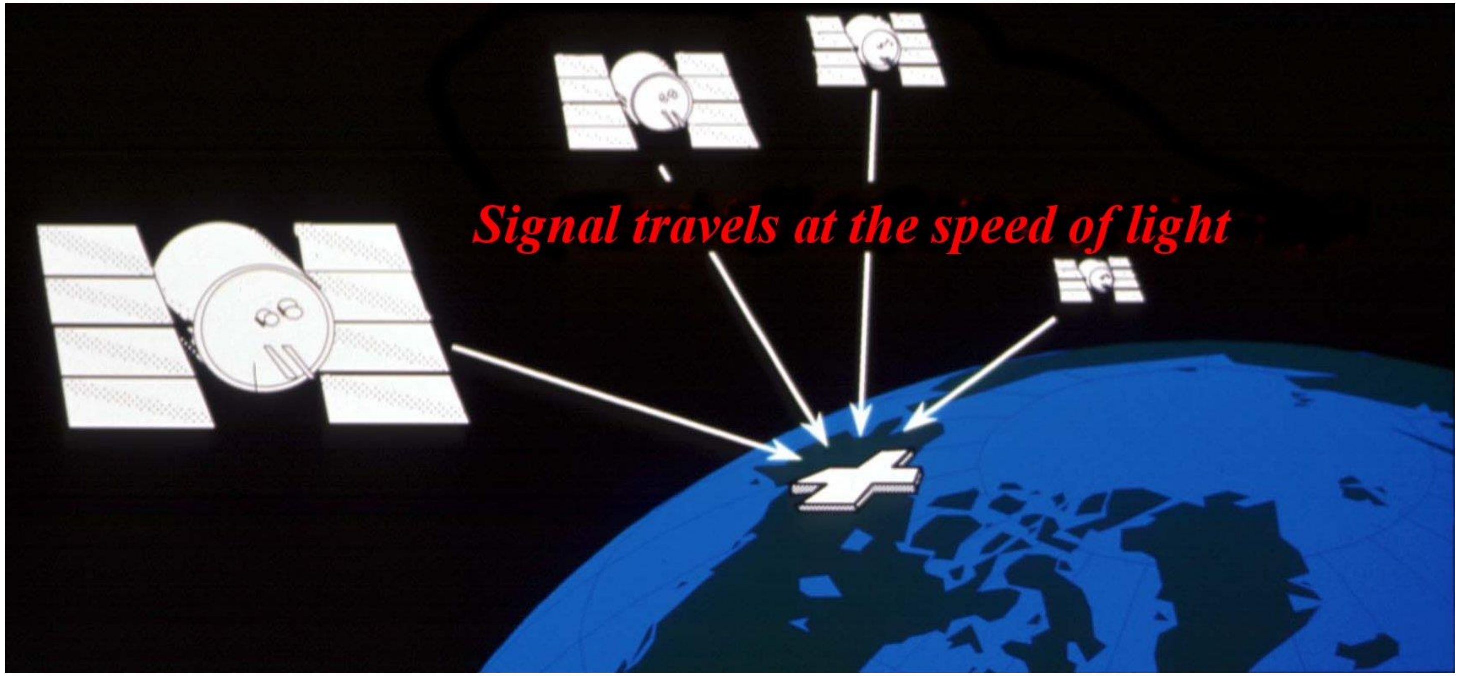


Geodetic Fundamental Computations

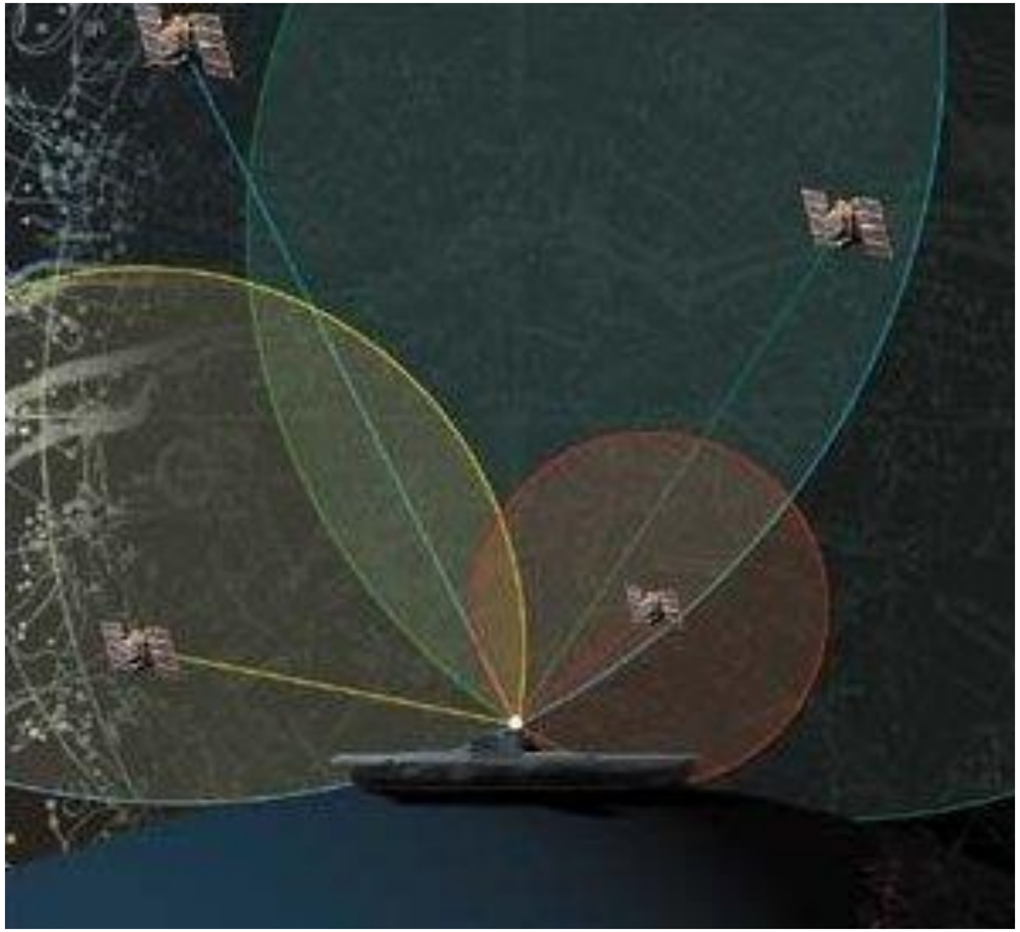
Easting, Northing, Elevation

Uses measurements from 4+ satellites

Distance = travel time x speed of light



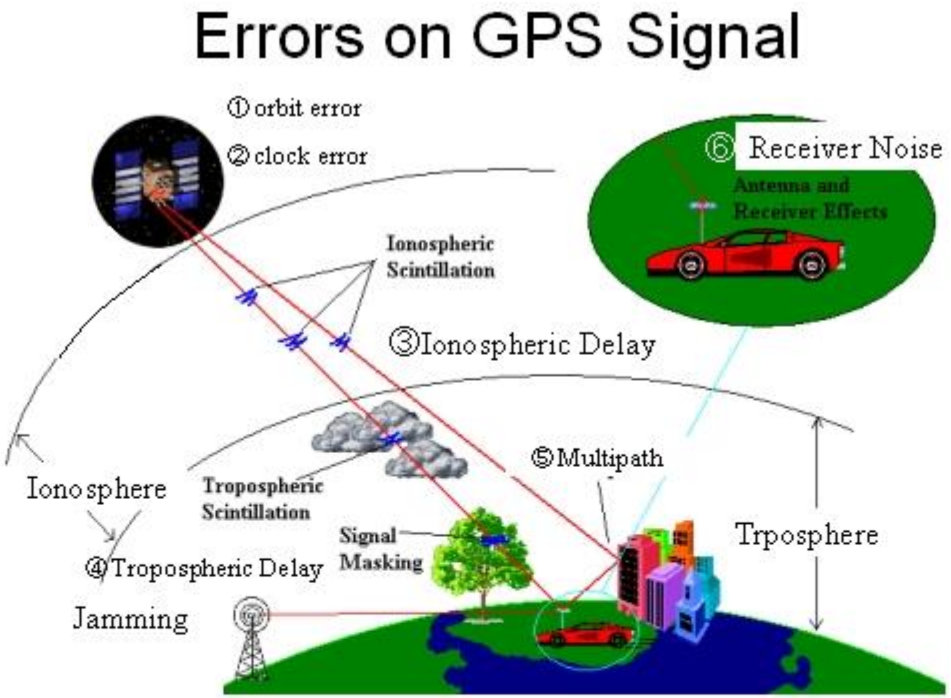
Determining the Position



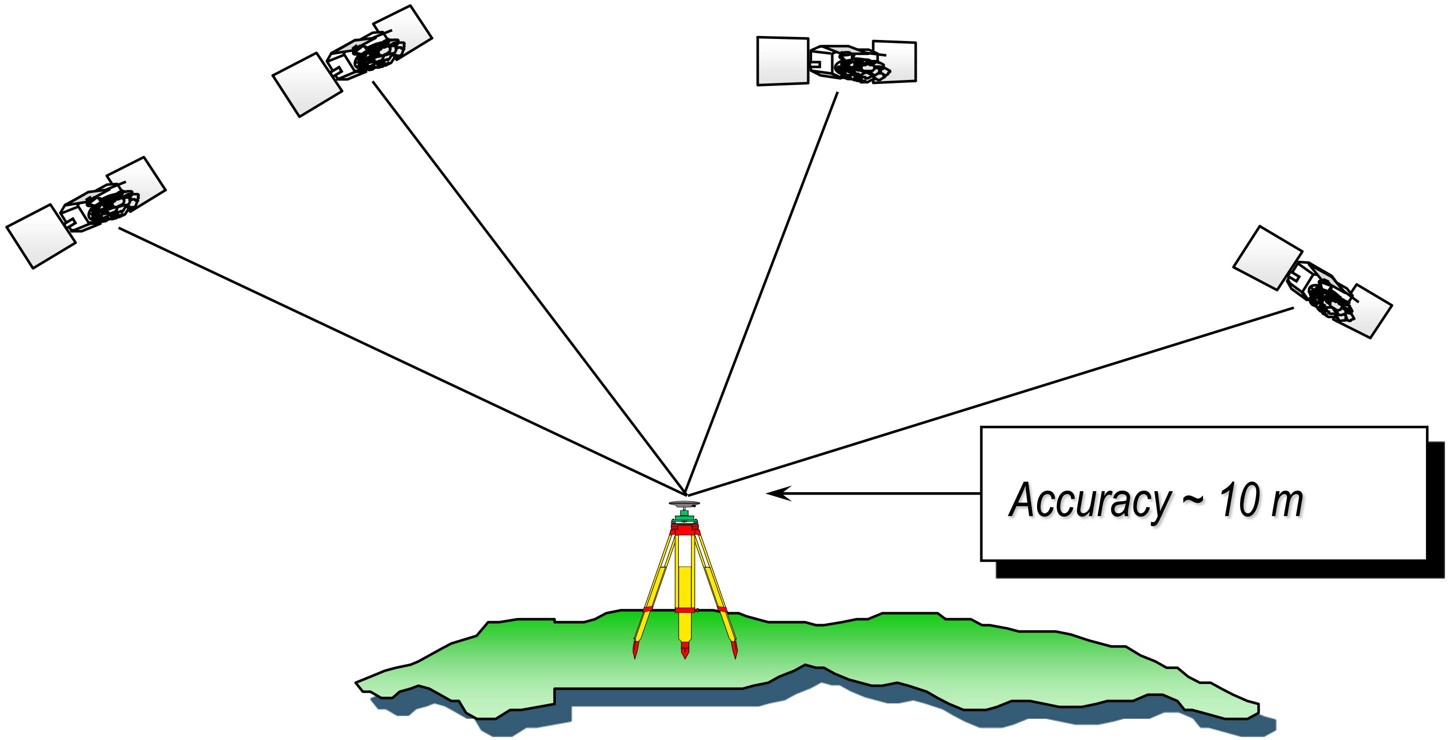
GPS errors include:

- Satellite errors
- Receiver errors
- Signal propagation errors

Various schemes can be employed to reduce or even eliminate these errors



Absolute Positioning

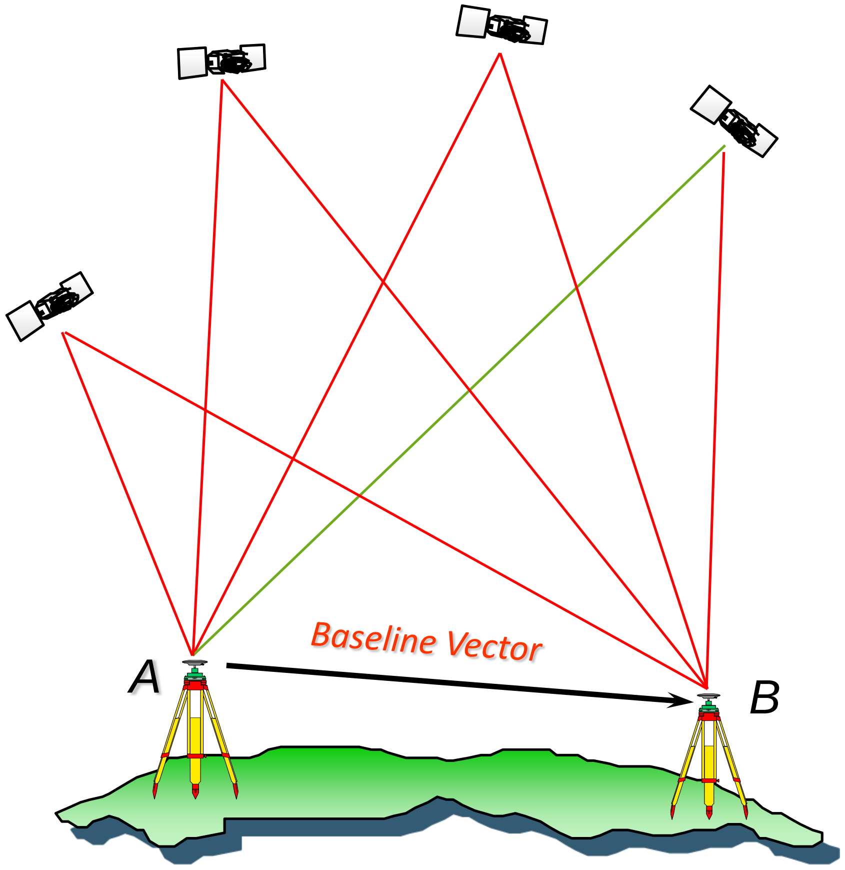


Relative Positioning

The position of Rover 'B' can be determine in relation to Reference 'A' provided

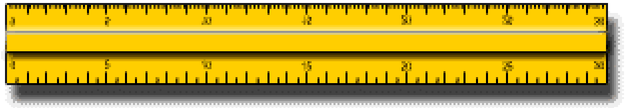
Coordinates of 'A' is known

Simultaneous GPS observations



TUSAGA-ACTIVE

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

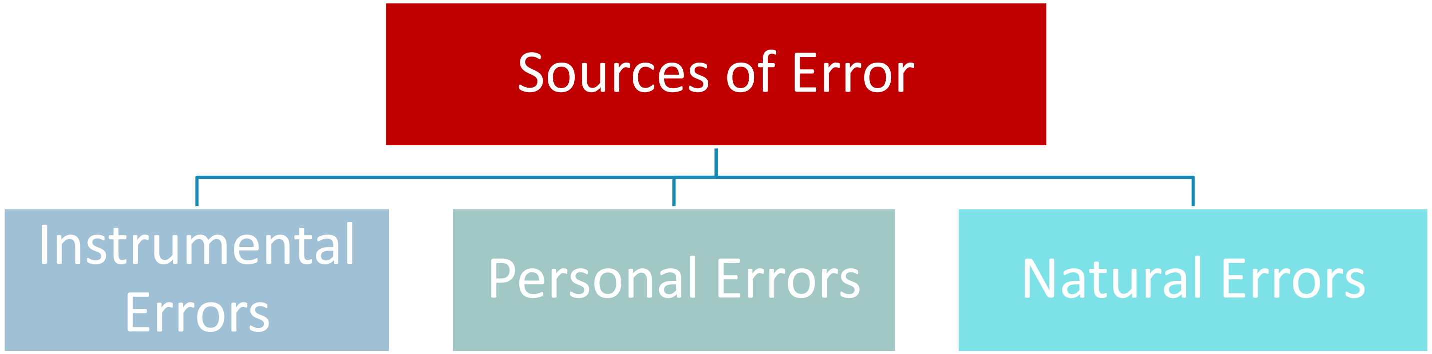
Difference between the actual value of a quantity and the value obtained by a measurement.

$\varepsilon_i = y_i - \mu$
ε_i = the error 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 contain 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

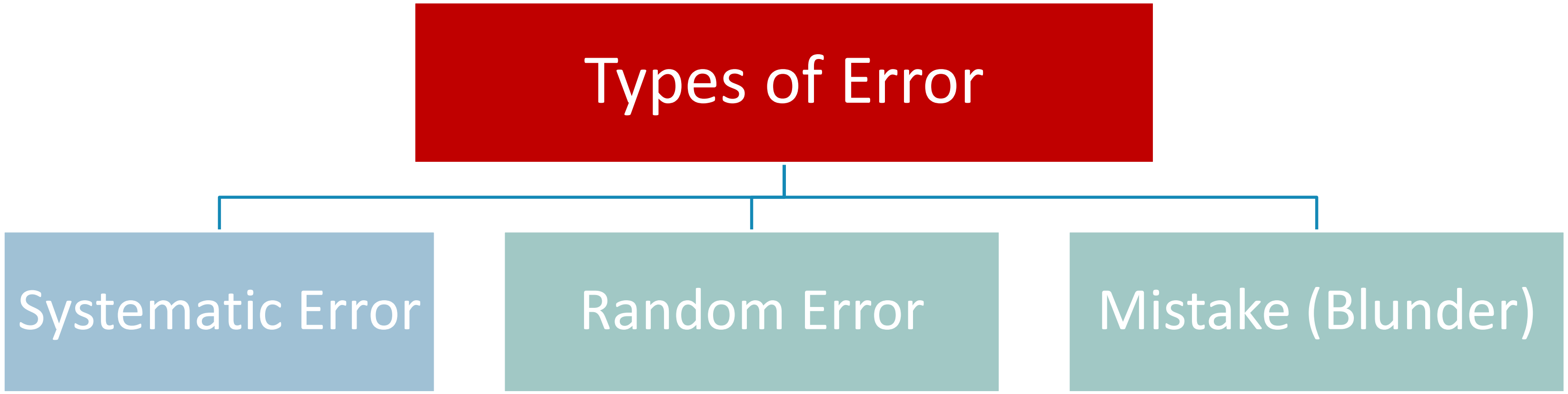
Personal errors arise principally from limitation of the human senses. As an example; a small error occurs in the observed value of a horizontal angle if the vertical crosshair in a theodolite is not aligned perfectly on the target.

Natural Errors

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

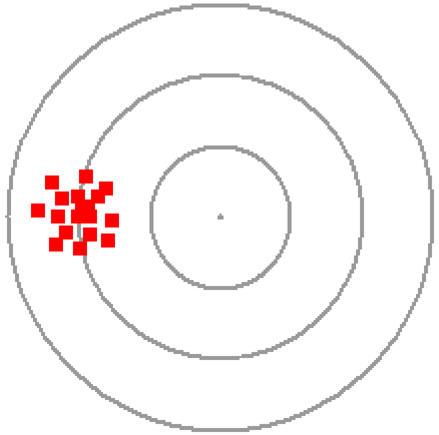
An example is a steel tape whose length varies with the changes in temperature..

Types of Error



Systematic Error

Systematic error is a type of error that deviates by a fixed amount from the true value of measurement.



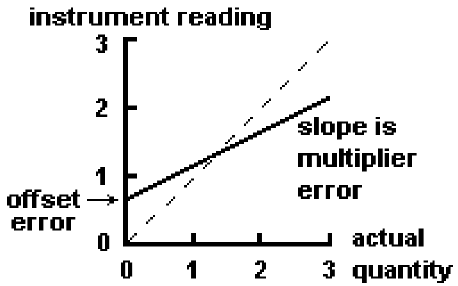
Systematic Error

Systematic errors in experimental observations usually come from the measuring instruments. They may occur because:

- there is something wrong with the instrument or its data handling system, or
- because the instrument is wrongly used by the experimenter.

Two types of systematic error can occur with instruments having a linear response:

1. Offset or zero setting error.
2. Multiplier or scale factor error



Correcting Systematic Errors

Because systematic errors are caused by the physics of the measurement system, they can be mathematically modeled and corrections computed to offset these
errors.

For example temperature correction for a steel tape:

$$C = k\,(T_m - T_s)L$$

Where k is a constant:, (6.45x10^{-6} for degrees Fahrenheit) ; T_m is the temperature of the tape; T_s is the standard temperature; and L is the uncorrected length measured. If the temperature is above standard, then the tape is too long, and a measured distance will be too short.

Correcting Systematic Errors

Total Station EDM Corrections for Systematic Errors

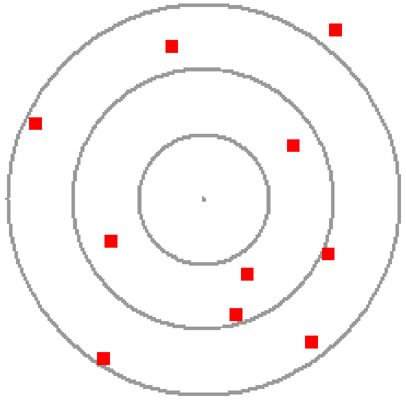
- The EDM (Electronic Distance Measurement) part of a total station measures distances using light waves. The velocity of light in air varies according to the air density. If the operator enters air temperature and pressure, the systematic error caused by this variation is corrected by most total stations.

- If the survey not at sea level, using sea level pressure introduces a systematic error. This error, of course, increases with elevation. Ignoring the correction at an elevation of 900 feet causes a distance error of about 10 ppm (parts per million).

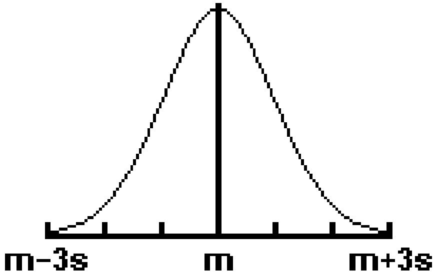
Random Error

Random errors in experimental measurements are caused by unknown and unpredictable changes in the experiment. These changes may occur in the measuring instruments or in the environmental conditions.

Examples of causes of random errors are:
- electronic noise in the circuit of an electrical instrument,
- irregular changes in the heat loss rate from a solar collector due to changes in the wind.


Random Error

Random errors often have a Gaussian normal distribution. In such cases statistical methods may be used to analyze the data.



The mean m of a number of measurements of the same quantity is the best estimate of that quantity, and the standard deviation s of the measurements shows the accuracy of the estimate.

<u>There is no absolute way to compute or eliminate them, but they can be estimated using adjustment procedures.</u>

Mistake (Blunder)

A blunder is an observation that is in error by more than the typical systematic or random error normally encountered.

It's a BIG error that happened because two numbers were transposed or the wrong back sight point was sighted.

Blunders are generally 'one time' errors that don't appear elsewhere in the survey.

Comparing several observations of the same quantity is one of the best ways to identify mistakes.

Assume that five observations of a line are recorded as; 67.91, 76.95, 67.89, 67.90, 67.89. The second value disagrees with the others, apparently because of a transposition of figures in reading or recording.

Most Probable Value (Expected Value) (x)

The true of any quantity is never known. However, its most probable value can be calculated if redundant observations have been made. Redundant observations are measurements in excess of minimum required to determine a quantity.

Most probably value is derived from a sample set of data rather than the population, and simply the mean if the repeated measurements have the same precision.

For a single unknown such as a line length that has been directly and independently observed a number of times using the same equipments and procedures, the most probable value in this case simply the arithmetic mean;

$x = (\Sigma l / n)$

Σl = the sum of the individual measurements y,

n = the total number of observations

Residuals

It is the differences between any individual measured quantity and the most probable value for that quantity.
The mathematical expression for a residual is;
$V_i = x - l_i$
Where V_i is the residual in any observation l_i and x is the most probable value for the quantity.

$\Sigma V_i = 0$ $[V] = 0$;

Absolute error:

When the true value of a observation is known it is possible to calculate absolute error with following formula:

$$\varepsilon = x - l$$

Where x is the real value and l is the observation.

Example-1

Internal angels of a triangle were measured as following values:

$\alpha = 75^g.4525$

$\beta = 67^g.2237$

$\gamma = 57^g.3251$

Please determine the type of the error and its quantity.

Total value of internal angels of a triangle is 180^0 (200^g).

So that $x = 200^g$.

Absolute error: $\boldsymbol{\varepsilon = x - l}$

$\varepsilon = 200 - (\alpha + \beta + \gamma) = -0.0013^g = -13^{cc}$

Average Error

1. Average error (Average of absolute error)(t):

$$t = \pm \frac{|\varepsilon 1| + |\varepsilon 2| + |\varepsilon 3| + \ldots + |\varepsilon n|}{n} = \pm \frac{[|\varepsilon|]}{n}$$

ε = errors

n = number of observation

$$t = \pm \frac{|v1| + |v2| + |v3| + \ldots + |vn|}{n} = \pm \frac{[|v|]}{n}$$

V = residuals

Root Mean Square Error

2. Root Mean Square Error (m):

$$m = \pm \frac{\sqrt{|\varepsilon 1^2| + |\varepsilon 2^2| + |\varepsilon 3^2| + \ldots + |\varepsilon n^2|}}{n} = \pm \sqrt{\frac{[|\varepsilon\varepsilon|]}{n}}$$

errors

number of observations

$$m = \pm \frac{\sqrt{|v1^2| + |v2^2| + |v3^2| + \ldots + |vn^2|}}{n-1} = \pm \sqrt{\frac{[|vv|]}{n-1}}$$

V = residuals

n-1 = redundant observations

$$m = \pm \sqrt{\frac{[|vv|]}{n-u}}$$

If two or more unknowns are exists,

u = number of unknowns n= number of observations

(n-u) = redundant observations

RMSE of most probable value
RMSE of the mean

$$M = \pm \frac{m}{\sqrt{n}}$$

Example - 3

A distance is measured 7 times and following measurements are obtained.

Observations (m):

l_1= 125.165 l_4 = 125.160

l_2 = 125.162 l_5 = 125.161 l_7= 125.164

l_3 = 125.166 l_6 = 125.163

Depending on above stated measurement values, please calculate:

a) Most probable value (x)

b) Average error (t)

b) Root Mean Square Error (m)

c) RMSE of most probable value (M)

Example - 3

Obs. Num	Measurements (l)	Probable Val. (x).	Residual (v)	v*v
1	125.165	125.163	-2	4
2	125.162		1	1
3	125.166		-3	9
4	125.160		3	9
5	125.161		2	4
6	125.163		0	0
7	125.164		-1	1
Total			0	28

a) Most probable value (x)

x= [l]/n =125.163

Example - 3

b) Average error (t)

$$t = \pm \frac{[|v|]}{n} \qquad [|v|] = 12mm$$

$$t = \pm \frac{[|v|]}{n} = \frac{12}{7} = \pm 1.7mm$$

Example - 3

c) Root Mean Square Error (m)

$$m = \pm\sqrt{\frac{[vv]}{n-1}}$$

$$m = \pm\sqrt{\frac{[vv]}{n-1}} = \pm\sqrt{\frac{28}{6}} = \pm 2.16mm$$

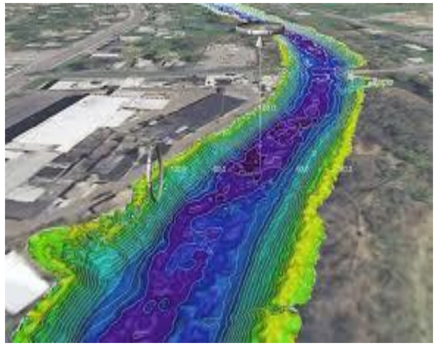
Example - 3

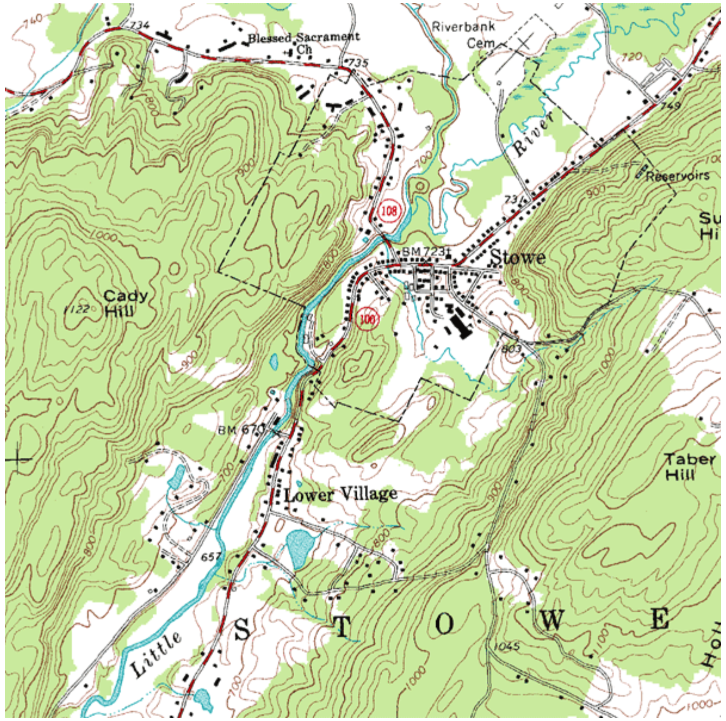
d) RMSE of most probable value (M)

$$M = \pm \frac{m}{\sqrt{n}} \qquad m = \pm \sqrt{\frac{[vv]}{n-1}}$$

$$M = \pm \frac{2.16}{\sqrt{7}} = \pm 0.82mm$$

Measurement, mapping and projecting studies for engineering projects-Week_3

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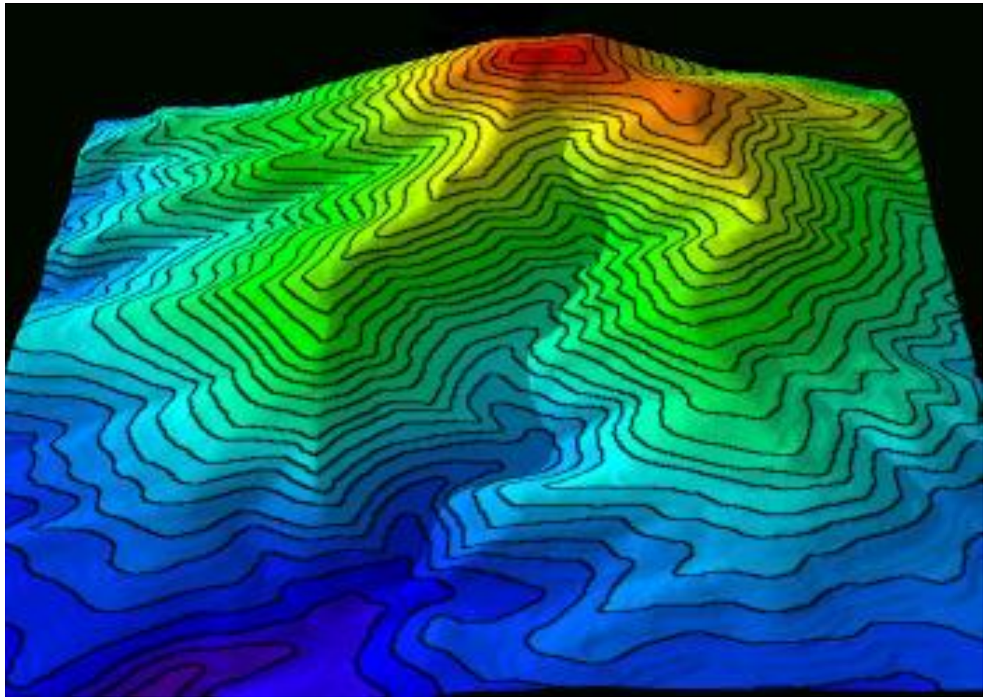
Riverbank Cem
River
Reservoirs
Stowe
Cady Hill
Lower Village
Taber Hill
Little
S T O W E




Total station
Electronic theodolite
Digital level and rod
AL24
PRECISION TOOLS
FARO
... others
Laser scanner
1870's Surveyor's Steel Tape
Satellite receiver

www.leica-geosystems.com

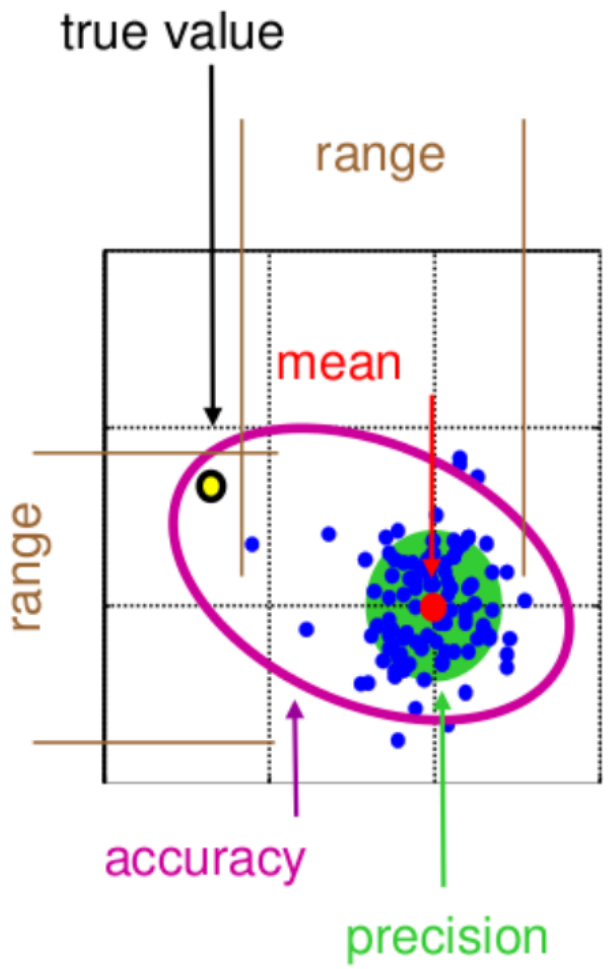
http://www.trimble.com

www.topconpositioning.com

http://www.railway-technology.com

Precision vs. Accuracy

- **Precision** describes the degree of repetability
  - internal measure of random errors and their effects
- **Accuracy** describes the degree of closeness
  - is a measure of agreement between the observed and the true (correct) value
  - Systematic & non-random errors in addition to random errors

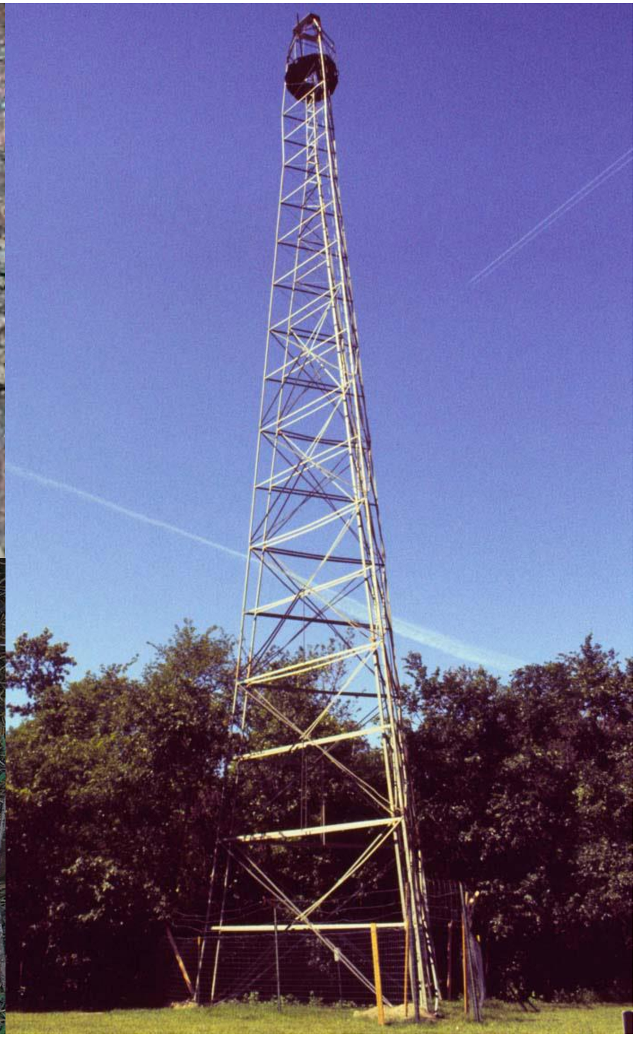


- Surveying and Geodesy relies on a set of permanently marked points, which is called the *Geodetic Control Network*.

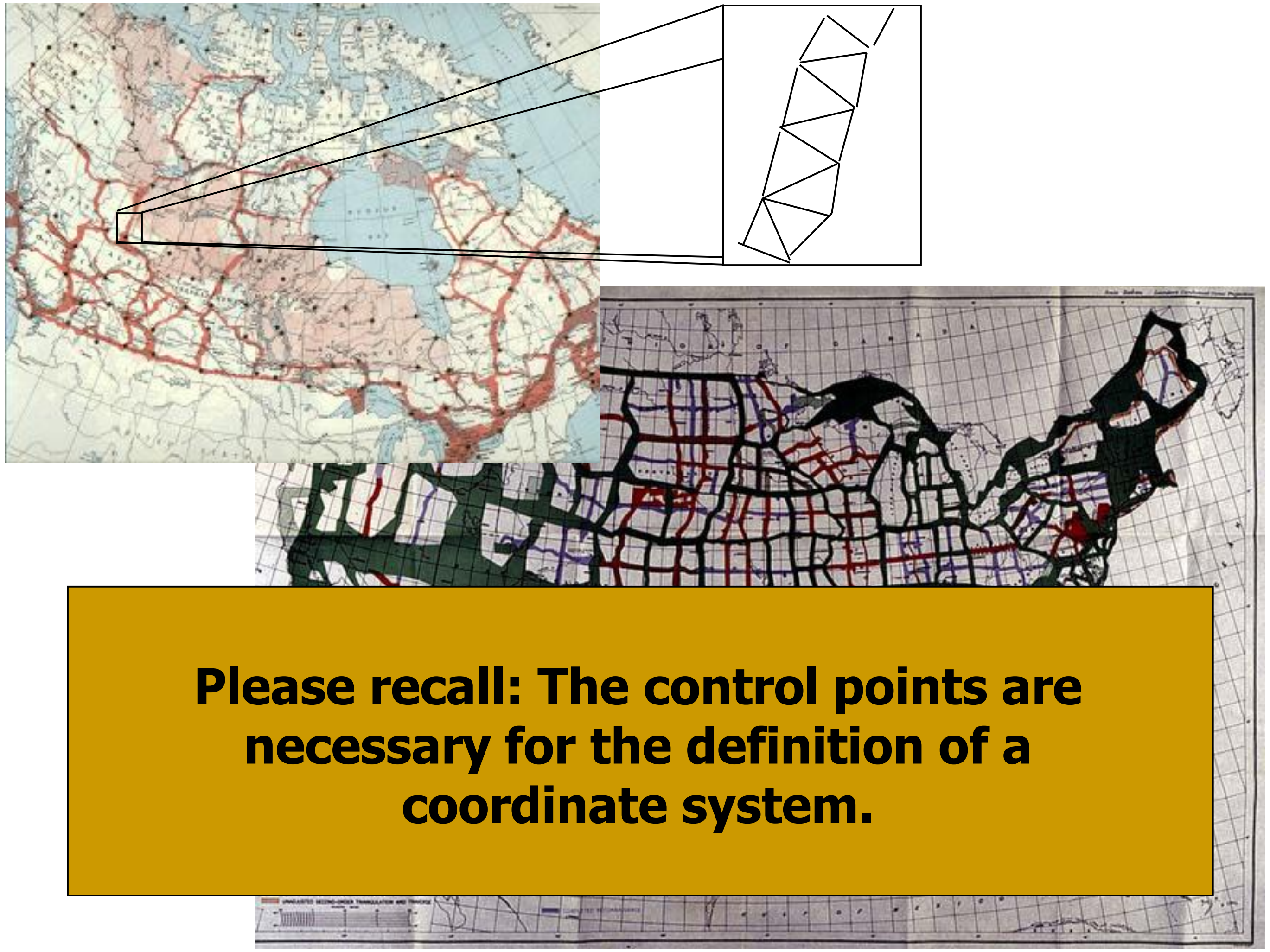
- The positions (co-ordinates) of these points are detemined using geodetic and gravimetric observations in an appropriate frame.

- Geodesy relies on triangulations, trilaterations, levellings, satellite geodetic observations and gravimetric observations

- The networks belong to the national/international infrastructure and serve as a basis for not only surveying, but geoinformation services, land registry and many other location based service.



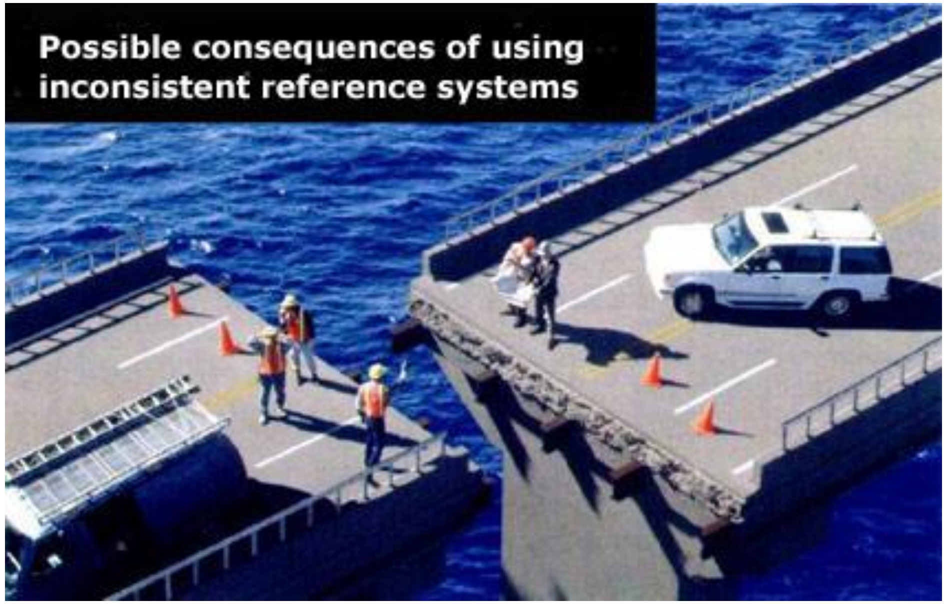
A set of control points covering a large region.



Please recall: The control points are necessary for the definition of a coordinate system.

The Control Network provide us with control points given in the same refence system (coordinate system).

Thus measuring the relative positions of unknown points using these control points, the coordinates of the new points can be computed in the same reference system.



Static vs Dynamic Networks

<u>Static view (up to the early 20th Century)</u>

The Earth is a rigid body, the coordinates and the gravity field do not change.

The contradictions between remeasured GCNs were explained by the higher errors of previous observations.

<u>Dynamic view</u>

The Earth is not rigid, plate tectonics exist, therefore the control points may change their coordinates.

Repeated observation and computation of the networks enable us to split the coordinate error in two parts:

- determined by the deformation of crust;
- caused by observation error.

Dynamic Networks

In order to assess the deformations of the crust:

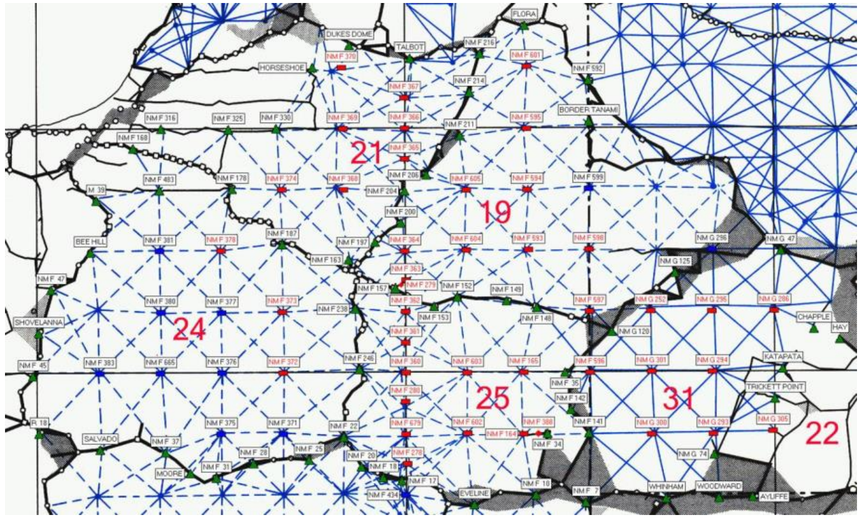
• the location of points should be chosen using the results of other disciplines (geophysics, geology, etc.);

• the points should be marked in a suitable manner;

• displacement rates of approx. 1mm/yr should be exceeded.

New Geodetic Control Networks should be planned and established so, that it provides a basis for surveying and geodesy as well as enables the determination of recent crust deformations.


Amersfoort
0
50km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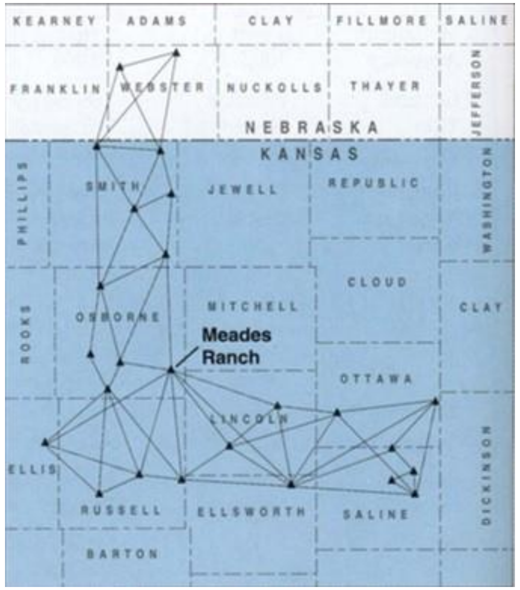
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SMITH
JEWELL
REPUBLIC
WASHINGTON
CLOUD
ROOKS
OSBORNE
MITCHELL
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OTTAWA
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ELLSWORTH
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DICKINSON
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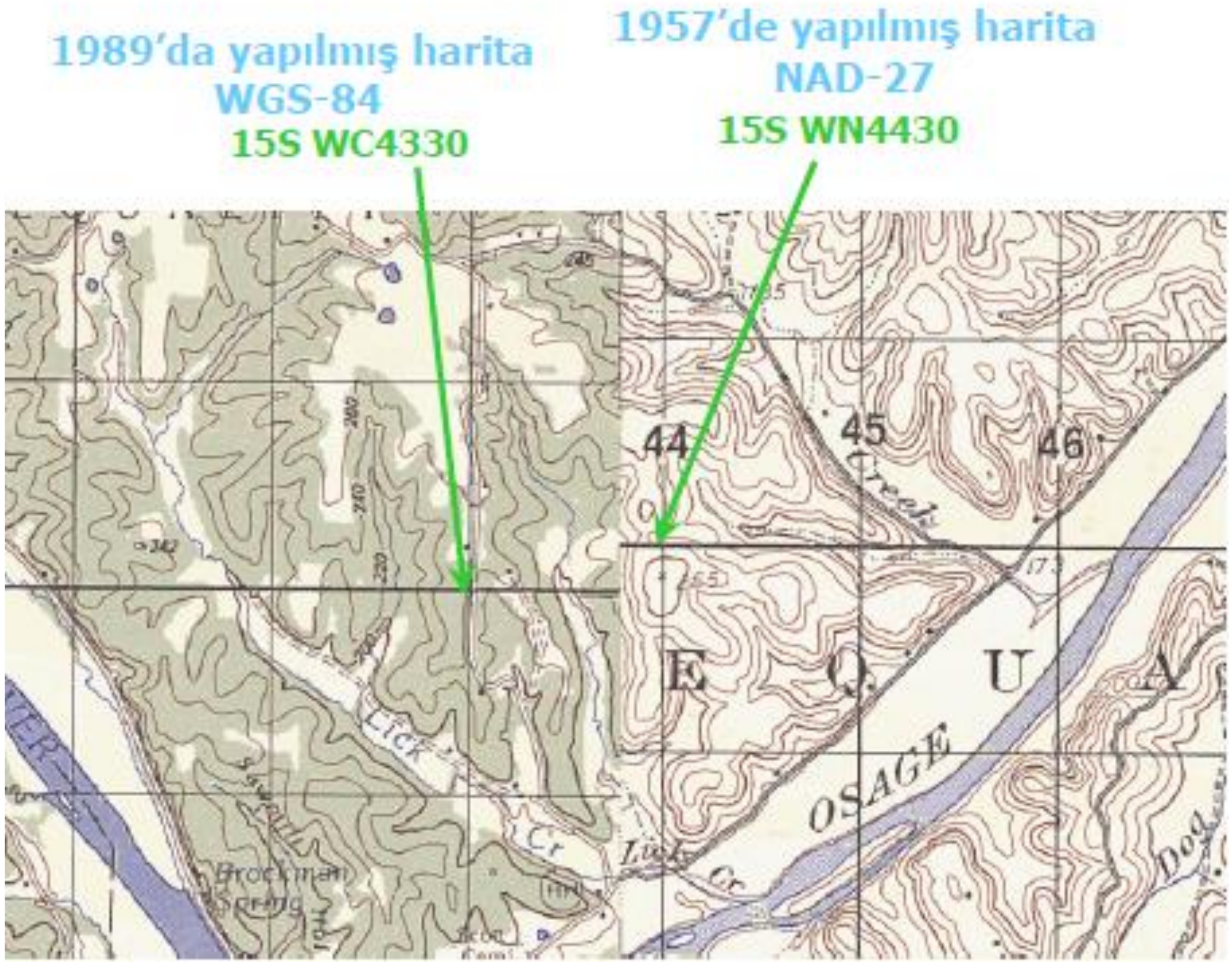
1989'da yapılmış harita
WGS-84
15S WC4330
1957'de yapılmış harita
NAD-27
15S WN4430
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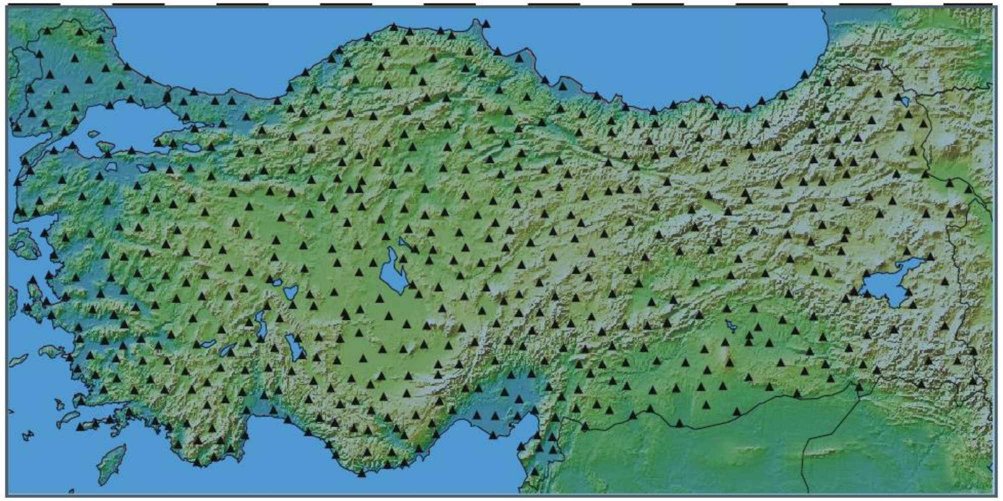
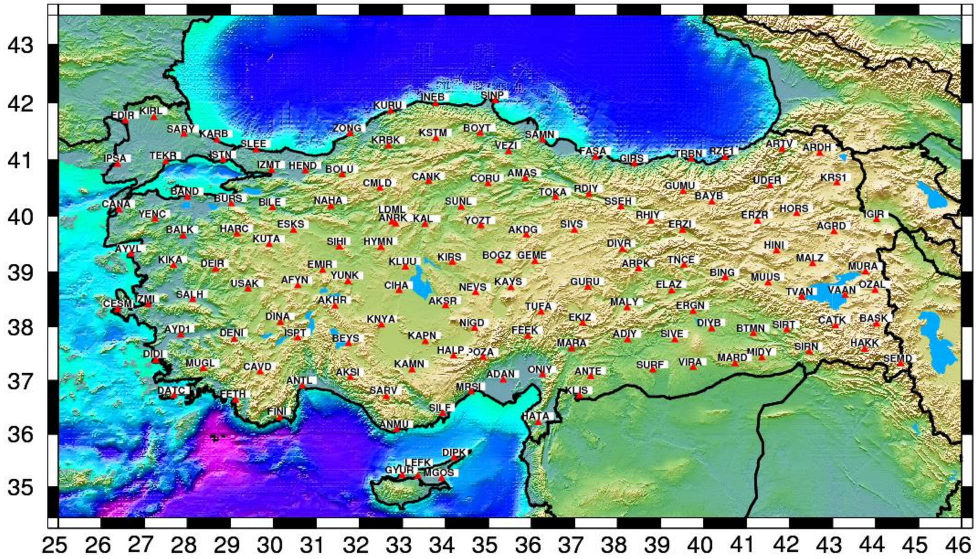
OSAGE
Lick
Cr
Brockman Spring
Dog

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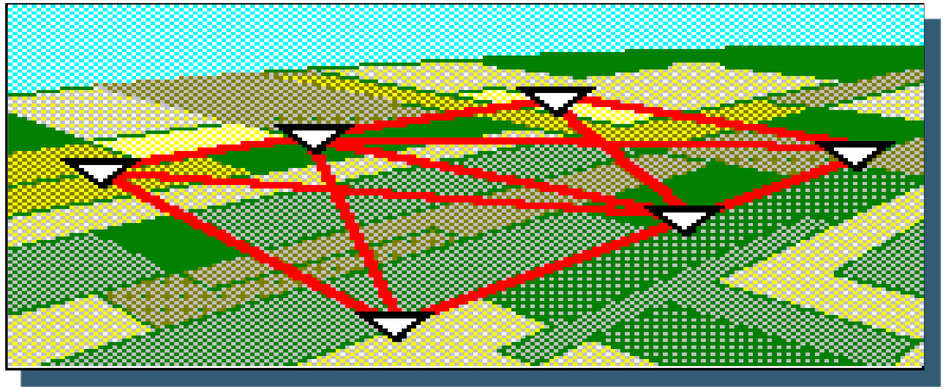


ÜÇÜNCÜ BÖLÜM
Jeodezik Çalışmalar

Referans çerçevesi ve izdüşüm sistemi

MADDE 10- (1) Bu Yönetmelik kapsamında hesaplanacak koordinatlar, TUREF'e dayalı olarak, GRS80 elipsoidi ve Transvers Mercator (TM) izdüşümünde üç derecelik dilim esasına göre belirlenir.

C1 derece ana GNSS ağının oluşturulması

MADDE 11- (1) TUTGA/TUSAGA-Aktif ile sıklaştırma alanındaki noktalar arasında bağlantıyı sağlayan C1 derece Ana GNSS ağı, sıklaştırma alanına 30 km'den yakın, her durumda en az iki TUTGA/TUSAGA-Aktif noktası ile diğerleri önceden tesis edilmiş C1 noktalarından olmak üzere en az üç noktadan ve en fazla 30 km uzunluğundaki bağımsız bazlardan oluşturulur. C1 noktaları aşağıdaki noktalardan oluşabilir.

a) I., II. ve dengelenmiş III. derece Ülke Yatay Kontrol (Nirengi) Ağı noktaları.

b) Mülga Büyük Ölçekli Haritaların Yapım Yönetmeliğine göre oluşturulmuş III. derece nirengi ağı noktaları.

c) Yerel ağların (ülke sistemine bağlı olmayan) yüksek dereceli noktaları.

ç) Yeni tesis edilecek noktalar.

C1 noktası için yer seçimi

MADDE 12- (1) C1 noktasının yer seçiminde aşağıdaki esaslar dikkate alınır.

a) Çevrede uydu sinyallerini yansıtacak yüzeyler (duvar, su yüzeyi, çatı ve benzeri yapılar) bulunmamalıdır.

C2 derece sıklaştırma GNSS ağının oluşturulması

MADDE 16- (1) TUTGA/TUSAGA-Aktif veya C1 noktalarından 15 km'yi geçmeyen en az iki bağımsız baz ile belirlenen C2 derece ağlar, sıklaştırma alanı içindeki aşağıdaki noktalardan oluşabilir.

a) I., II. ve dengelenmiş III. derece Ülke Nirengi Ağı noktaları.

b) Mülga Büyük Ölçekli Haritaların Yapım Yönetmeliğine göre oluşturulmuş III. derece yüzey ağı noktaları.

c) Yerel yatay kontrol ağlarının yüksek dereceli noktaları.

ç) Yeni tesis edilecek noktalar.

C2 noktası için yer seçimi

MADDE 17- (1) C2 noktası için yer seçiminde; bu Yönetmeliğin 12 nci maddesinde yer alan esaslara ek olarak, eğer C3 dereceden nokta sıklaştırması aynı proje kapsamında yapılmayacak ise her C2 noktası aynı veya üst dereceden bir başka ağ noktasını görmelidir. Seçilen C2 dereceli noktalar bu Yönetmeliğin 12 nci maddesinde belirtilen yer seçim kanavasında gösterilir.

C2 noktasının tesisi

MADDE 18- (1) C2 noktasının tesisinde;

a) Tahrip olmayan eski noktaların zemin tesisleri aynen korunur.

b) Yeni C2 noktaları ek-4'te yer aldığı gibi tesis edilir.

C2 noktalarının GNSS tekniğiyle ölçülmesi

MADDE 19- (1) C2 noktalarının ölçümlerinde;

a) Aynı anda en az altı uydudan kayıt yapabilen jeodezik amaçlı GNSS alıcıları kullanılır.

b) Eş zamanlı oturumlar halinde gerçekleştirilecek statik ölçmelerde;

1) Uydu sayısı: En az beş adet,

2) Kayıt aralığı: 15 saniye veya daha az,

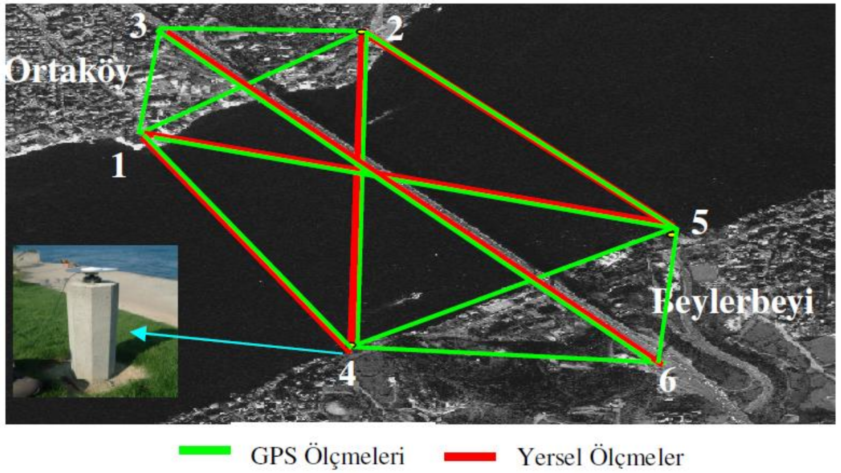
3) Uydu yüksekliği: 10°,

4) Kayıt süresi: Bazlarda tek oturumda 60 dakika (tek frekanslı alıcılar için 90 dakika), alınır.

c) TUREF koordinatları bilinmeyen ve pilye tesisi olmayan noktalarda 30 dakikalık (tek frekanslı alıcılar için 45 dakika) iki oturumlu ölçüm yapılır. Her oturumdaki anten yükseklikleri arasında en az 10 cm'lik fark olmalıdır.

ç) Anten yüksekliği ölçüye başlamadan önce ve sonra iki kez mm duyarlığında ölçülür.

d) Her oturumda, ek-5'te yer alan GNSS Ölçme ve Kayıt Karnesi düzenlenir.


Ortaköy
Beylerbeyi
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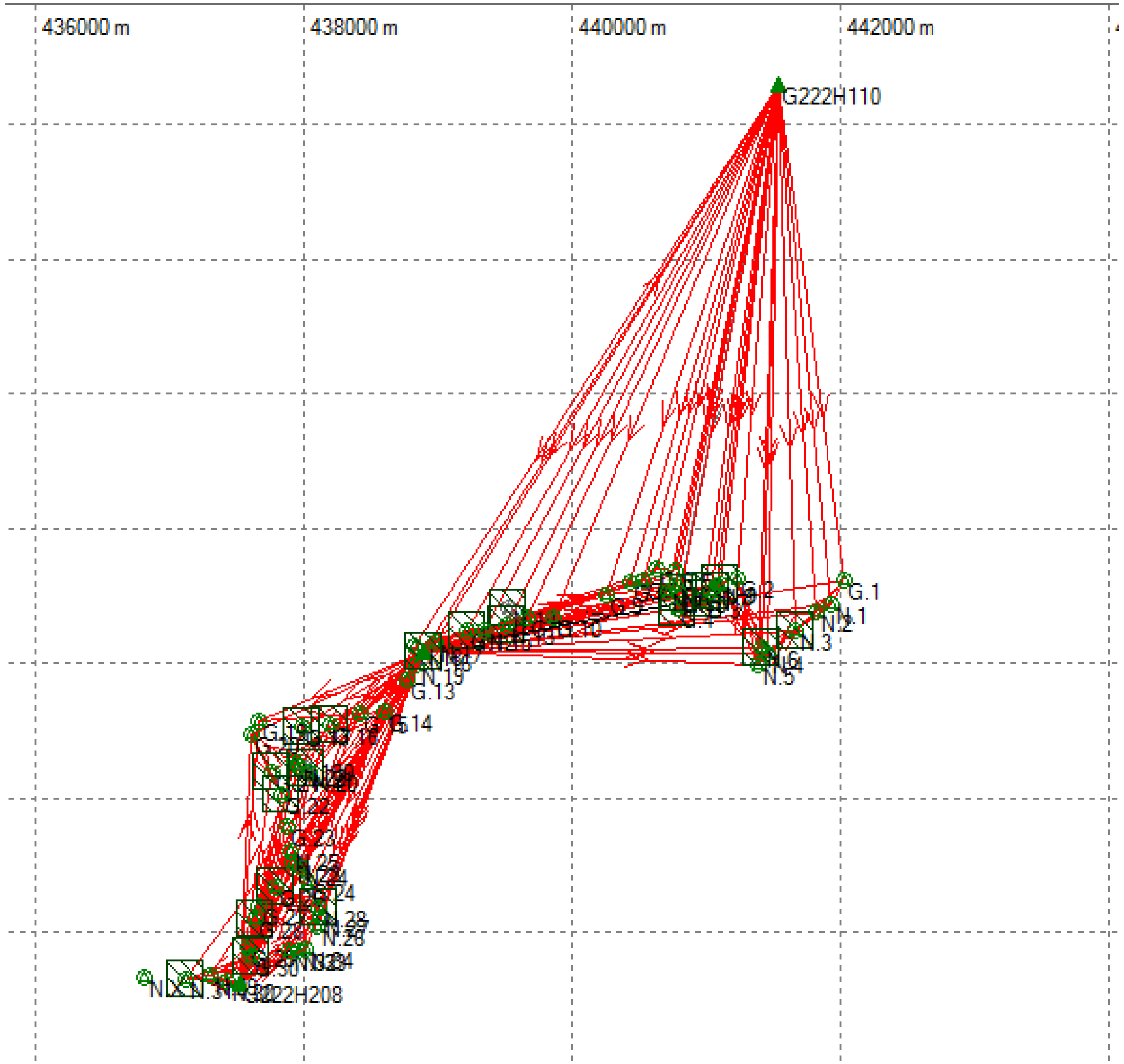
GPS Ölçmeleri
Yersel Ölçmeler


436000 m
438000 m
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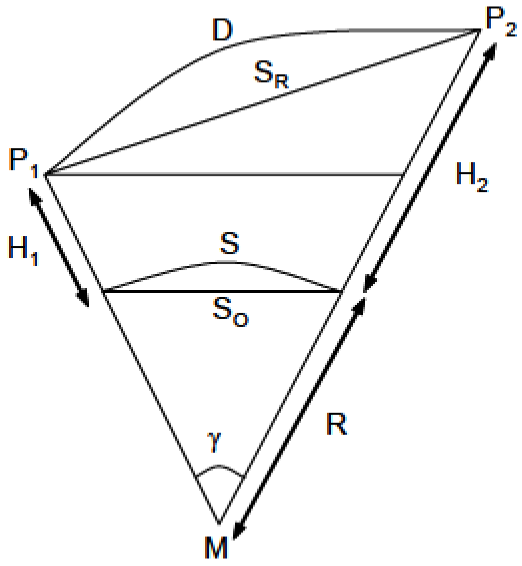
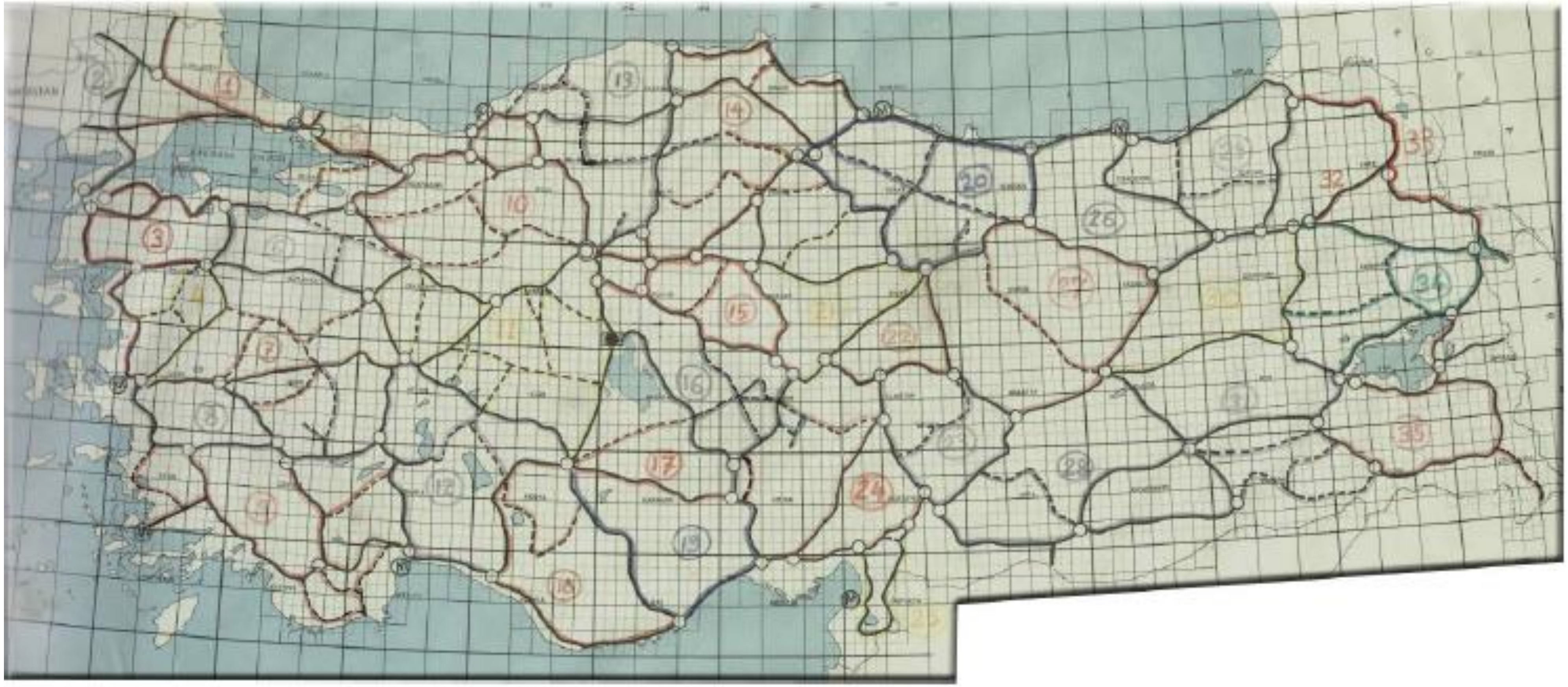
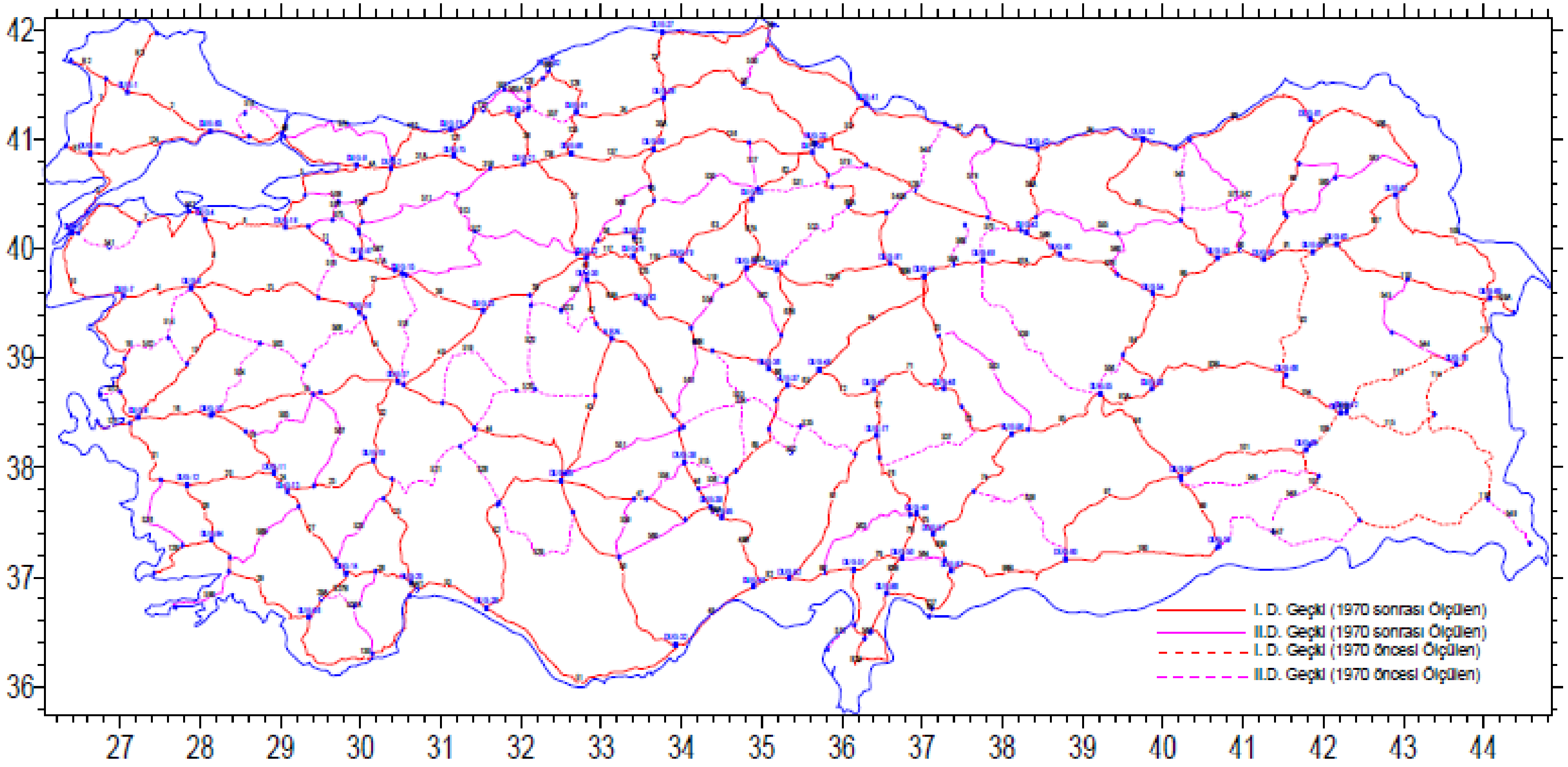
G.1
G.13
G222H208



	Düzeltme/İndirgeme	Bağıntı	Numara
Düzeltmeler	Modülasyon frekansı hatası	$K_F = D_Ö \frac{f_0 - f}{f}$	3.91
	Çevrel faz hatası	$K_Ç = A \sin\left((D_Ö - C)\frac{2\pi}{U}\right)$	3.94
	Sıfır noktası hatası	$K_S = a_0 + a_1 D_Ö$	3.106
	1. Hız düzeltmesi	$K_{1H} = D_Ö (n_O - n_L)$	3.122
	2. Hız düzeltmesi	$K_{2H} = -(k - k^2)\frac{(D_Ö)^3}{12R^2}$	3.123
	Düzeltilmiş Uzunluk	$D=D_Ö+K_F+K_Ç+K_S+K_{1H}+K_{2H}$	3.124
İndirgemeler	Işın yolu eğriliği	$\dot{I}_{ie} = -k^2 \frac{D^3}{24R^2}$	3.125
	Işın yolu kirişi	$S_R = D + \dot{I}_{ie}$	3.126
	Eğim ve yükseklik düzeltmesi	$\dot{I}_{ey} = S_R\left(\sqrt{\frac{1-\left(\frac{\Delta H}{S_R}\right)^2}{\left(1+\frac{H_1}{R}\right)\left(1+\frac{H_2}{R}\right)}} - 1\right)$	3.134
	Referans düzlemi kirişi	$S_0 = S_R + \dot{I}_{ey}$	3.135
	Yeryüzü eğriliği	$\dot{I}_{ye} = \frac{S_0^3}{24R^2}$	3.133
	Deniz yüzeyindeki uzunluk	$S = S_0 + \dot{I}_{ey}$	3.127
	Projeksiyon indirgemesi	$\dot{I}_p = (y_1^2 + y_1 y_2 + y_2^2)\frac{S}{6R^2}$	3.141
	Projeksiyon düzlemindeki uzunluk	$D=S+\dot{I}_p$	3.143



1970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I. D. Geçki (1970 sonrası Ölçülen)
II.D. Geçki (1970 sonrası Ölçülen)
I. D. Geçki (1970 öncesi Ölçülen)
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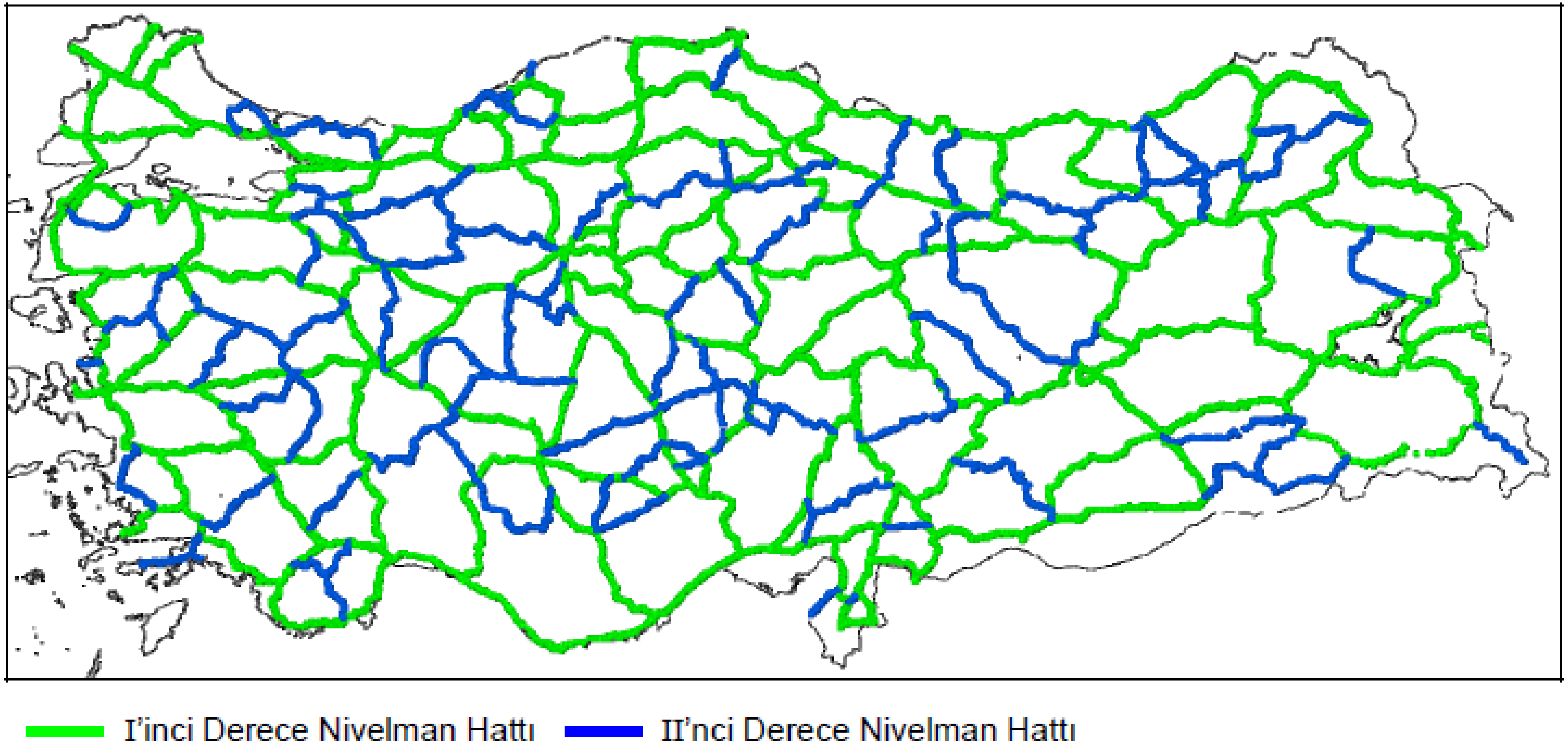
TUDKA-92



TUDKA-99

Büyük Ölçekli Harita ve Harita Bilgileri Üretim Yönetmeliği
Madde-8

Türkiye Ulusal Düşey Kontrol (Nivelman) Ağı ve bu ağa dayalı olarak oluşturulan düşey kontrol ağlarının derecelendirilmesi:

1- I. Derece Nivelman Ağı ve Noktaları: Ülke Nivelman Ağı ve Noktaları

2- II. Derece Nivelman Ağı ve Noktaları: Ülke Nivelman Ağı ve Noktaları

3- III. Derece Nivelman Ağı ve Noktaları: En çok 40 km uzunluğundaki luplarla üst dereceli ağlara dayalı sıklaştırma ağı ve noktaları. Ana Nivelman Ağı

4- IV. Derece Nivelman Ağı ve Noktaları: En çok 10 km uzunluğundaki luplarla üst dereceli ağlara dayalı sıklaştırma ağı ve noktaları. Ara Nivelman Ağı

5- V. Derece Nivelman Ağı ve Noktaları: Poligon ve tamamlayıcı nivelman ağı ve noktaları

Nivelman Gidiş – Dönüş Kapanma Değerleri

BÖHHBÜY, Madde 37 - Gidiş – dönüş nivelmanında bulunan kapanma değeri (w),

Ana ve bağlantı nivelmanında : $w_{[\,mm\,]} \leq 12 \sqrt{S}_{\,[km]}$

Ara nivelmanda : $w_{[\,mm\,]} \leq 15 \sqrt{S}_{\,[km]}$

Yardımcı nivelmanda : $w_{\,[mm\,]} \leq 20 \sqrt{S}_{\,[km]} + 0.0002\,\Delta H$

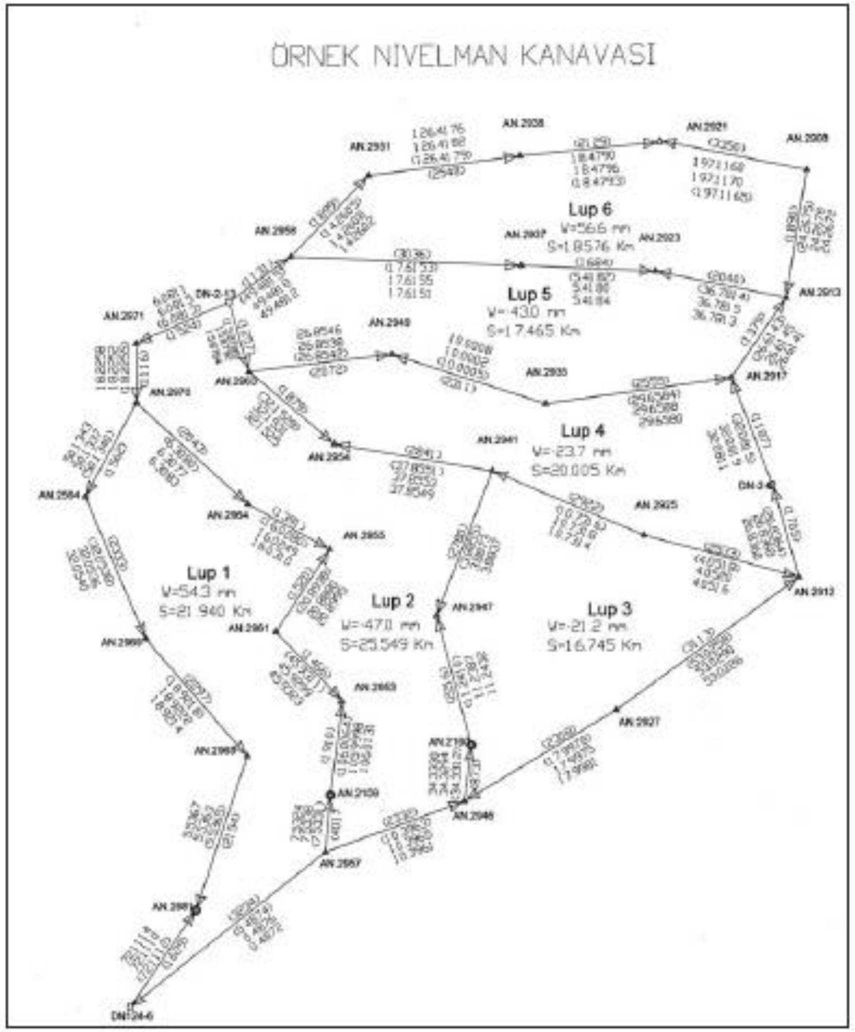
olmalıdır. Burada S, km biriminde nivelman yolunun uzunluğu, ΔH iki nokta arasındaki yükseklik farkıdır. Nivelman yolu üzerindeki ardışık noktalar arasında bu kontrol yapılır.

Nivelman Lup Kapanma Değerleri

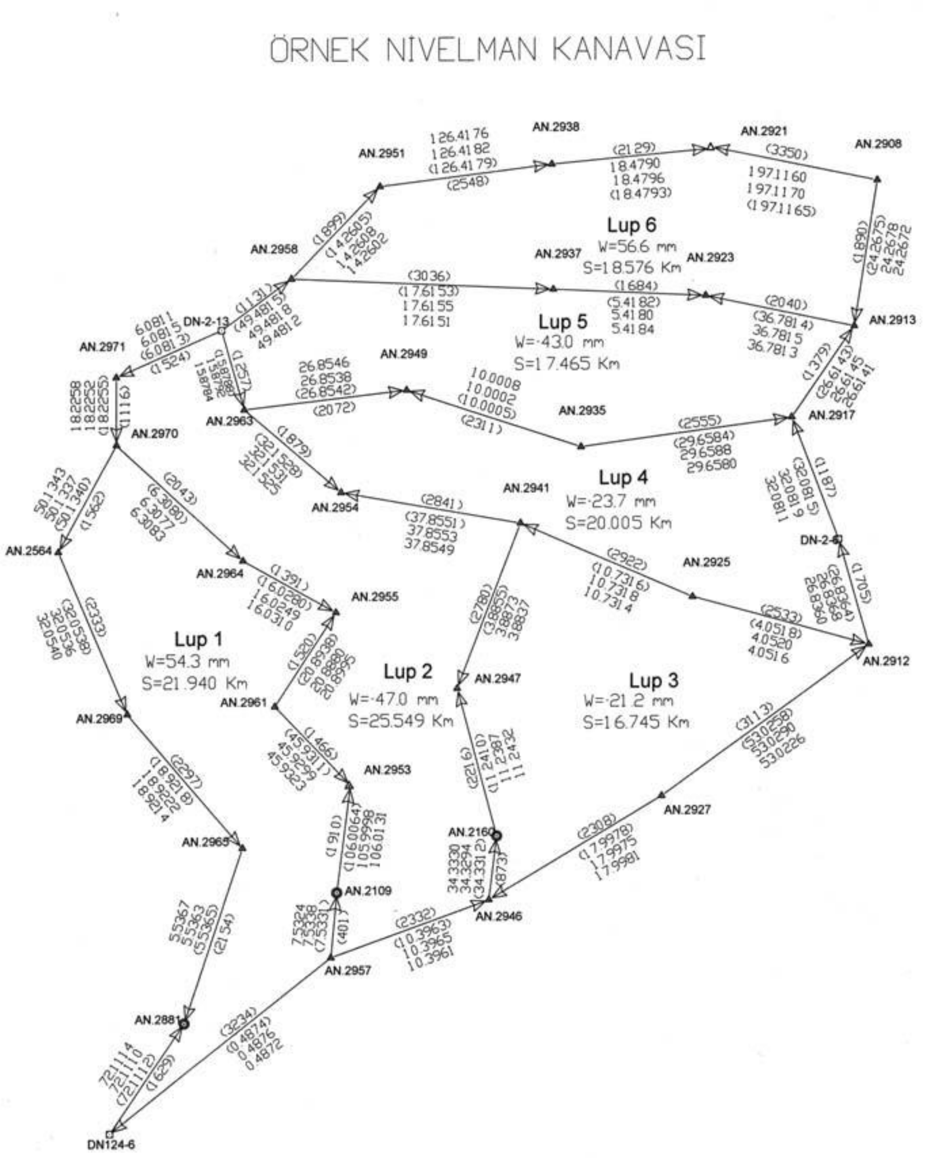
BÖHHBÜY, Madde 38 - Gidiş–dönüş yükseklik farklarının ortalamalarından hesaplanan lup kapanmaları (wL),

Ana nivelmanda : $w_{L[mm]} \leq 15\sqrt{L_{[km]}}$

Ara nivelmanda : $w_{L[mm]} \leq 18\sqrt{L_{[km]}}$


ÖRNEK NIVELMAN KANAVASI
Lup 1
Lup 2
Lup 3
Lup 4
Lup 5
Lup 6

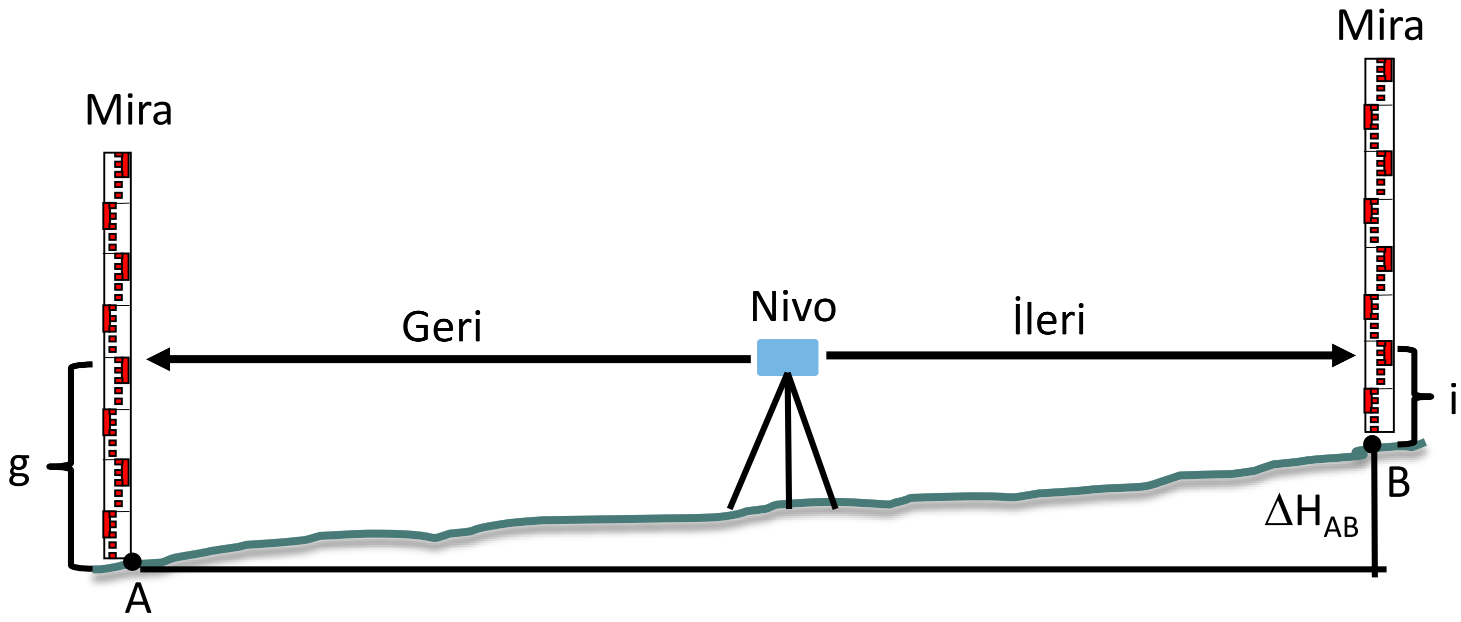

H110
RS015
RS014
RS001
RS005
RS003
RS004
RS007
RS006
RS002
RS008
RS009
RS010
RS011
4B-YDN530201
RS013
H208
RS012



LUP 1

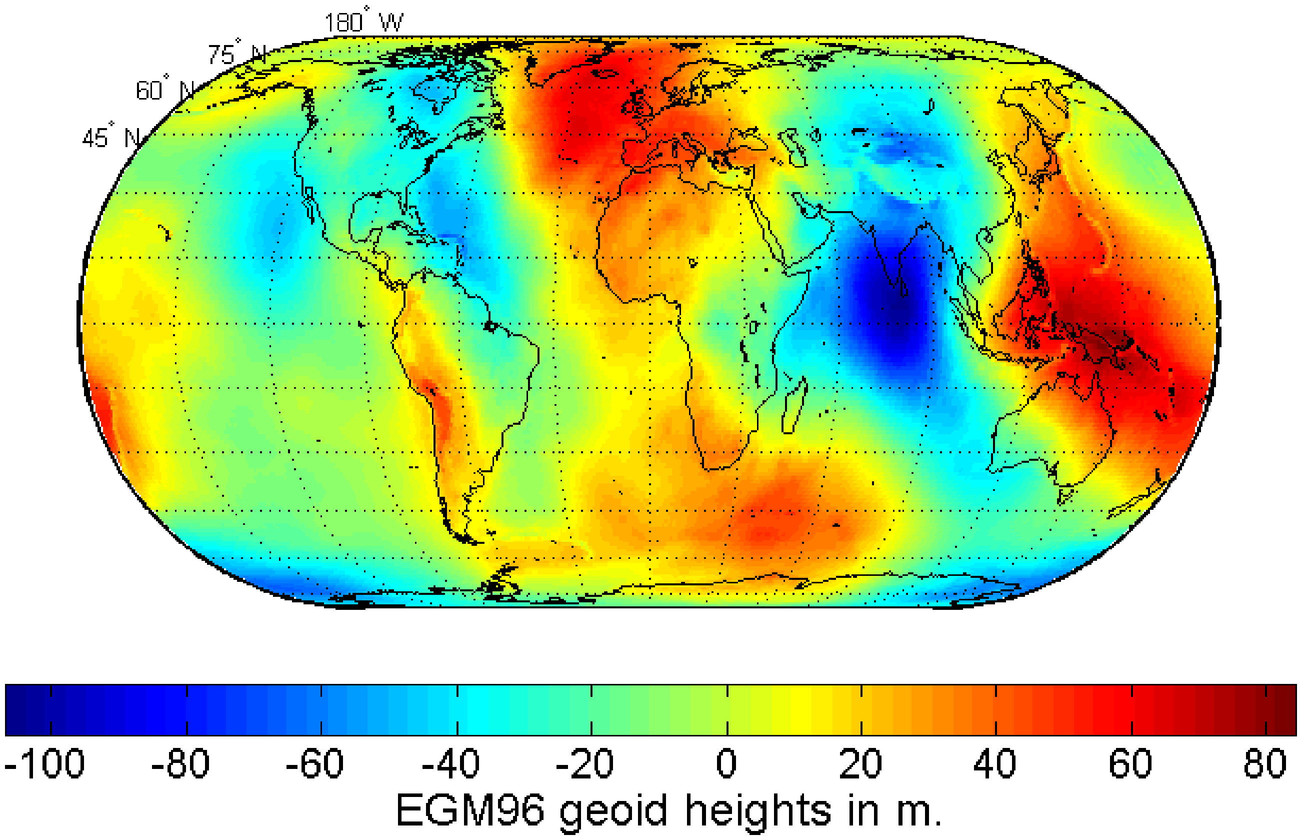
Nivelman hattı		Gidiş (m)	Dönüş (m)	Fark (mm)	Hata sınırı (mm)	Ortalama ΔH (m)	Nivelman Yolu (km)
DN124-6	AN2881	72.1110	72.1114	0.4	15.3	72.1112	1.629
AN2881	AN2965	-5.5367	-5.5363	0.4	17.6	-5.5365	2.154
AN2965	AN2969	-18.9214	-18.9222	-0.8	18.2	-18.9218	2.297
AN2969	AN2564	-32.0540	-32.0536	0.4	18.3	-32.0538	2.333
AN2564	AN2970	50.1343	50.1337	-0.6	15.0	50.1340	1.562
AN2970	AN2964	6.3077	6.3083	0.6	17.2	6.3080	2.043
AN2964	AN2955	16.0249	16.0310	6.1	14.2	16.0280	1.391
AN2955	AN2961	-20.8880	-20.8995	-11.5	14.8	-20.8938	1.520
AN2961	AN2953	45.9299	45.9323	2.4	14.5	45.9311	1.466
AN2953	AN2109	-106.0131	-105.9998	13.3	16.6	-106.0065	1.910
AN2109	AN2957	-7.5338	-7.5324	1.4	7.6	-7.5331	0.401
AN2957	DN124-6	0.4876	0.4872	-0.4	21.6	0.4874	3.234
					w_1(mm) =	54.3	21.940

Lup No	S (km)	Kapanma w (mm)	Hata sınırı $15\sqrt{L_{[km]}}$ (mm)	Normlandırılmış kapanma $\overline{w} = \sqrt{w^2 / S}$ (mm/km)
1	21.940	54.3	± 70.3	± 11.59
2	25.549	-47.0	± 75.8	± 9.30
3	16.745	-21.2	± 61.4	± 5.18
4	20.005	-23.7	± 67.0	± 5.30
5	17.465	-43.0	± 62.7	± 10.29
6	18.576	56.6	± 64.6	± 13.13
Toplam	120.280	m_{0_d} = ± 9.61 mm		

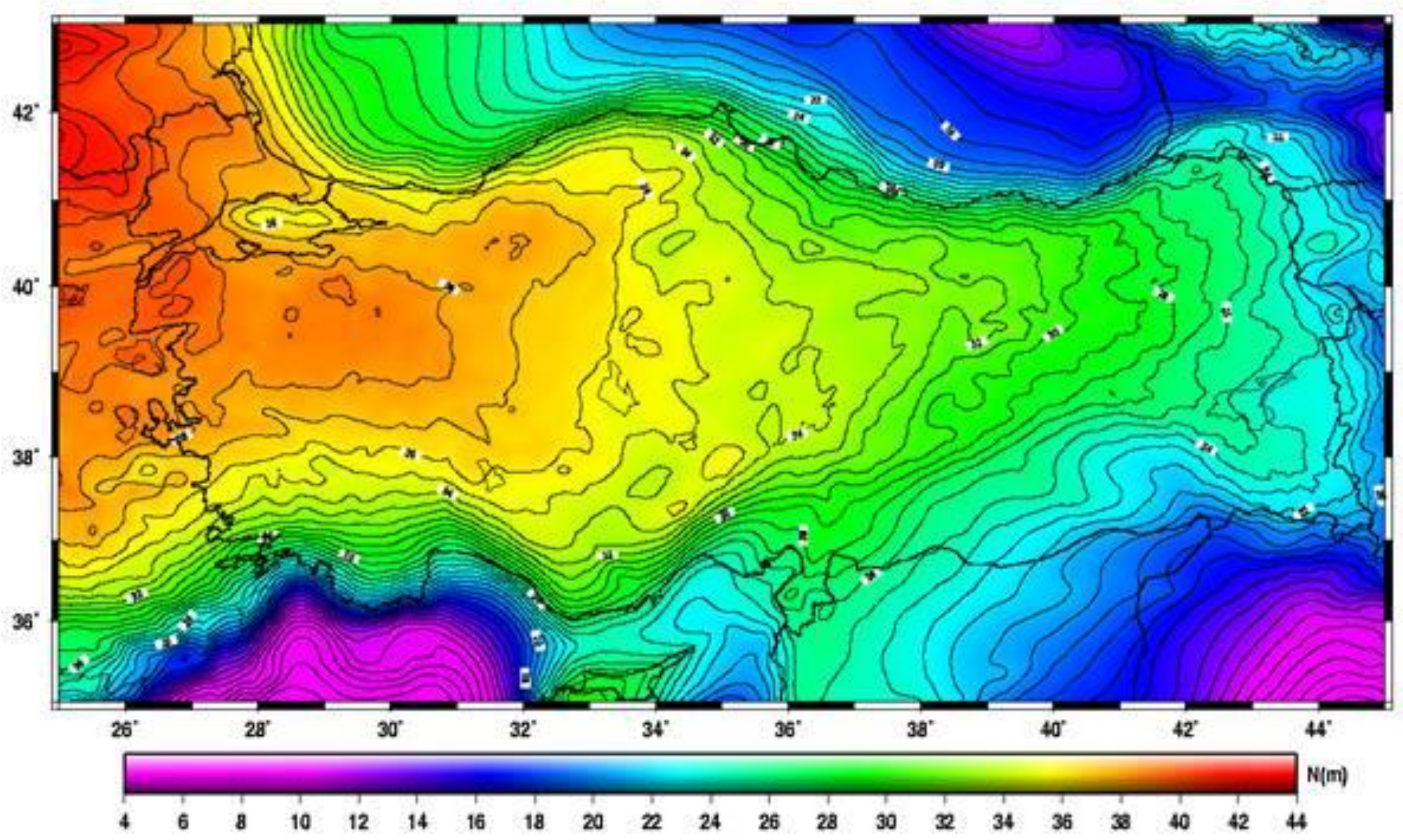

Mira
Mira
Geri
Nivo
İleri
g
i
A
B
ΔH_AB

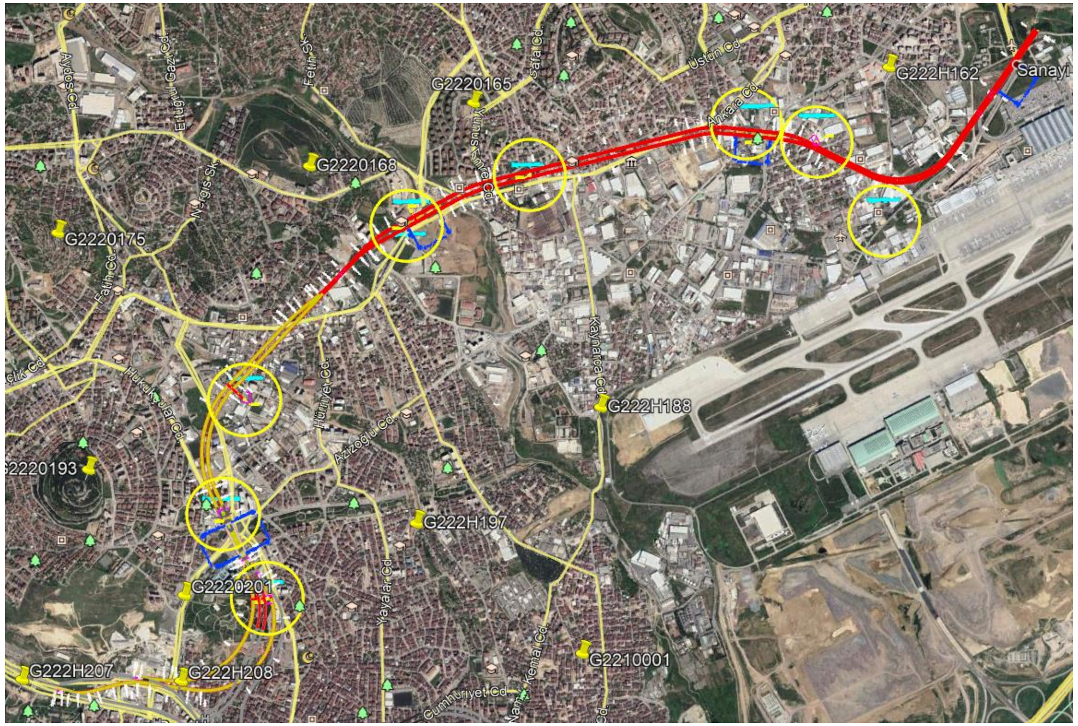
GNSS nivelmanı yöntemiyle Helmert ortometrik yüksekliklerinin belirlenmesi

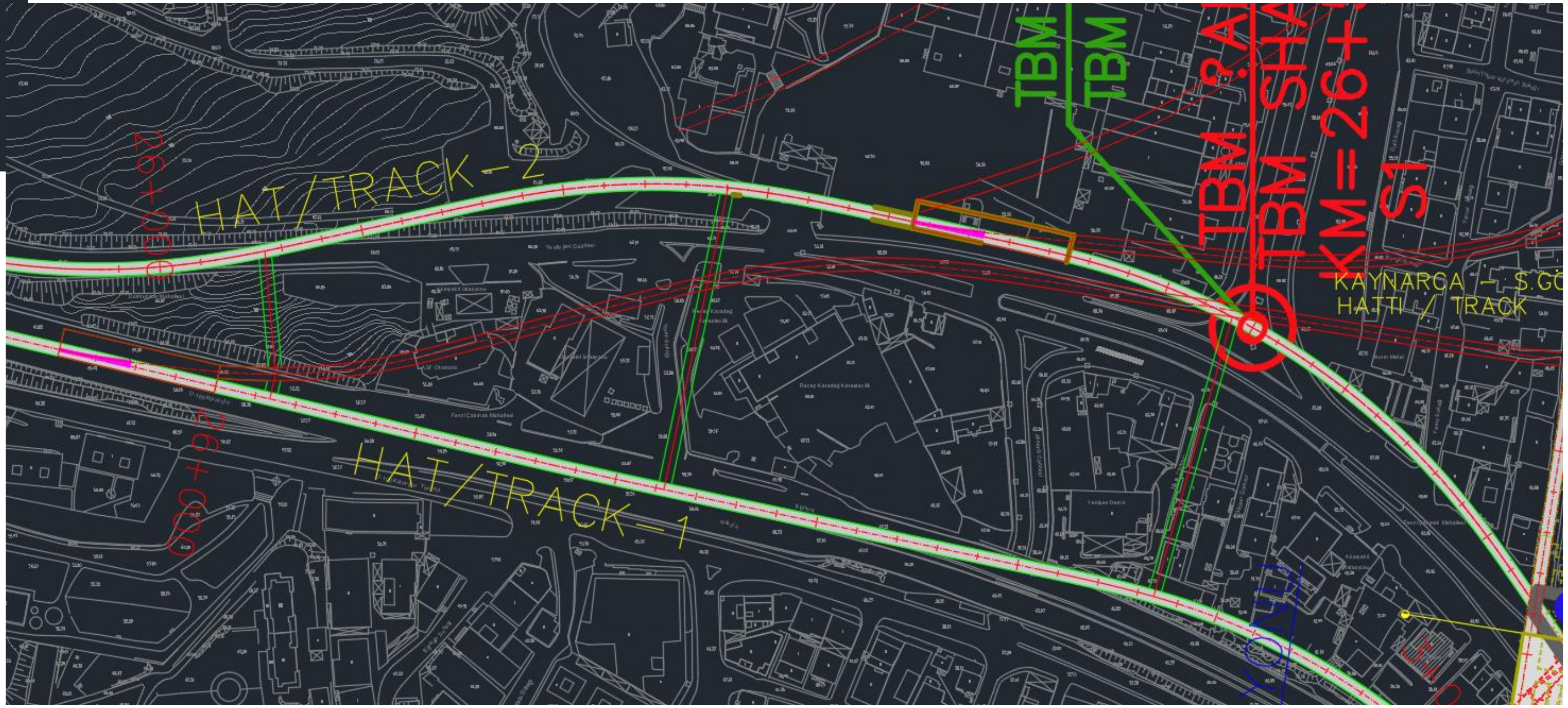
MADDE 41- (1) GNSS ile bulunan elipsoit yüksekliğinden Helmert ortometrik yüksekliklere dönüşüm için TGyy veya yerel GNSS nivelman jeoidi kullanılarak GNSS nivelmanı uygulanır.

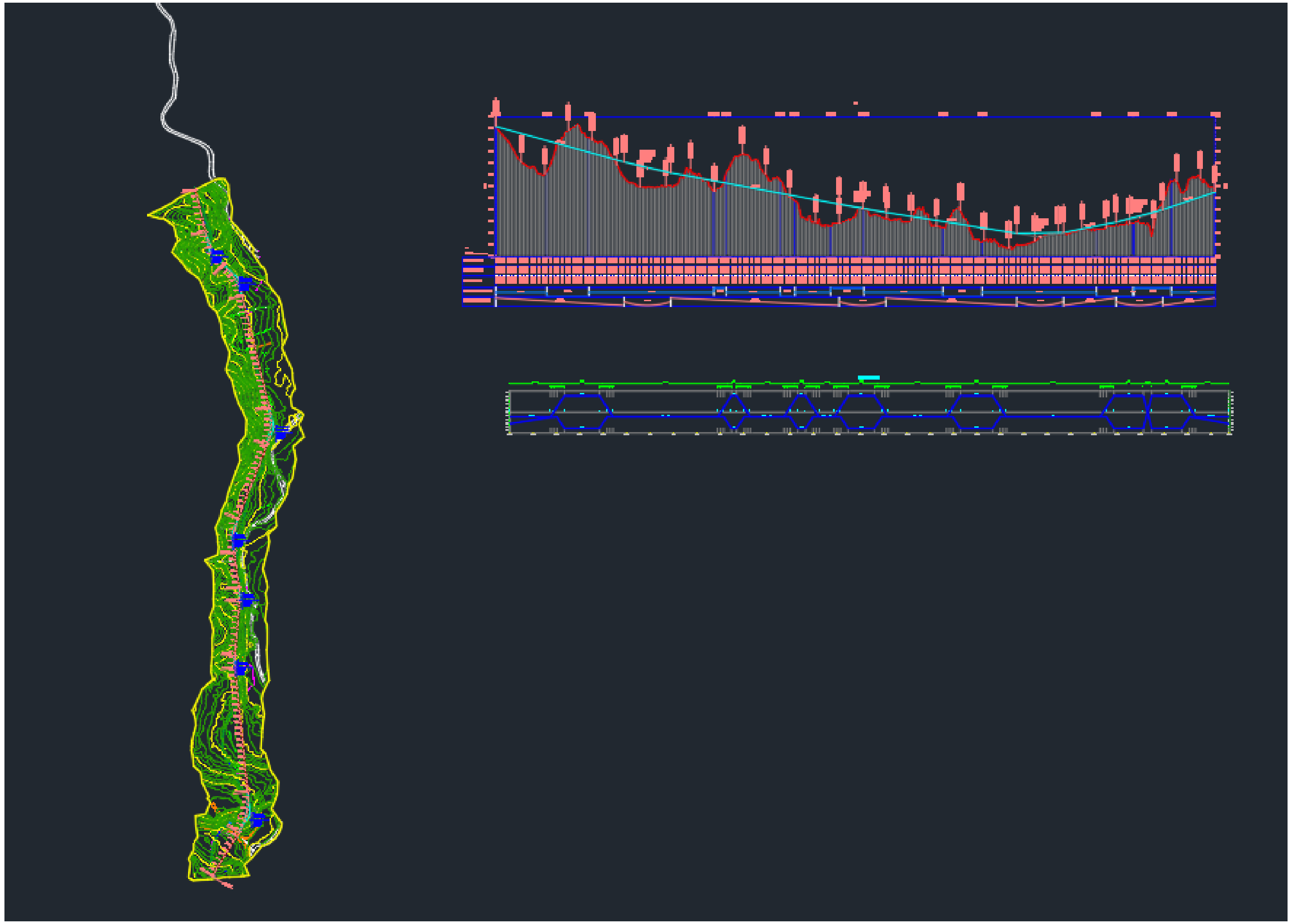


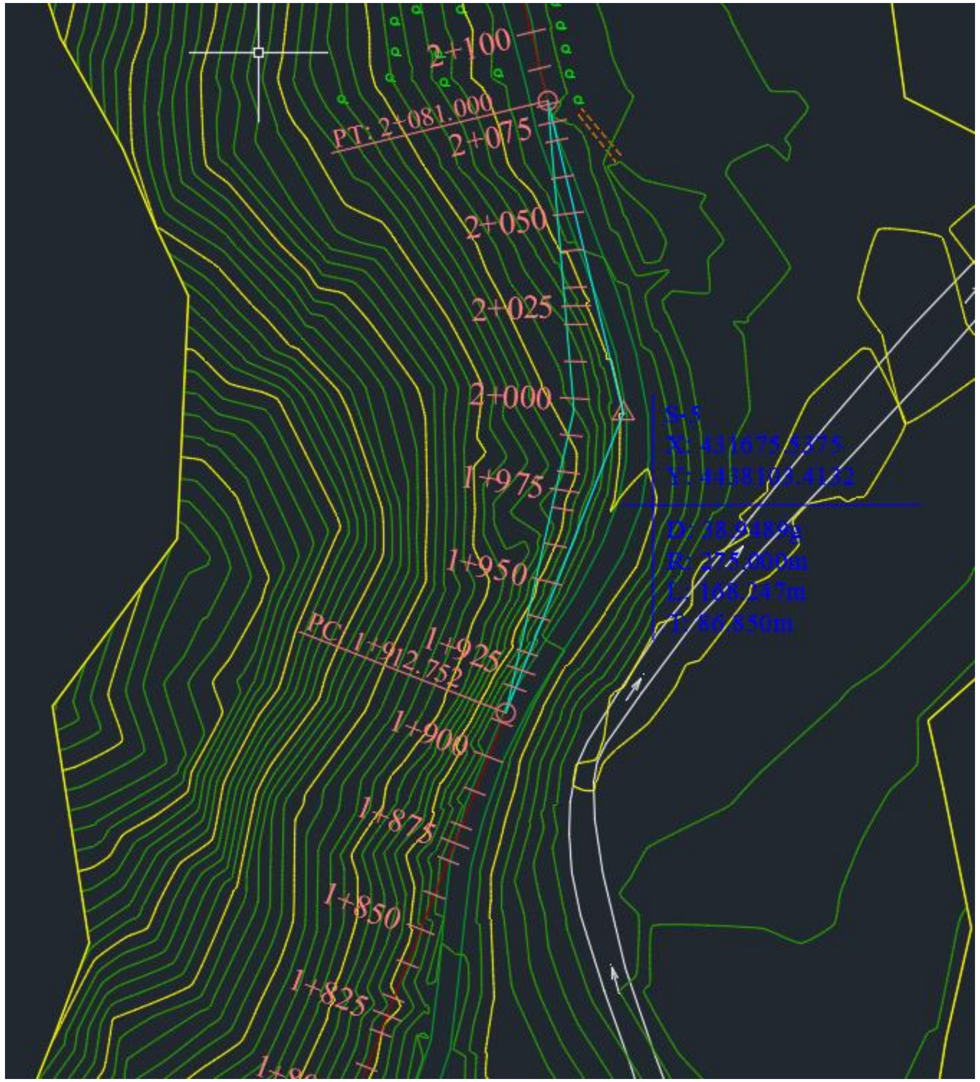
TÜRKİYE HİBRİD JEOİT MODELİ-2009 (THG-09)

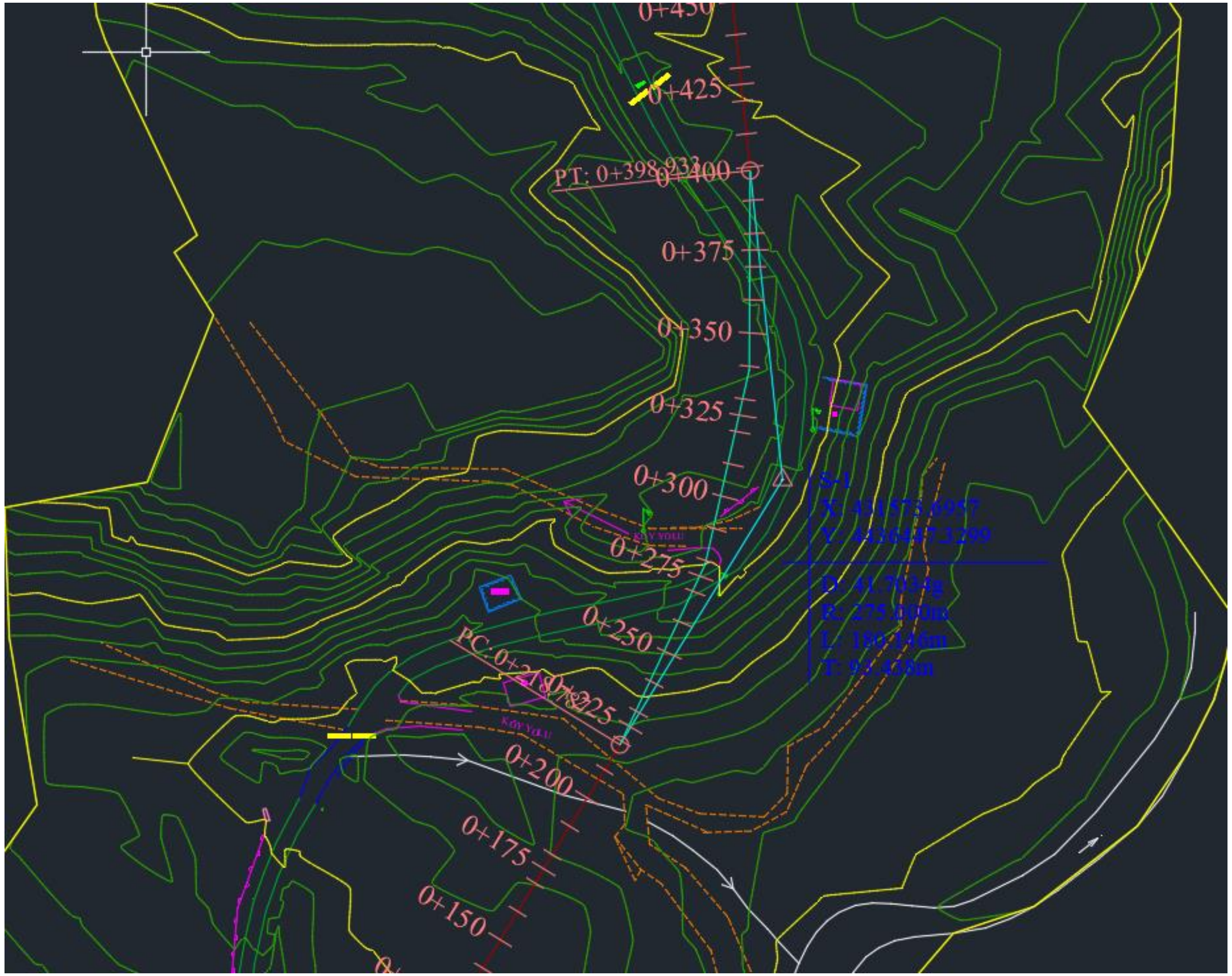



G2220165
G2220168
G2220175
G222H162
Sanayi
G222H188
G222H197
G2220201
G222H207
G222H208
G2210001

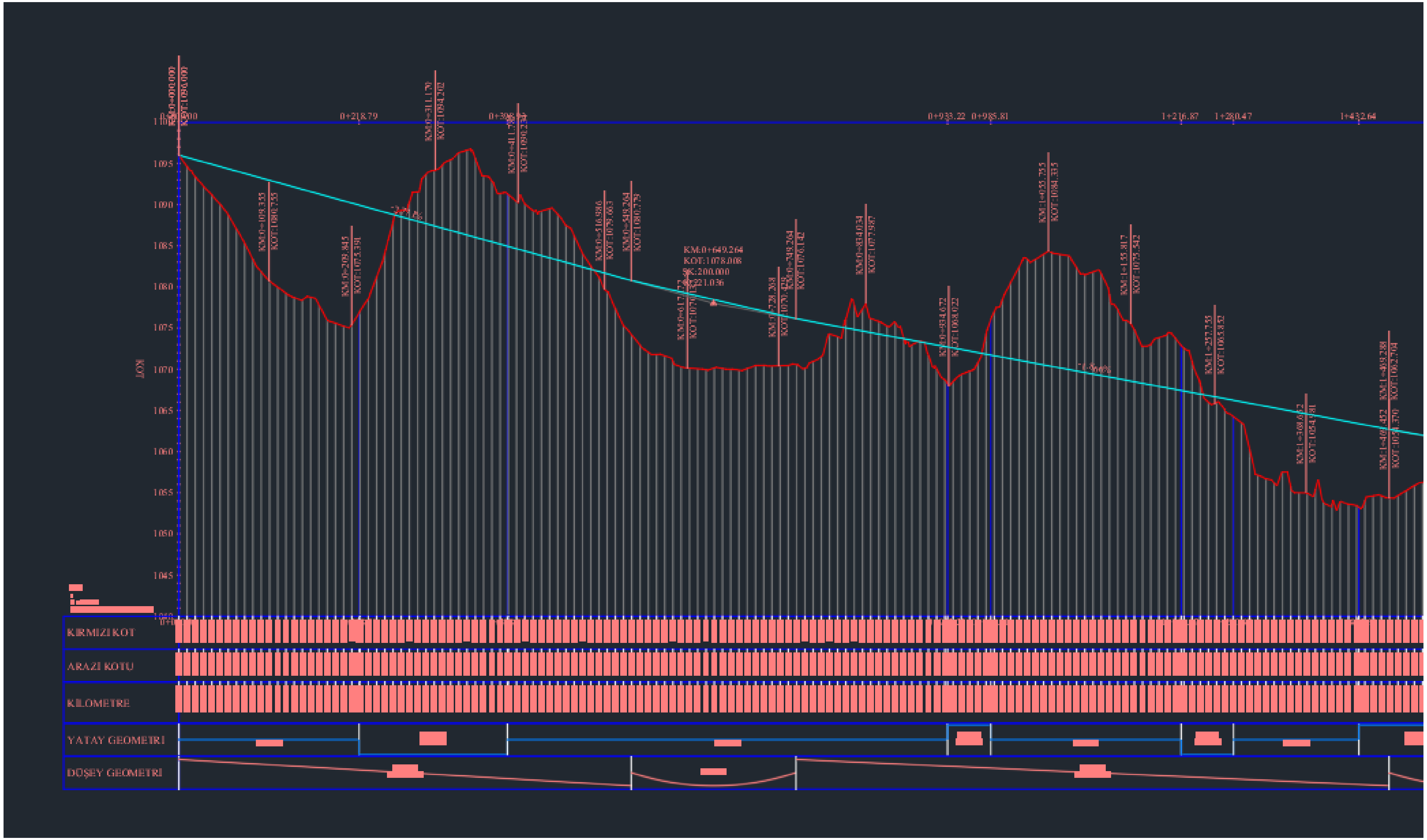

HAT / TRACK – 2
HAT / TRACK – 1
KAYNARCA – S.GÖ
HATTI / TRACK
TBM
TBM
KM=26+
S1

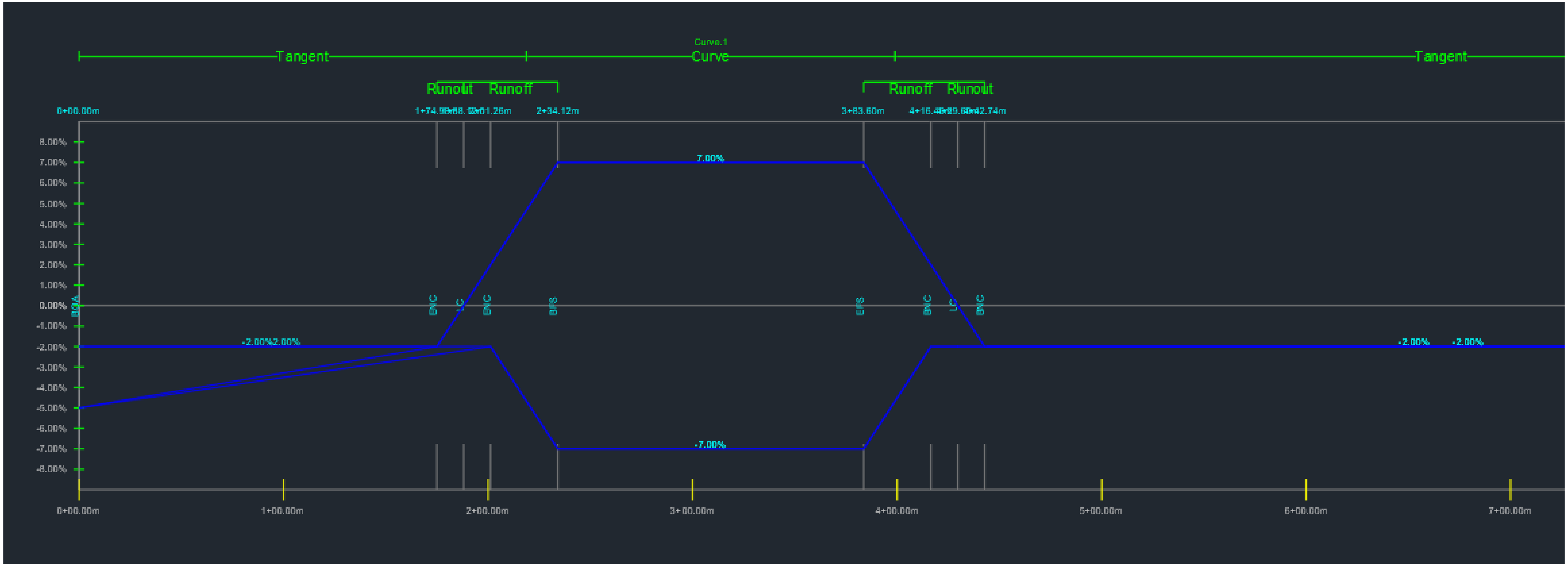



2+100
PT: 2+081.000
2+075
2+050
2+025
2+000
1+975
1+950
1+925
PC: 1+912.752
1+900
1+875
1+850
1+825


0+425
PT: 0+398.933
0+400
0+375
0+350
0+325
0+300
0+275
0+250
0+225
0+200
0+175
0+150

Measurement, mapping and projecting studies for engineering projects

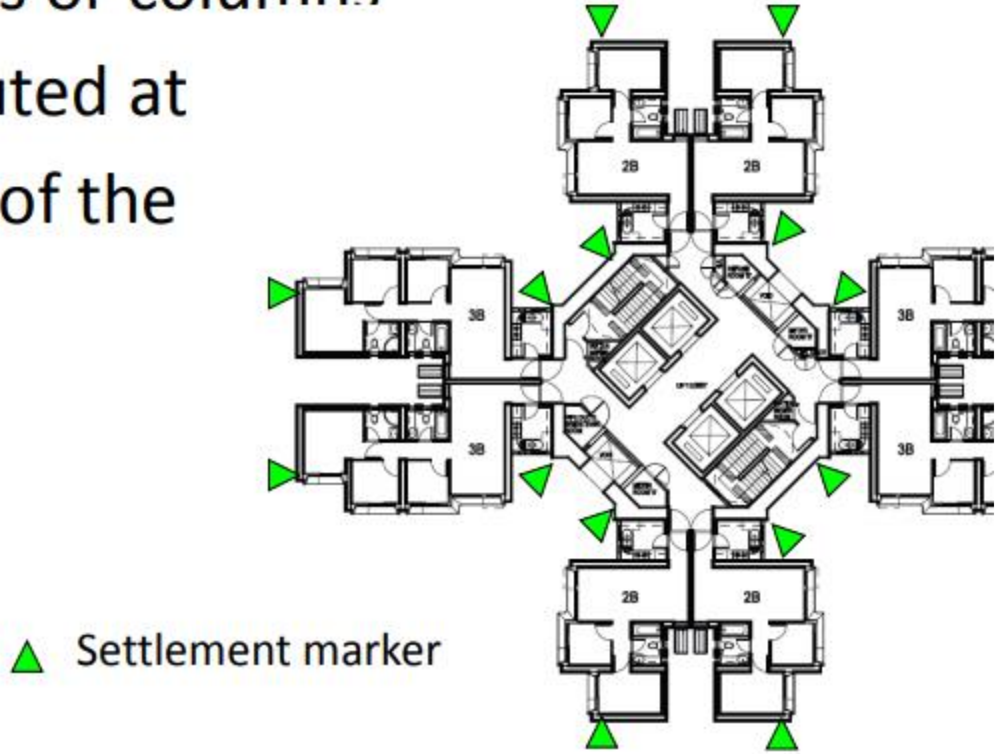



Curve.1
Tangent
Curve
Tangent
Runout
Runoff
Runoff
Runout
0+00.00m
2+34.12m
3+83.60m
7.00%
-7.00%
-2.00%
8.00%
7.00%
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
-1.00%
-2.00%
-3.00%
-4.00%
-5.00%
-6.00%
-7.00%
-8.00%
0+00.00m
1+00.00m
2+00.00m
3+00.00m
4+00.00m
5+00.00m
6+00.00m
7+00.00m

Geodetic measurements in engineering constructions – Week_4

1. Introduction
2. Current Practice of Monitoring Survey for Public Housing Estates
3. Brief Review of Other Building Monitoring Technologies
4. Survey Data Management

- Settlement Monitoring
  - Engineer specifies locations of markers at structural walls or columns
  - Evenly distributed at the periphery of the building



Benchmark of Lands Department

Establish temporary benchmark

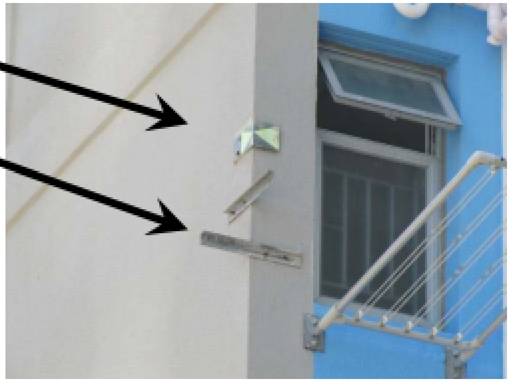
Survey settlement markers

13

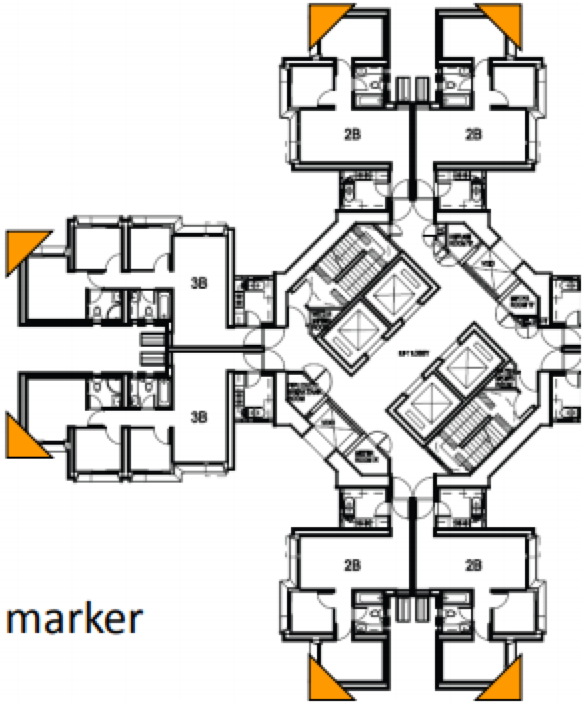
- **Verticality Checking**
  - Engineer specifies locations of markers at ext building corners
  - Linear scales will be fixed below the verticality marker at 1/F

Marker

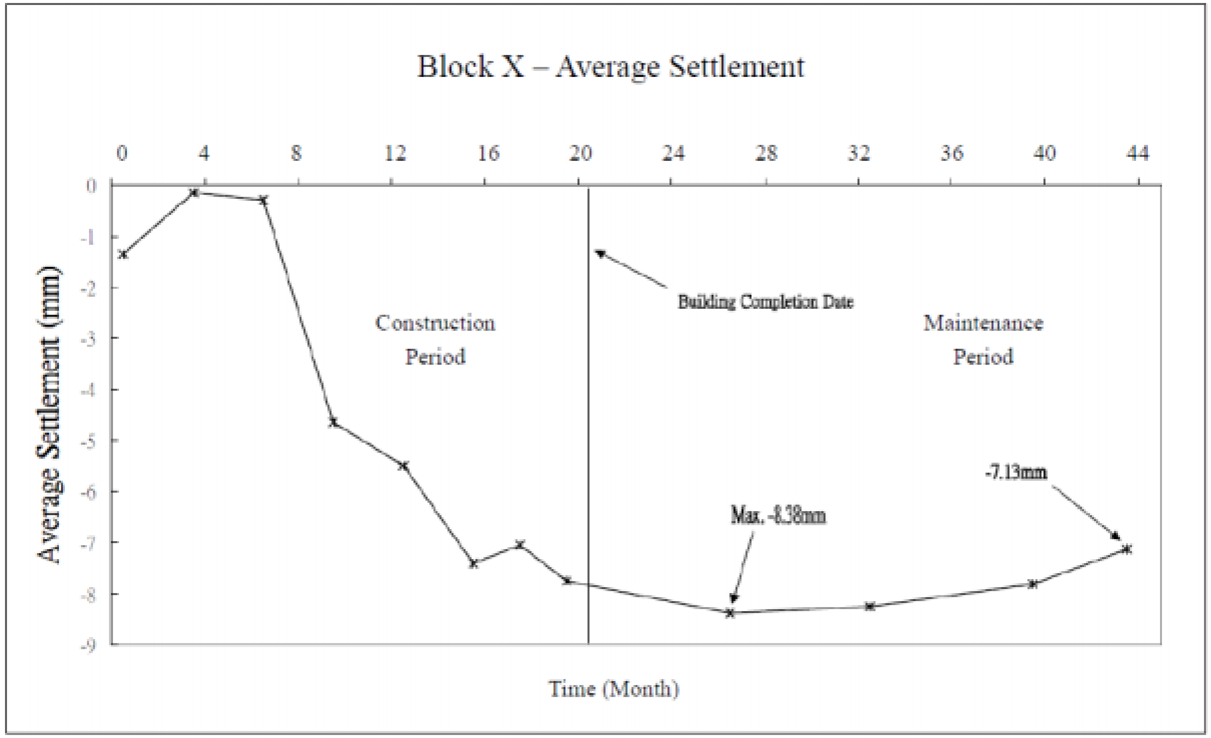
Linear Scales



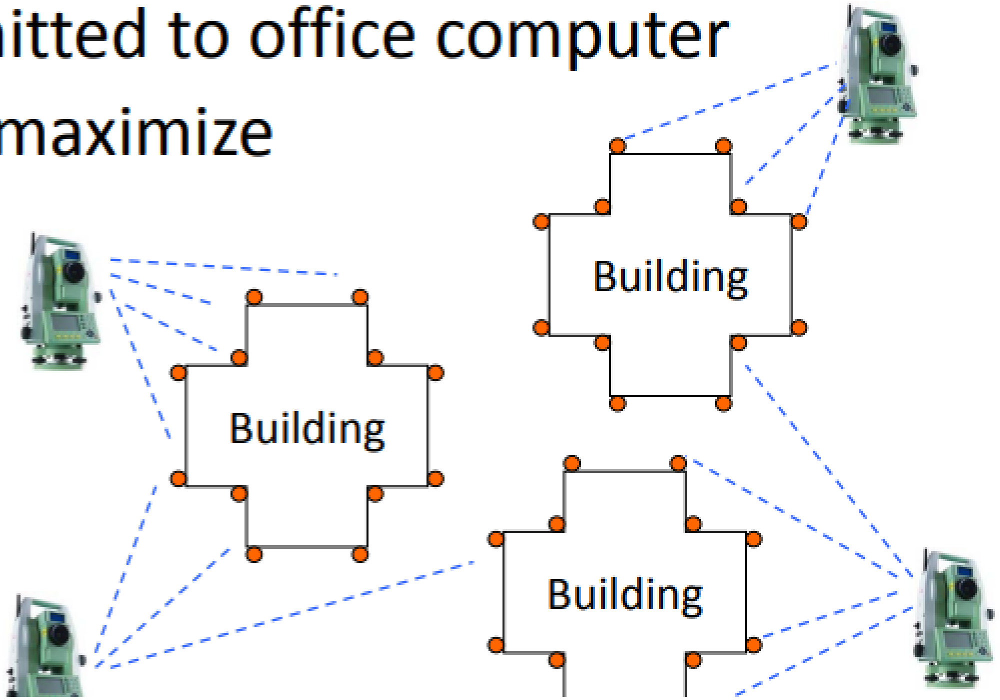
Verticality marker



- Survey result to structural engineer for analysis
- Calculate average settlement

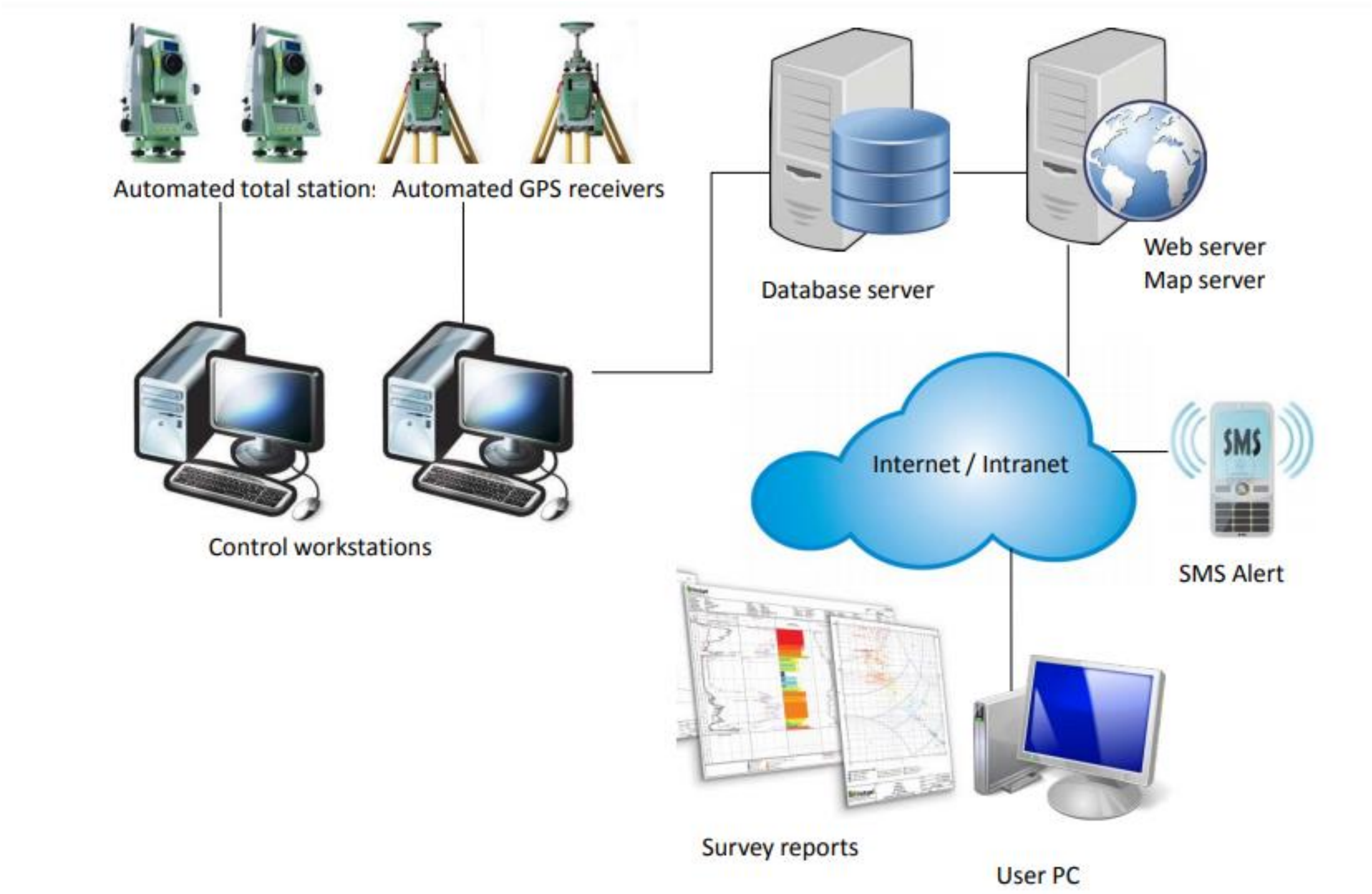


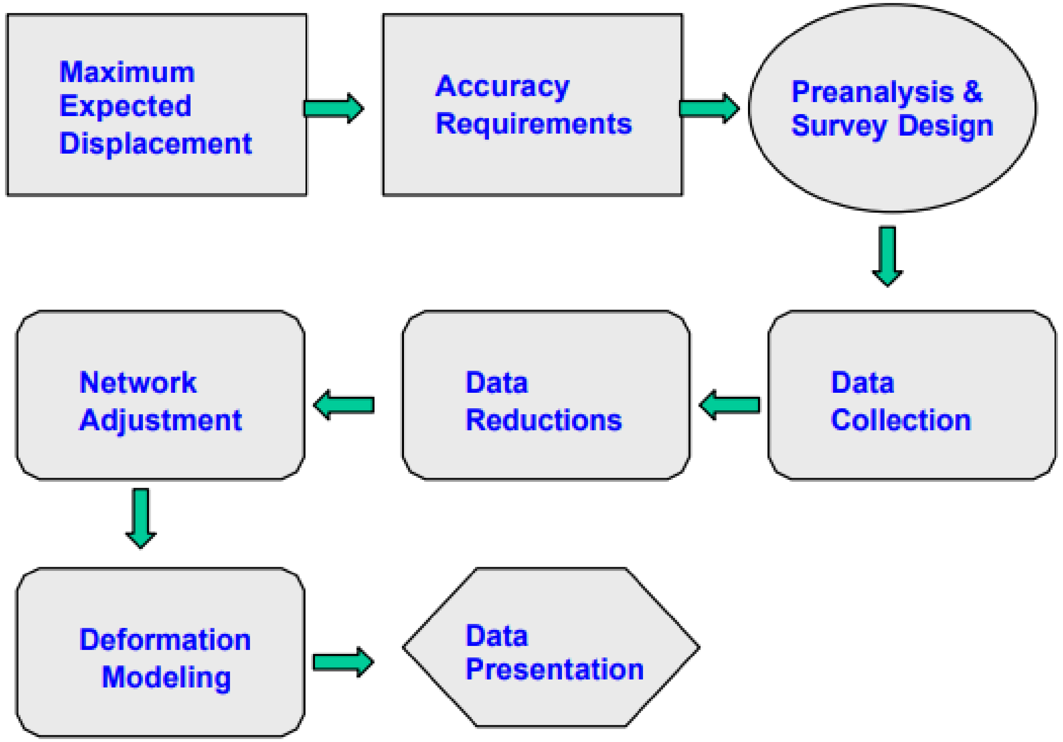
- Robotic Total Station
  - Automatic target recognition
  - x, y, z : settlement, displacement and tiling
  - Data can be transmitted to office computer
  - Open field of view maximize cost effectiveness
  - High setup cost to observe all points if stations are fixed



- Laser Scanning
  - Virtually unlimited no. of monitoring points
  - Whole building profile, cracks on facades
  - Measured surface, scanning angle → intensity
  - Building block usually over 100m high → scanning ray distance 150m to 200m from ground
  - Construction site in lack of stable 3-D control points for registration → establish control points every time from outside the site

- **Proposed Monitoring Survey Information Hub**
  - Automatic deformation monitoring system (ADMS)
  - Data source from total stations, GPS receivers, piezometers, tiltmeters and manual input for non-automated devices
  - WebGIS : map browsing, spatial queries and textual searching
  - Reporting
  - Alarming
  - Handling of survey requests


Automated total station:
Automated GPS receivers
Database server
Web server
Map server
Control workstations
Internet / Intranet
SMS
SMS Alert
Survey reports
User PC



1. Survey system design. Although accuracy and sensitivity criteria may differ considerably between various monitoring applications, the basic principles of the design of monitoring schemes and their geometrical analysis remain the same. For example, a study on the stability of magnets in a nuclear accelerator may require determination of relative displacements with an accuracy of +0.05 mm while a settlement study of a rock-fill dam may require only +10 mm accuracy. Although in both cases, the monitoring techniques and instrumentation may differ, the same basic methodology applies to the design and analysis of the deformation measurements.

(a) Instrumentation plan (design). The instrumentation plan is mainly concerned with building or installing the physical network of surface movement points for a monitoring project. Contained in the instrumentation plan are specifications, procedures, and descriptions for:

· Required equipment, supplies, and materials,
· Monument types, function, and operating principles,
· Procedures for the installation and protection of monuments,
· Location and coverage of monitoring points on the project,
· Maintenance and inspection of the monitoring network.

(b) Measurement scheme (design). The design of the survey measurement scheme should include analysis and specifications for:

· Predicted performance of the structure,
· Measurement accuracy requirements,
· Positioning accuracy requirements,
· Number and types of measurements,
· Selection of instrument type and precision,
· Data collection and field procedures,
· Data reduction and processing procedures,
· Data analysis and modeling procedures,
· Reporting standards and formats,
· Project management and data archiving.

(2) Data collection.

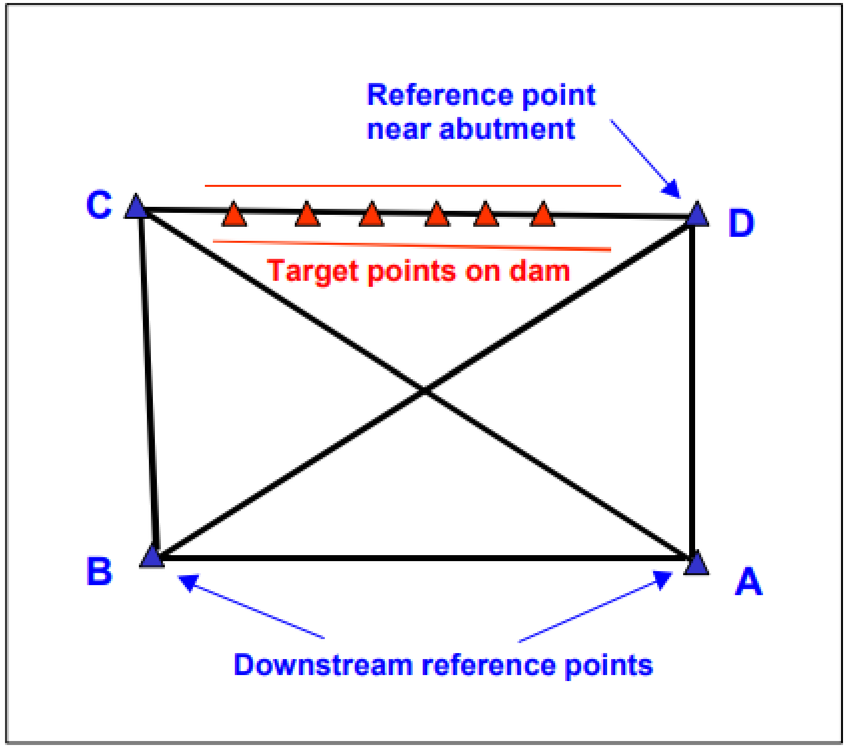
The data collection required on a project survey is specifically prescribed by theresults of network preanalysis. The data collection scheme must provide built-in levels of both accuracy and reliability to ensure acceptance of the raw data.

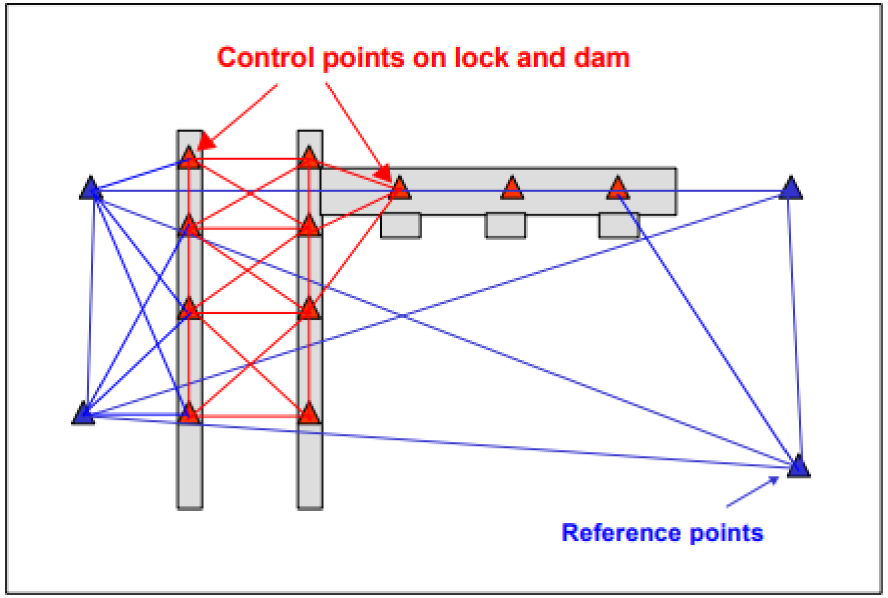
(a) Accuracy. Achieving the required accuracy for monitoring surveys is based on instrument performance and observing procedures. Minimum instrument resolution, data collection options, and proper operating instructions are determined from manufacturer specifications. The actual data collection is executed according to the results of network preanalysis so that the quality of the results can be verified during data processing and post-analysis of the network adjustment.

(b) Reliability. Reliability in the raw measurements requires a system of redundant measurements, sufficient geometric closure, and strength in the network configuration. Geodetic surveying methods can yield high redundancy in the design of the data collection scheme.

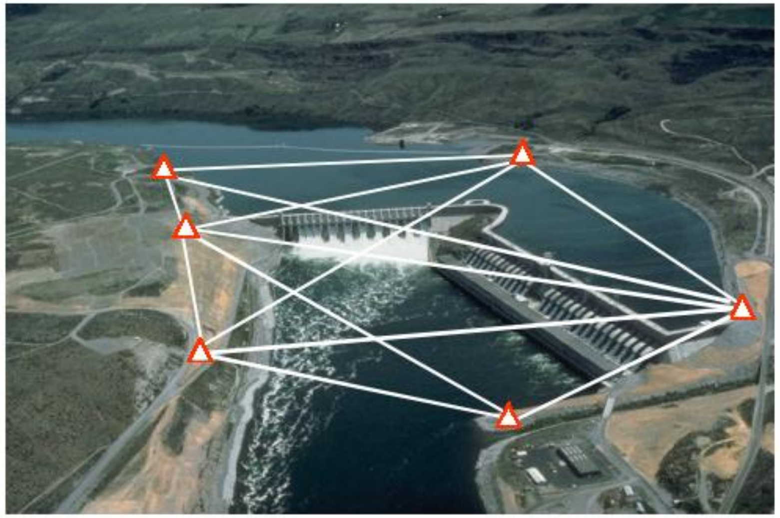
(3) Data processing. Raw survey data must be converted into meaningful engineering values during the data processing stage. Several major categories of data reductions are:

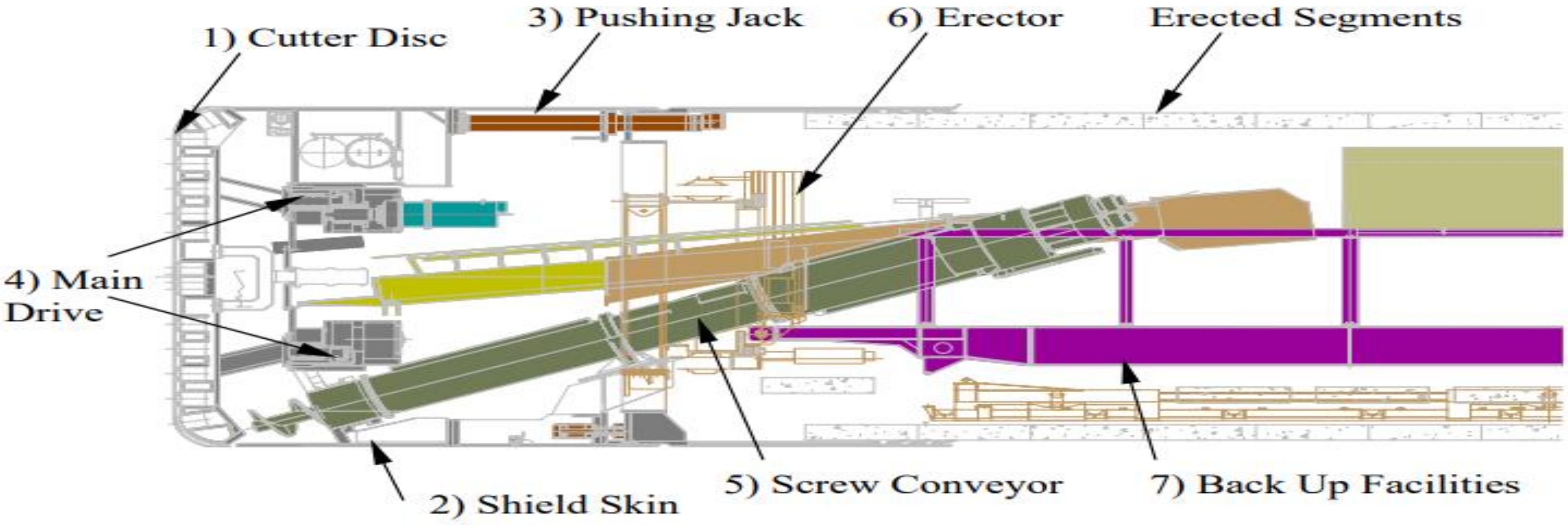
· Applying pre-determined calibration values to the raw measurements,
· Finding mean values for repeated measurements of the same observable,
· Data quality assessment and statistical testing during least squares adjustment,
· Measurement outlier detection and data cleaning prior to the final adjustment.


Reference point
near abutment
C
D
Target points on dam
B
A
Downstream reference points

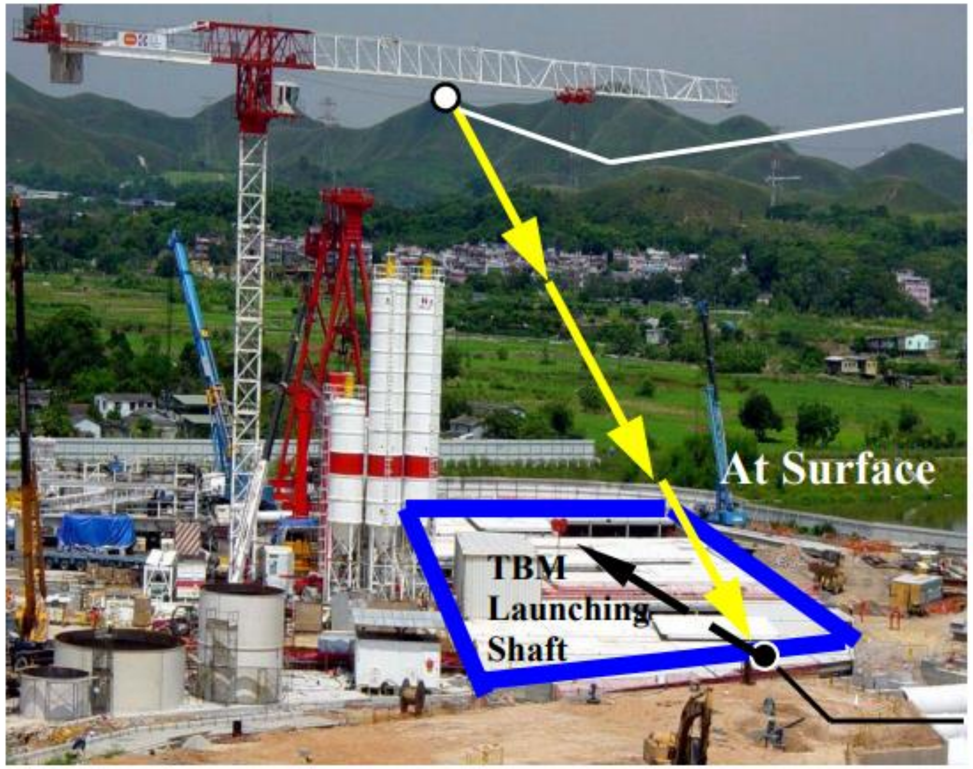

Control points on lock and dam
Reference points

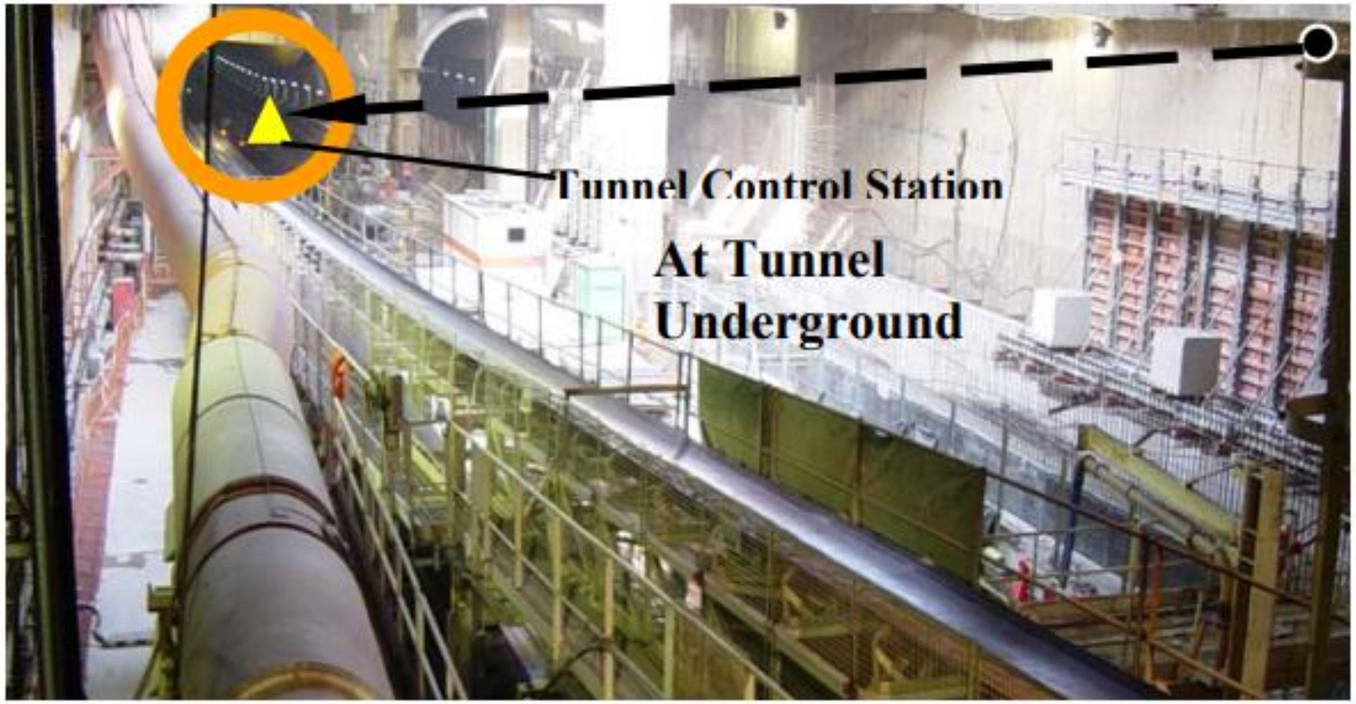

Reference points
Control points



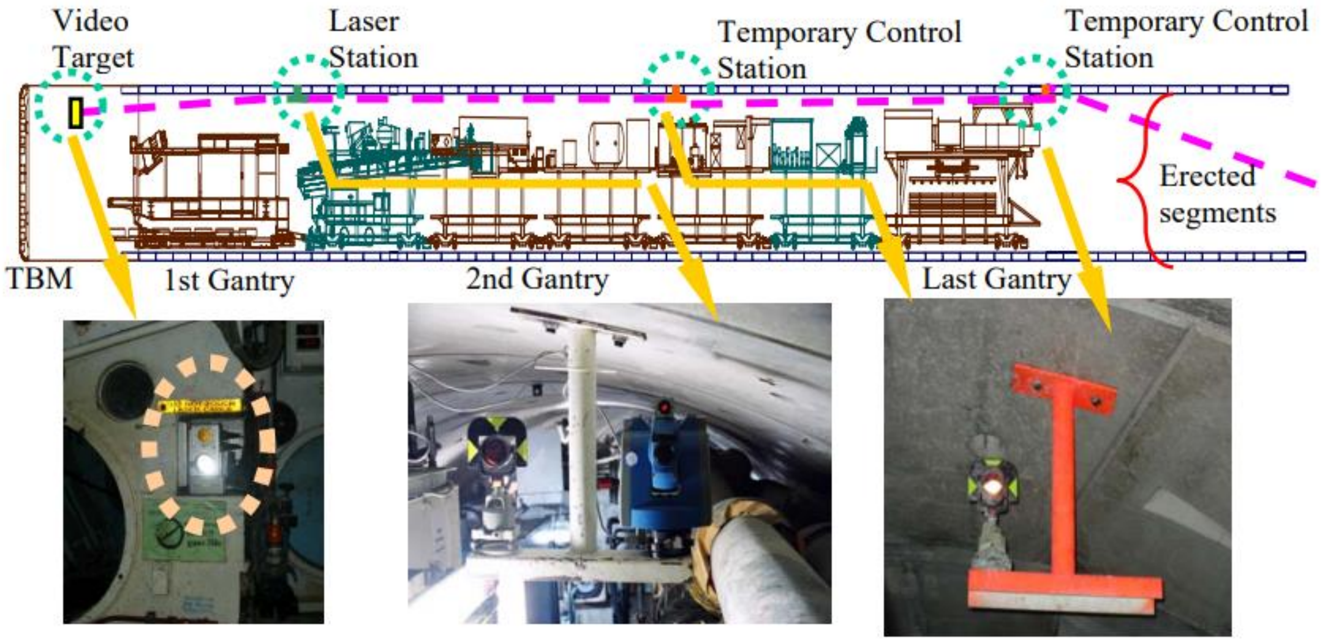


	Component	Function
1	Cutter Disc	To excavate rock or soft ground by the rotation of an assembly of teeth or cutting wheels under pressure against rock face.
2	Shield Skin	To keep the soil from getting into the machine and to provide a safe space for the workers.
3	Pushing Jack	To be in full contact with the erected segment and extend by hydraulic as the cutter disc turns and thrusts forward.
4	Main Drive	To provide a force in rotating the cutter disc and is powered by electricity.
5	Screw Conveyor	To move the spoil at the cutter disc and feed onto a conveyor system.
6	Erector	To erect the segments to form a complete ring after shoving at the tail of the TBM.
7	Back Up Facilities	To travel with the TBM and to service the operation of annular grouting, welding, extension of ventilation, power and track etc.


At Surface
TBM
Launching
Shaft


Tunnel Control Station
At Tunnel
Underground

Inside the Tunnel



Stake out, relievo and control measurements – Week_5

- Construction plans, maps, facility plans, and CAD/GIS databases are created by a variety of terrestrial, satellite, acoustic, or aerial mapping techniques that acquire planimetric, topographic, hydrographic, or feature attribute data.

- Specifications for obtaining these data should be "performance-based" and not overly prescriptive or process oriented.

- They should be derived from the functional project requirements and use recognized industry accuracy standards where available.

SEKİZİNCİ BÖLÜM
Uygulama İşleri

Uygulama işleri

MADDE 80- (1) Uygulamalar aşağıdaki esaslara göre yapılır.

a) Uygulama, yersel veya uydu tekniklerinden yararlanılarak yapılabilir.

b) Uygulama, kontrol noktalarına dayalı olarak yapılır. Kontrol noktalarının bulunmaması durumunda, bu Yönetmelik esasları çerçevesinde sıklaştırma yapılır.

c) Mülkiyet sınırlarının aplikasyonu ve mülkiyete ilişkin yer gösterme işlemleri Tapu ve Kadastro Genel Müdürlüğünün belirleyeceği esaslar çerçevesinde yapılır.

ç) Plan ve projelerin zemine uygulanması için uygulama planları veya krokileri hazırlanır.

d) Uygulamada gereken koordinat dönüşümleri bu Yönetmelik esasları çerçevesinde yapılır.

e) Uygulama, fiziksel (arazi) yüzeye dönüştürülmüş değerlerle yapılır.

f) Yersel tekniklerle gerçekleştirilecek uygulamalarda uzunluk ölçme doğruluğu ±(3 mm + 3 ppm) (dahil)'den daha iyi ve açı ölçme doğruluğu $\pm 10^{cc}$ (3″) (dahil)'den daha iyi olan elektronik takeometreler kullanılır. Uygulama uzunluğu 500 m'yi geçemez.

g) GNSS ile uygulamada jeodezik GNSS alıcıları kullanılır.

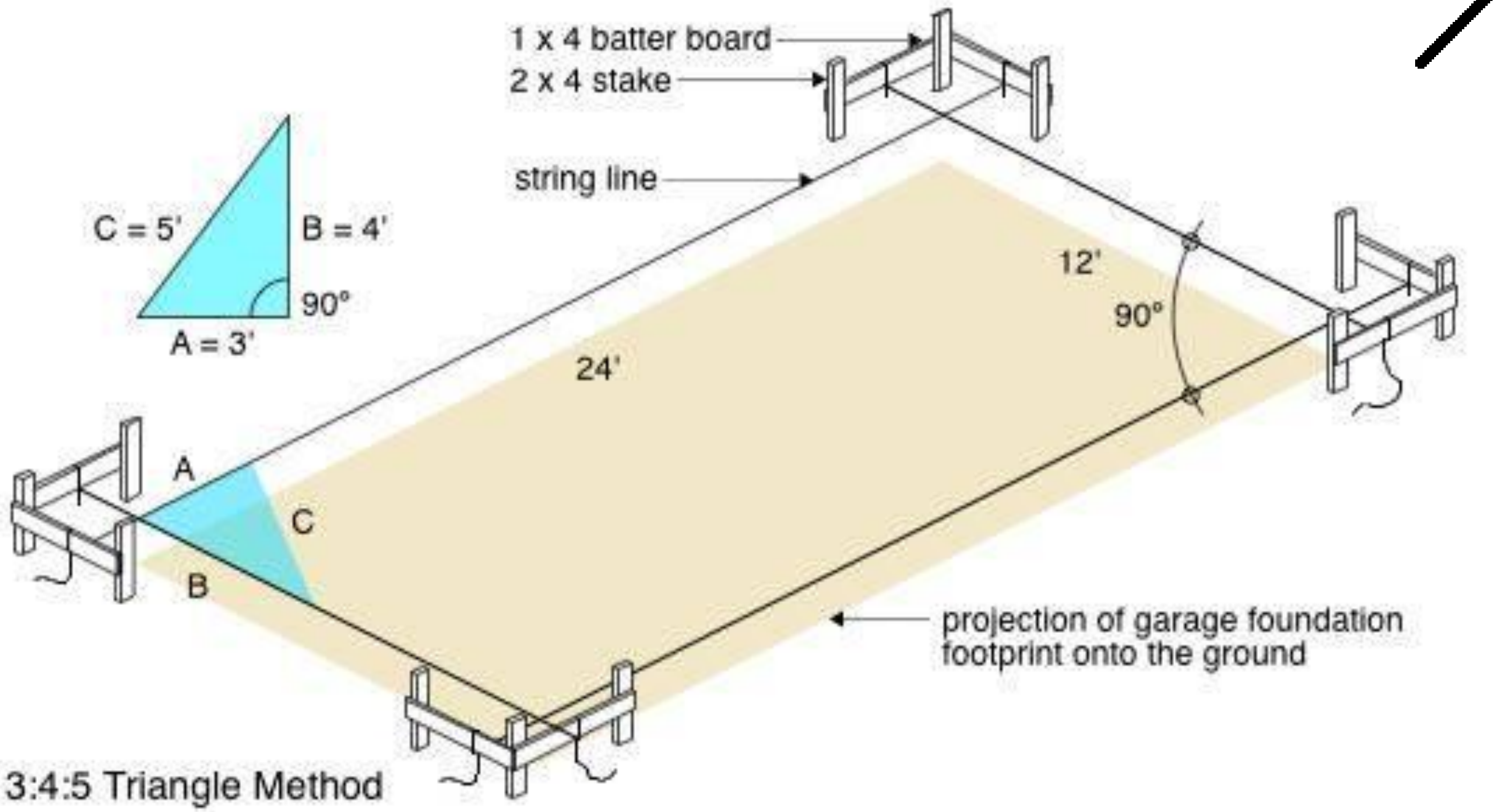
ğ) Klasik GZK ile GNSS referans istasyonlarından yararlanarak gerçekleştirilen uygulamalarda en büyük baz uzunluğu 5 km'yi geçemez.

h) Ada köşelerinin proje ana eksen ve karakteristik noktalarının (aliyman üstü noktalar, some noktası, T_o, T_F ve benzeri noktalar) uygulamaları;

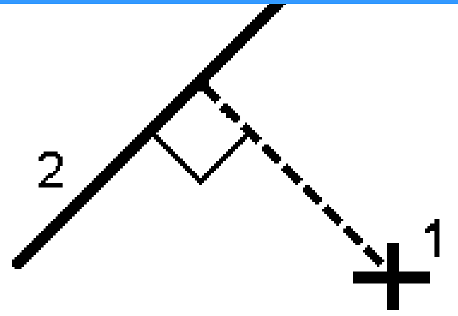
1) Eğer yersel teknikler kullanılıyor ise en az üç kontrol noktasının oluşturduğu iki ayrı nokta çiftinden,

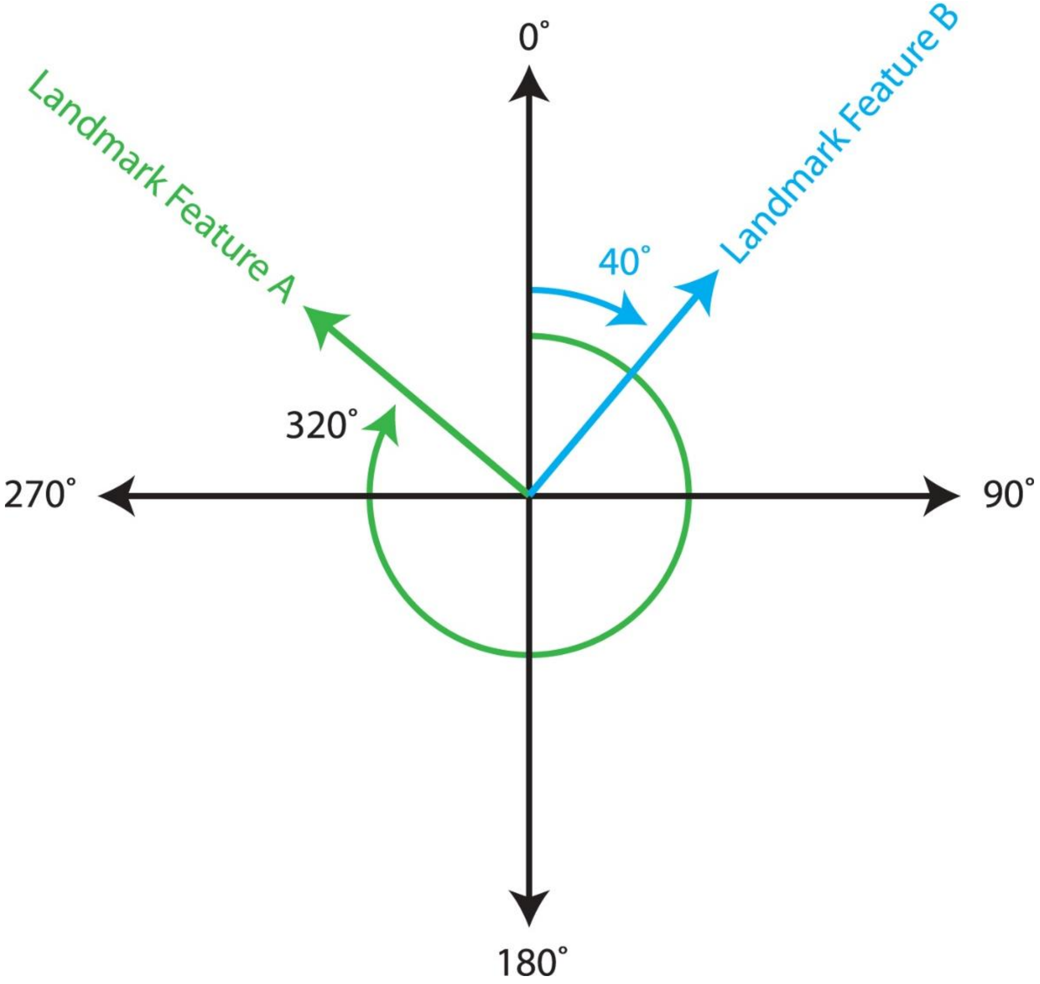
2) GNSS kullanılıyor ise en az iki kontrol noktasından,

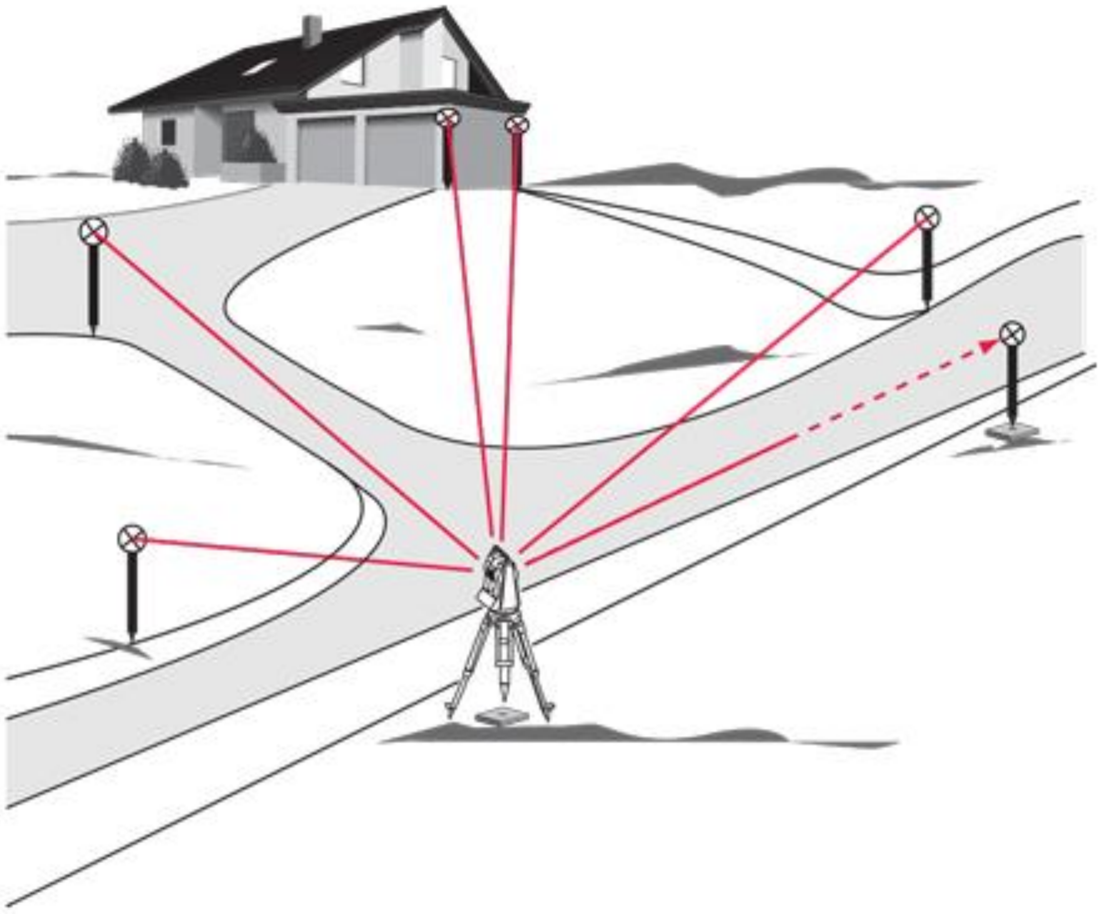
koordinatlarla yapılır. İki kontrol noktasından elde edilen koordinatlar arasındaki fark ±8 cm (dahil)'den küçük olmalıdır.

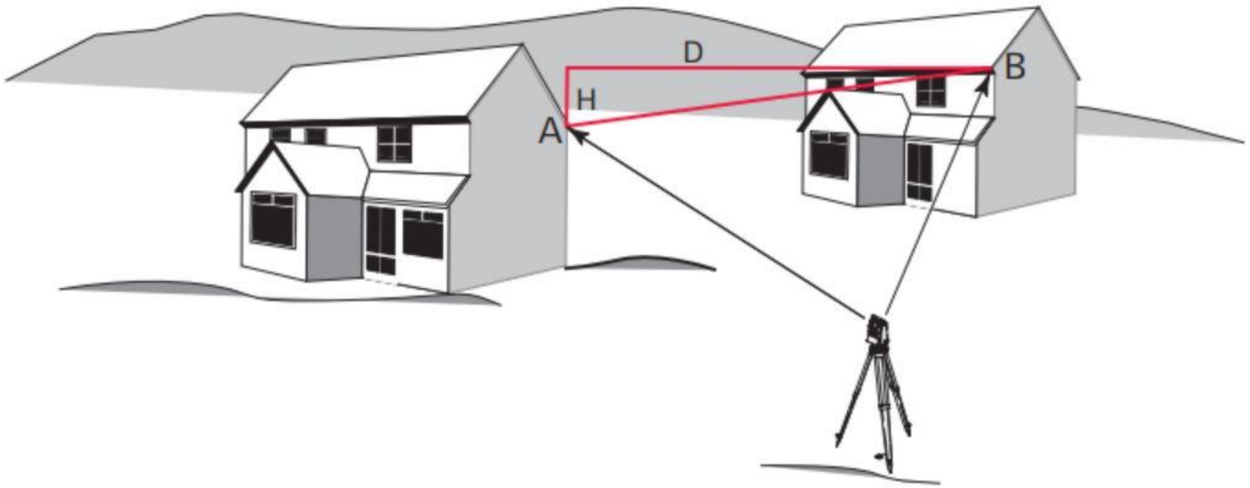


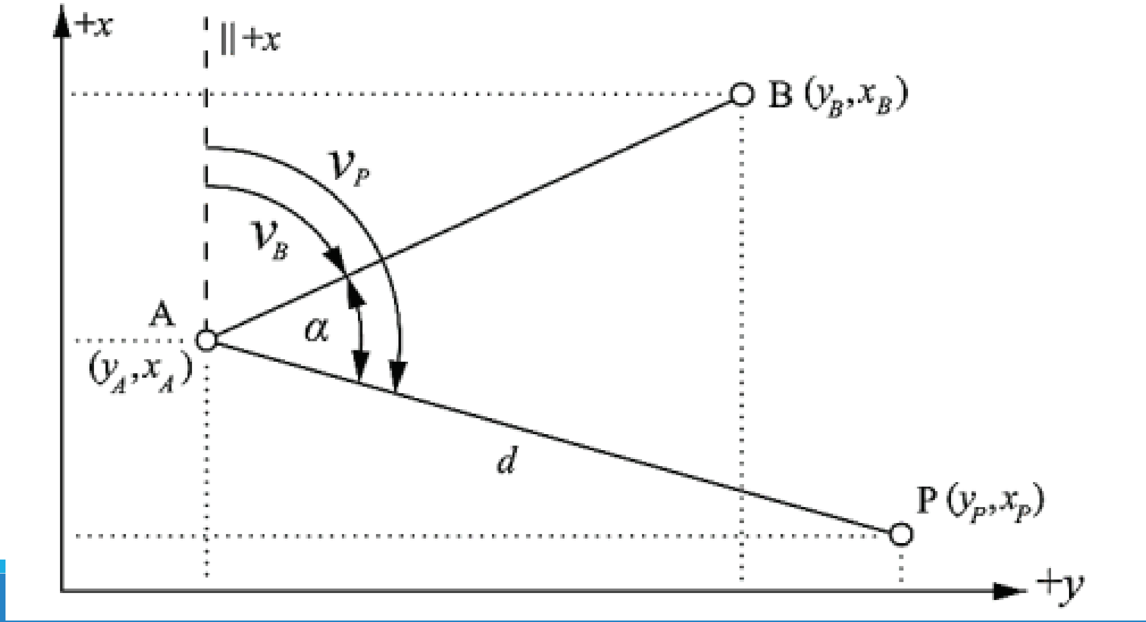
3:4:5 Triangle Method




0°
Landmark Feature A
Landmark Feature B
40°
320°
270°
90°
180°

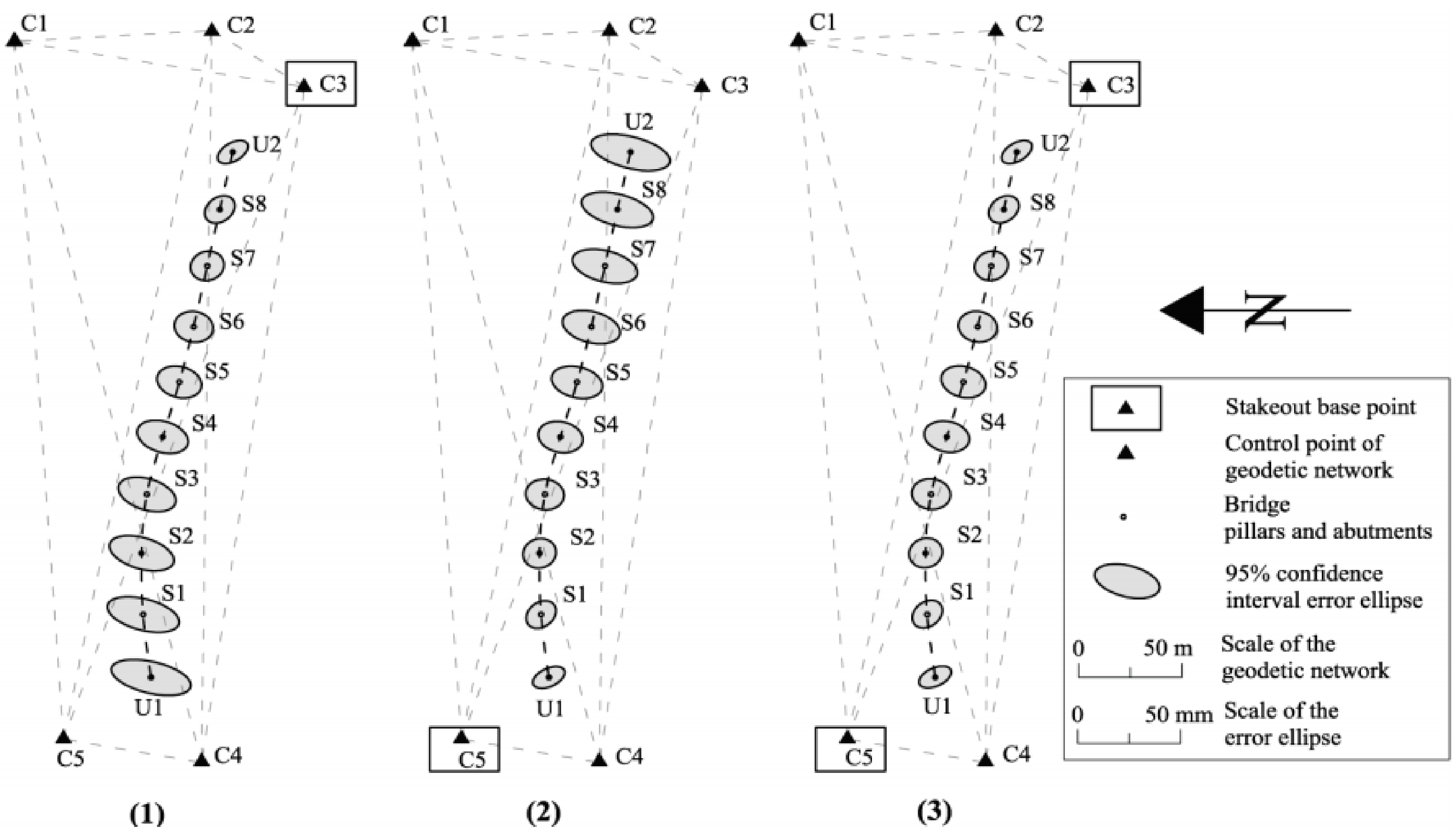



D
B
H
A

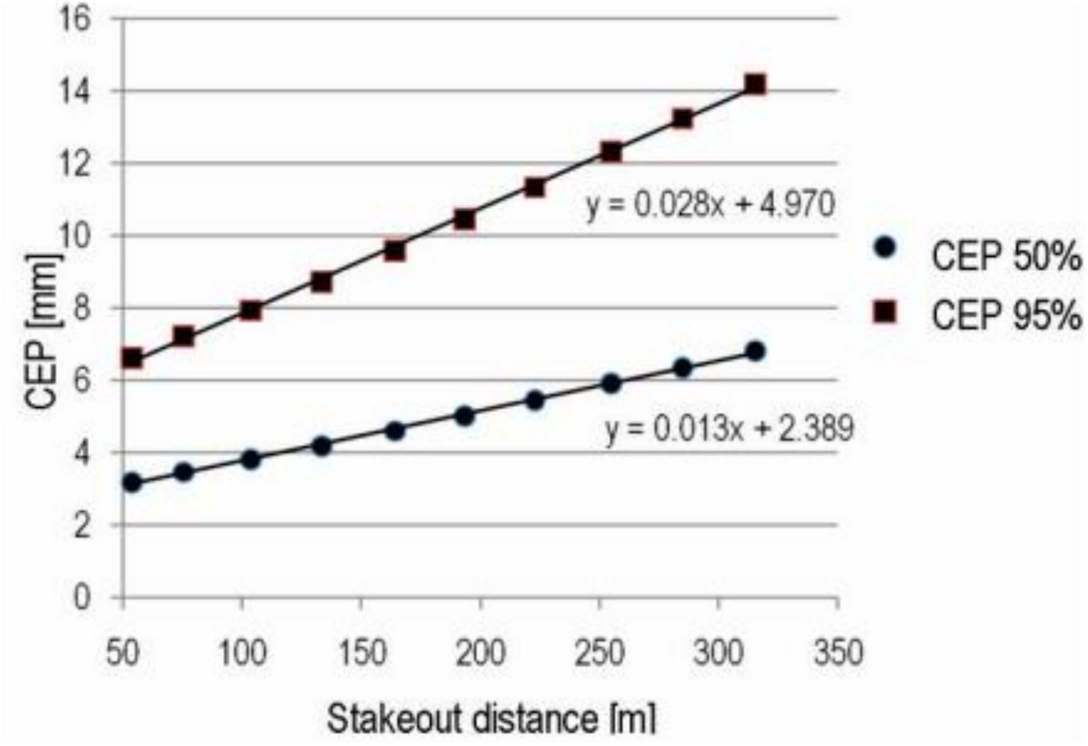


+x
|| +x
B (y_B, x_B)
ν_P
ν_B
A
α
(y_A, x_A)
d
P (y_P, x_P)
+y

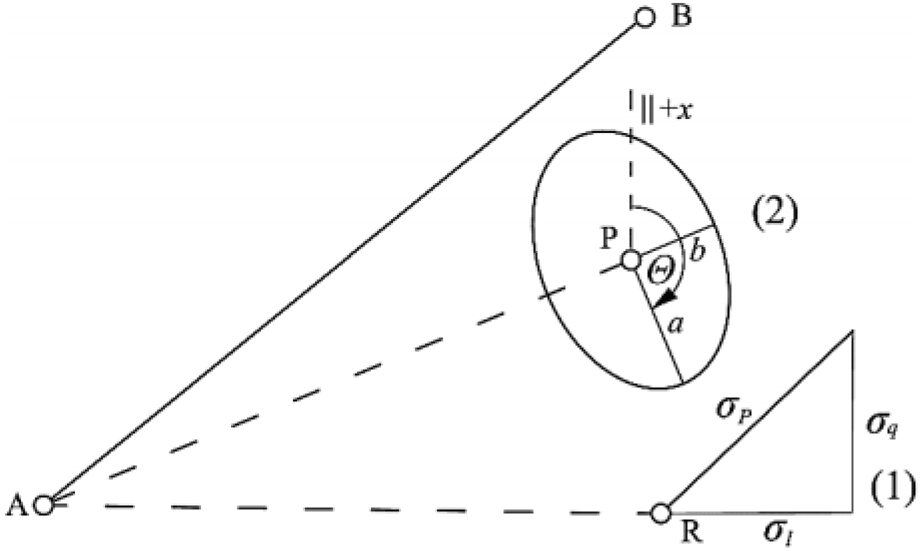
Geodetic Network Datum



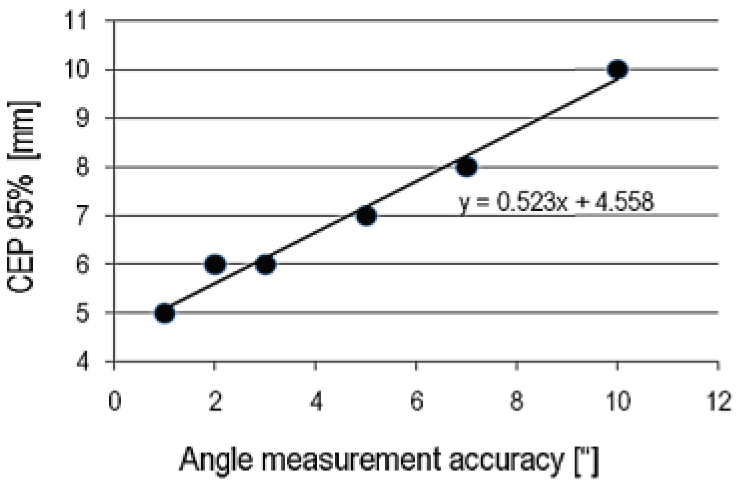
The influence of the distance of bridge points to the station point on the accuracy of staking: (1) station C3; (2) station C5; (3) stations C3 and C5

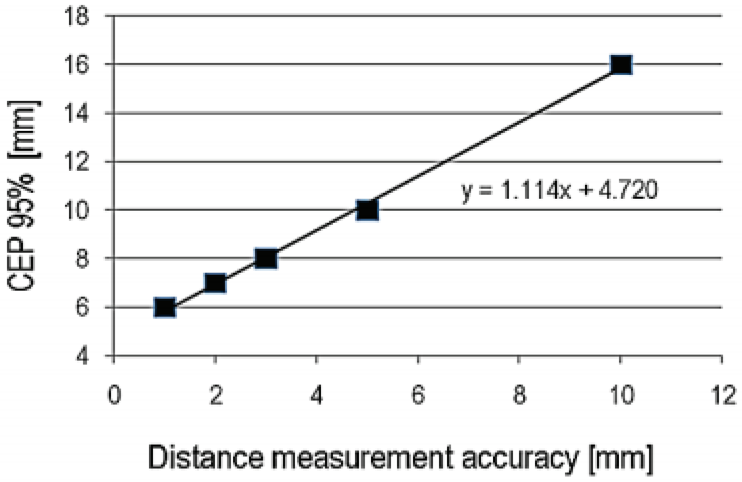


The relationship of distance between the bridge stakeout points and the instrument and the accuracy of staking



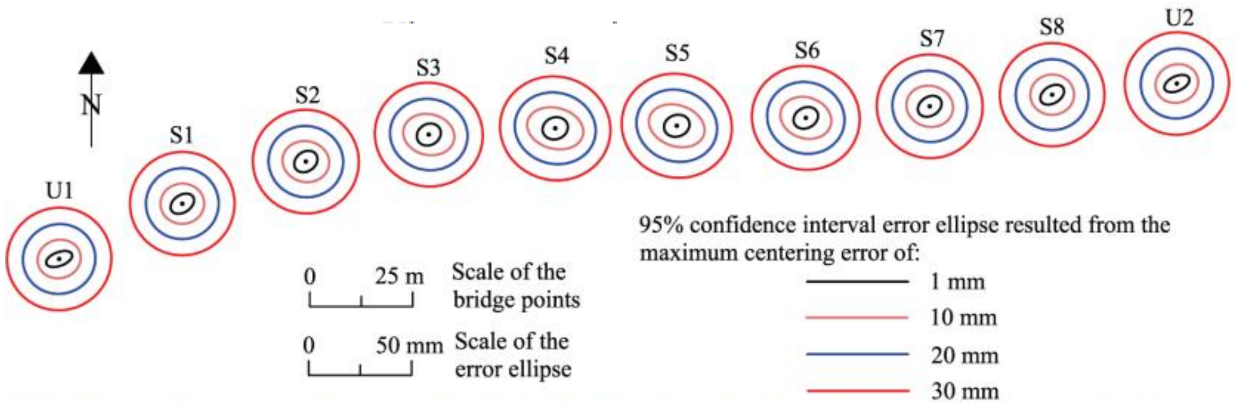
The Precision of Electronic Tacheometers



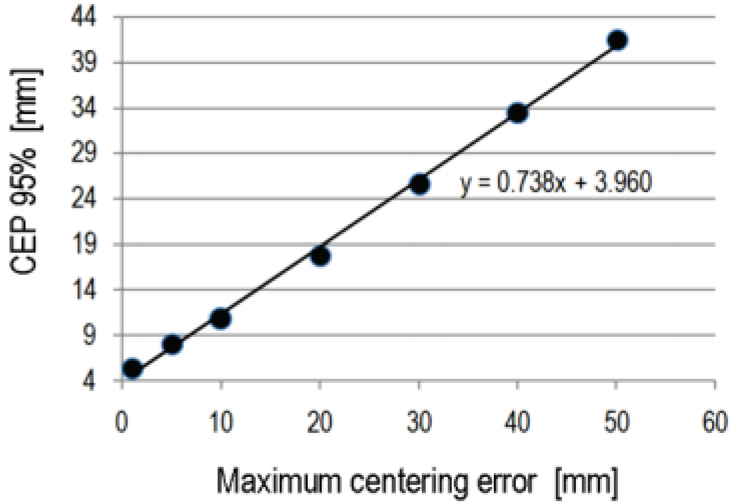


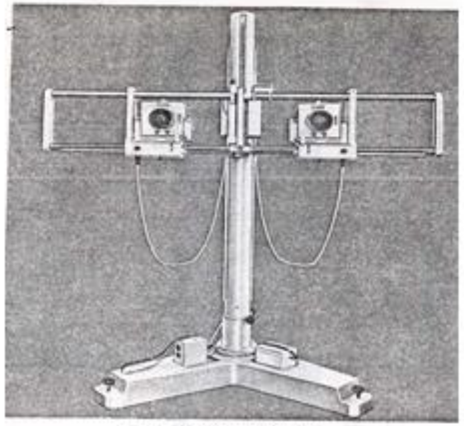
The trend of average values of the accuracy of staking depending on the precision of the total station

The Effect of Target Miscentering



10 The influence of the distance of bridge points to the station point on the accuracy of staking: (1) station C3; (2) station C5; (3) stations C3 and C5

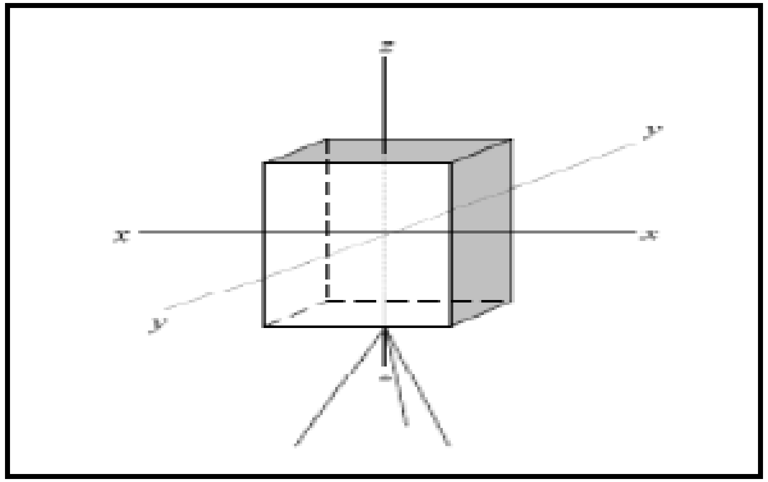


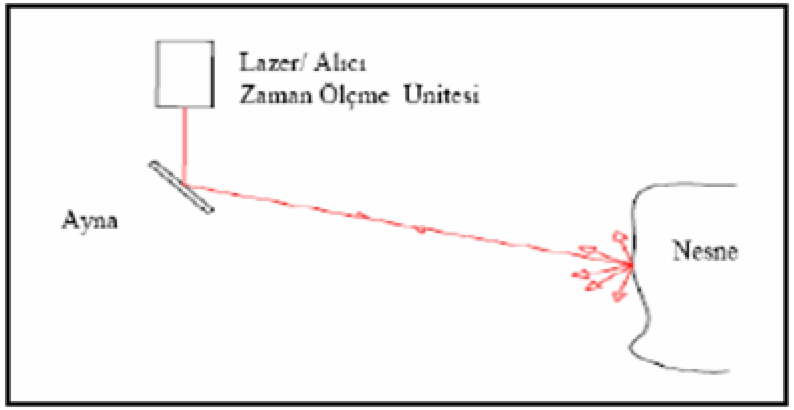


Jena UMK 10/1318

A) Riegl LMS-Z210i B) Optech -ILRIS 3D C) Trimble- (Mensi) GS200 D) IQSun -880

E) Minolta- VIVID 910 F) Callidus -CP 3200 G) L [Adsız])S 4500 H) Zoller + Fröhlich

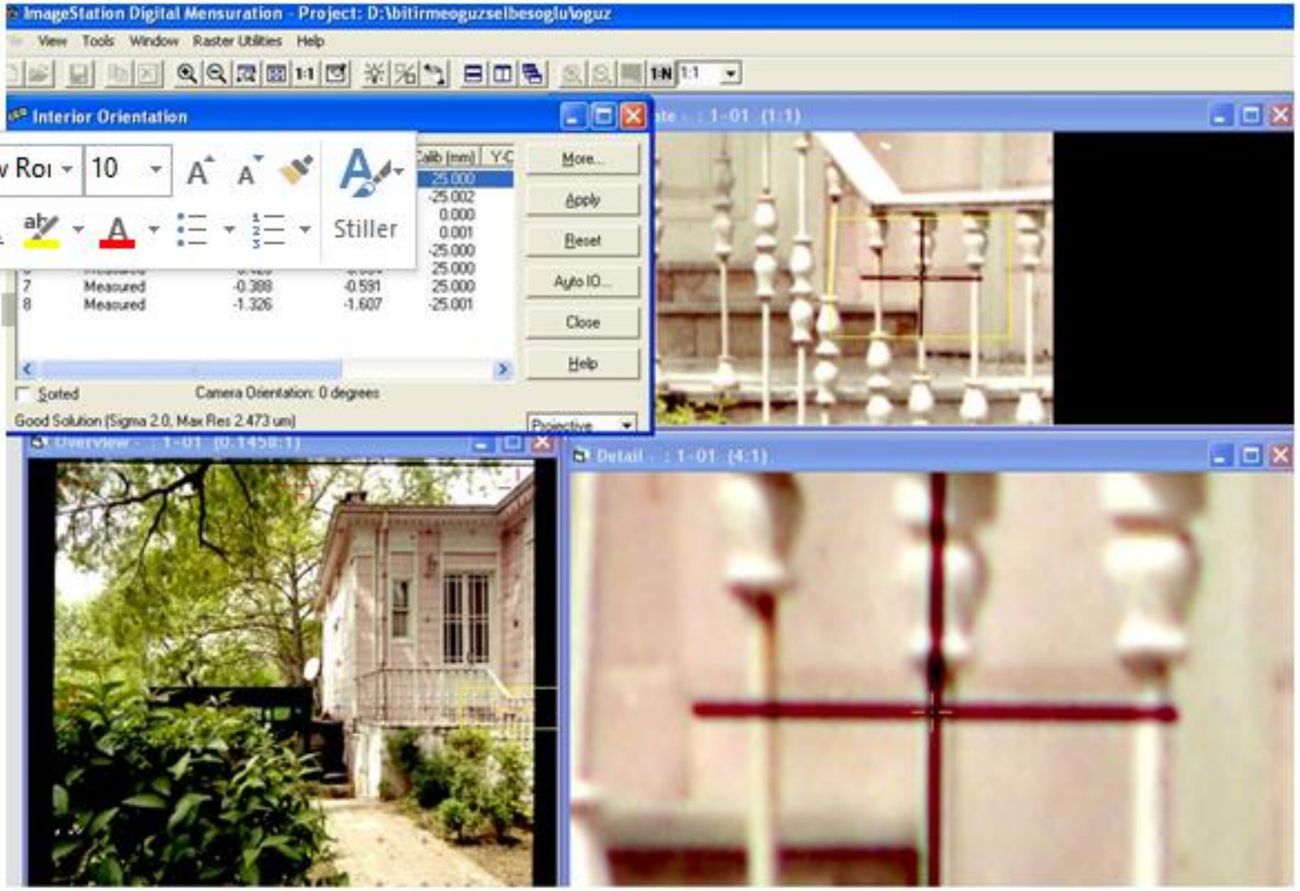


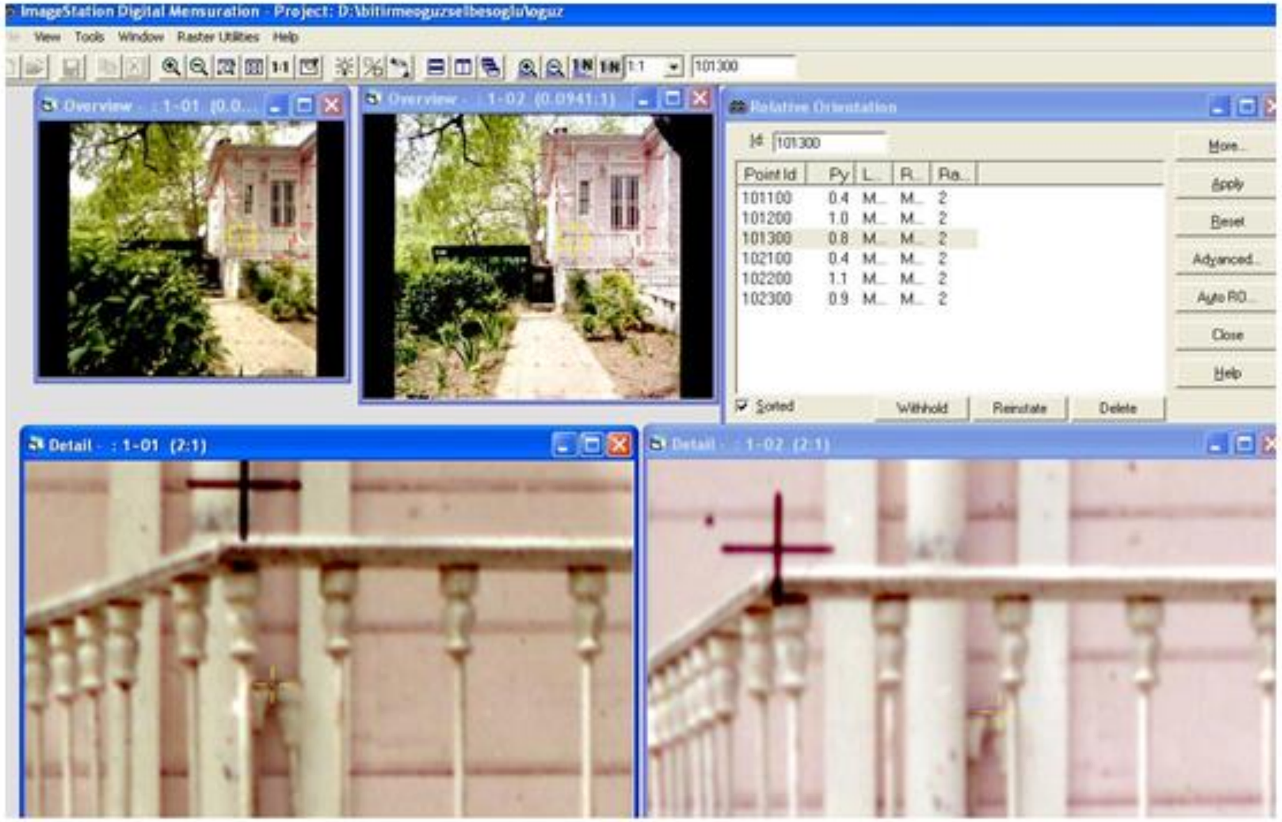


Renk	Dalgaboyu aralığı	Frekans aralığı
Kırmızı	~ 625 to 740 nm	~ 480 to 405 THz
Turuncu	~ 590 to 625 nm	~ 510 to 480 THz
Sarı	~ 565 to 590 nm	~ 530 to 510 THz
Yeşil	~ 525 to 565 nm	~ 580 to 530 THz
Turkuaz	~ 500 to 520 nm	~ 600 to 580 THz
Mavi	~ 430 to 500 nm	~ 700 to 600 THz
Mor	~ 380 to 430 nm	~ 790 to 700 THz

Left Photo

Right Photo


ImageStation Digital Mensuration - Project: D:\bitirmeoguzselbesoglu\oguz
View Tools Window Raster Utilities Help
Interior Orientation
Stiller
More...
Apply
Reset
Auto IO...
Close
Help
7 Measured -0.388 -0.591 25.000
8 Measured -1.326 -1.607 -25.001
Sorted
Camera Orientation: 0 degrees
Good Solution (Sigma 2.0, Max Res 2.473 um)
Detail - : 1-01 (4:1)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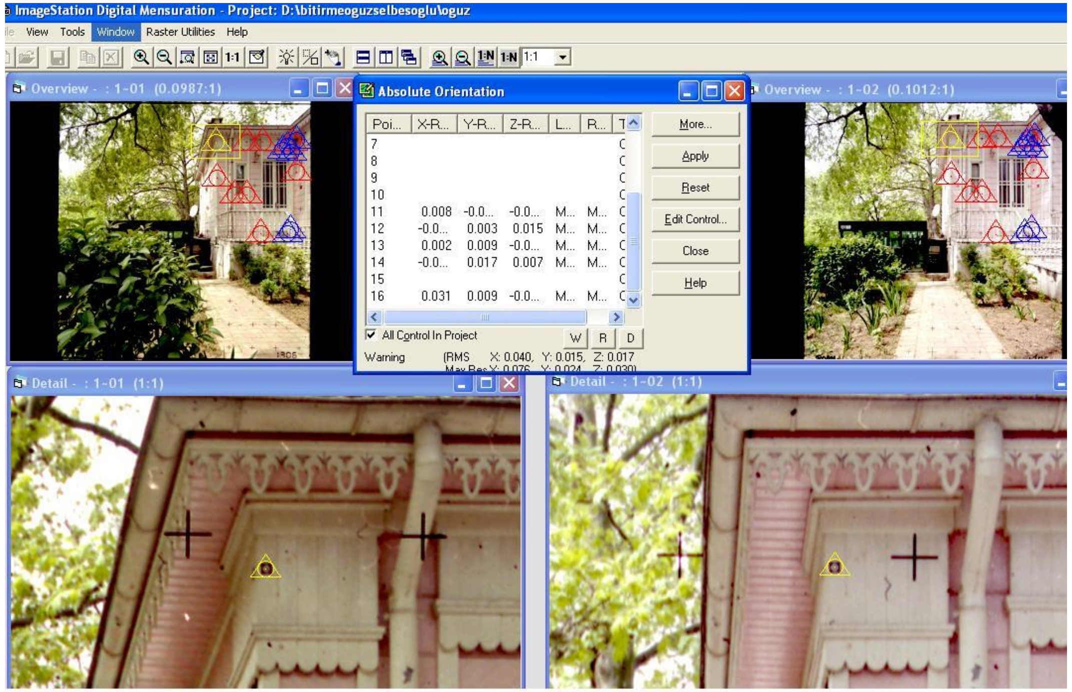
View Tools Window Raster Utilities Help
Overview - : 1-01
Overview - : 1-02 (0.0941:1)
Relative Orientation
Id 101300
Point Id Py L.. R.. Ra..
101100 0.4 M.. M.. 2
101200 1.0 M.. M.. 2
101300 0.8 M.. M.. 2
102100 0.4 M.. M.. 2
102200 1.1 M.. M.. 2
102300 0.9 M.. M.. 2
More...
Apply
Reset
Advanced...
Auto RO...
Close
Help
Sorted
Withhold
Reinstate
Delete
Detail - : 1-01 (2:1)
Detail - : 1-02 (2:1)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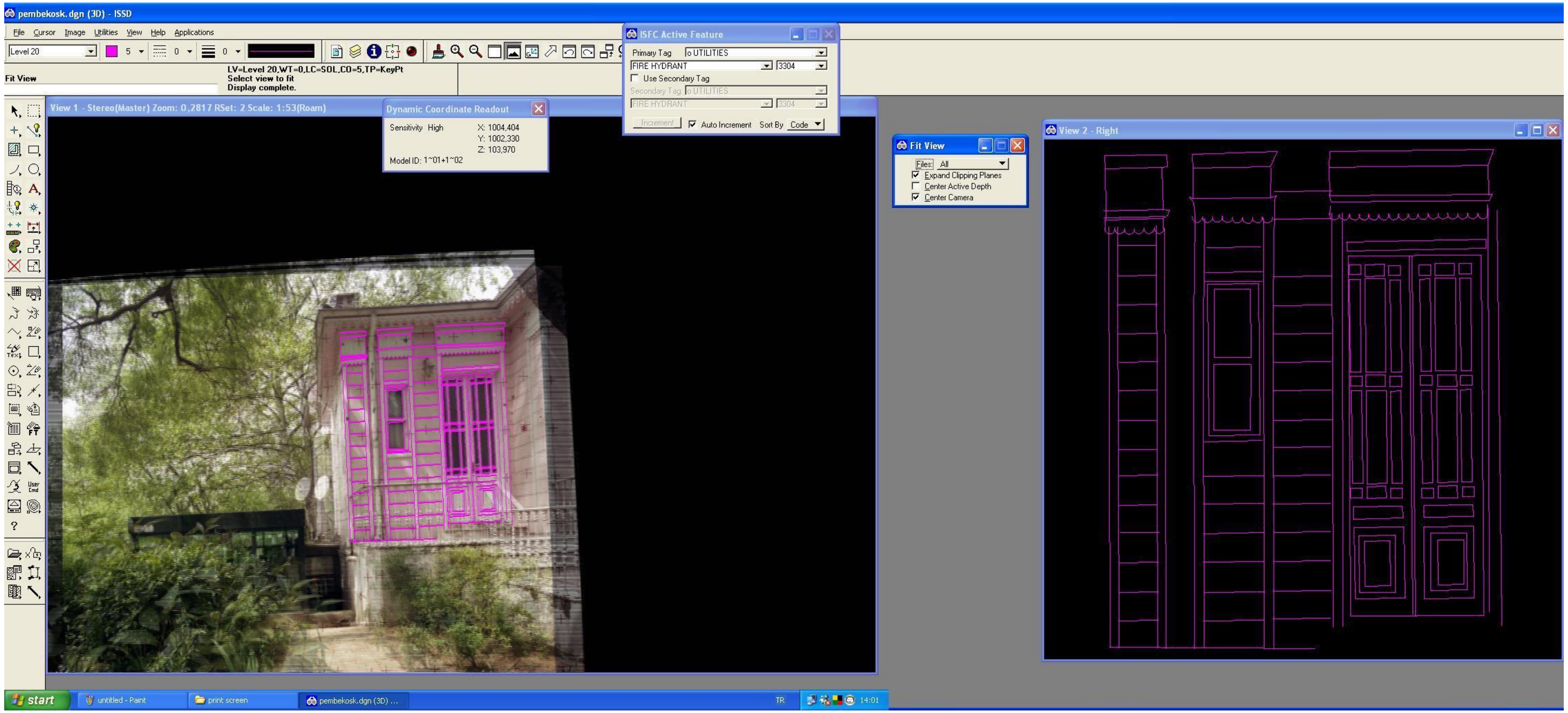
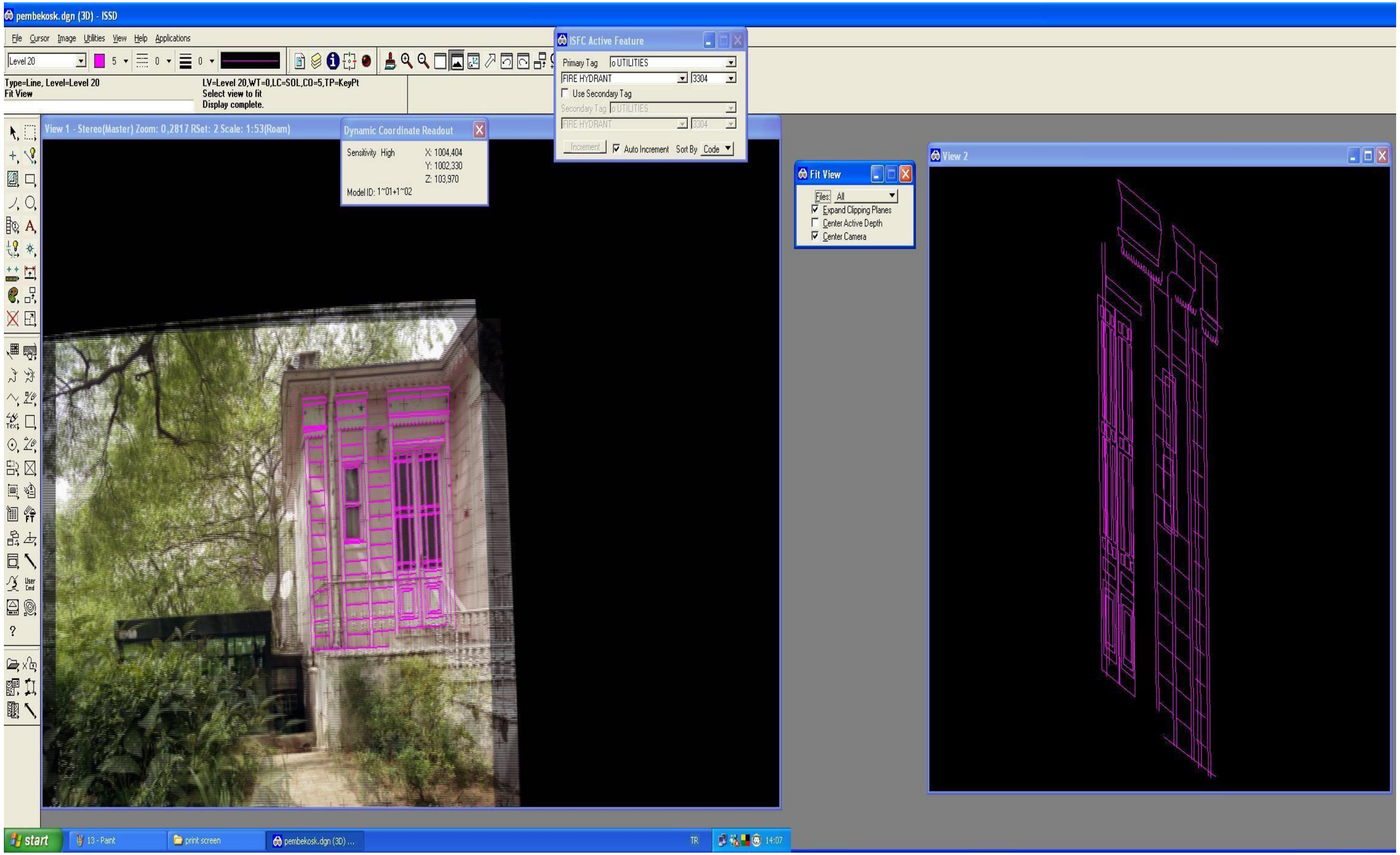
View Tools Window Raster Utilities Help
Overview - : 1-01 (0.0987:1)
Absolute Orientation
Overview - : 1-02 (0.1012:1)
More...
Apply
Reset
Edit Control...
Close
Help
All Control In Project
Warning
Detail - : 1-01 (1:1)
Detail - : 1-02 (1:1)


pembekosk.dgn (3D) - ISSD
File Cursor Image Utilities View Help Applications
Level 20
LV=Level 20,WT=0,LC=SOL,CO=5,TP=KeyPt
Select view to fit
Display complete.
Fit View
View 1 - Stereo(Master) Zoom: 0,2817 RSet: 2 Scale: 1:53(Roam)
Dynamic Coordinate Readout
Sensitivity High
X: 1004,404
Y: 1002,330
Z: 103,970
Model ID: 1~01+1~02
ISFC Active Feature
Primary Tag
0 UTILITIES
FIRE HYDRANT
3304
Use Secondary Tag
Secondary Tag
Increment
Auto Increment
Sort By
Code
Fit View
Files:
All
Expand Clipping Planes
Center Active Depth
Center Camera
View 2 - Right
start
untitled - Paint
print screen
pembekosk.dgn (3D) ...
TR
14:01


pembekosk.dgn (3D) - ISSD
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Level 20
Type=Line, Level=Level 20
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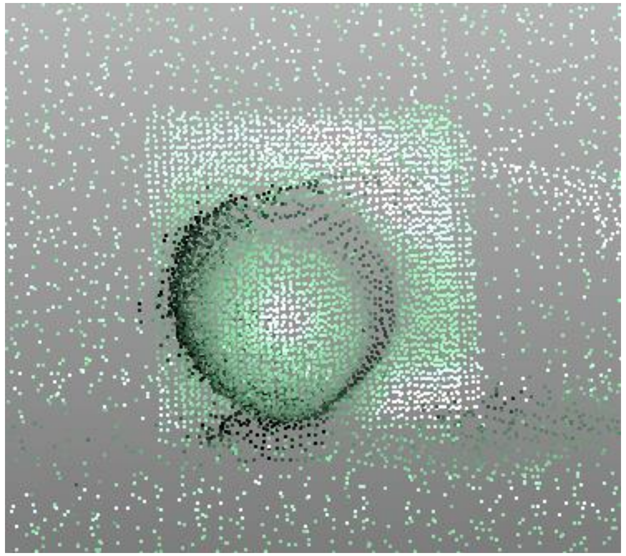
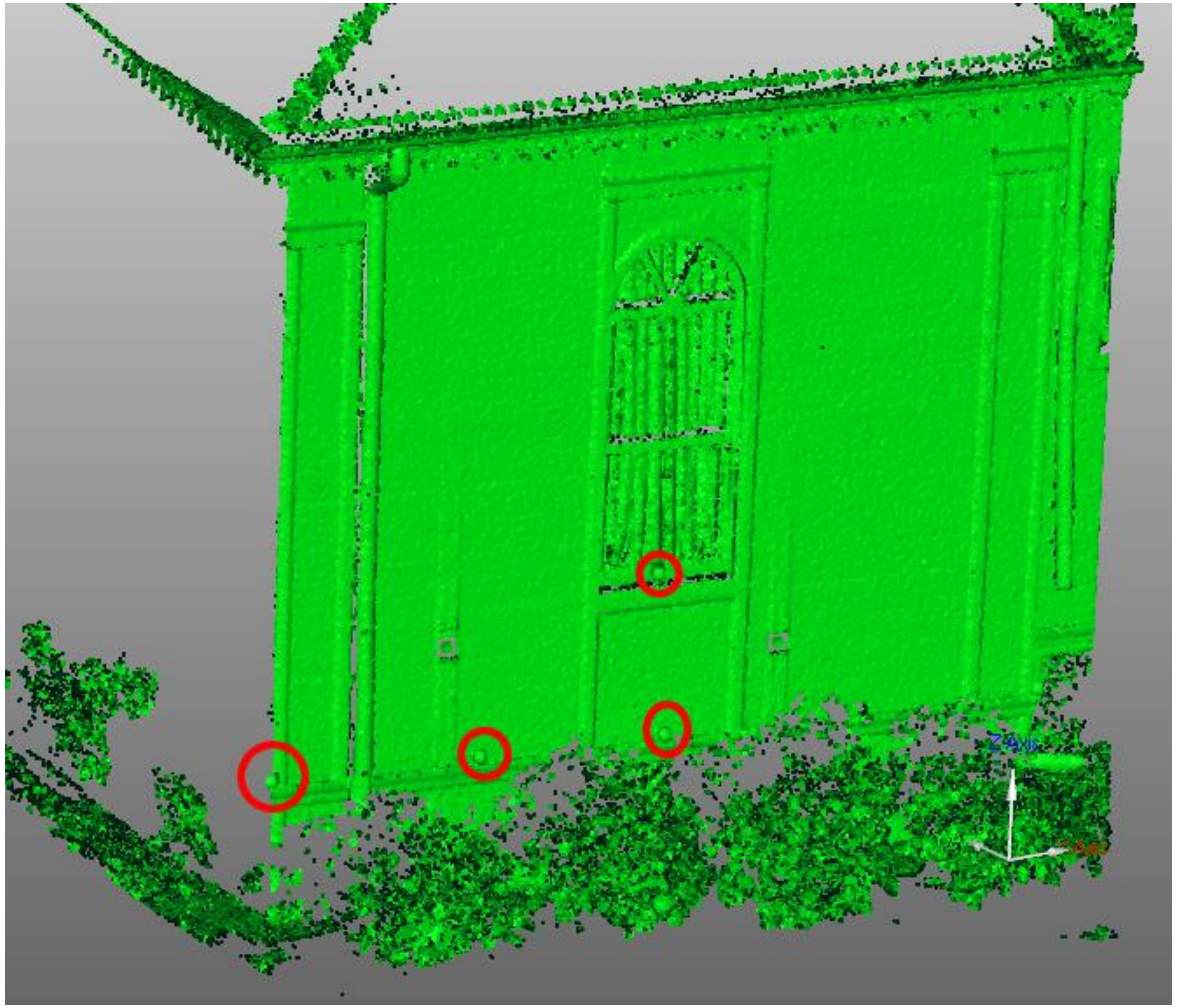
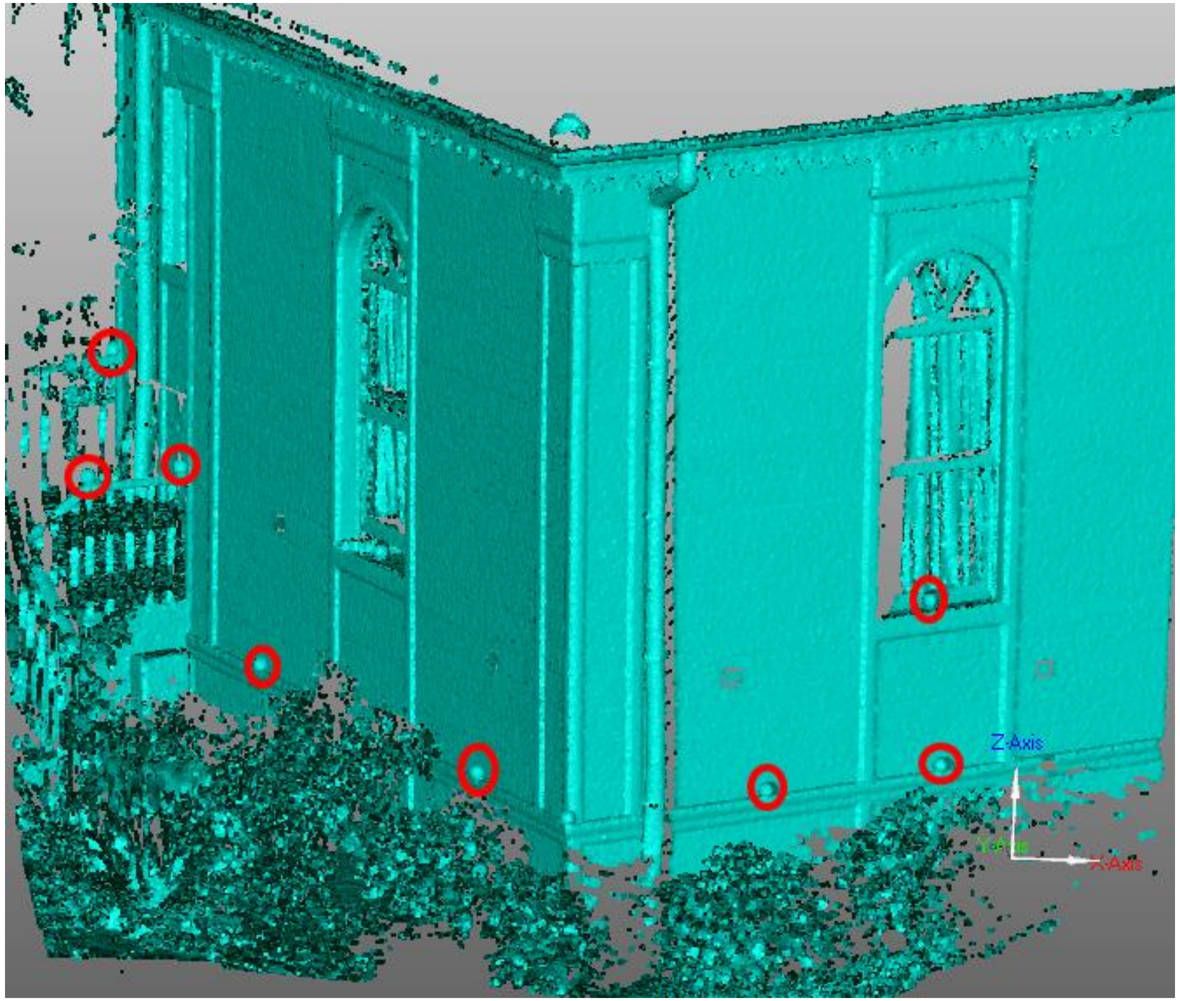
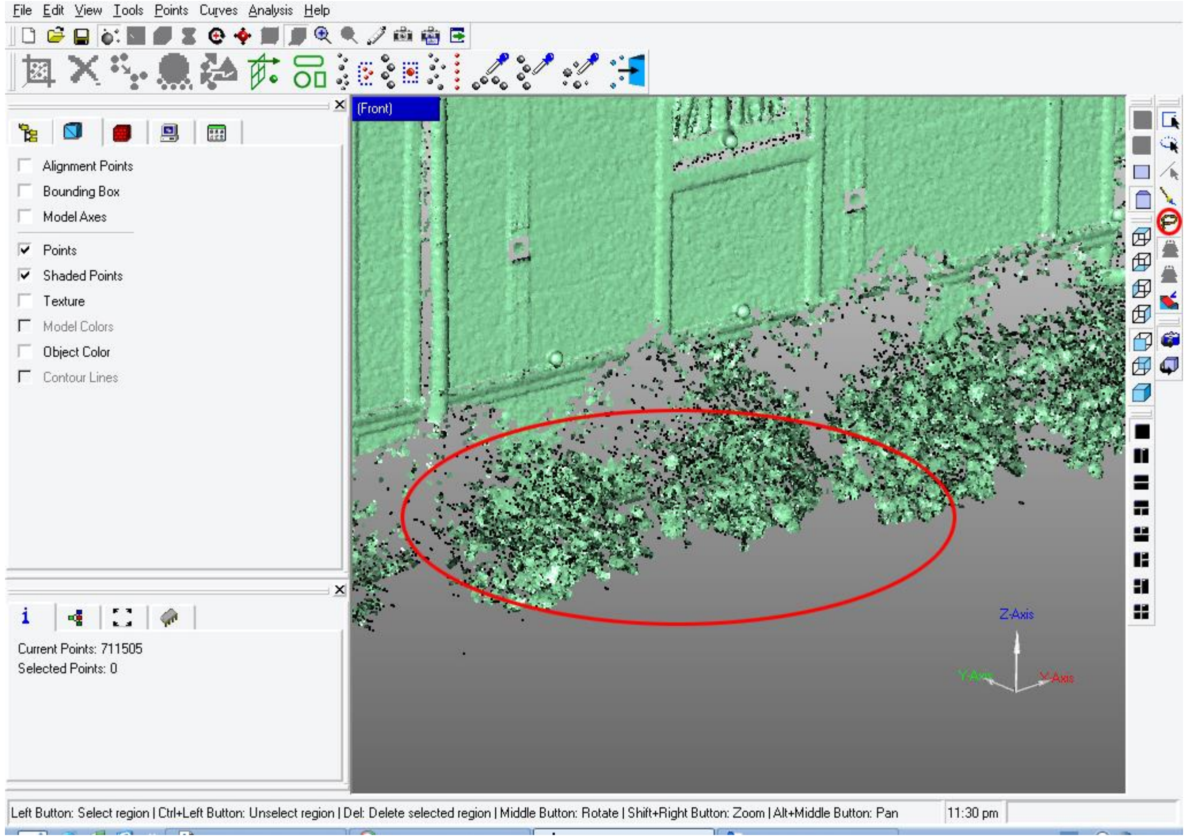
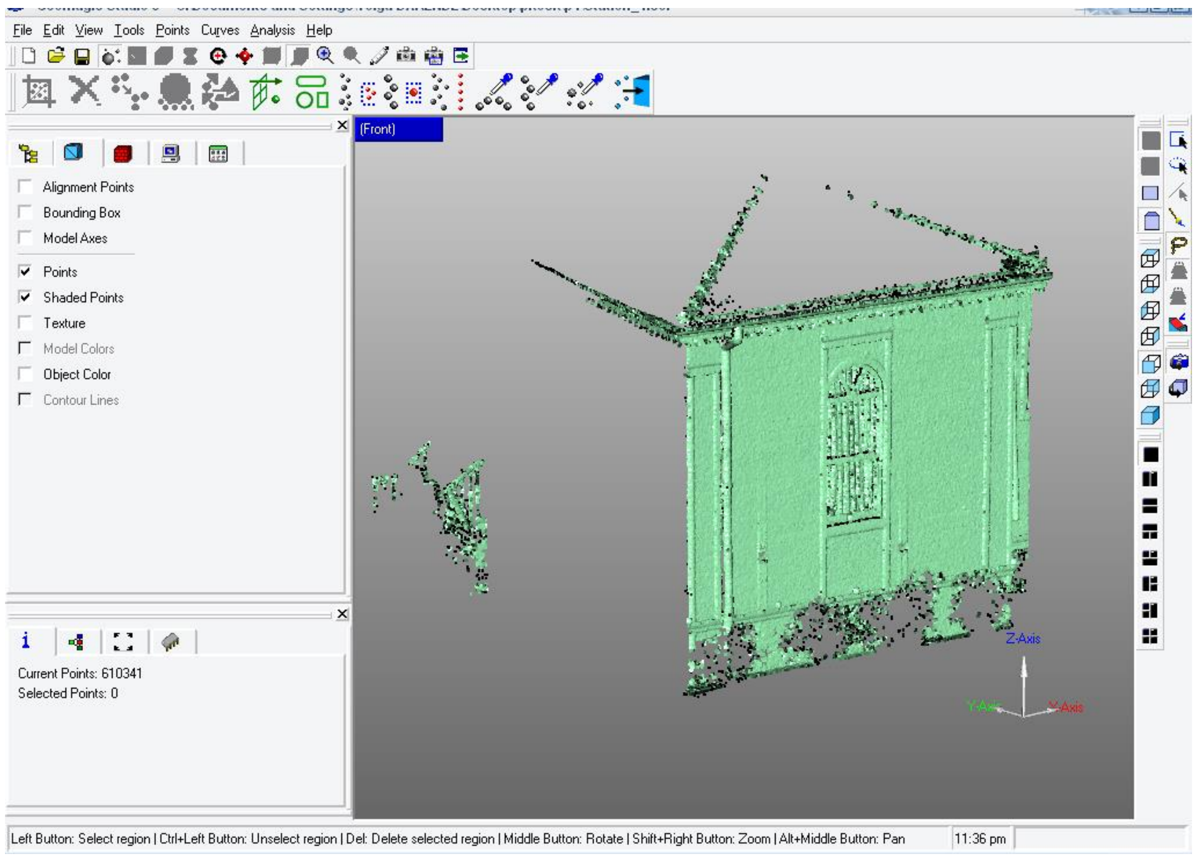
LV=Level 20,WT=0,LC=SOL,CO=5,TP=KeyPt
Select view to fit
Display complete.
View 1 - Stereo(Master) Zoom: 0,2817 RSet: 2 Scale: 1:53(Roam)
Dynamic Coordinate Readout
Sensitivity High
X: 1004,404
Y: 1002,330
Z: 103,970
ISFC Active Feature
Primary Tag
FIRE HYDRANT
3304
Use Secondary Tag
Auto Increment
Sort By Code
Fit View
Expand Clipping Planes
Center Active Depth
Center Camera
View 2
start
13 - Paint
print screen
pembekosk.dgn (3D) ...
14:07

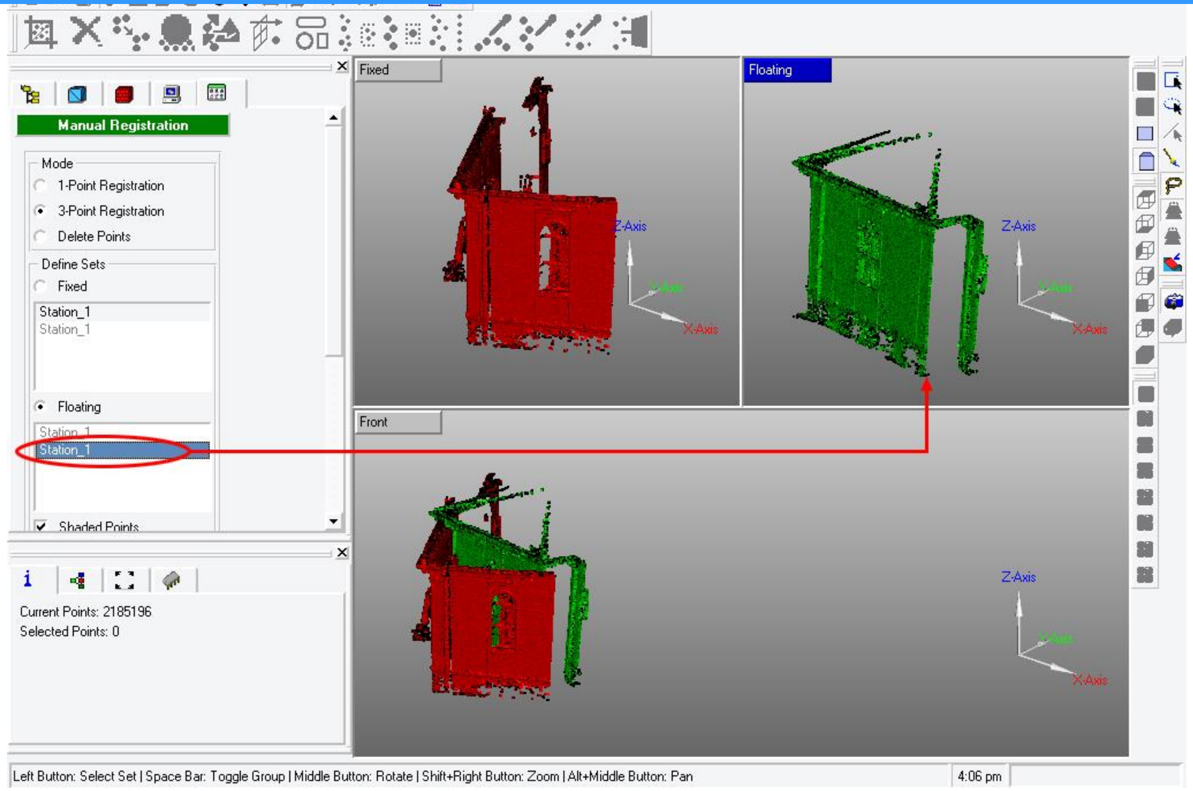


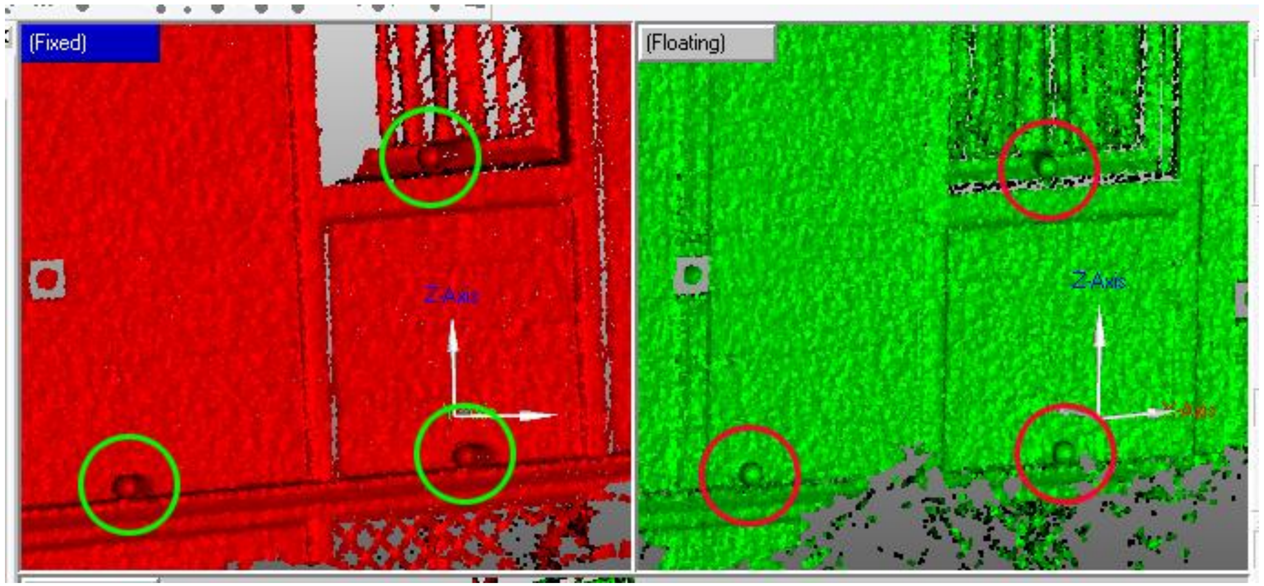


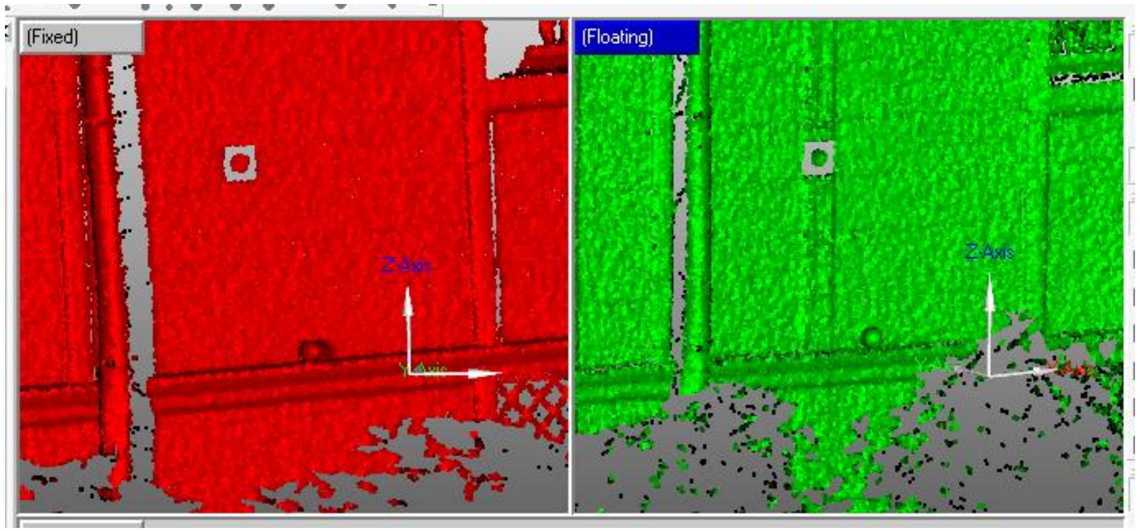

Z-Axis
X-Axis


File Edit View Tools Points Curves Analysis Help
Alignment Points
Bounding Box
Model Axes
Points
Shaded Points
Texture
Model Colors
Object Color
Contour Lines
(Front)
Current Points: 711505
Selected Points: 0
Z-Axis
Y-Axis
X-Axis
Left Button: Select region | Ctrl+Left Button: Unselect region | Del: Delete selected region | Middle Button: Rotate | Shift+Right Button: Zoom | Alt+Middle Button: Pan
11:30 pm


File Edit View Tools Points Curves Analysis Help
Alignment Points
Bounding Box
Model Axes
Points
Shaded Points
Texture
Model Colors
Object Color
Contour Lines
(Front)
Current Points: 610341
Selected Points: 0
Z-Axis
Y-Axis
X-Axis
Left Button: Select region | Ctrl+Left Button: Unselect region | Del: Delete selected region | Middle Button: Rotate | Shift+Right Button: Zoom | Alt+Middle Button: Pan
11:36 pm


Manual Registration
Mode
1-Point Registration
3-Point Registration
Delete Points
Define Sets
Fixed
Station_1
Station_1
Floating
Station_1
Station_1
Shaded Points
Current Points: 2185196
Selected Points: 0
Fixed
Floating
Front
Left Button: Select Set | Space Bar: Toggle Group | Middle Button: Rotate | Shift+Right Button: Zoom | Alt+Middle Button: Pan
4:06 pm


(Fixed)
(Floating)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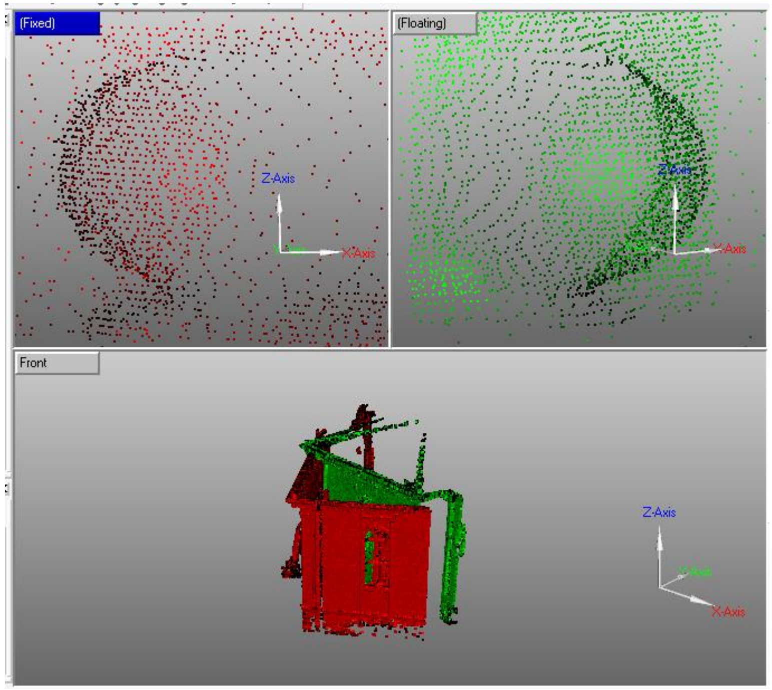
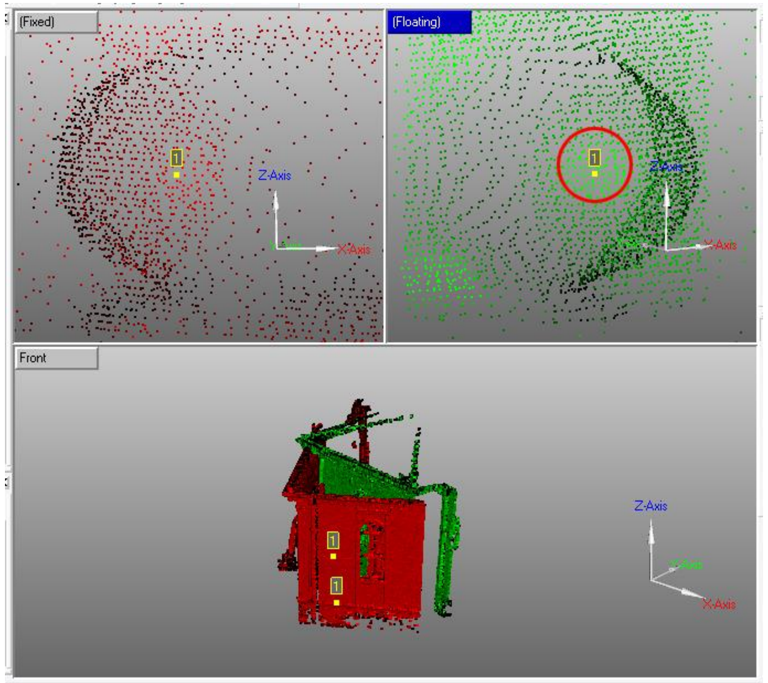
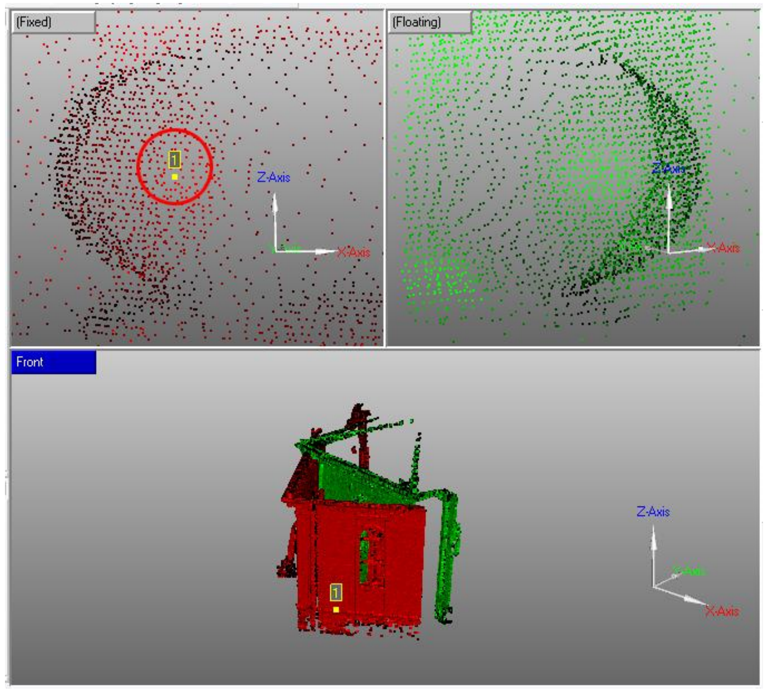
(Floating)


(Fixed)
(Floating)
Front
Z-Axis
X-Axis


(Fixed)
(Floating)
Front
Z-Axis
X-Axis
1


(Fixed)
(Floating)
Front
Z-Axis
X-Axis
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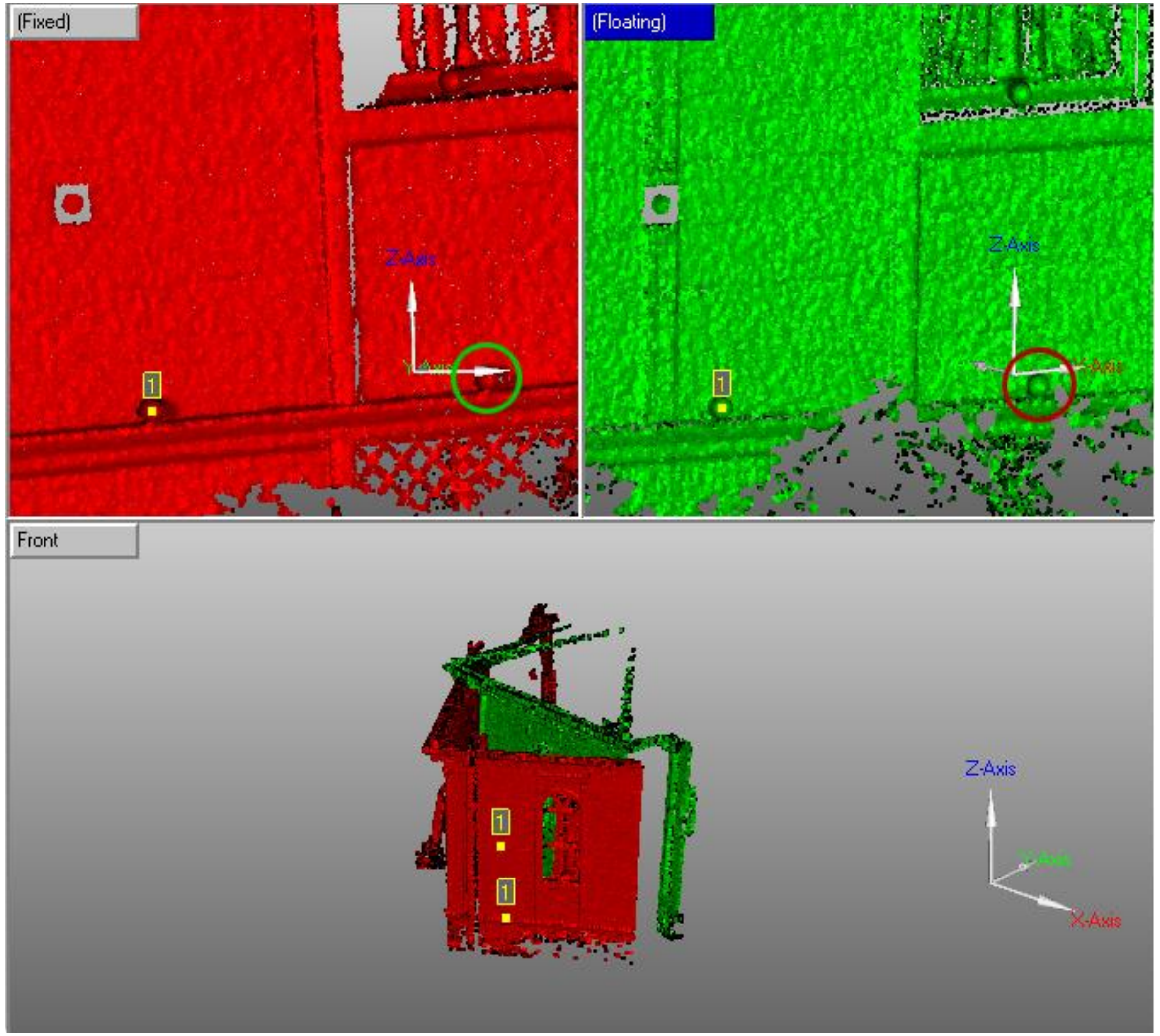
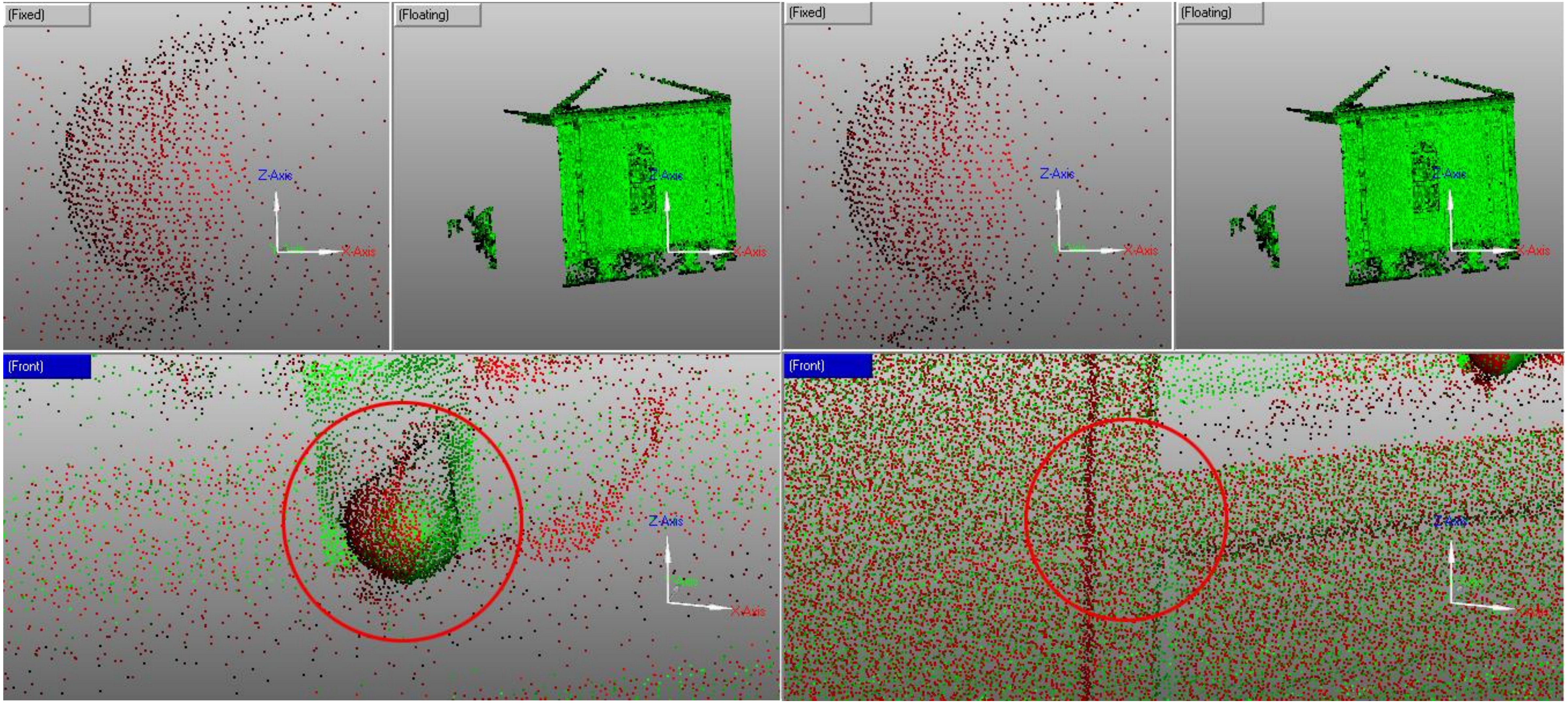
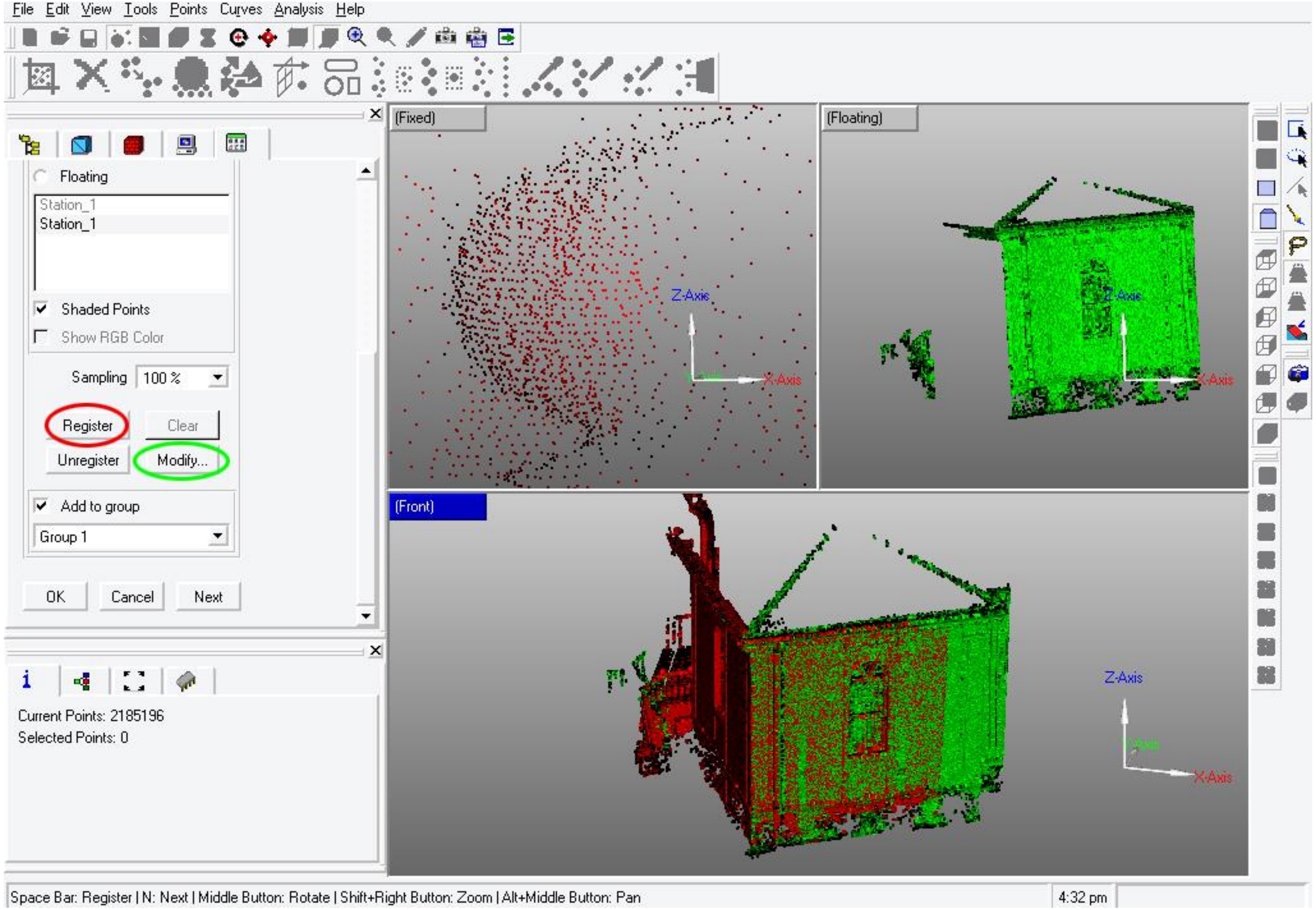
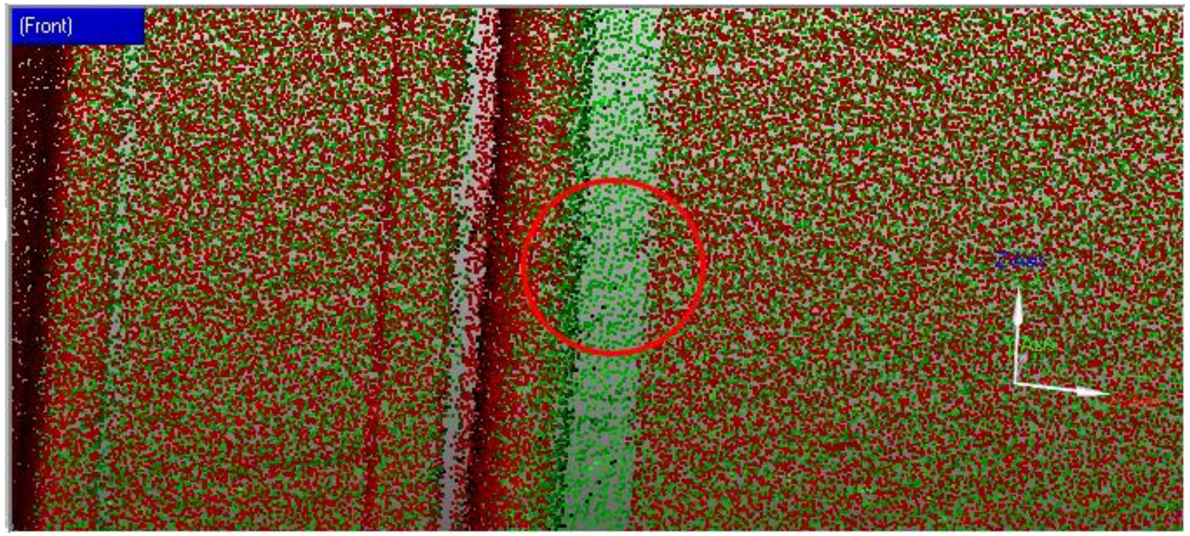
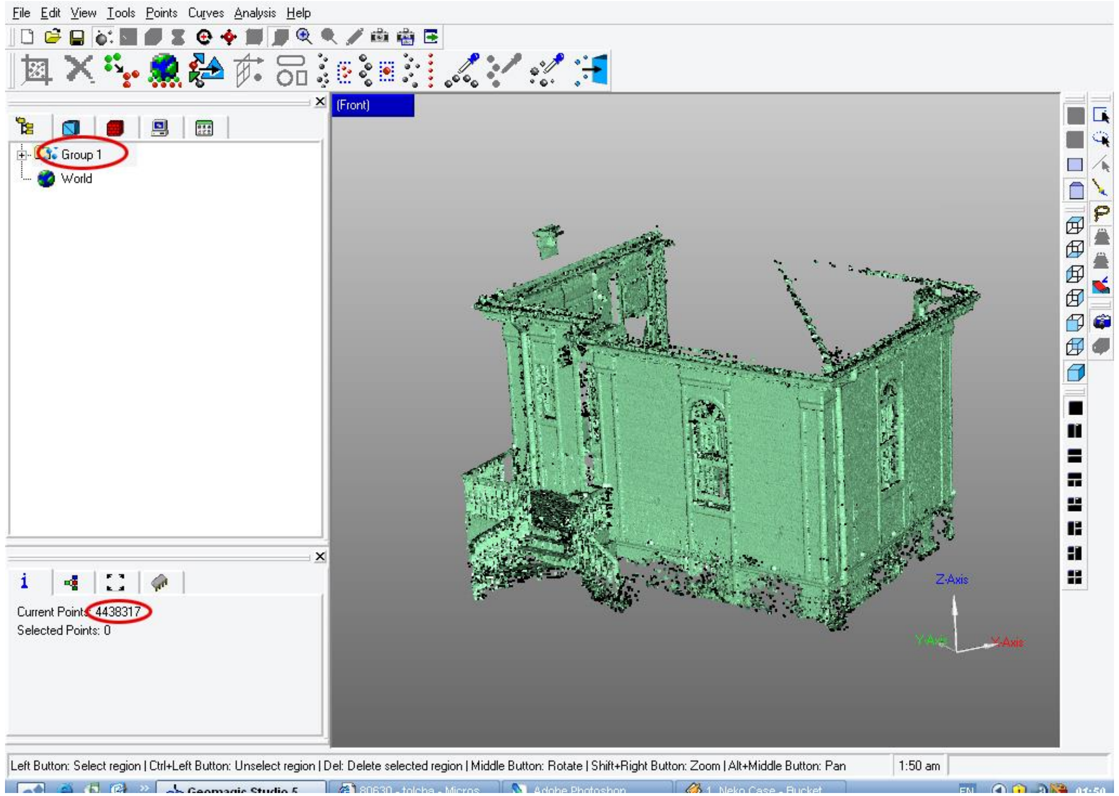
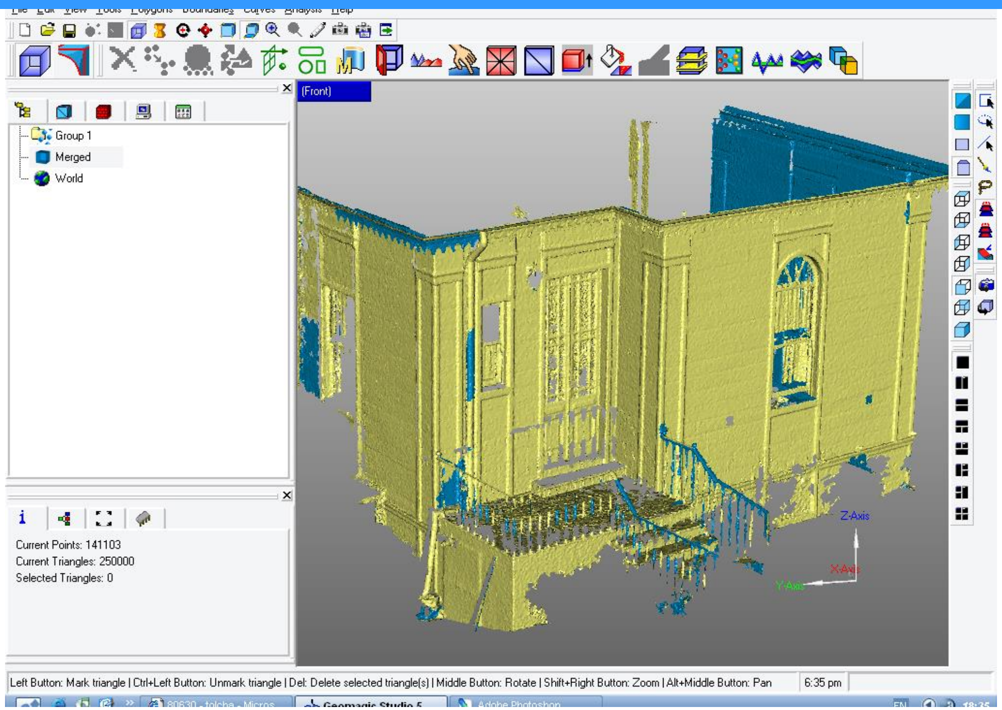

(Fixed)
(Floating)
Front
Z-Axis
Z-Axis
Z-Axis
X-Axis
1
1
1
1

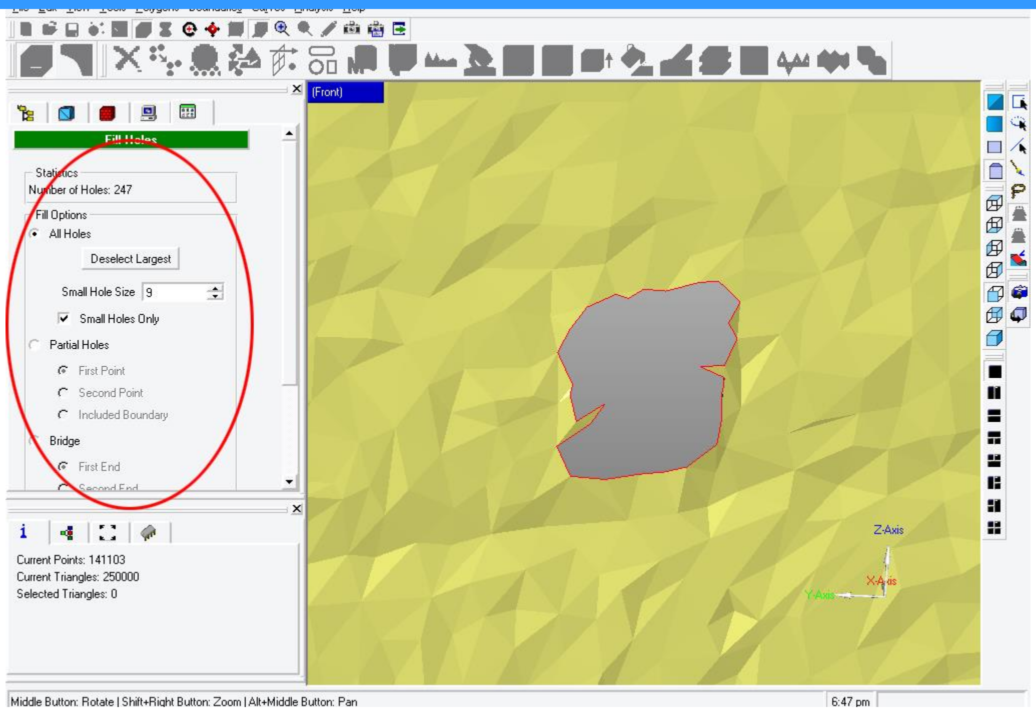

(Fixed)
Z-Axis
X-Axis
(Floating)
Z-Axis
X-Axis
(Fixed)
Z-Axis
X-Axis
(Floating)
Z-Axis
X-Axis
(Front)
Z-Axis
X-Axis
(Front)
Z-Axis

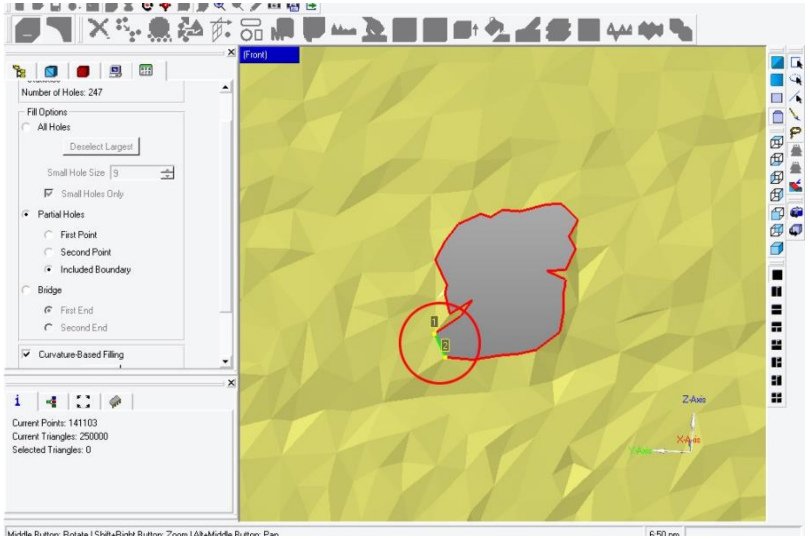

File Edit View Tools Points Curves Analysis Help
Floating
Station_1
Station_1
Shaded Points
Show RGB Color
Sampling 100 %
Register
Clear
Unregister
Modify...
Add to group
Group 1
OK
Cancel
Next
Current Points: 2185196
Selected Points: 0
(Fixed)
(Floating)
(Front)
Z-Axis
X-Axis
Space Bar: Register | N: Next | Middle Button: Rotate | Shift+Right Button: Zoom | Alt+Middle Button: Pan
4:32 pm

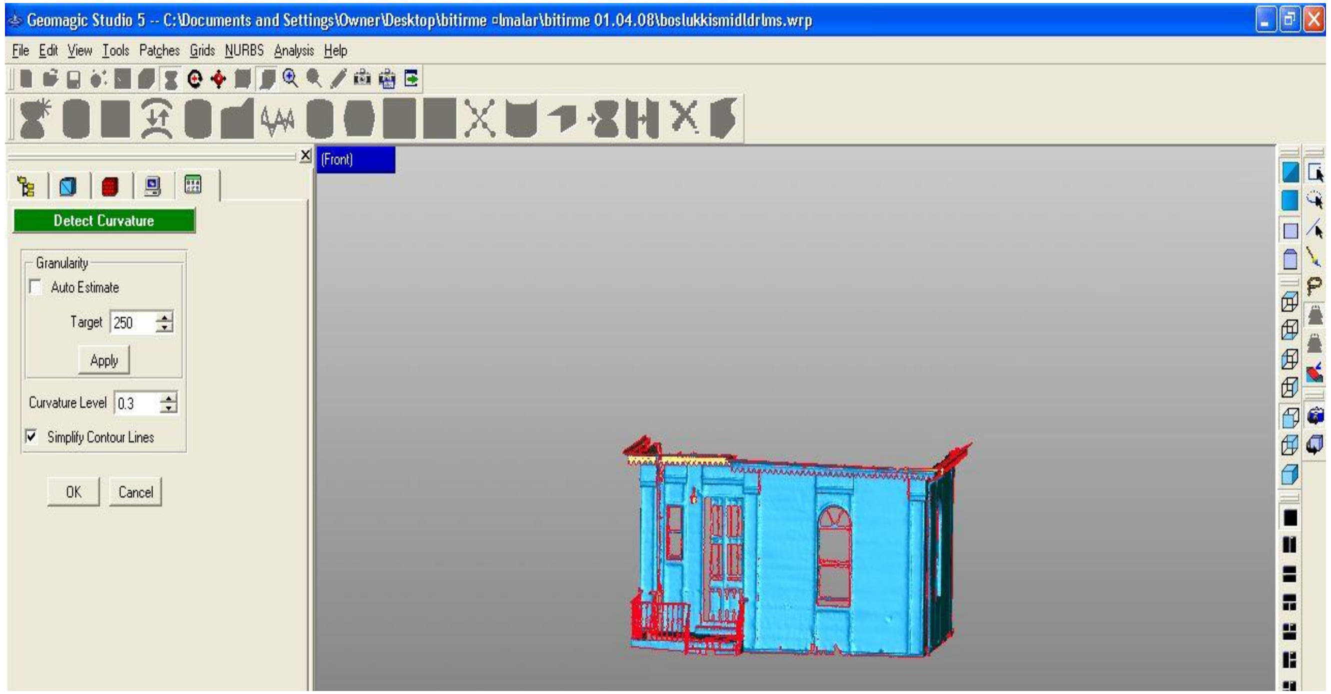

(Front)

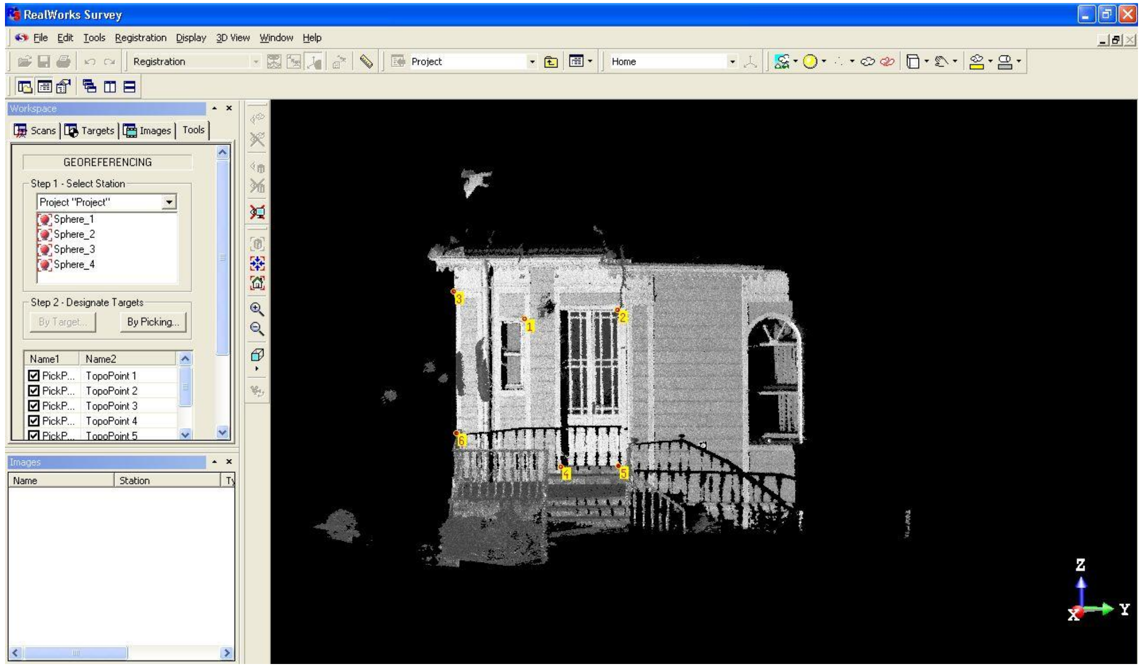

File Edit View Tools Points Curves Analysis Help
(Front)
Group 1
World
Current Points: 4438317
Selected Points: 0
Z-Axis
Y-Axis
X-Axis
Left Button: Select region | Ctrl+Left Button: Unselect region | Del: Delete selected region | Middle Button: Rotate | Shift+Right Button: Zoom | Alt+Middle Button: Pan
1:50 am

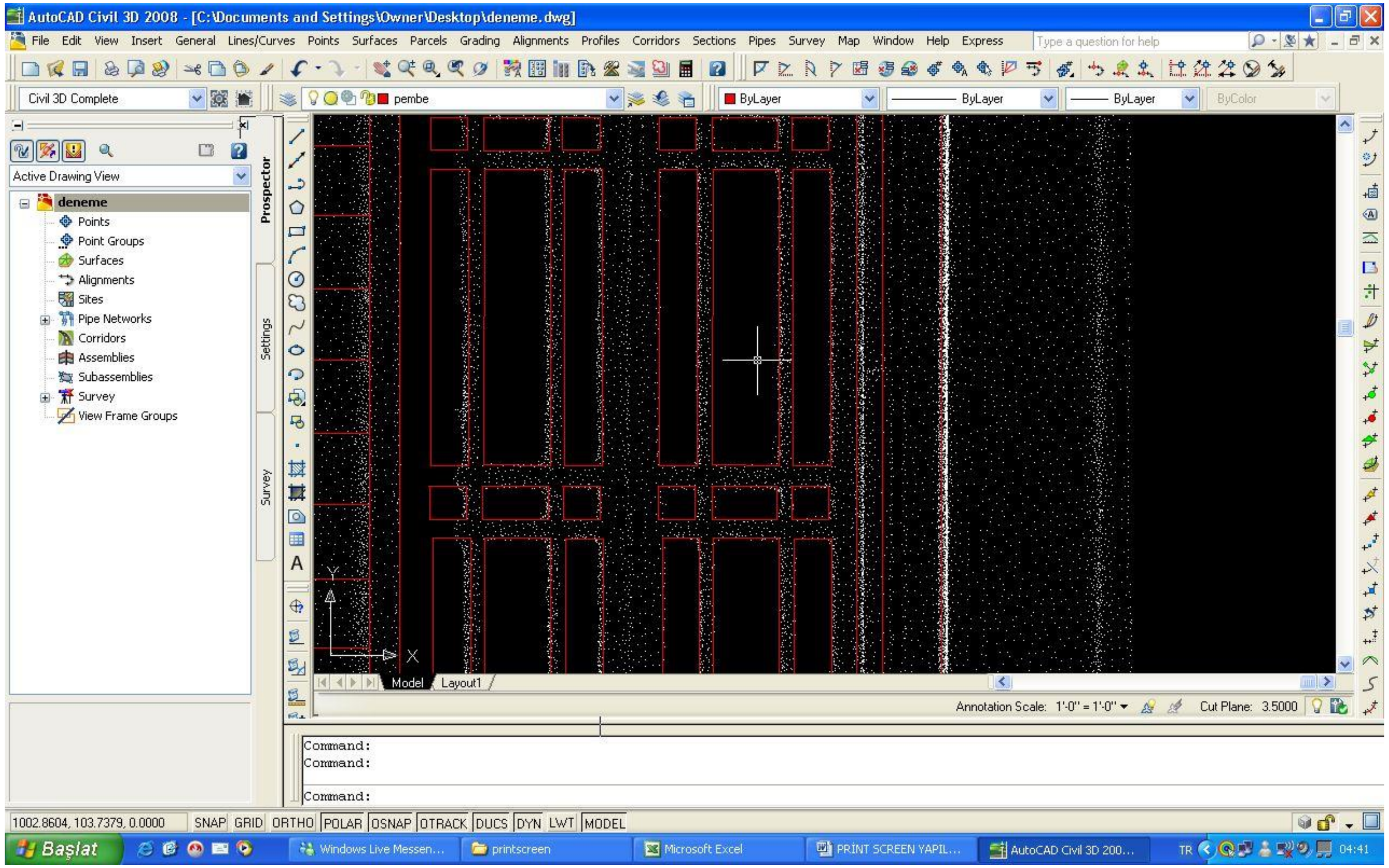

Group 1
Merged
World
(Front)
Current Points: 141103
Current Triangles: 250000
Selected Triangles: 0
Z-Axis
X-Axis
Y-Axis
Left Button: Mark triangle | Ctrl+Left Button: Unmark triangle | Del: Delete selected triangle(s) | Middle Button: Rotate | Shift+Right Button: Zoom | Alt+Middle Button: Pan
6:35 pm

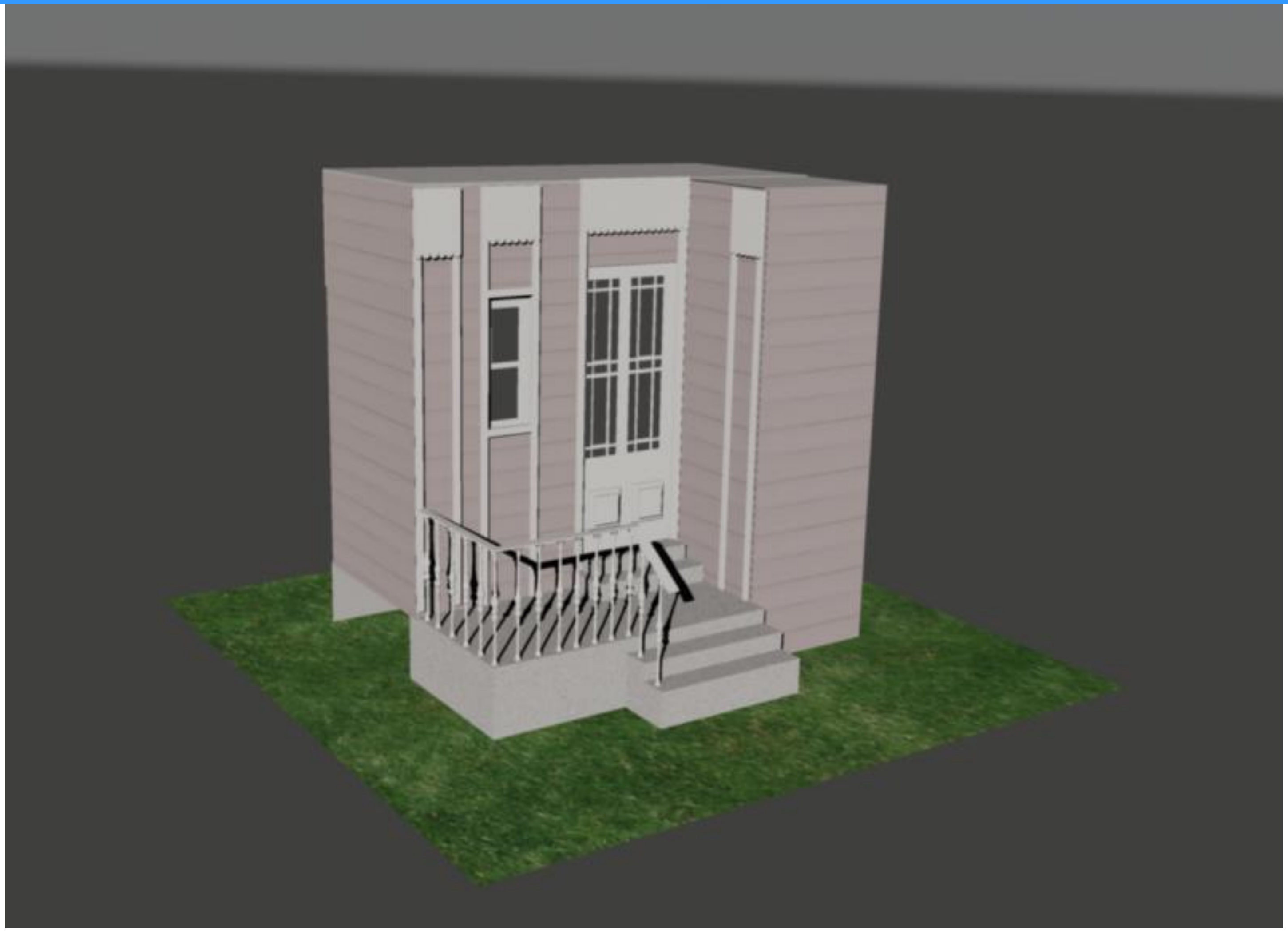

Fill Holes
Statistics
Number of Holes: 247
Fill Options
All Holes
Deselect Largest
Small Hole Size 9
Small Holes Only
Partial Holes
First Point
Second Point
Included Boundary
Bridge
First End
(Front)
Current Points: 141103
Current Triangles: 250000
Selected Triangles: 0
Z-Axis
X-Axis
Y-Axis
Middle Button: Rotate | Shift+Right Button: Zoom | Alt+Middle Button: Pan
6:47 pm


Number of Holes: 247
Fill Options
All Holes
Deselect Largest
Small Hole Size 9
Small Holes Only
Partial Holes
First Point
Second Point
Included Boundary
Bridge
First End
Second End
Curvature-Based Filling
(Front)
Current Points: 141103
Current Triangles: 250000
Selected Triangles: 0
Z-Axis
X-Axis
Y-Axis

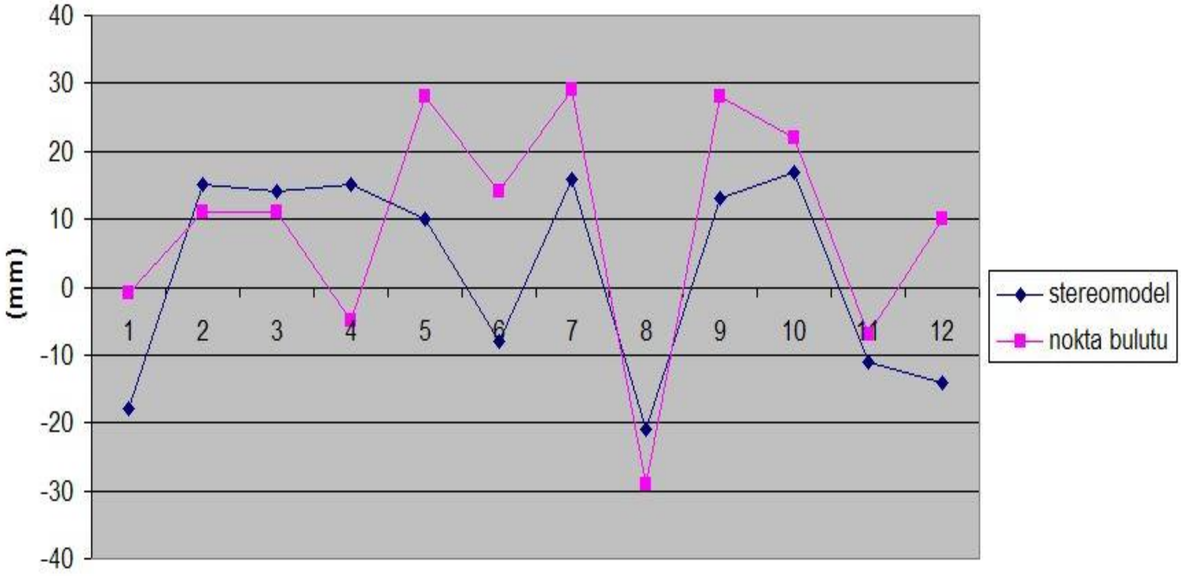

Geomagic Studio 5 -- C:\Documents and Settings\Owner\Desktop\bitirme çalmalar\bitirme 01.04.08\boslukkismidldrlms.wrp
File Edit View Tools Patches Grids NURBS Analysis Help
(Front)
Detect Curvature
Granularity
Auto Estimate
Target 250
Apply
Curvature Level 0.3
Simplify Contour Lines
OK
Cancel

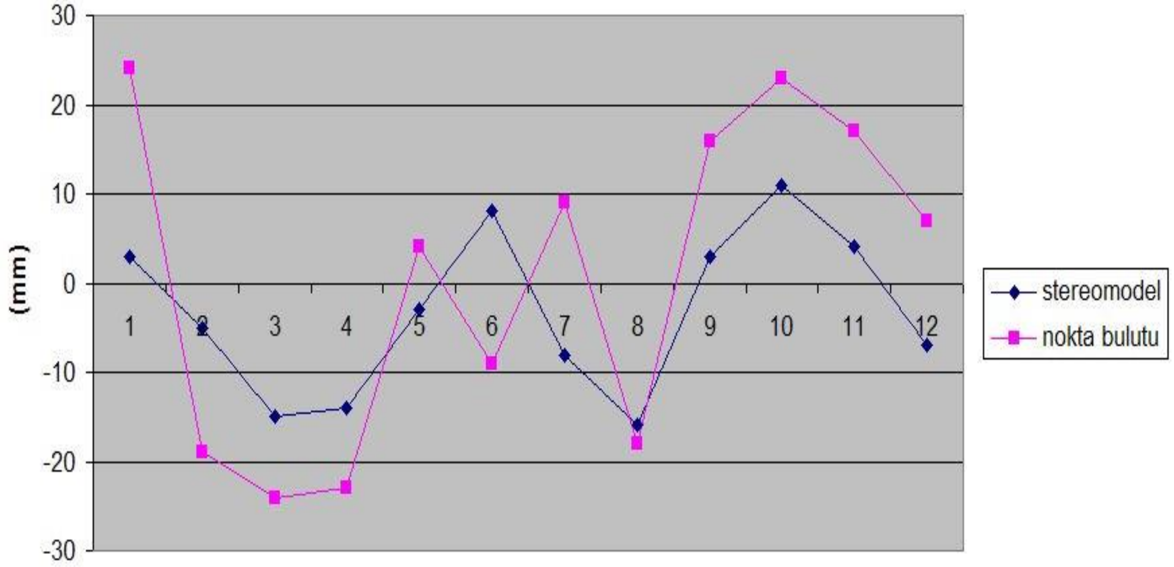

RealWorks Survey
File Edit Tools Registration Display 3D View Window Help
Registration
Project
Home
Workspace
Scans
Targets
Images
Tools
GEOREFERENCING
Step 1 - Select Station
Project "Project"
Sphere_1
Sphere_2
Sphere_3
Sphere_4
Step 2 - Designate Targets
By Target...
By Picking...
Name1
Name2
TopoPoint 1
TopoPoint 2
TopoPoint 3
TopoPoint 4
TopoPoint 5
Images
Name
Station
Z
Y
X

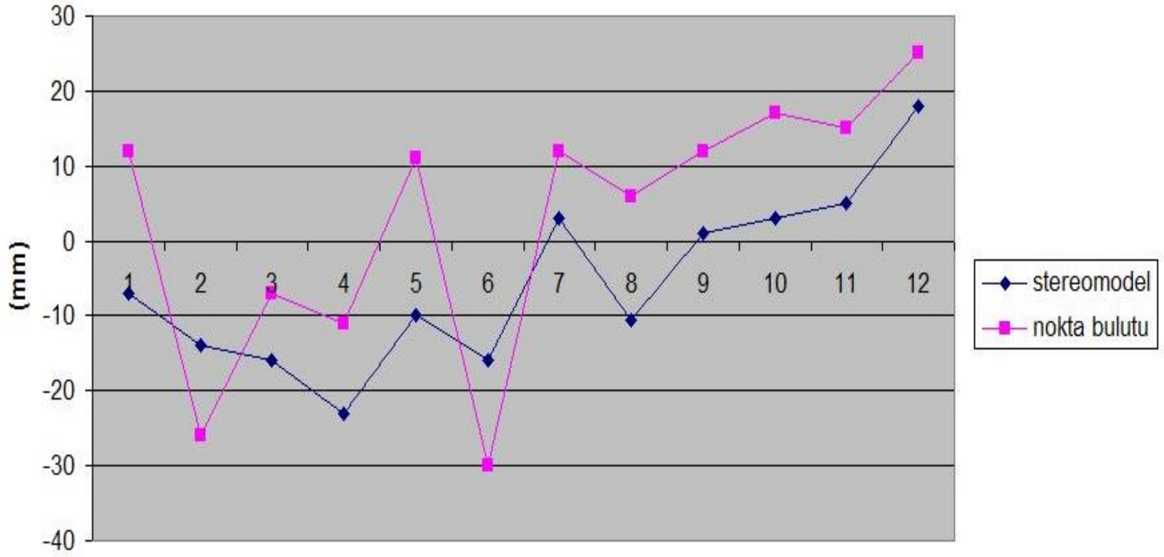

AutoCAD Civil 3D 2008 - [C:\Documents and Settings\Owner\Desktop\deneme.dwg]
File Edit View Insert General Lines/Curves Points Surfaces Parcels Grading Alignments Profiles Corridors Sections Pipes Survey Map Window Help Express
Type a question for help
Civil 3D Complete
pembe
ByLayer
ByLayer
ByLayer
ByColor
Active Drawing View
deneme
Points
Point Groups
Surfaces
Alignments
Sites
Pipe Networks
Corridors
Assemblies
Subassemblies
Survey
View Frame Groups
Prospector
Settings
Survey
Model
Layout1
Annotation Scale: 1'-0" = 1'-0"
Cut Plane: 3.5000
Command:
Command:
Command:
1002.8604, 103.7379, 0.0000
SNAP GRID ORTHO POLAR OSNAP OTRACK DUCS DYN LWT MODEL
Başlat
Windows Live Messen...
printscreen
Microsoft Excel
PRINT SCREEN YAPIL...
AutoCAD Civil 3D 200...
TR
04:41



	JEODEZİK KOORDİNATLAR			STEREO MODEL KOORDİNATLARI			NOKTA BULUTU KOORDİNATLARI		
	X	Y	Z	X	Y	Z	X	Y	Z
1	1004,452	999,949	105,089	1004,470	999,946	105,096	1004,453	999,925	105,077
2	1004,443	1001,226	105,105	1004,428	1001,231	105,119	1004,432	1001,245	105,131
3	1004,432	1001,895	105,111	1004,418	1001,910	105,127	1004,421	1001,919	105,118
4	1004,427	1003,179	105,131	1004,412	1003,193	105,154	1004,432	1003,202	105,142
5	1004,480	999,982	103,586	1004,470	999,985	103,596	1004,452	999,978	103,575
6	1004,467	1001,938	104,445	1004,475	1001,930	104,461	1004,453	1001,947	104,475
7	1004,457	1003,132	104,461	1004,441	1003,140	104,458	1004,428	1003,123	104,449
8	1004,448	1001,837	101,240	1004,469	1001,853	101,251	1004,477	1001,855	101,234
9	1004,477	1000,757	104,232	1004,464	1000,754	104,231	1004,449	1000,741	104,220
10	1004,471	1001,263	104,233	1004,454	1001,252	104,230	1004,449	1001,240	104,216
11	1004,458	1001,259	102,867	1004,469	1001,255	102,862	1004,465	1001,242	102,852
12	1004,465	1000,750	102,866	1004,479	1000,757	102,848	1004,455	1000,743	102,841







Line-route Survey and Calculations – Week_6-7

History of route networks in TURKEY

• BC The Babil-Thapsakus road, which was an extension of the road network built by Assyrians and Babylonians in Mesopotamia and Syria, was built in 2000. Between 1700-1200 Hatuşaş Hittites capitals; In the 6th century, the King King of the 2165 km-long King Road, built by Darius of the Persian king, Sardes and Sus. Alexander had the Sart-Milet-Finike coastal road in 34, and later this road combined with King's Road.

• During the Byzantine Empire, the Istanbul-Izmit-Konya road was built and connected to the old Roman roads. This road was called the Pilgrimage Road in the time of the Ottomans.

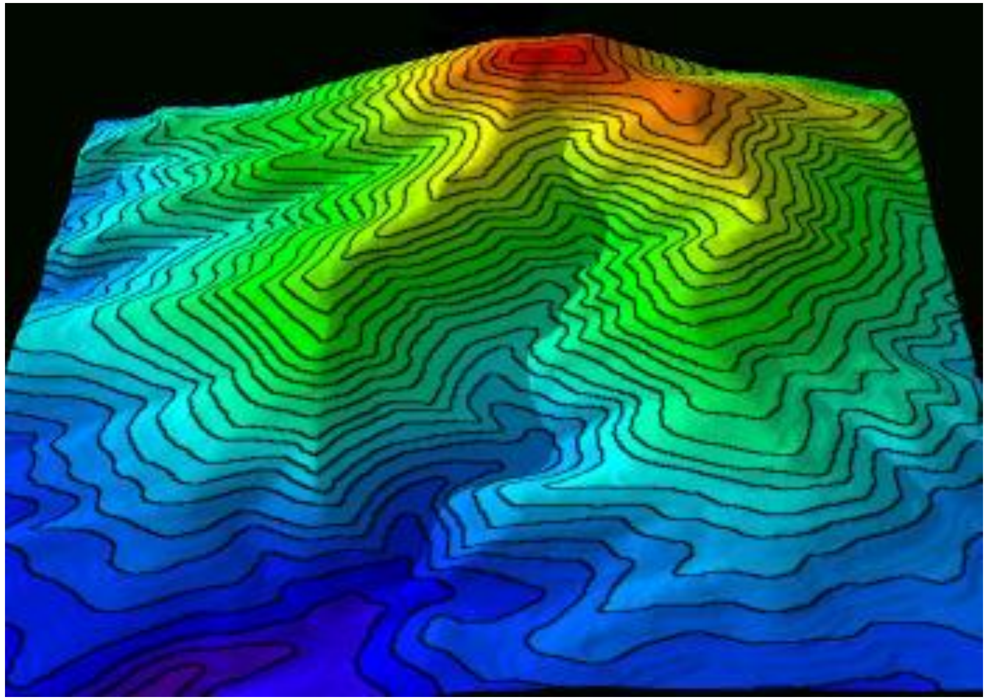
• During the Seljuk period, a road network was established around Antalya-Alanya-Konya-Aksaray-Sivas-Erzurum-Erzincan. In these roads, the inn, caravanserai and fountain, such as accommodation facilities throughout the road.

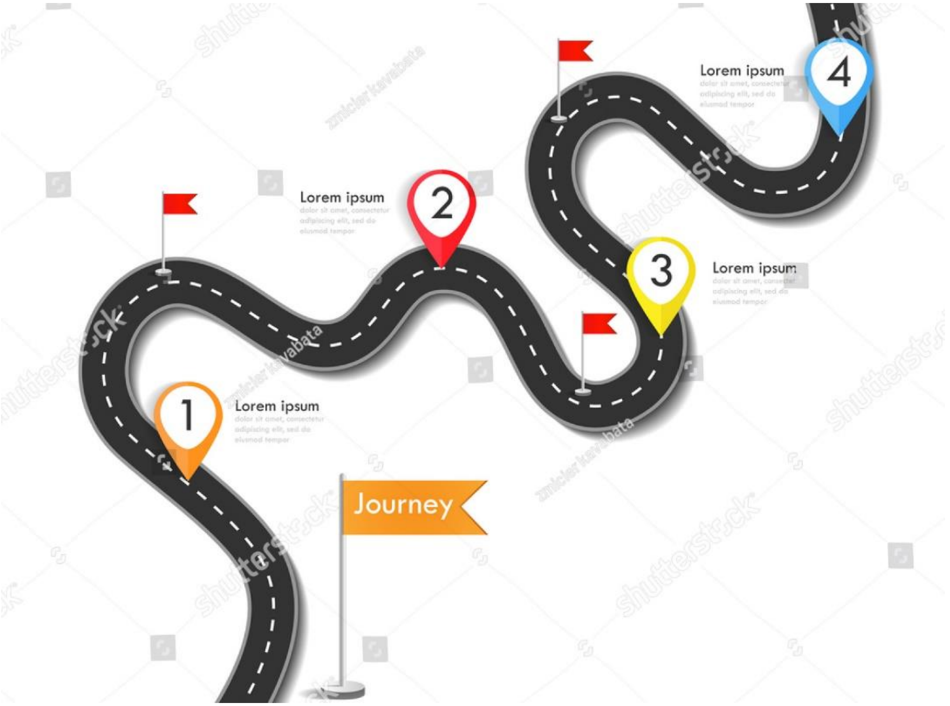
• Road works stopped during World War I and Independence Wars and existing roads disappeared from maintenance. 13885 km damaged surface metalled road from the Ottoman Empire, 4450 km dirt road, including 18335 km of roads and 94 bridges on these roads has remained the heritage of the Republic of Turkey.

• In a real sense, Turkey, planned and entered into force on March 1, 1950's modern road construction 5539 No. established by law in the Ministry of Public Works General Directorate of Highways (KGM) has established that all kinds begin with take the road construction is considered

Any data about the infrastructure of the highway may affect the design directly or indirectly.

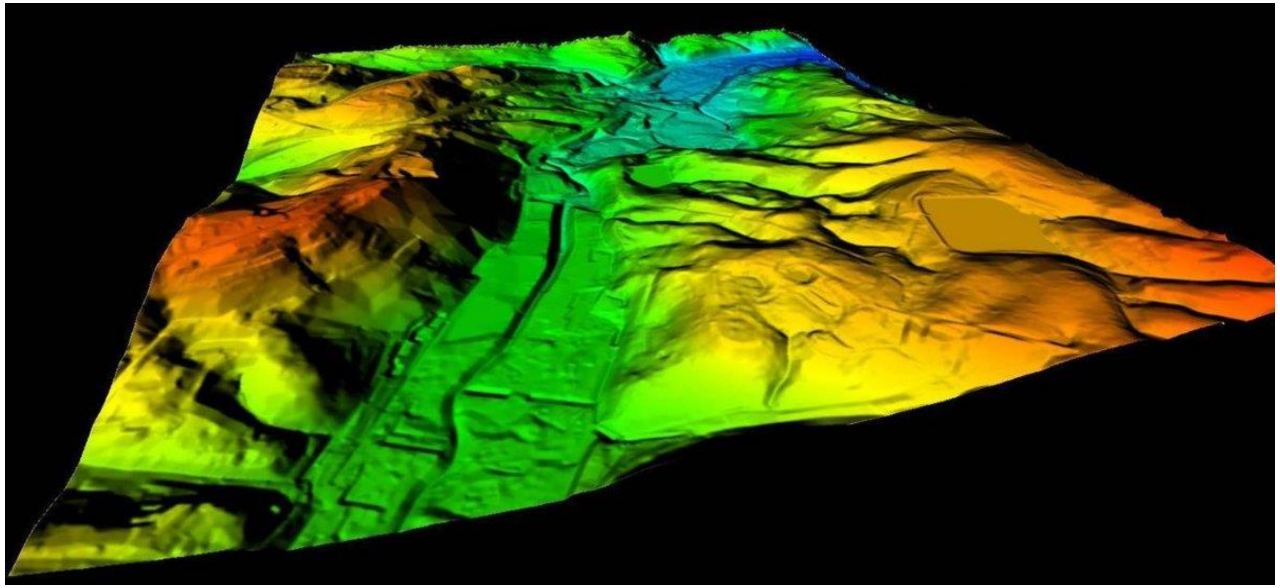
According to the nature of the work to be done, according to the characteristics of the region where the route is passed, different data groups should be brought together and accurate and current data should be used to design the optimum route.

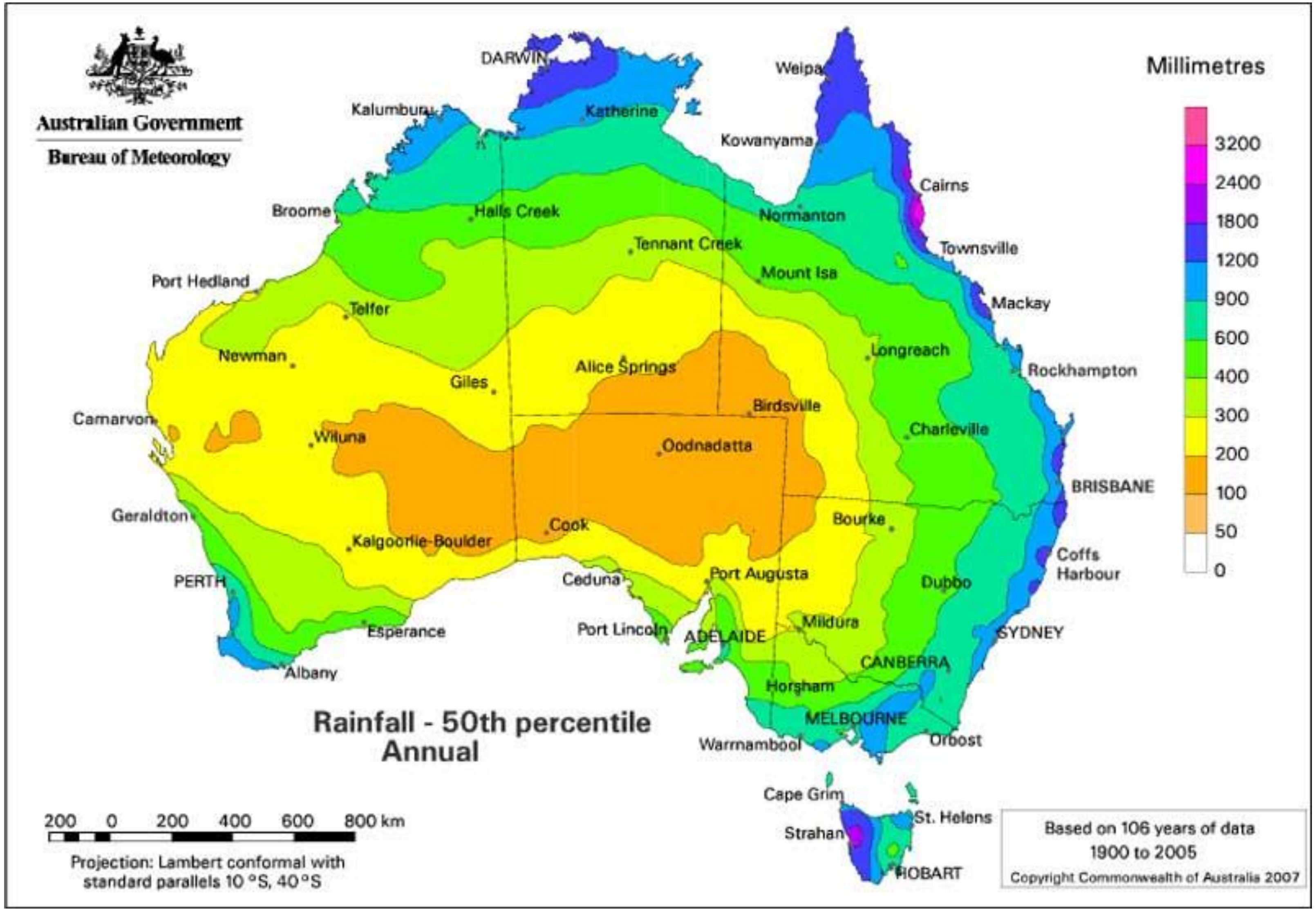




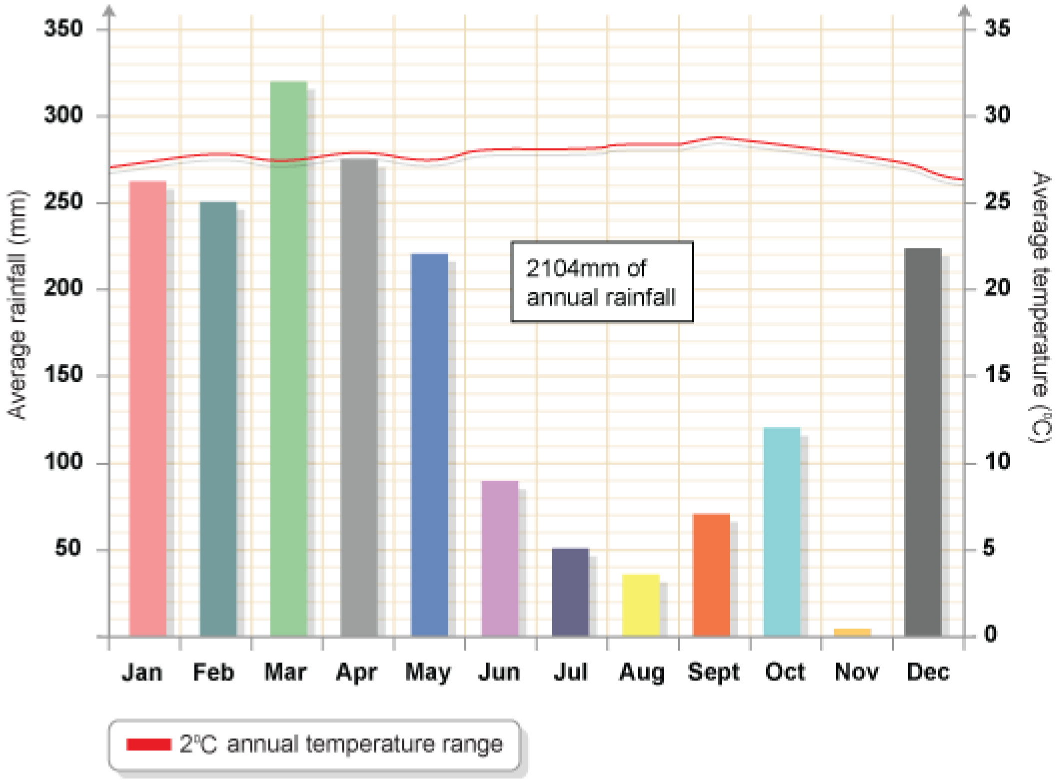
Data can be used for route design;

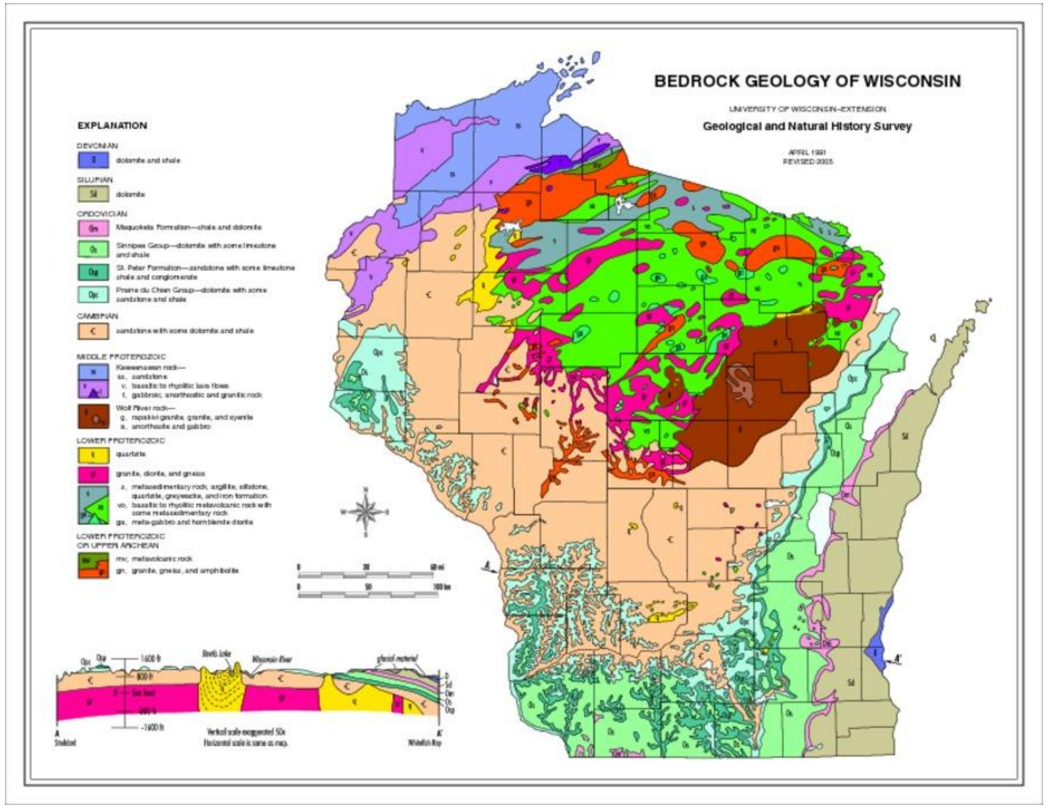
- Land Data (3D Data)
- Water Collection Lines, Basin Areas
- Climatic Conditions of the Region, Precipitation Data
- Reconstruction-Cadastral Status Maps
- Existing Drainage Lines
- Vegetation Map
- Geology Map
- Infrastructure Data
    - Drinking Water / Wastewater / Drainage Lines
    - Electricity, Energy Transmission Lines
    - Stationary Stations
    - Energy and Electric Networks
    - Cemeteries
    - Planned projects
- Environmental Data
    - Tree inventory, green areas, parks
    - Pedestrian Road Planning
    - Noise Map

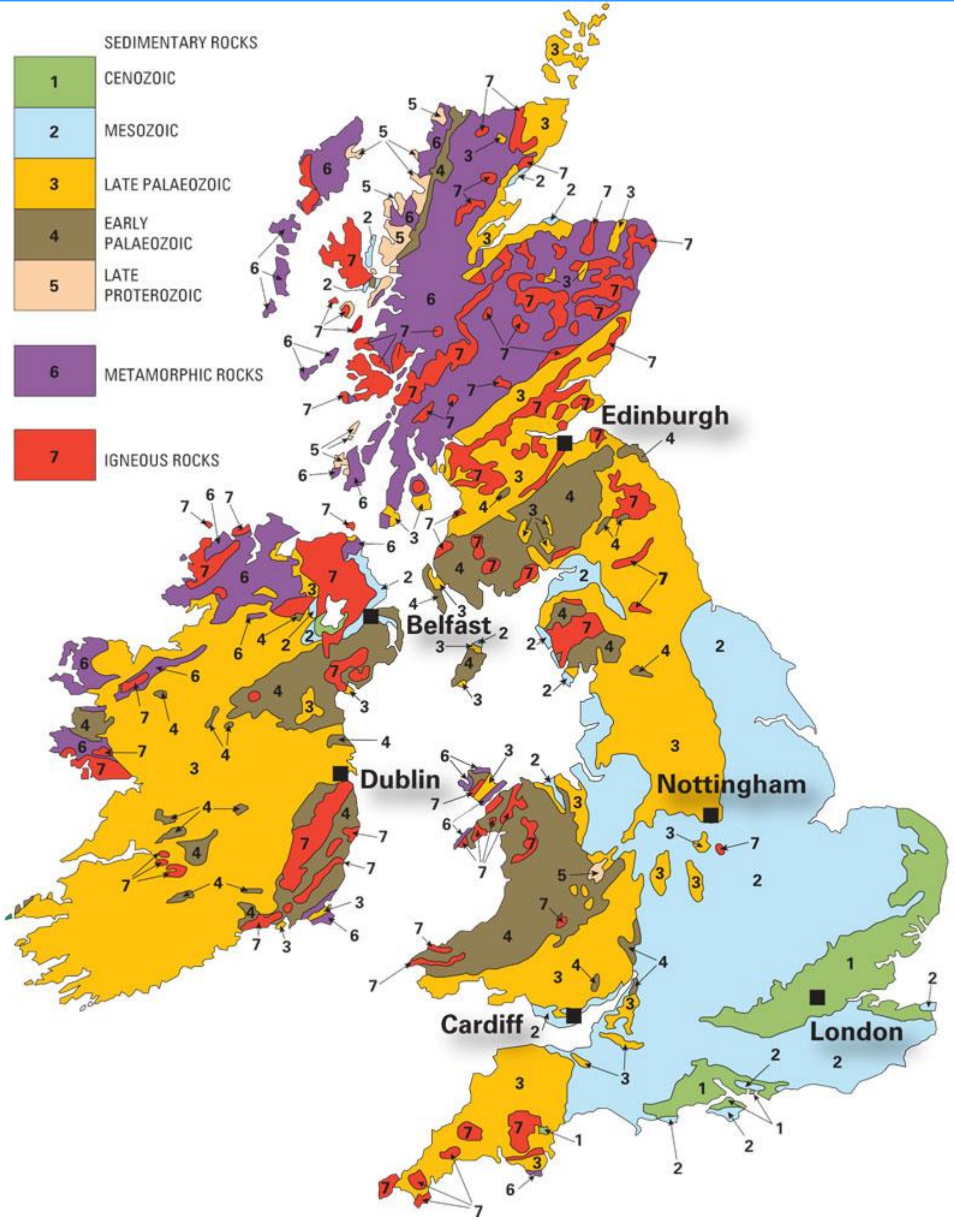


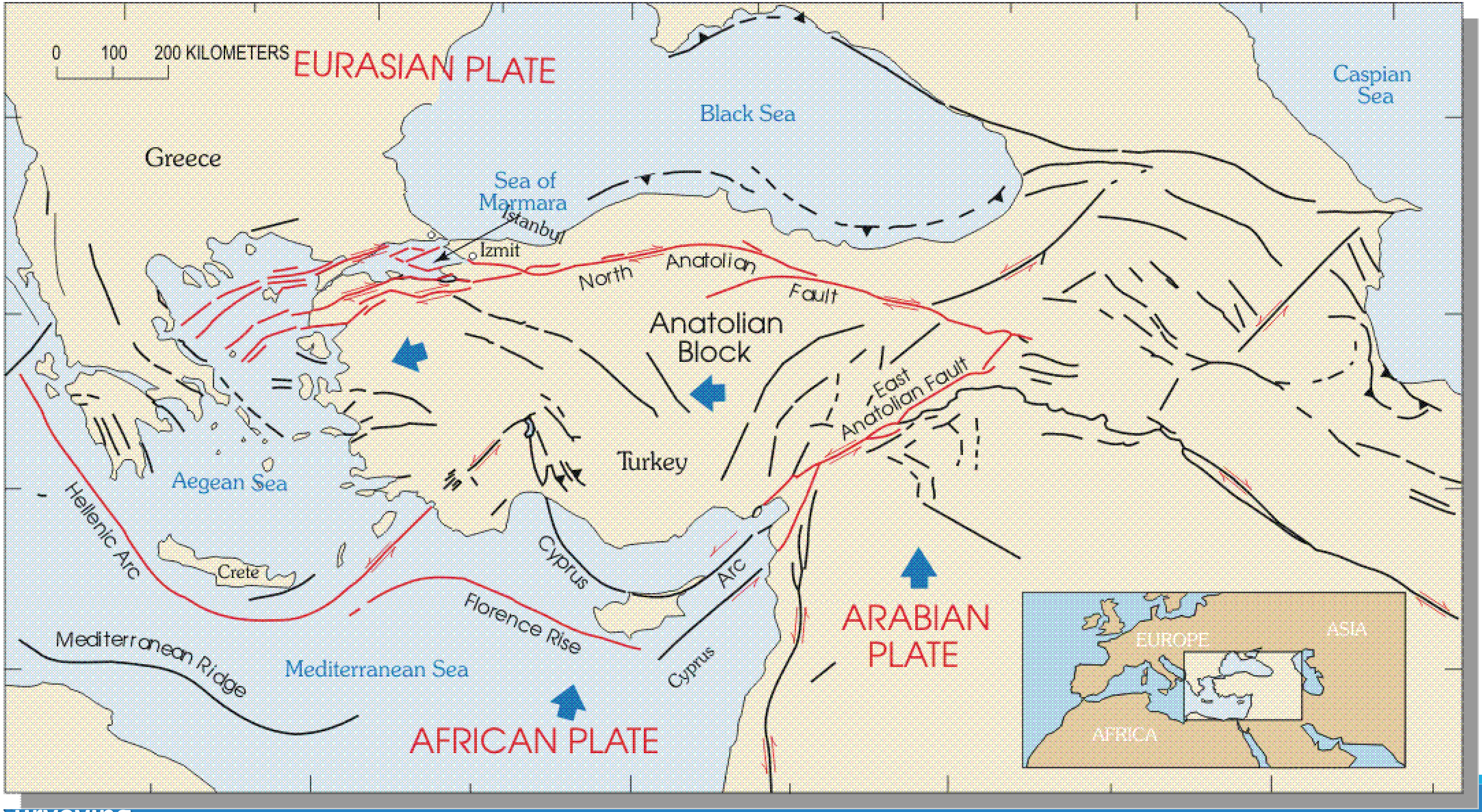


Australia's 50th percentile annual rainfall

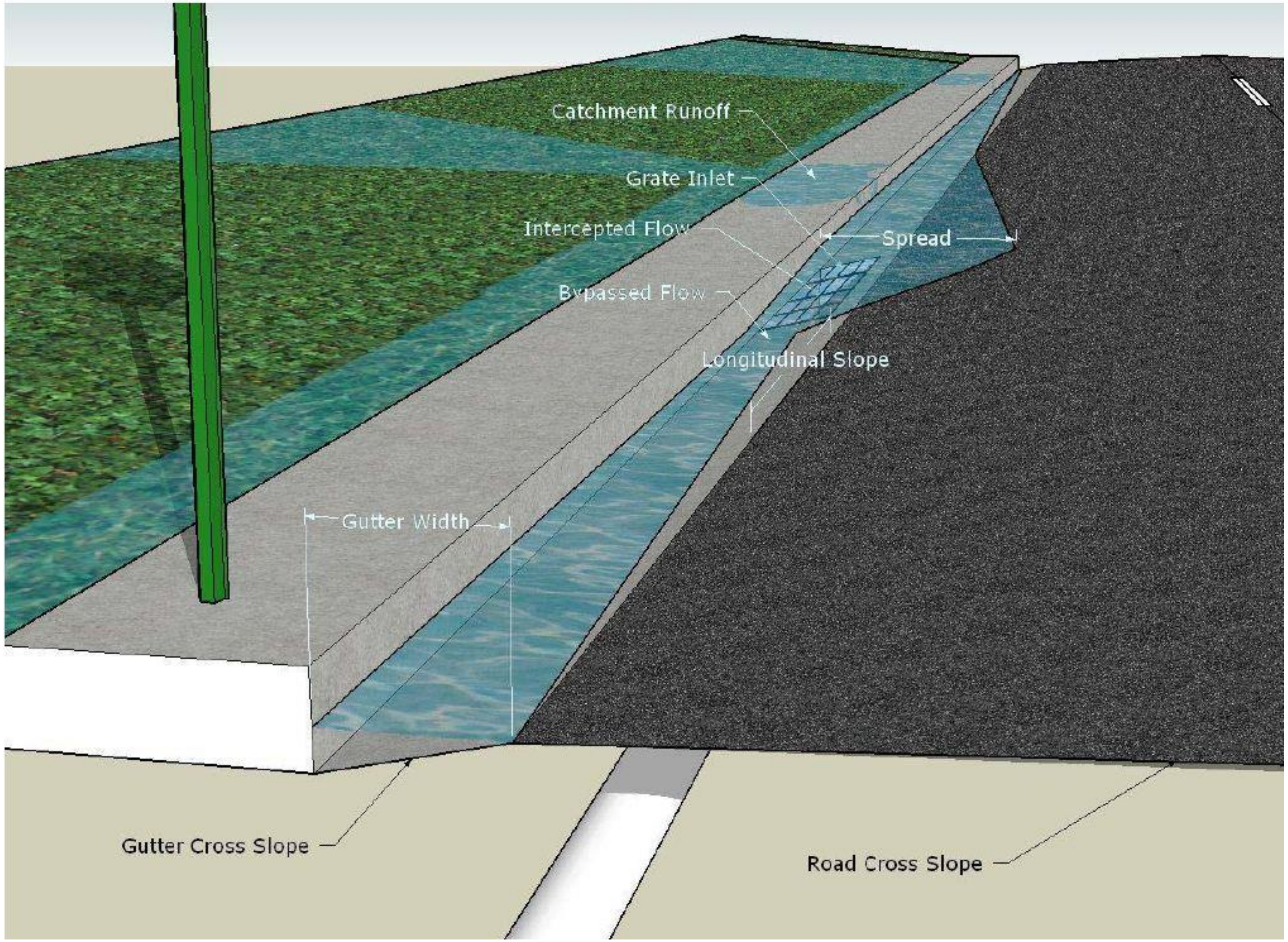

350
300
250
200
150
100
50
35
30
25
20
15
10
5
0
Average rainfall (mm)
Average temperature (°C)
2104mm of
annual rainfall
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
2°C annual temperature range

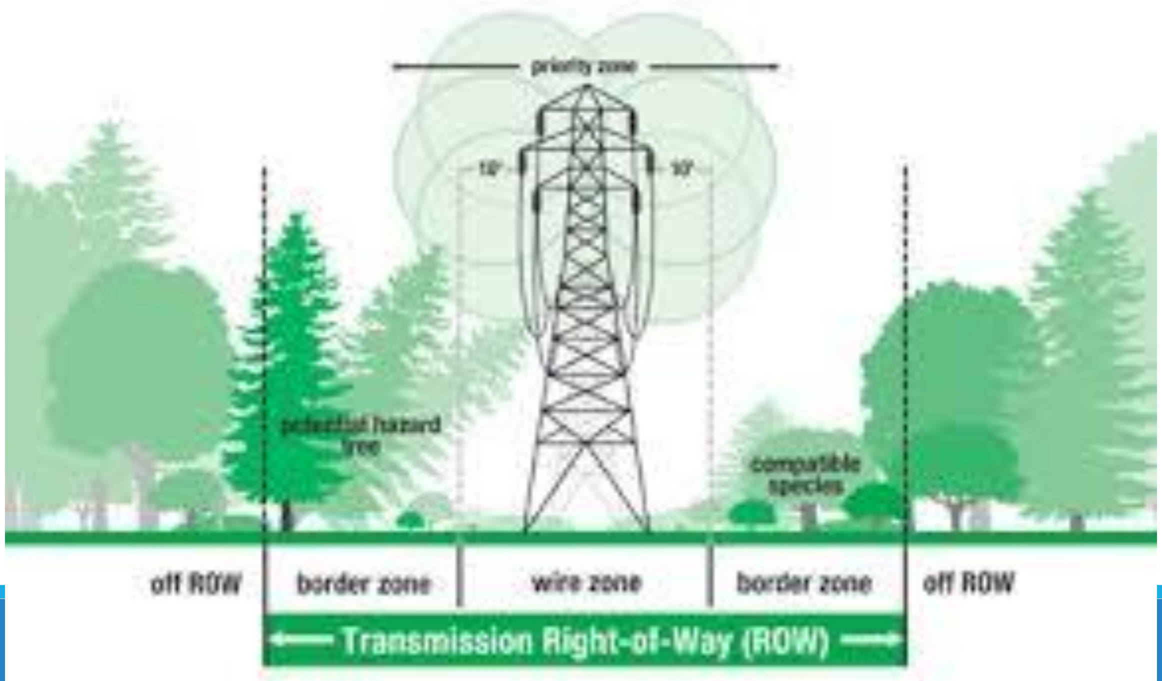

BEDROCK GEOLOGY OF WISCONSIN
UNIVERSITY OF WISCONSIN–EXTENSION
Geological and Natural History Survey
EXPLANATION

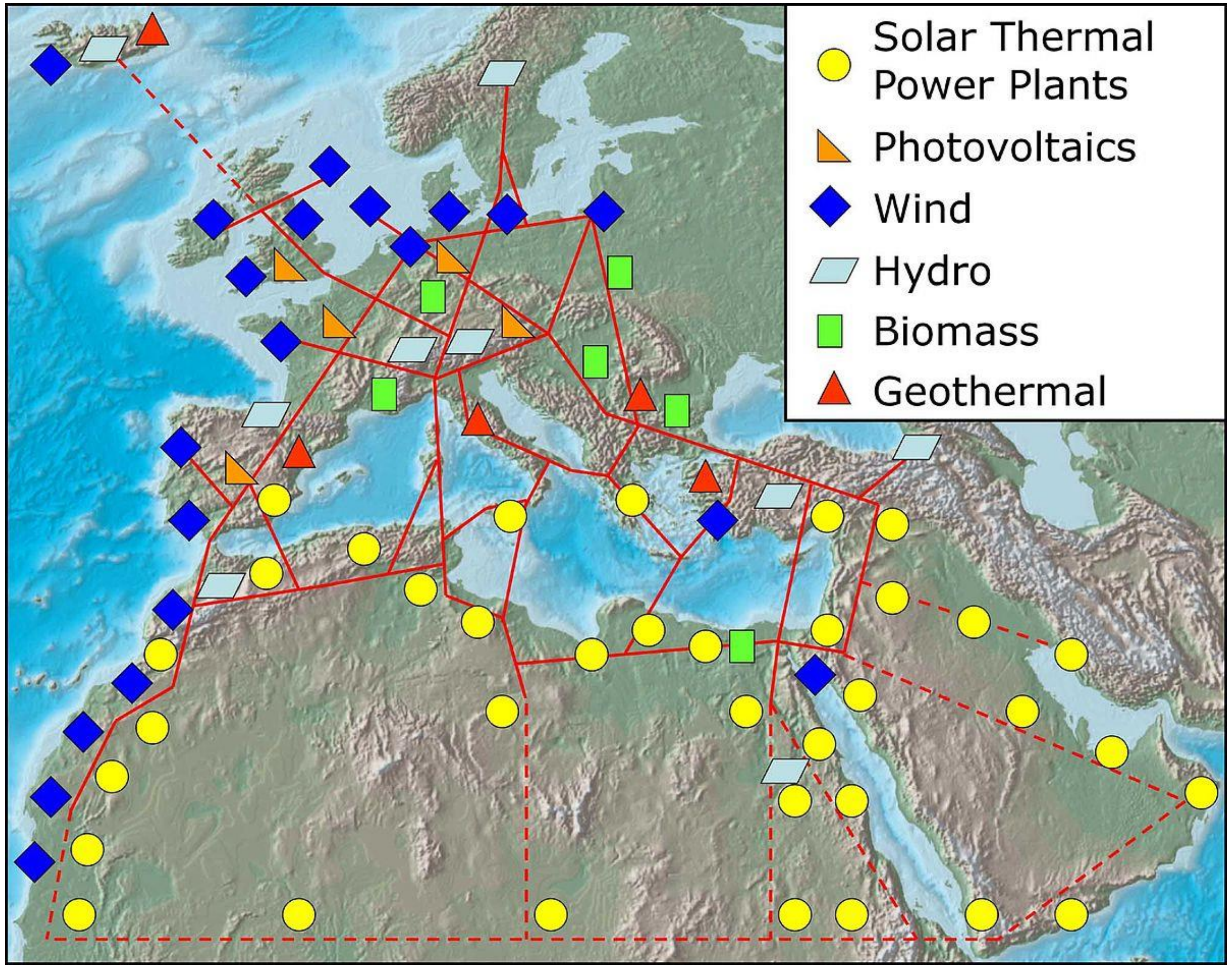

SEDIMENTARY ROCKS
1 CENOZOIC
2 MESOZOIC
3 LATE PALAEOZOIC
4 EARLY PALAEOZOIC
5 LATE PROTEROZOIC
6 METAMORPHIC ROCKS
7 IGNEOUS ROCKS
Edinburgh
Belfast
Dublin
Nottingham
Cardiff
London



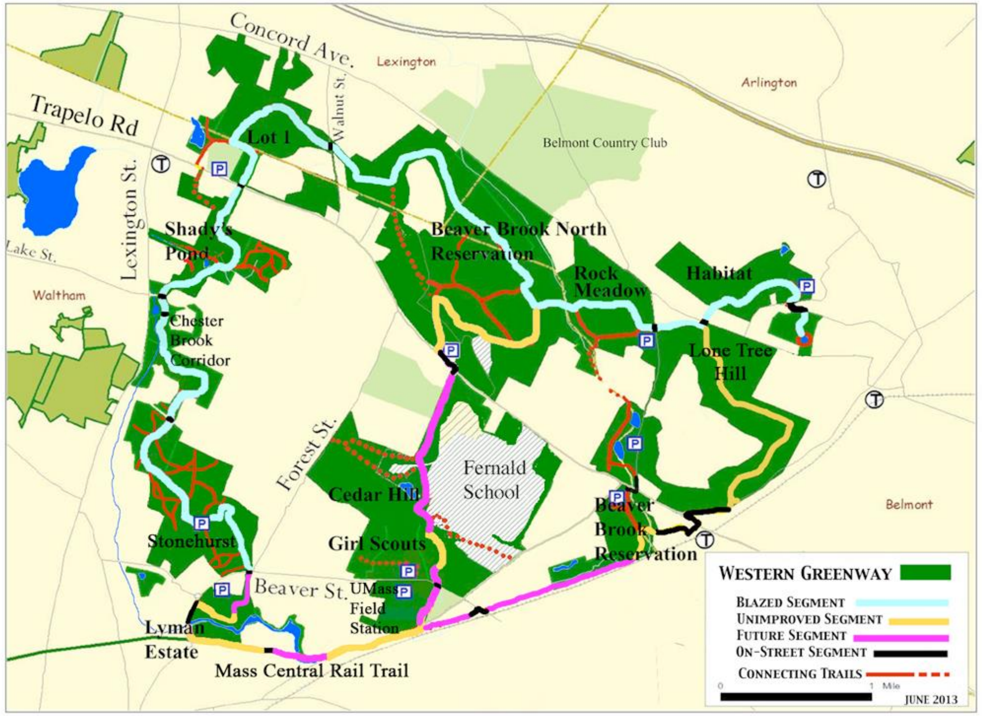
21°
27°
33°
39°
45°
51°
42°
39°
36°
33°
0 100 200 KILOMETERS
EURASIAN PLATE
Black Sea
Caspian Sea
Greece
Sea of Marmara
Istanbul
Izmit
North Anatolian Fault
Anatolian Block
East Anatolian Fault
Turkey
Aegean Sea
Hellenic Arc
Crete
Cyprus Arc
Florence Rise
Mediterranean Ridge
Mediterranean Sea
Cyprus
AFRICAN PLATE
ARABIAN PLATE
EUROPE
ASIA
AFRICA


Catchment Runoff
Grate Inlet
Intercepted Flow
Spread
Bypassed Flow
Longitudinal Slope
Gutter Width
Gutter Cross Slope
Road Cross Slope

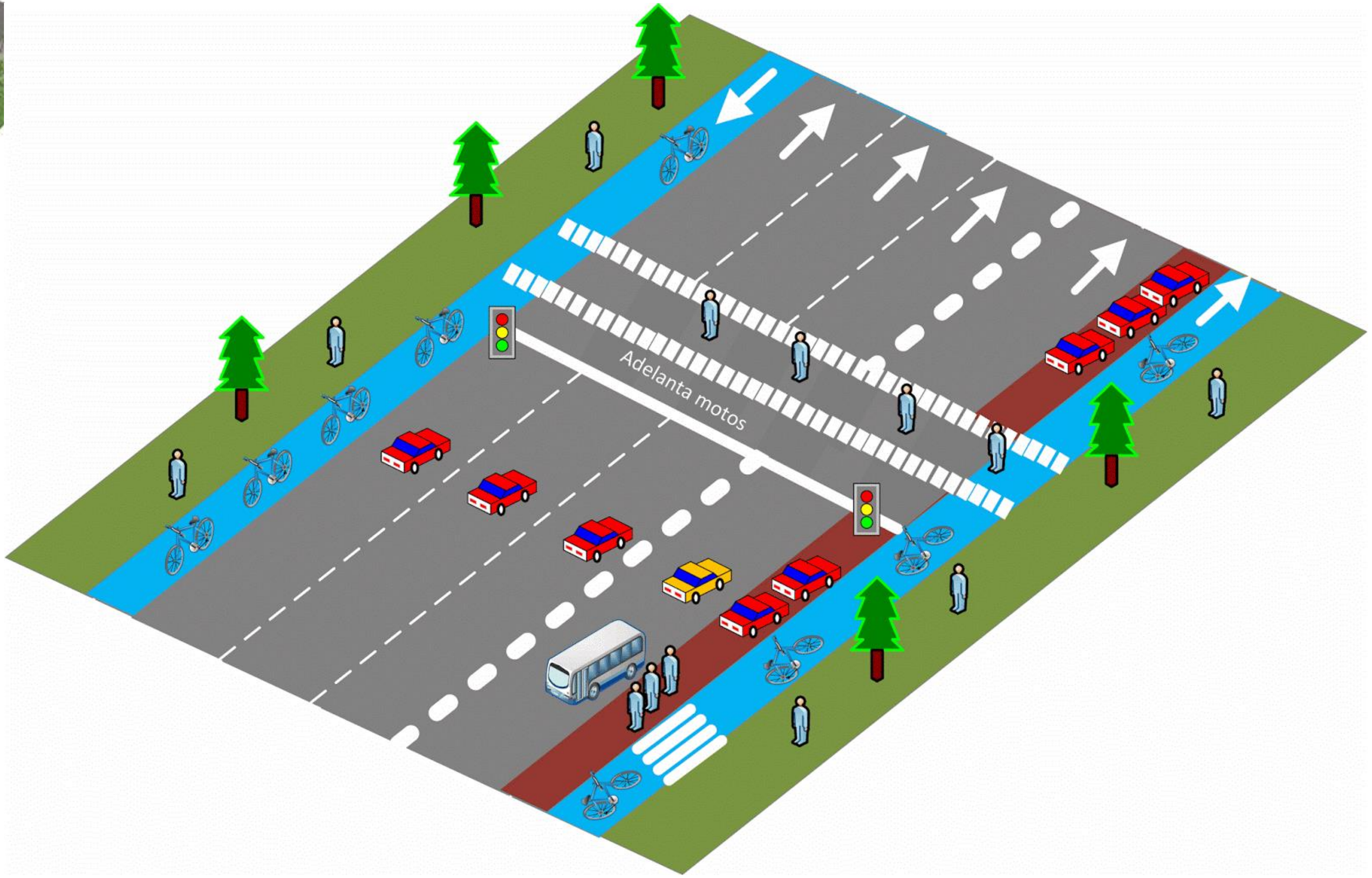

priority zone
potential hazard tree
compatible species
off ROW
border zone
wire zone
border zone
off ROW
Transmission Right-of-Way (ROW)

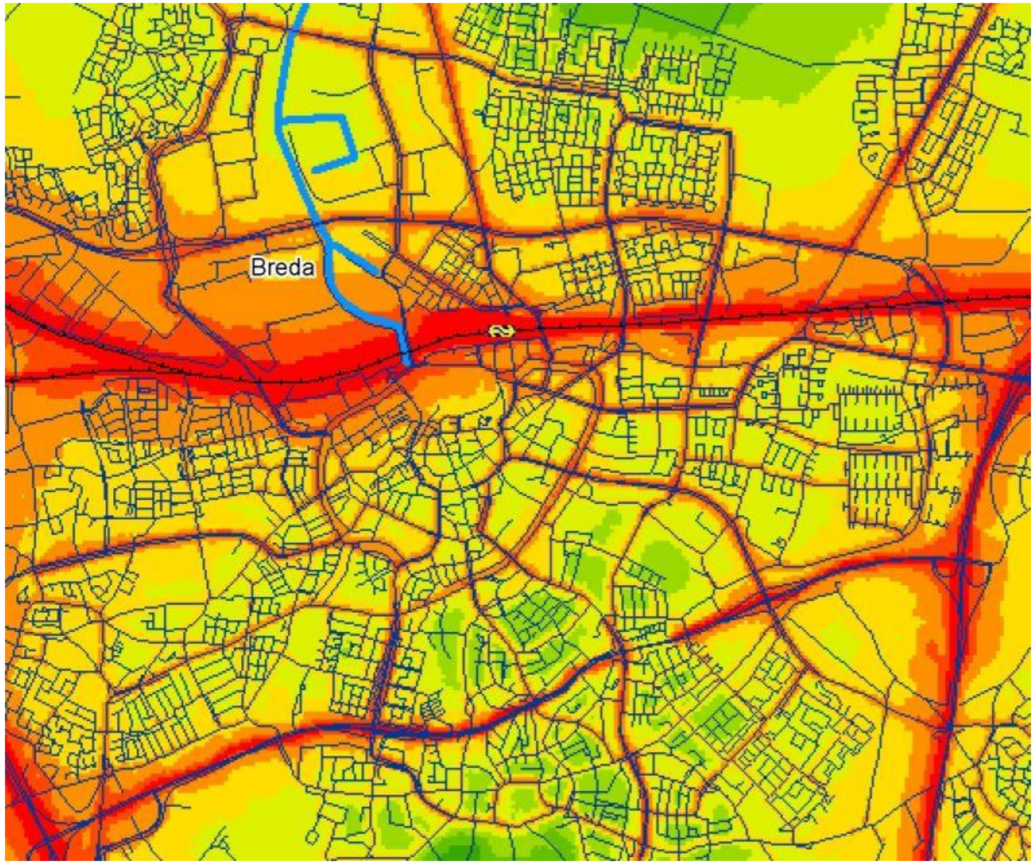

Solar Thermal Power Plants
Photovoltaics
Wind
Hydro
Biomass
Geothermal


EXPRESS
SCANIA
DUP 833

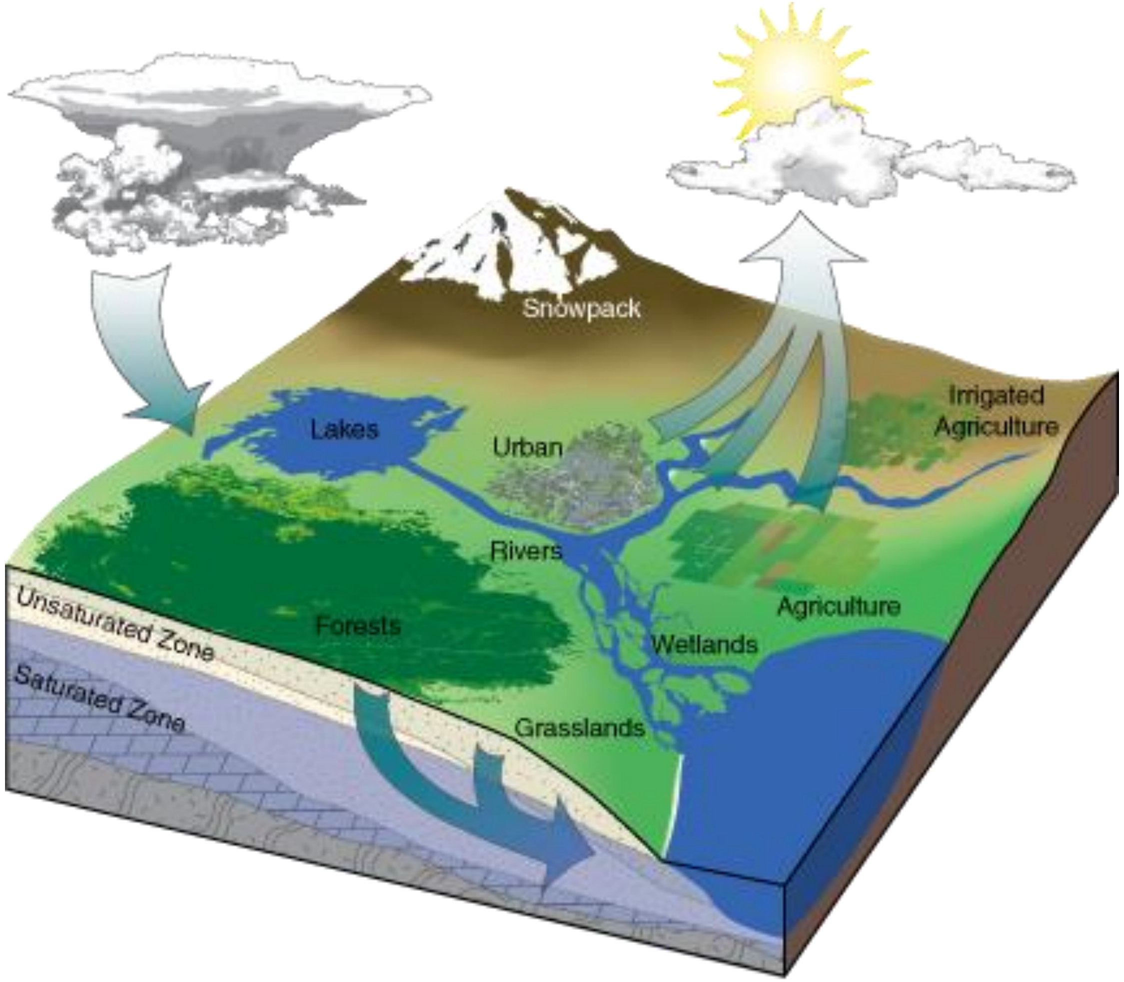

Concord Ave.
Lexington
Arlington
Trapelo Rd
Lot 1
Walnut St.
Belmont Country Club
Lexington St.
Lake St.
Waltham
Shady's Pond
Beaver Brook North Reservation
Rock Meadow
Habitat
Chester Brook Corridor
Lone Tree Hill
Forest St.
Fernald School
Cedar Hill
Girl Scouts
Beaver Brook Reservation
Belmont
Stonehurst
Beaver St.
UMass Field Station
Lyman Estate
Mass Central Rail Trail
WESTERN GREENWAY
BLAZED SEGMENT
UNIMPROVED SEGMENT
FUTURE SEGMENT
ON-STREET SEGMENT
CONNECTING TRAILS
JUNE 2013


ÔNIBUS
ÔNIBUS


Adelanta motos



Noise Map of Netherlands



The Landscape Hydrology Model

TRANSITION AND PLAN

As a general definition, the projection of the axis lines is called the route. Combining the two points taken on the land depending on the appropriate slope value is the transition/route research.

- The preliminary examination is a step of determining the options that are first seen by making a general examination of the region where the line will pass. In the preliminary examination stage, the zero polygon study is performed by taking the topographic condition of the area belonging to the transition over the isohips map.
- In the study stage, a more detailed examination of the passages that provide the standards for the design of the line and which are approved at the end of the preliminary examination are made.
- In the last stage, an economic comparison is made between the options.

GEOMETRIC FACTORS FOR DESIGNING THE HIGHWAYS AND MOTORWAYS

In a road project, the horizontal and vertical axis design should be done by taking into account the factors such as driver, land, climate, environment, etc., to achieve the predefined standards.

Horizontal and vertical axes should be designed and combined together to allow safe, comfortable, fast and economical transportation depending on the road geometric standards.

<u>The environmental and social issues</u> to be considered in **<u>this design</u>** can be listed as follows.

• The natural structure of the area, vegetation, climate, geological structure should be considered.

• The intersections that intersect the designed road with the existing roads should be planned as a whole and should be planned as a whole in terms of their geometric and physical standards.

• Ensure safe and efficient access by reducing travel time.

• The routes and standards of transit traffic should not disturb urban traffic, should be passed outside the urban areas as possible and provide inter-regional transport by ring roads.

• For the safety of the pedestrians, special zones should be established and the locations of the underpass and overpasses should be stated in the plan.

• It should be ensured that other public buildings are least affected by motor vehicle traffic.

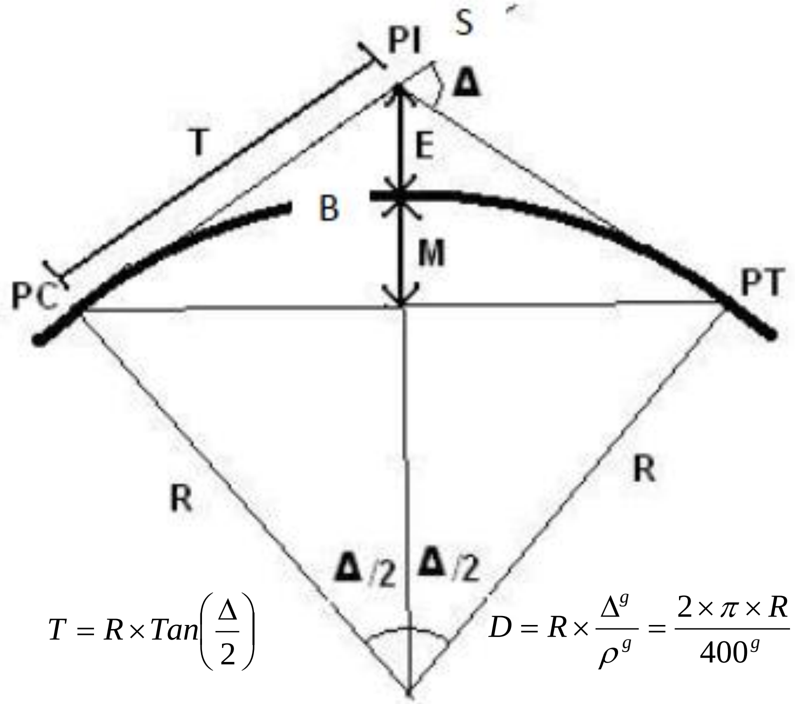
• The roads used by motor vehicles should be made short in order not to cause pollution.

HORIZONTAL CURVES

- **Simple Circular Curves**

- **Transition Curves**

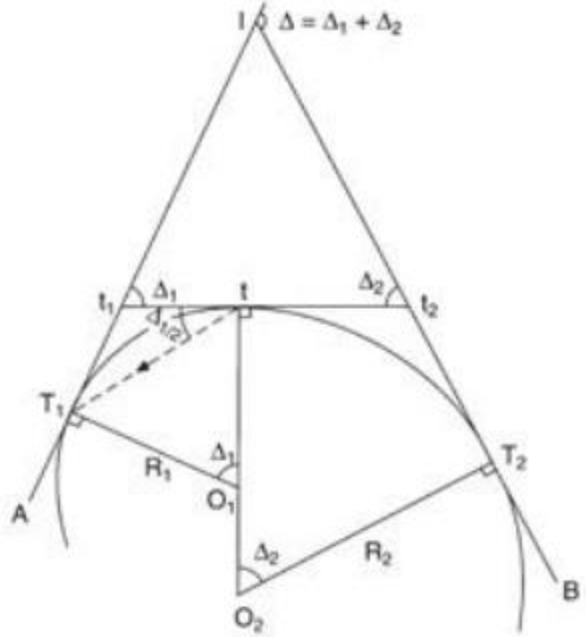
- Simple Circular Curves
- Combined Circular Curves
- Reverse Circular Curves



$$T = R \times Tan\left(\frac{\Delta}{2}\right)$$

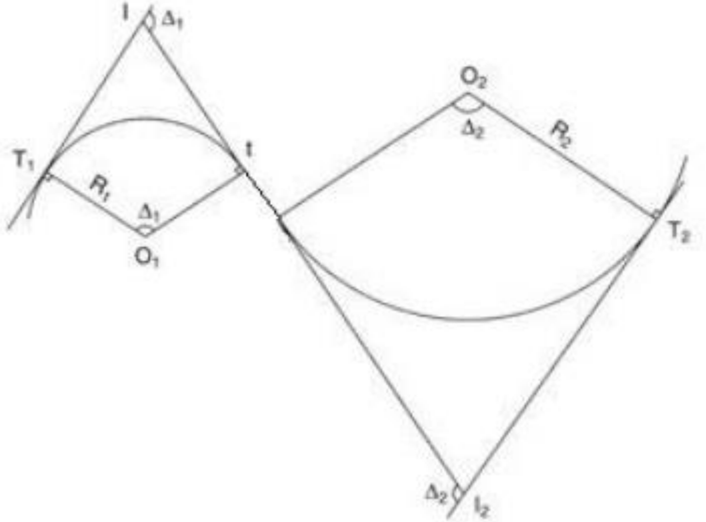
$$D = R \times \frac{\Delta^g}{\rho^g} = \frac{2 \times \pi \times R}{400^g} \times \Delta^g$$

$$E = B = \frac{R}{Cos\frac{\Delta}{2}} - R = R \times \left(\frac{1}{Cos\frac{\Delta}{2}} - 1\right)$$

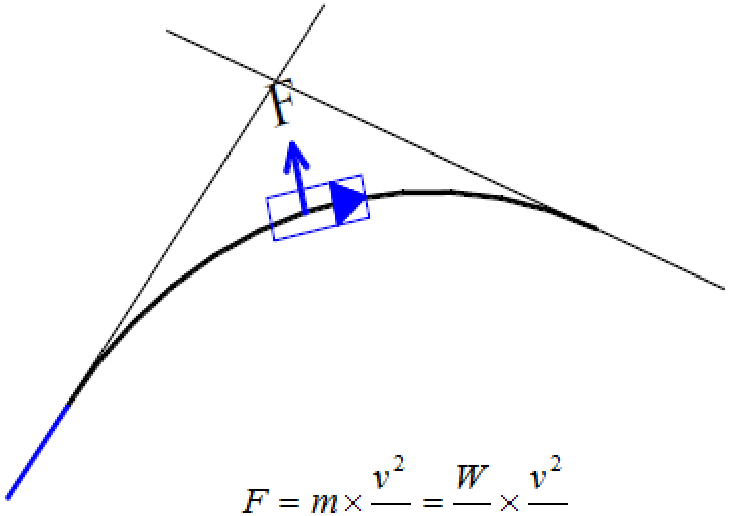


$$R_2 \geq 1.5 \times R_1$$

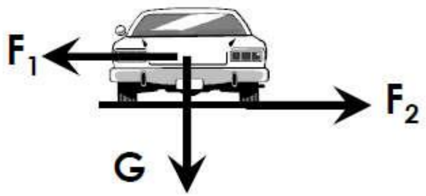
$$T_1 = R_1 \times Tan\left(\frac{\Delta_1}{2}\right) \qquad T_2 = R_2 \times Tan\left(\frac{\Delta_2}{2}\right)$$



Stability Of The Vehicles on Curves



$$F = m \times \frac{v^2}{R} = \frac{W}{g} \times \frac{v^2}{R}$$



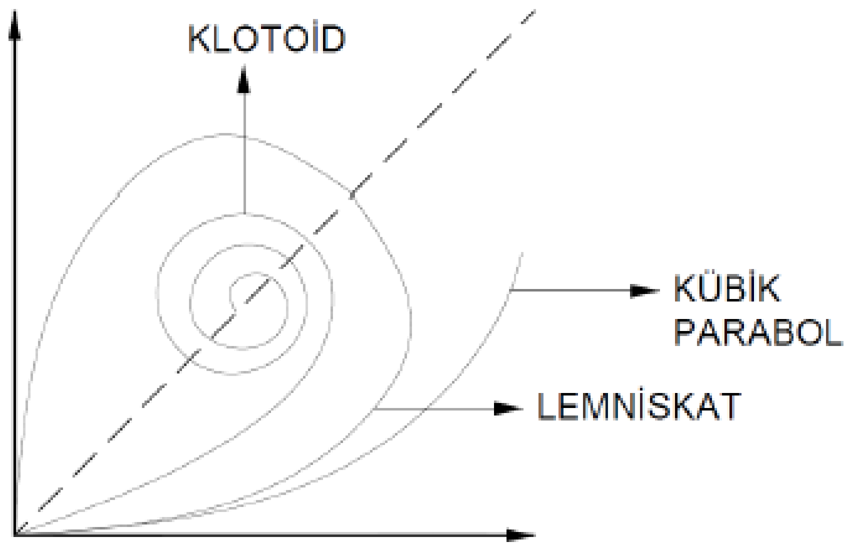
$$F_1 = m \times \frac{v^2}{R} = \frac{G}{g} \times \frac{\left(V/3{,}6\right)^2}{R}$$

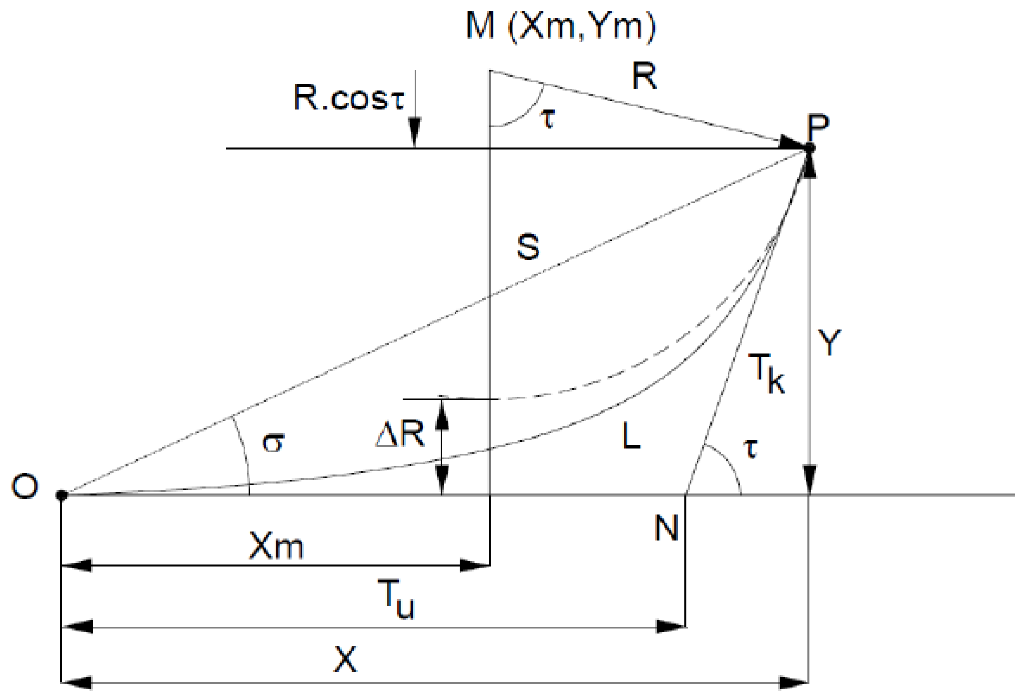
$$F_2 = \mu_e \times N = \mu_e \times G$$

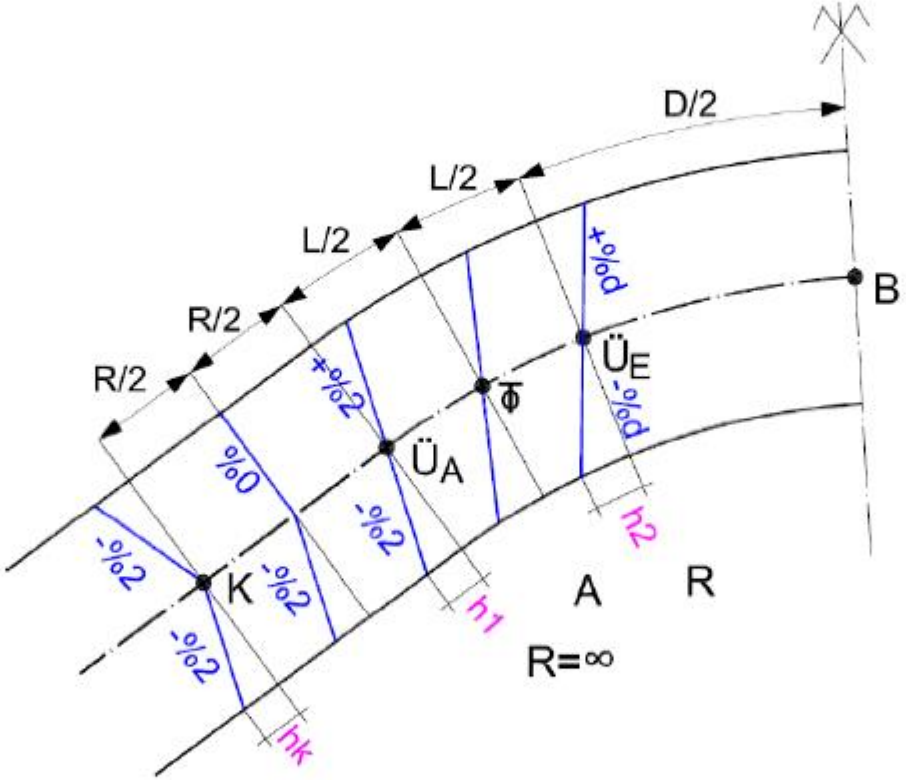
A vehicle that enters the horizontal curve from the forehead is exposed to a centrifugal force outside the route. This force acting on the vehicle is called the centrifugal force and the vehicle is also subjected to friction force in its opposite direction depending on the vehicle weight and road surface friction coefficient. Under the influence of these forces, the vehicle can be skid or tip over.

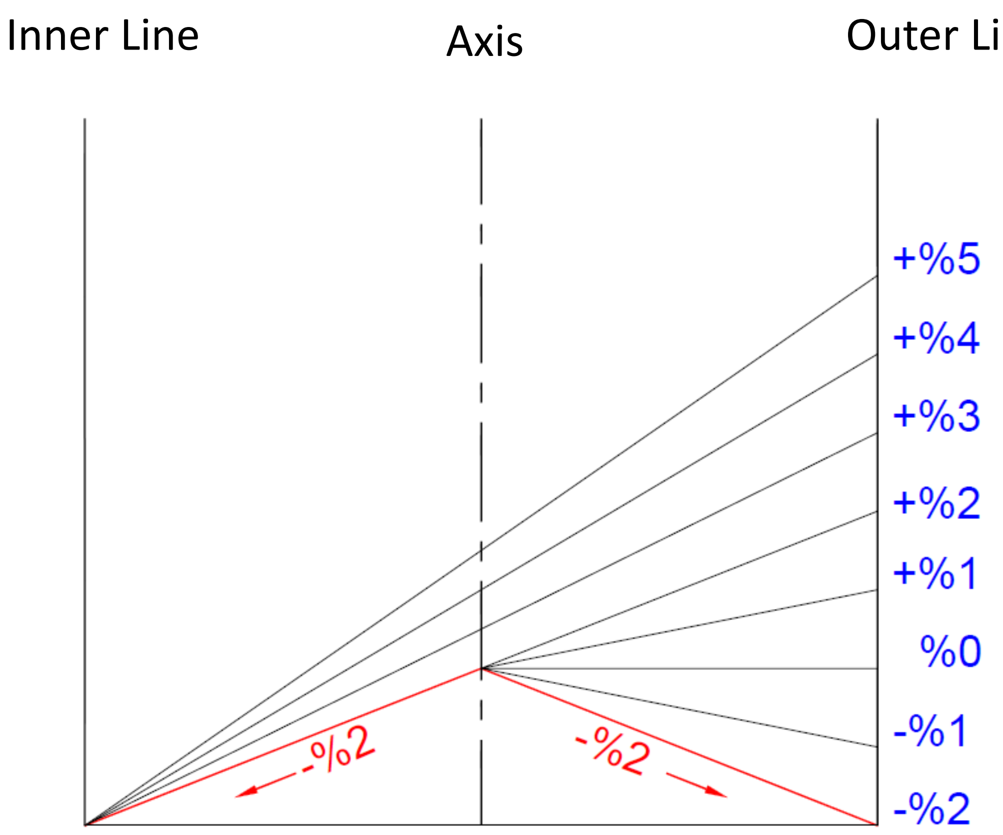
TRANSITION CURVES

A sudden centrifugal force arises at the entrance of a moving vehicle with V velocity at the entrance to the victim or at the entrance of a different curve to a different curve from the radius of curvature. A transition curve between the alignment and the curve is placed next to the cant application at the entrance to the victim in order to balance the force that is tossing and tilting the stone out of the victim.






D/2
L/2
L/2
R/2
R/2
B
ÜE
ÜA
K
A
R
R=∞
+%p
-%p
+%2
-%2
0%
h1
h2
hk



Türkiye' de KGM tarafından kullanılan dever bağıntısı aşağıdaki gibidir.

$$d_{pratik} = 0.00443 \times \frac{V_p^2}{R}$$

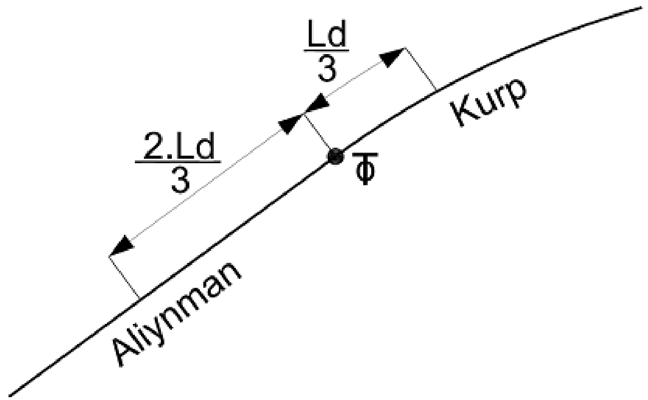
Deverin Uygulanacağı Uzunluk (Rakordman Boyu)

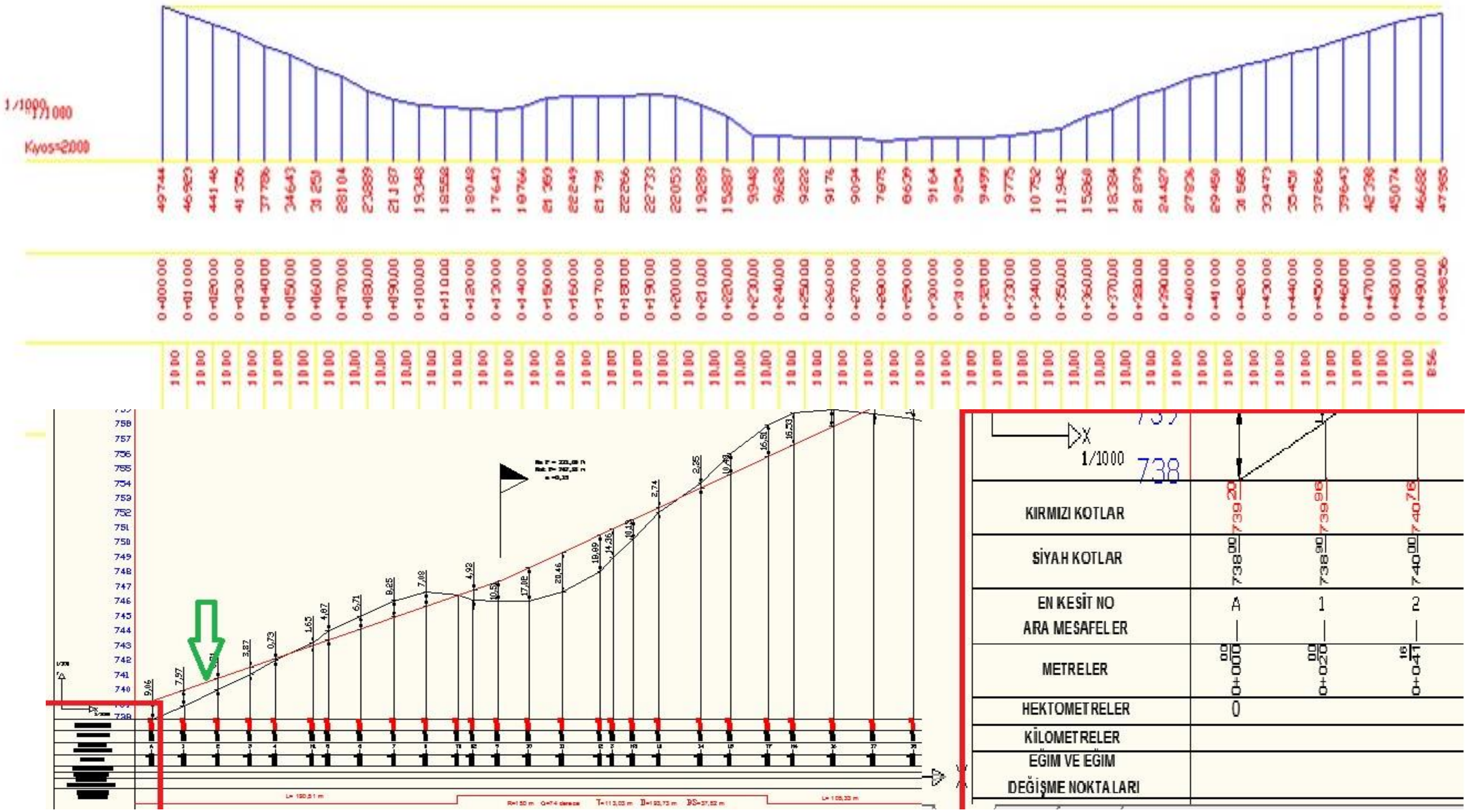
$$L_d = 0.0354 \times \frac{V_p^3}{R}$$

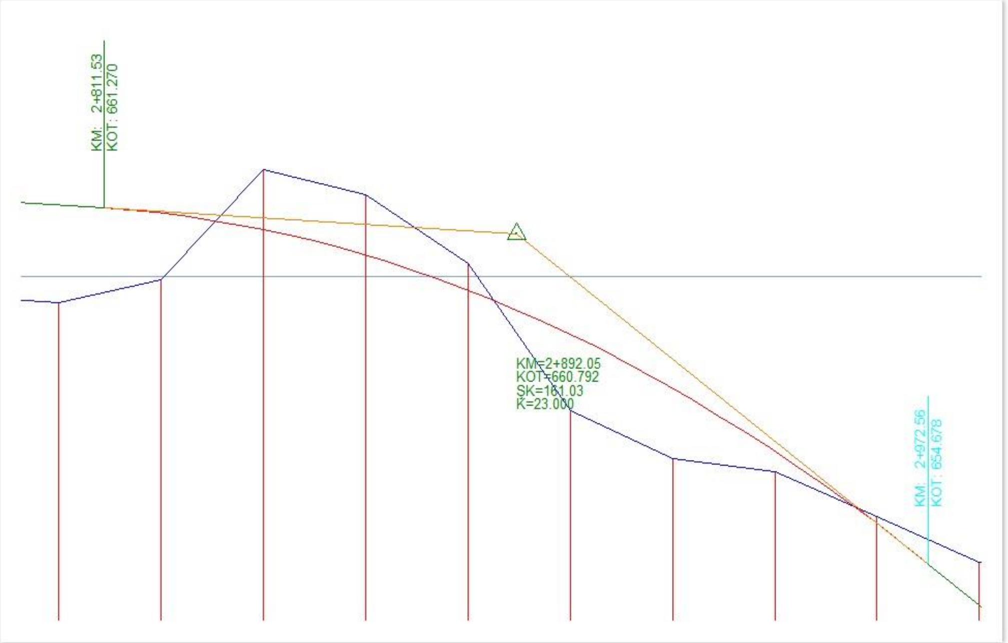
$$L_{d(\min)} = 45\ m$$

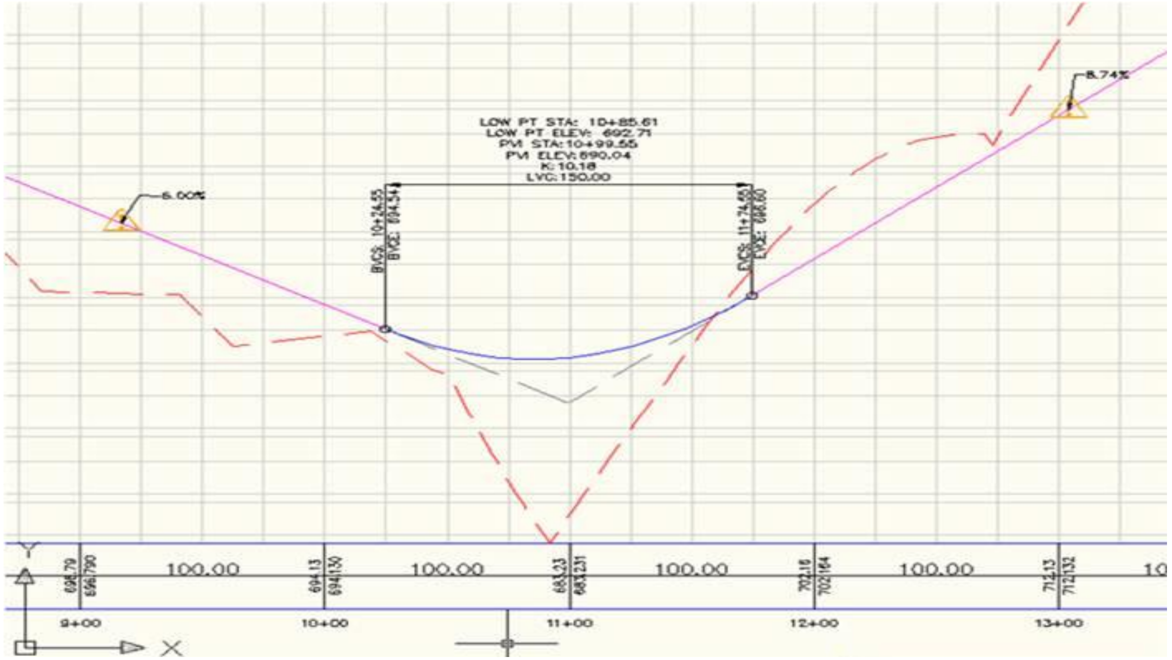
$$L_{d(\min)} \geq 45\ m$$

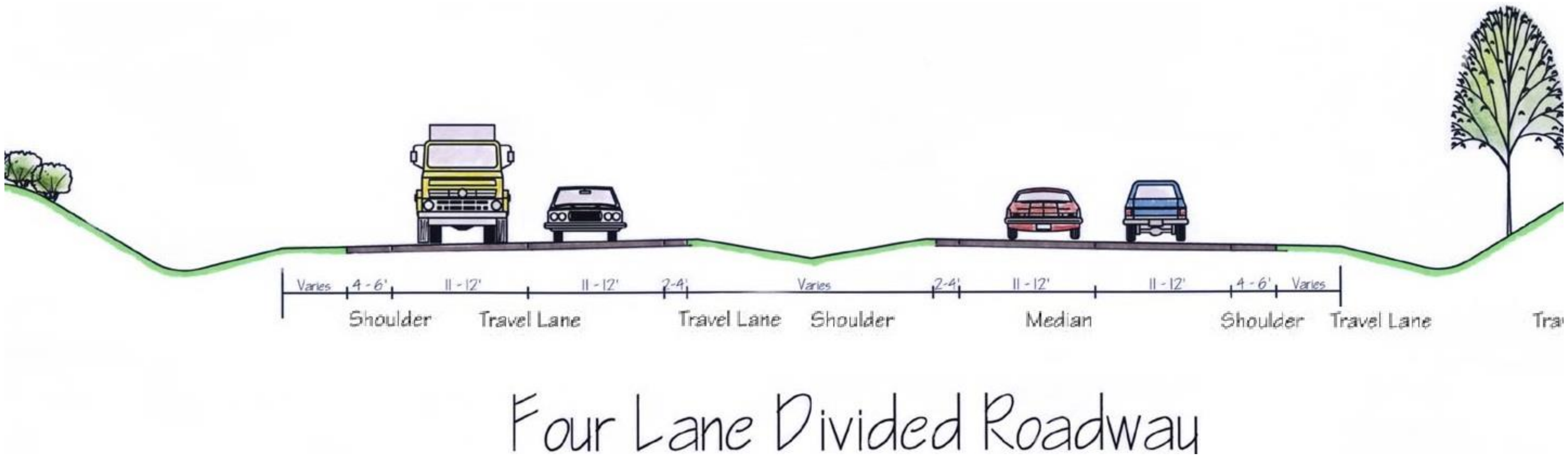
$\frac{2}{3} L_d = Aliynmanda$, $\frac{1}{3} L_d = Kurp\ içinde$ uygulanır.

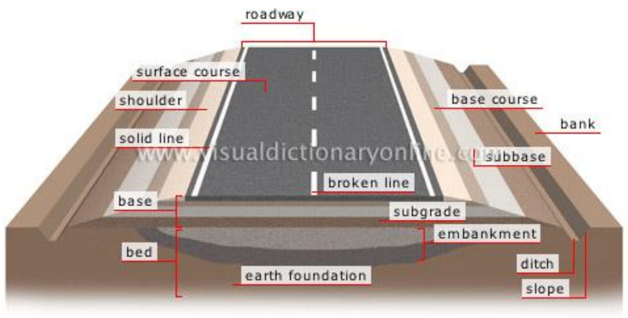


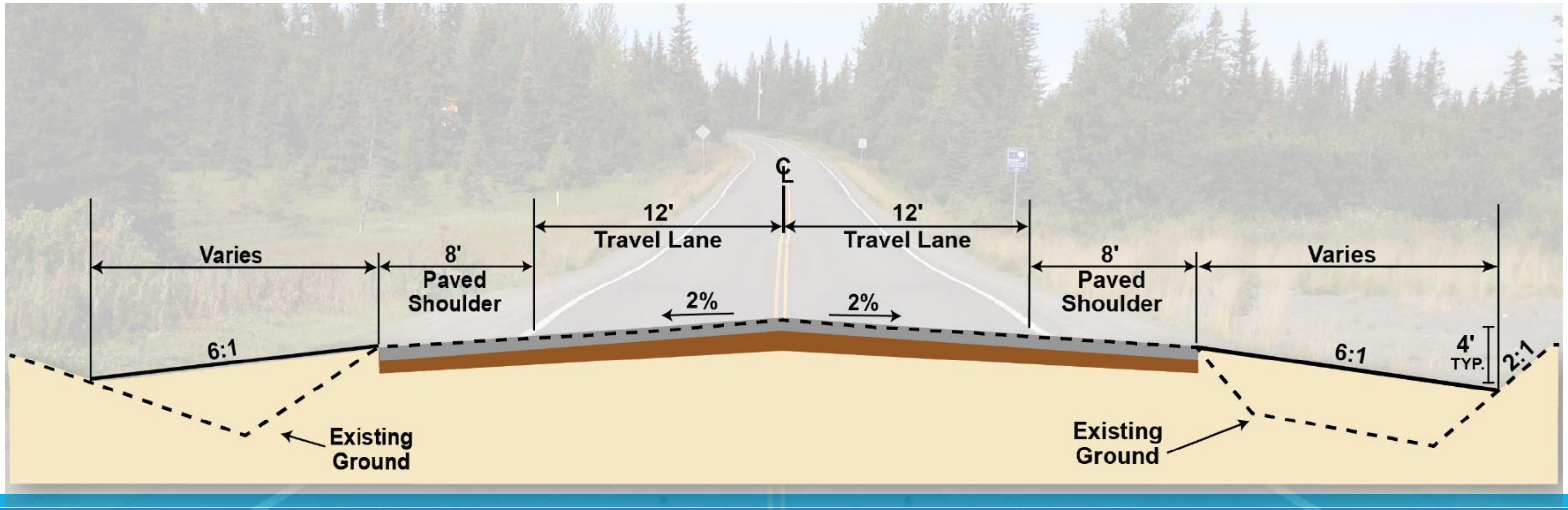

Kıyas=2000
1/1000
738
KIRMIZI KOTLAR
SİYAH KOTLAR
EN KESİT NO
ARA MESAFELER
METRELER
HEKTOMETRELER
KİLOMETRELER
EGİM VE EGİM
DEĞİŞME NOKTALARI
A
1
2
0
739.20
739.96
740.78
738.90
738.90
740.00
0+000.00
0+020.00
0+041.16


KM: 2+811.53
KOT: 661.270
KM=2+892.05
KOT=660.792
SK=161.03
K=23.000
KM: 2+972.56
KOT: 654.678


LOW PT STA: 10+85.61
LOW PT ELEV: 692.71
PVI STA:10+99.55
PVI ELEV:690.04
K:10.18
LVC:150.00
6.00%
8.74%
100.00
100.00
100.00
100.00
9+00
10+00
11+00
12+00
13+00
Y
X


Varies
4 - 6'
11 - 12'
11 - 12'
2-4'
Varies
2-4'
11 - 12'
11 - 12'
4 - 6'
Varies
Shoulder
Travel Lane
Travel Lane
Shoulder
Median
Shoulder
Travel Lane
Four Lane Divided Roadway


roadway
surface course
shoulder
solid line
base
bed
base course
bank
subbase
broken line
subgrade
embankment
ditch
slope
earth foundation


Varies
8'
Paved
Shoulder
12'
Travel Lane
12'
Travel Lane
8'
Paved
Shoulder
Varies
2%
2%
6:1
6:1
4'
TYP.
2:1
Existing
Ground
Existing
Ground

In the plan, the values taken in the digital environment or the pre-measured values are caled as ‘APPLICATION’.

The application can also be defined as the inverse of the measure job. It can also be considered as a marking in the general sense.
The application is handled in two part:

1. Horizontal Application

2. Vertical Application

1. Horizontal Application

Position elements in the horizontal plane are used to mark the points on the ground. Application elements are usually taken from the plan. Polygon points are used for application of points. The polygon edges are taken from the process line and the application values are taken from the plan and the points are marked on the floor. If necessary, new polygon points can be installed for the application. According to the sensitivity of the work, building and prominent parcel corners, telephone and electric poles can be used as application points.

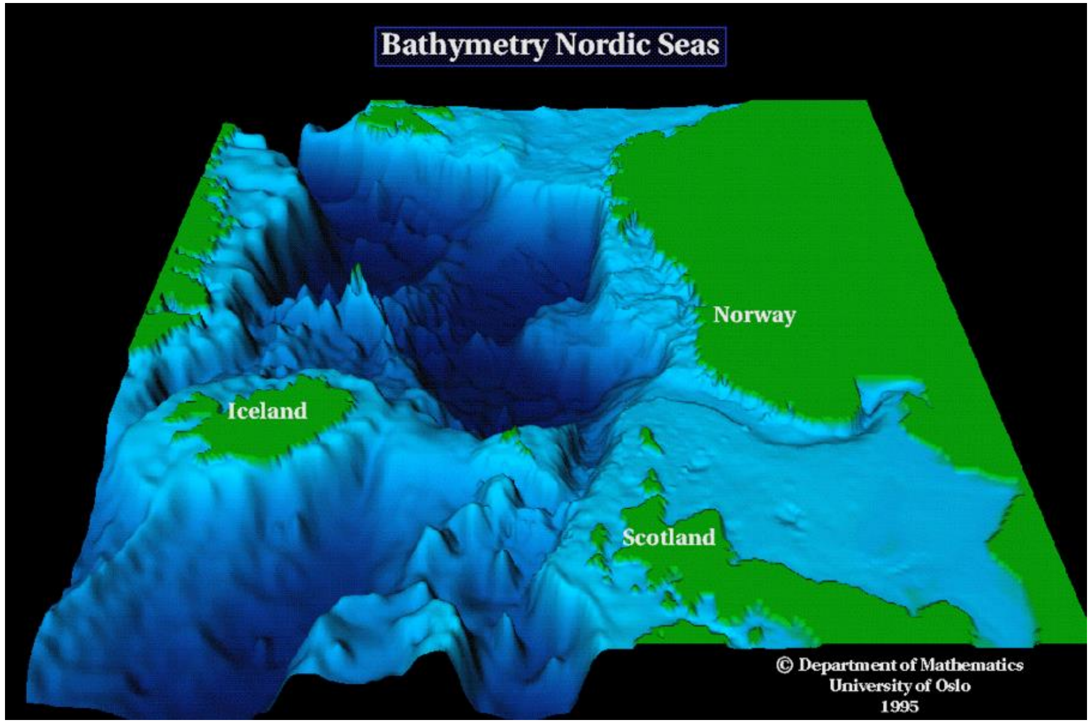
Bathymetric Surveying

- Definition & Importance
- The history of bathymetry (ocean depths) and ocean floor topography.
- Echo sounding
- satellites bathymetry.
- Optical
- RADAR
- GNSS-R

Definition:

Bathymetry is the measurement of water depth: height from water bed to water surface. (Sounding)

- Measures the vertical distance from the ocean surface to mountains, valleys, plains, and other sea floor features - 70.8% of Earth is covered by oceans



Importance of Bathymetry

- Navigation Safety: Nautical charts
- Water volume computation
- Pollution control
- Mineral & Fish industries
- Under water engineering construction

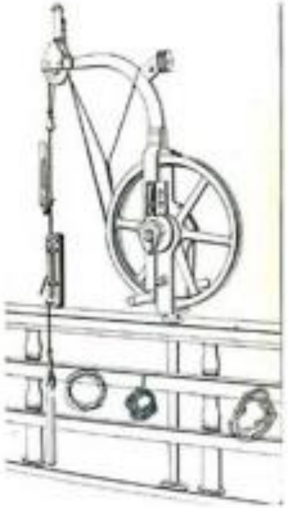
Historical Sounding

- Sounding Pole:

sounding Lead

History of sounding

Sounding Machines

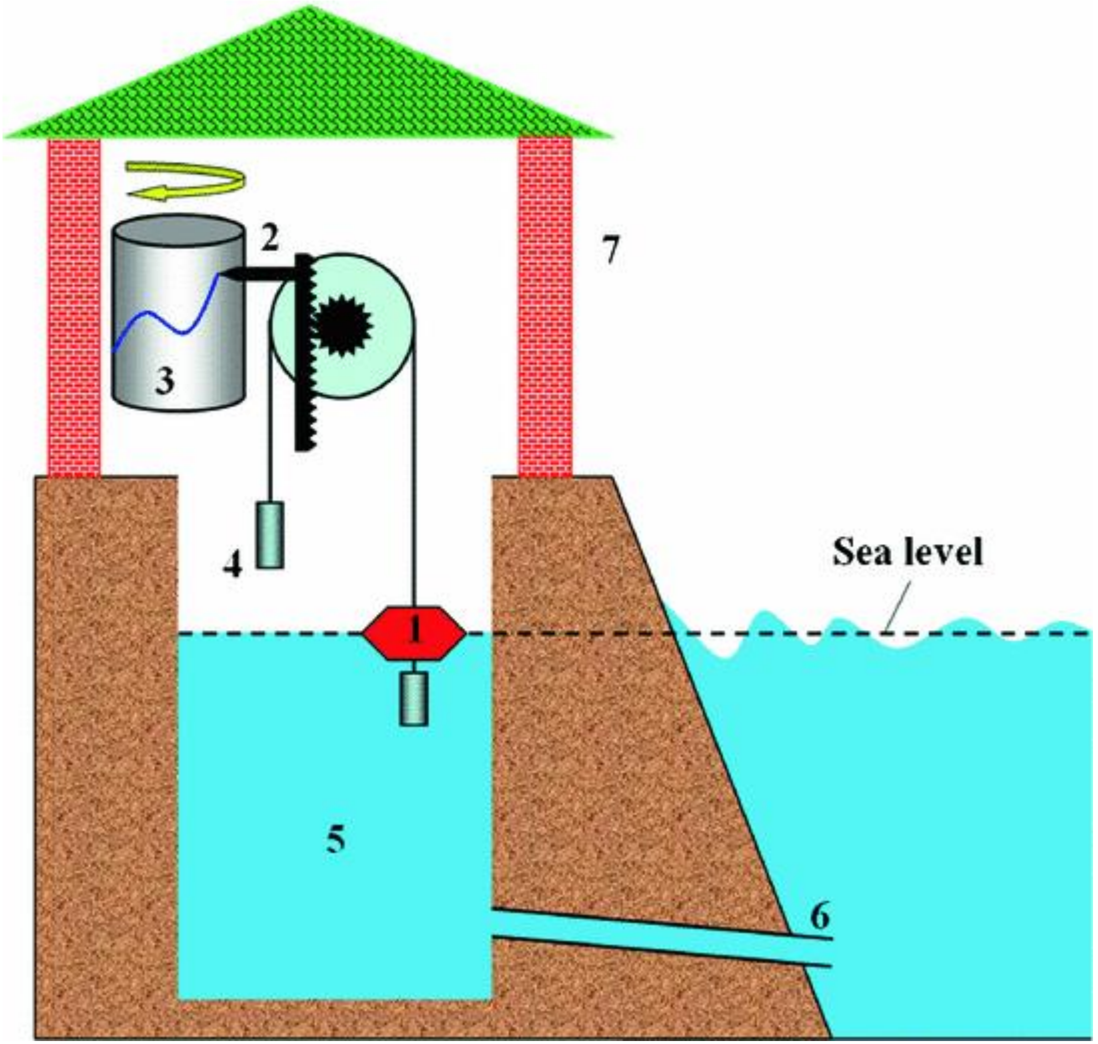


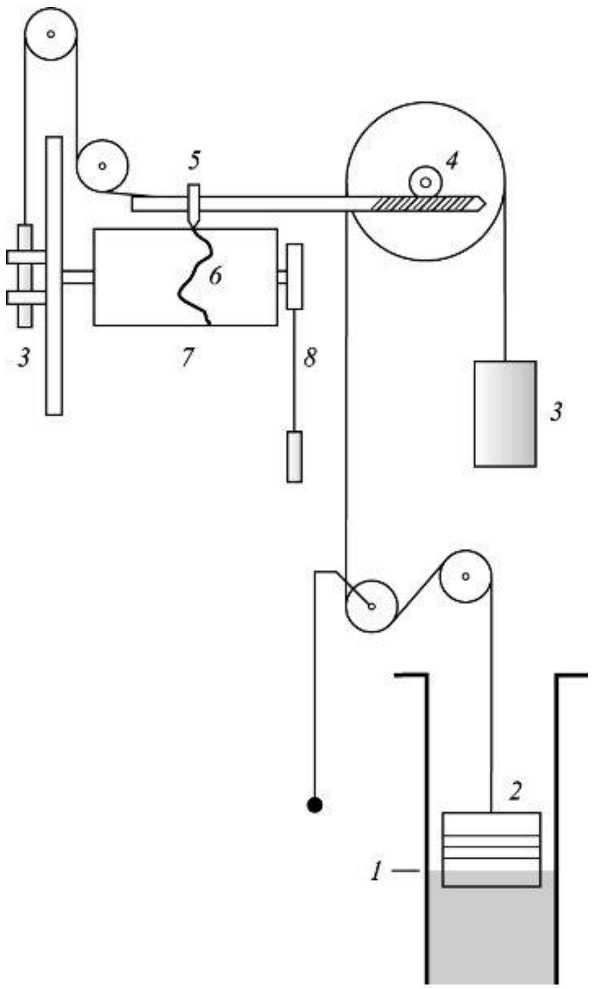
Charles Wilkes (NOAA)

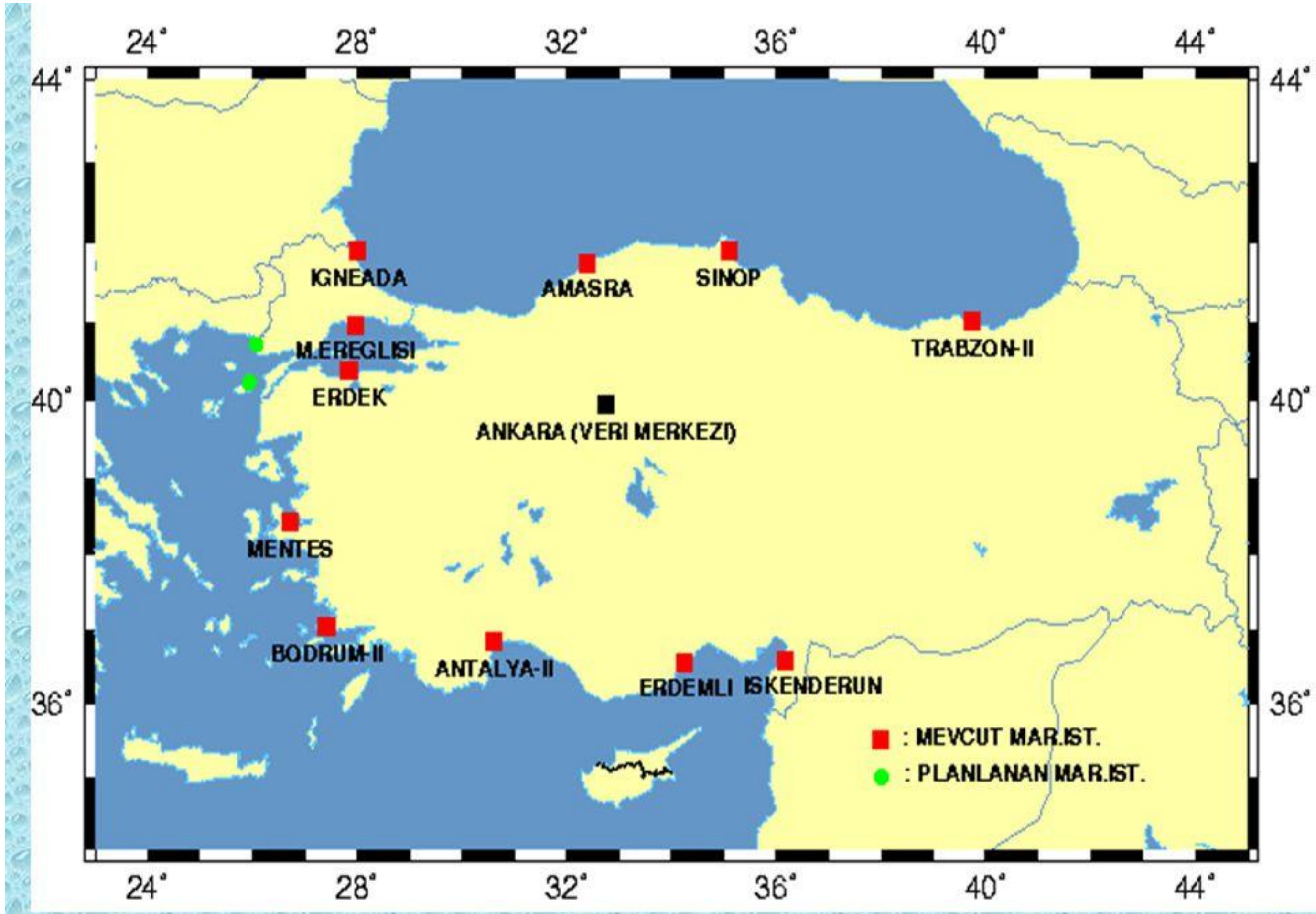
Lord Kelvin


13
12
11
10


© Гомельские ведомости newsgomel.by

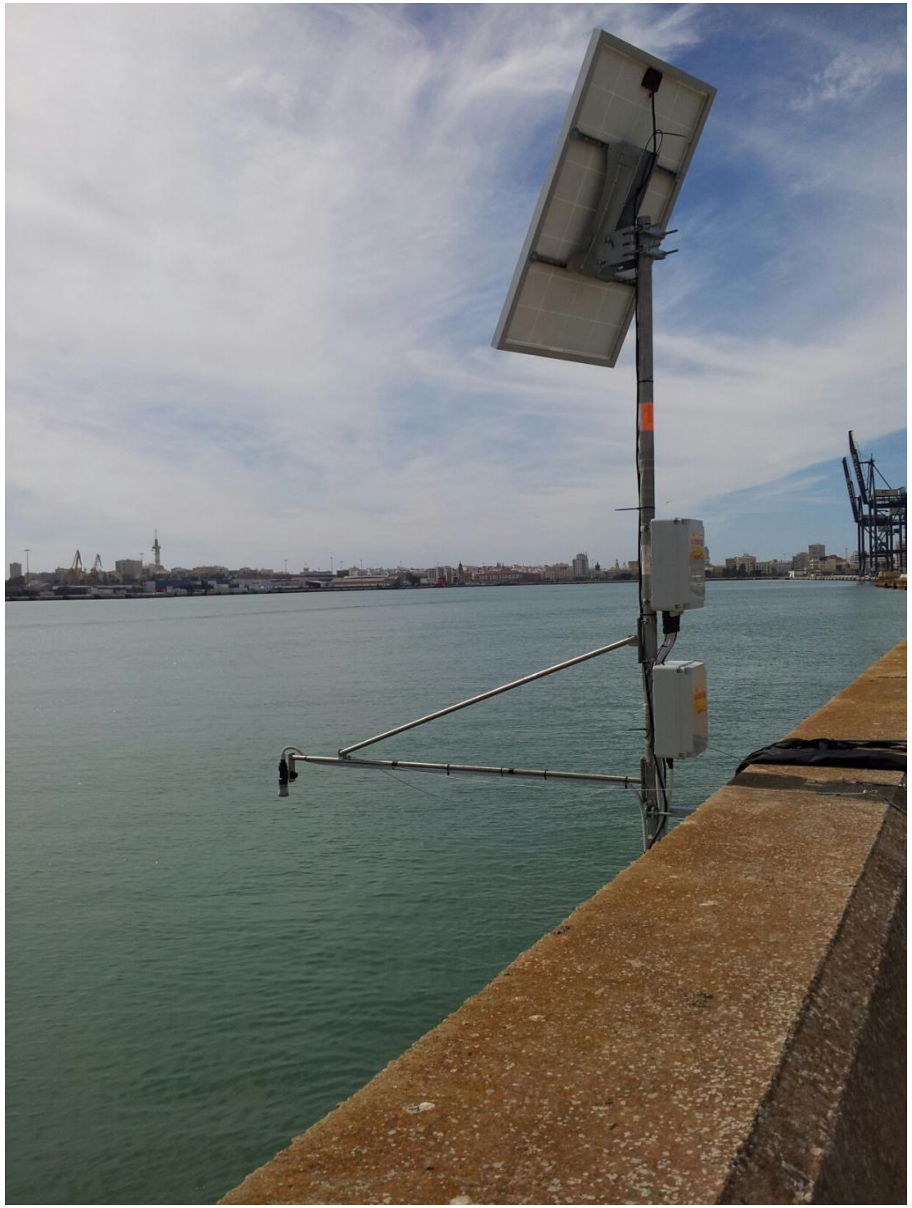

2
7
3
4
Sea level
1
5
6


5
4
6
3
7
8
3
2
1



TUDES Mareoraf İstasyonlarının Dağılımı

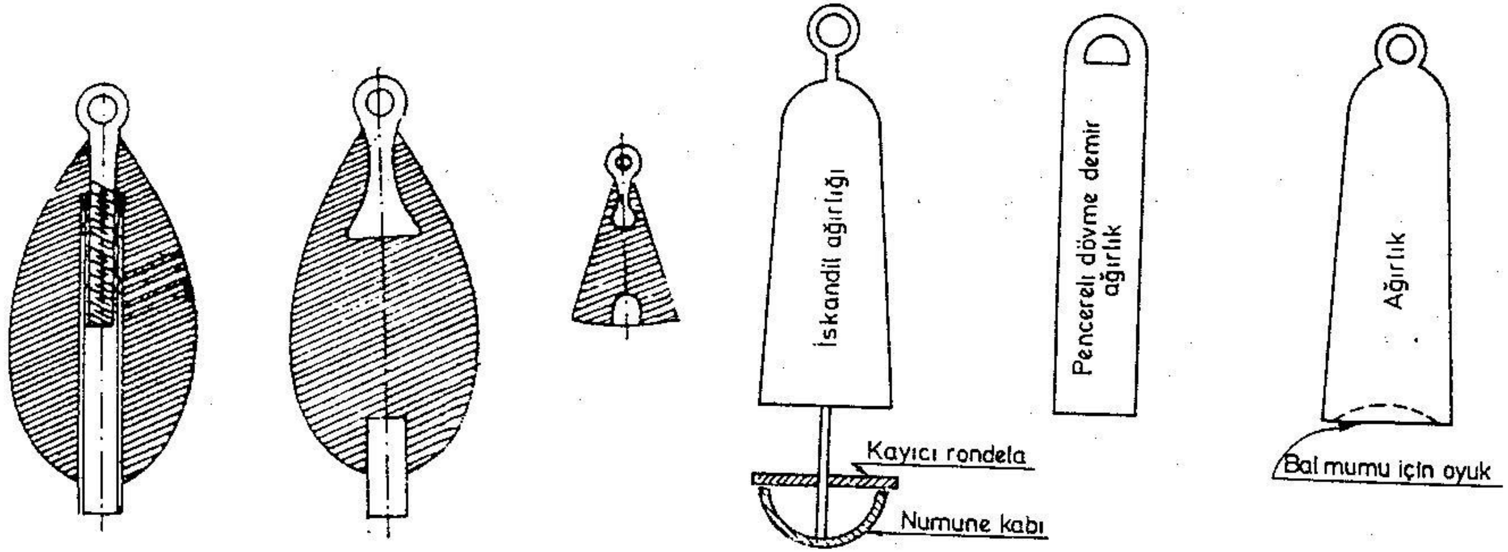

Tsunami çalışmaları kapsamında kurulan SM istasyonları (sarı) ve bu yıl içerisinde kurulacak İstasyonlar (kırmızı)
24° 25° 26° 27° 28° 29° 30° 31° 32° 33° 34° 35° 36° 37° 38° 39° 40° 41° 42° 43° 44° 45° 46°
43° 42° 41° 40° 39° 38° 37° 36° 35° 34°



CHCNAV
SHOT ON MI 9T
AI TRIPLE CAMERA

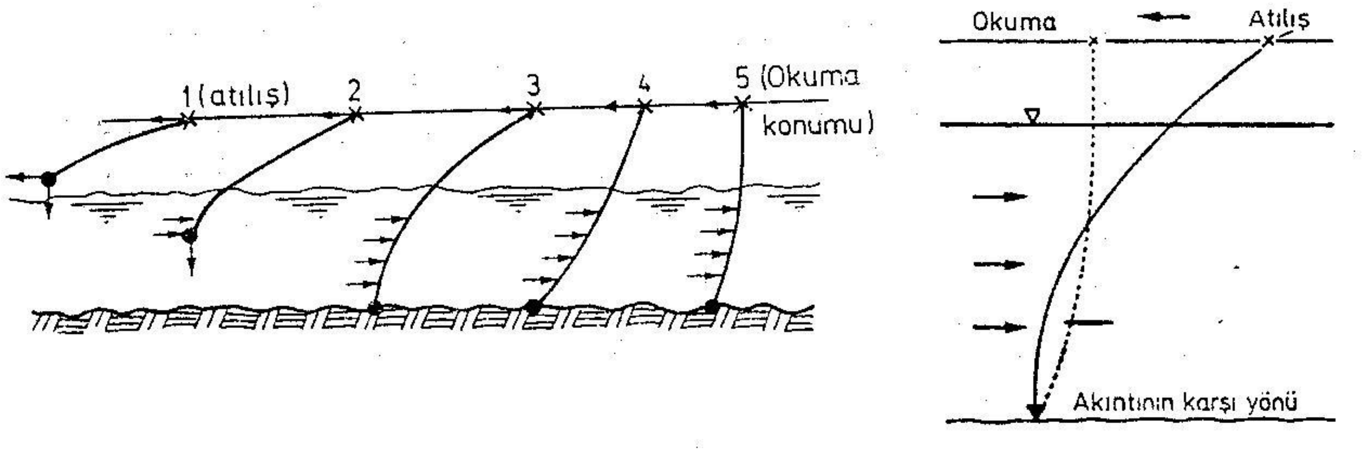

M1
PV1
PV2
EZDAS


CHCNAV
PERSONEL
HARICI
GIRMEK
YASAKTIR
SHOT ON MI 9T
AI TRIPLE CAMERA

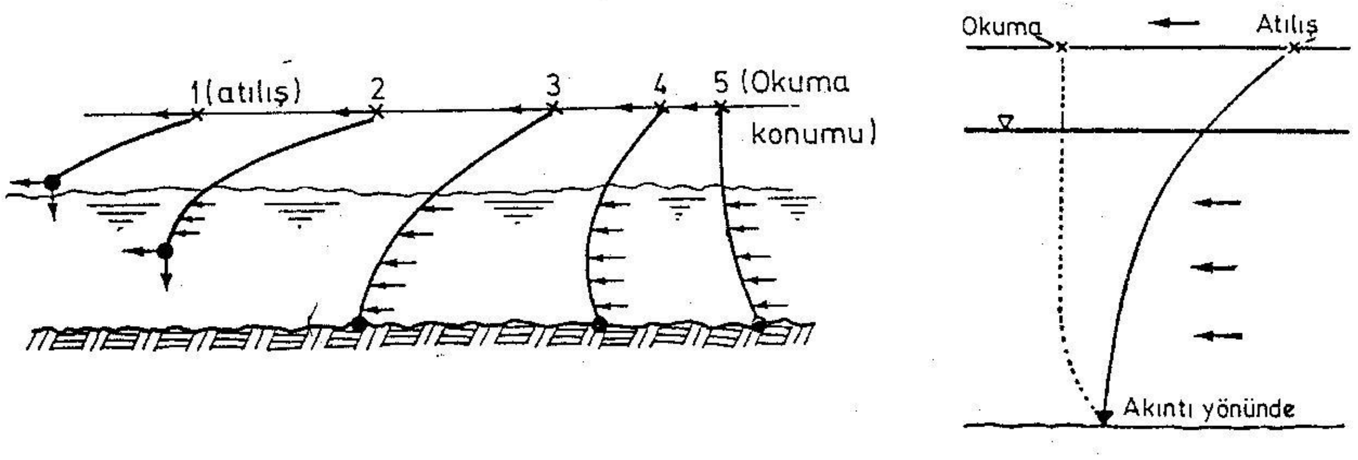


İskandil Ağırlıkları

Accuracy approximately ± 10 cm for under 30 meter depth.



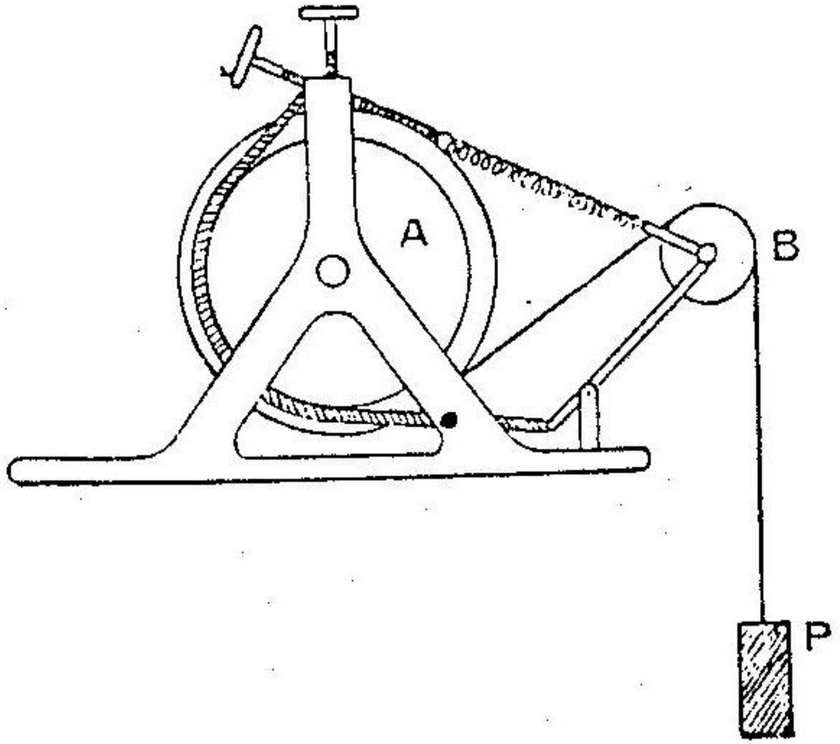
Akıntının karşı yönünde botun ilerlemesi durumu



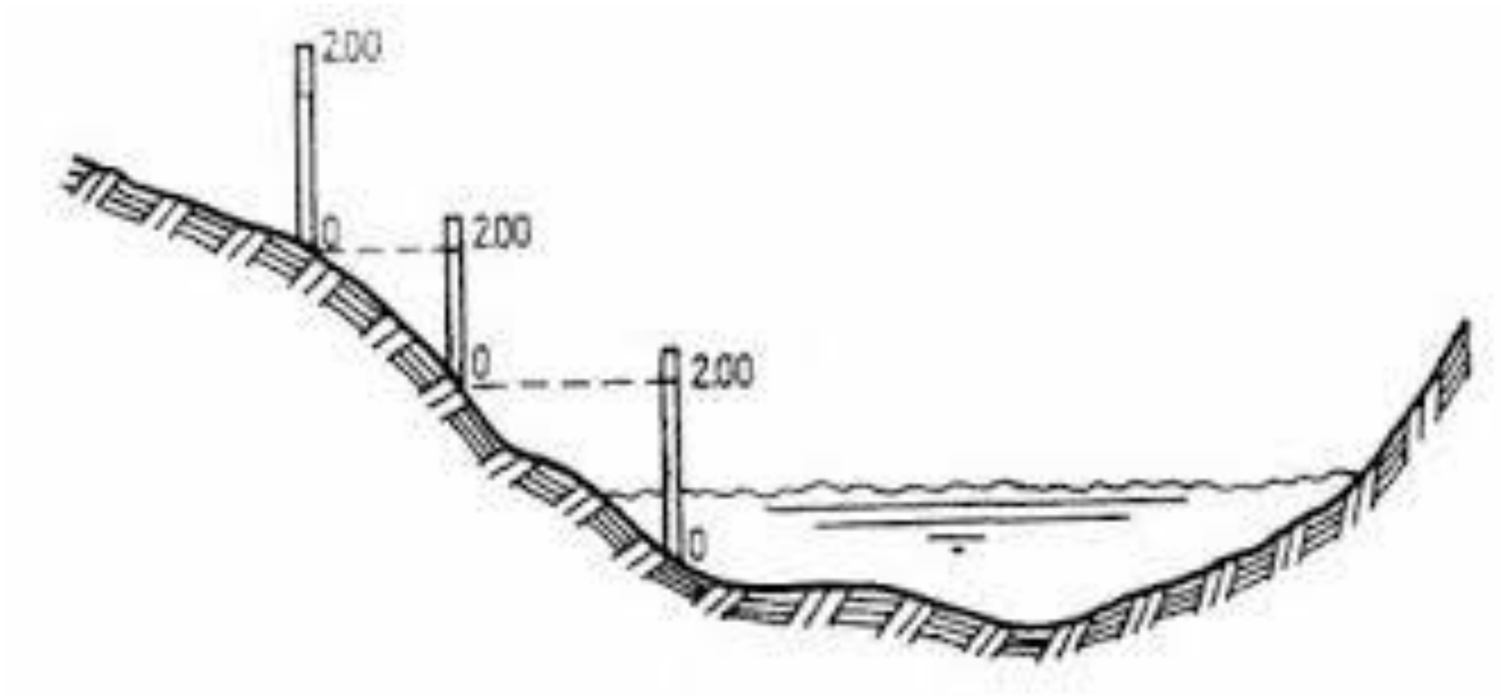
Akıntı yönünde botun ilerlemesi durumu

Errors Caused by Water Environment

- Speed and direction of the water flow
- Speed of the boat



Mekanik İskandil aletinin şematik görünümü


2.00
0
2.00
0
2.00
0

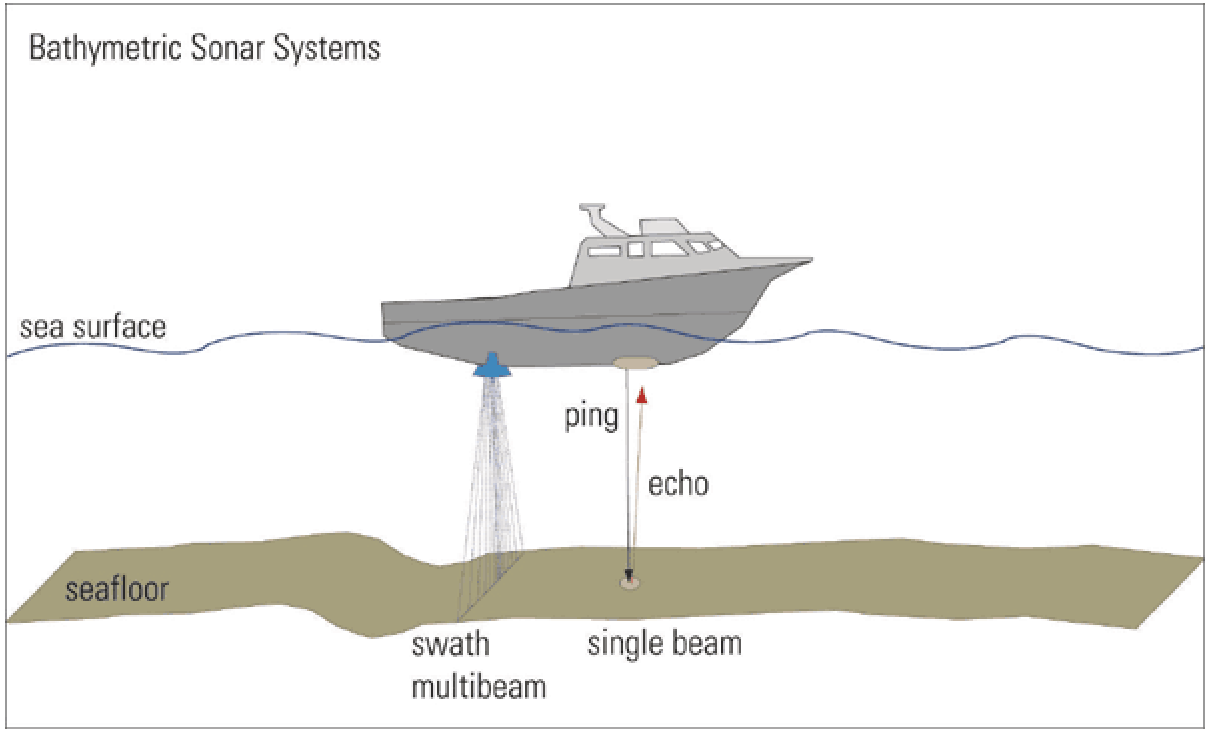
Hydrostatic Sounding

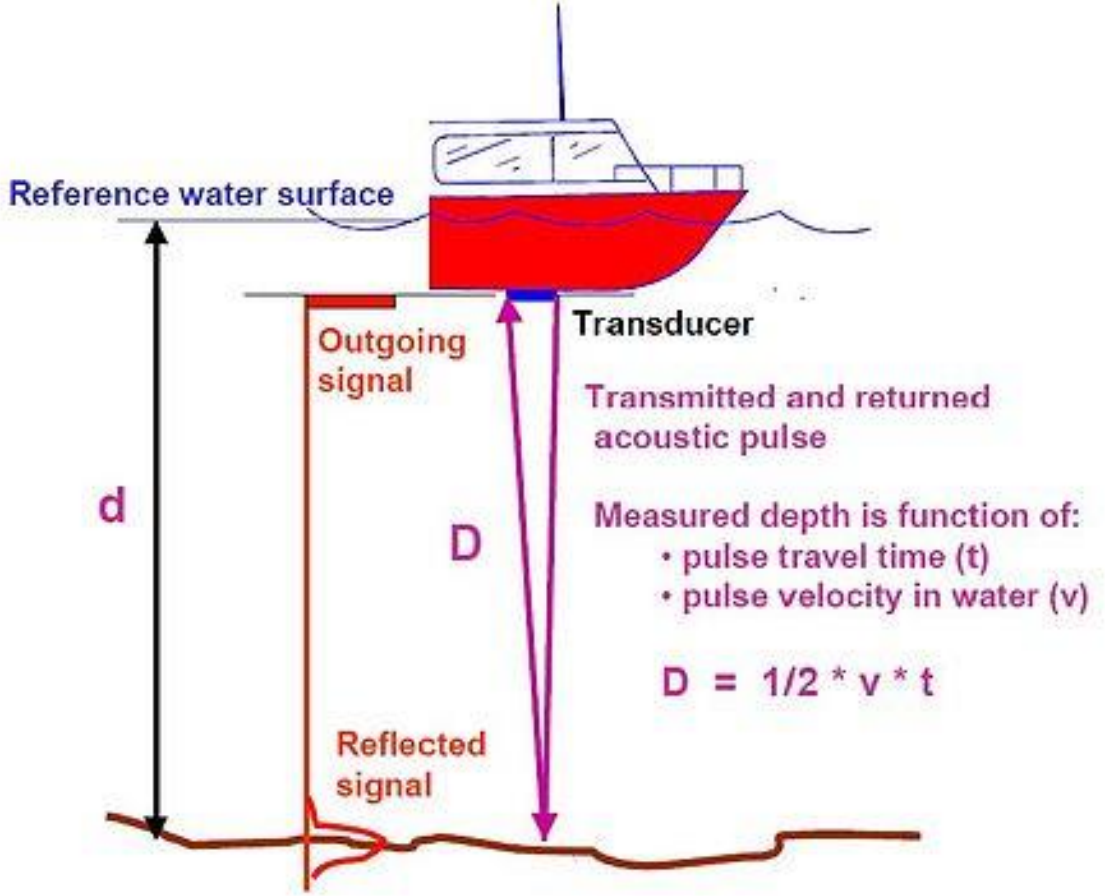
The determination of depth by the hydrostatic pressure measured in the underwater floor constitutes the basic principle of the method. Hydrostatic pressure gauges are used as a sounding instrument. The instrument is reduced to the underwater base with a rope or wire at the point to be measured and the hydrostatic pressure is measured as a function of the water depth at that point. Hydrostatic sounding is an indirect method. The hydrostatic sounding instrument is used at depths up to 100 - 200 meters and the average fineness is ± 3-5 meters. As the depth increases, the fineness is reduced, so it is not suitable for deep water or for precise measurements. Since it does not allow continuous and fast measurement, it is not practical.

Acoustic Sounding

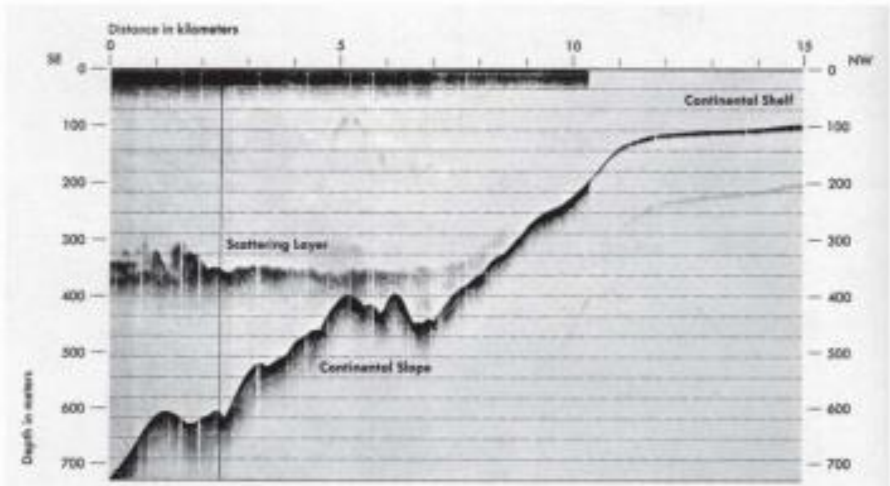
The measurement of depth by using the diffusion and reflection characteristics of the sound waves is the basic principle of the method. The sound impulses supplied from a sound generator in the water and directed in the vertical direction reach the underwater floor by spreading in waves and are reflected in the water surface again. Since the propagation speed V of the sound waves is known, the travel time of the pulses is measured by measuring the time t and the water depth.

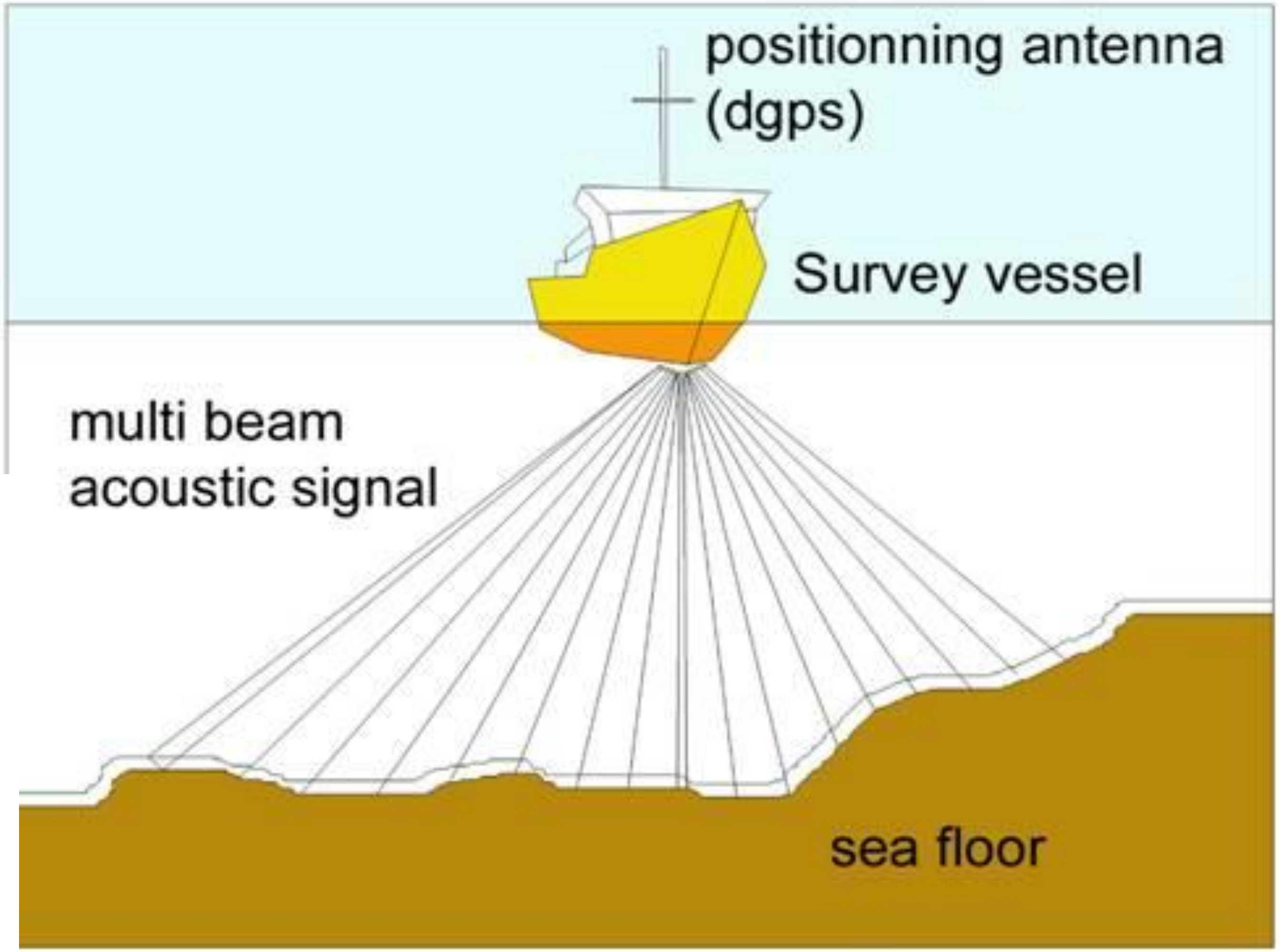
$$\boxed{H = \frac{t}{2} V}$$


Bathymetric Sonar Systems
sea surface
ping
echo
seafloor
swath
multibeam
single beam


Reference water surface
Transducer
Outgoing signal
Transmitted and returned acoustic pulse
d
D
Measured depth is function of:
• pulse travel time (t)
• pulse velocity in water (v)
D = 1/2 * v * t
Reflected signal

Recorded depth from echo-sounder





Multi Beam Sonar

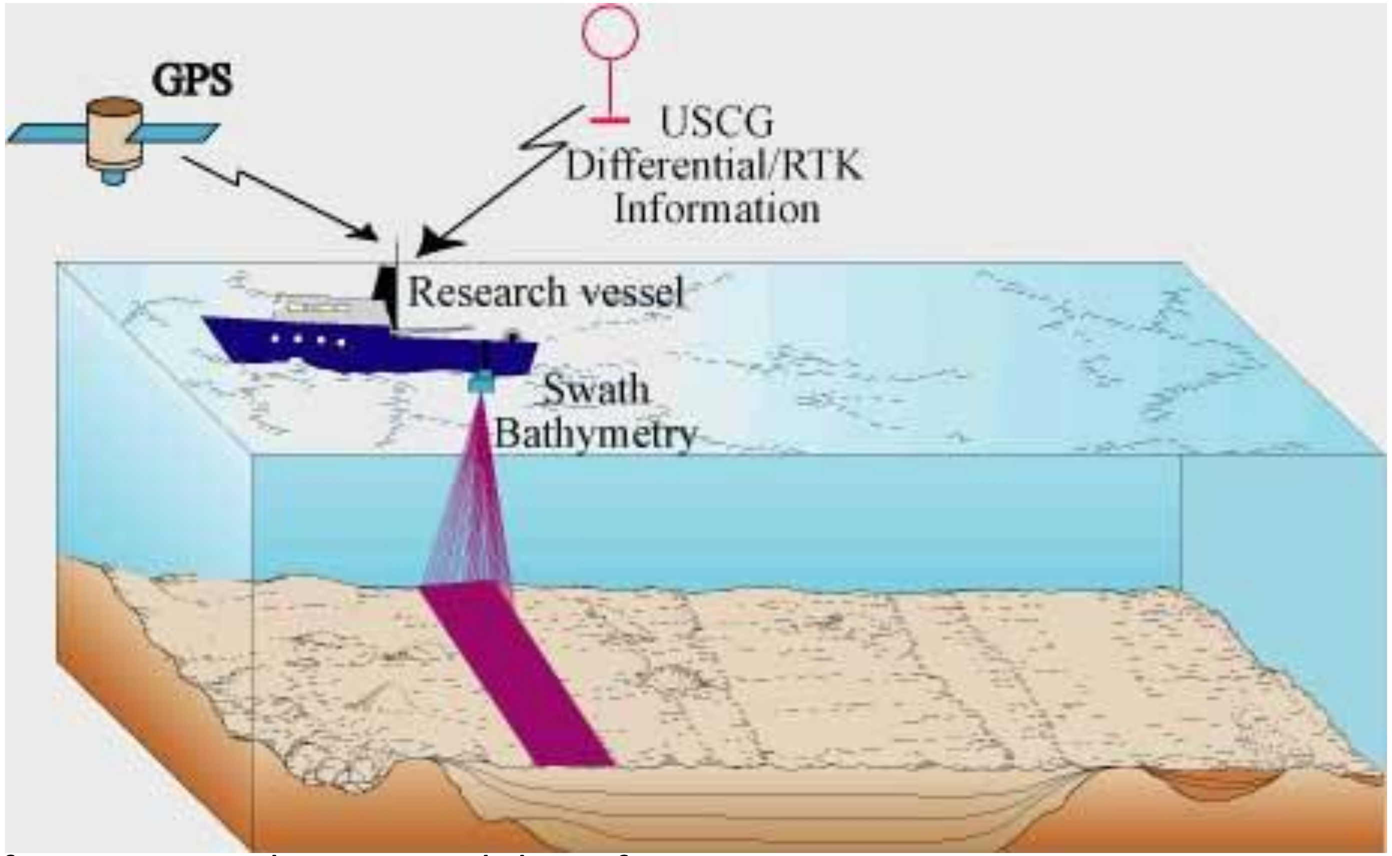
Increased:

- **Bottom Coverage**
- **Productivity**
- **Resolution**
- **Confidence**

Vertical Beam Echo-sounding (VBES)

Used from 1939 to the present

Better coverage than lead-lines

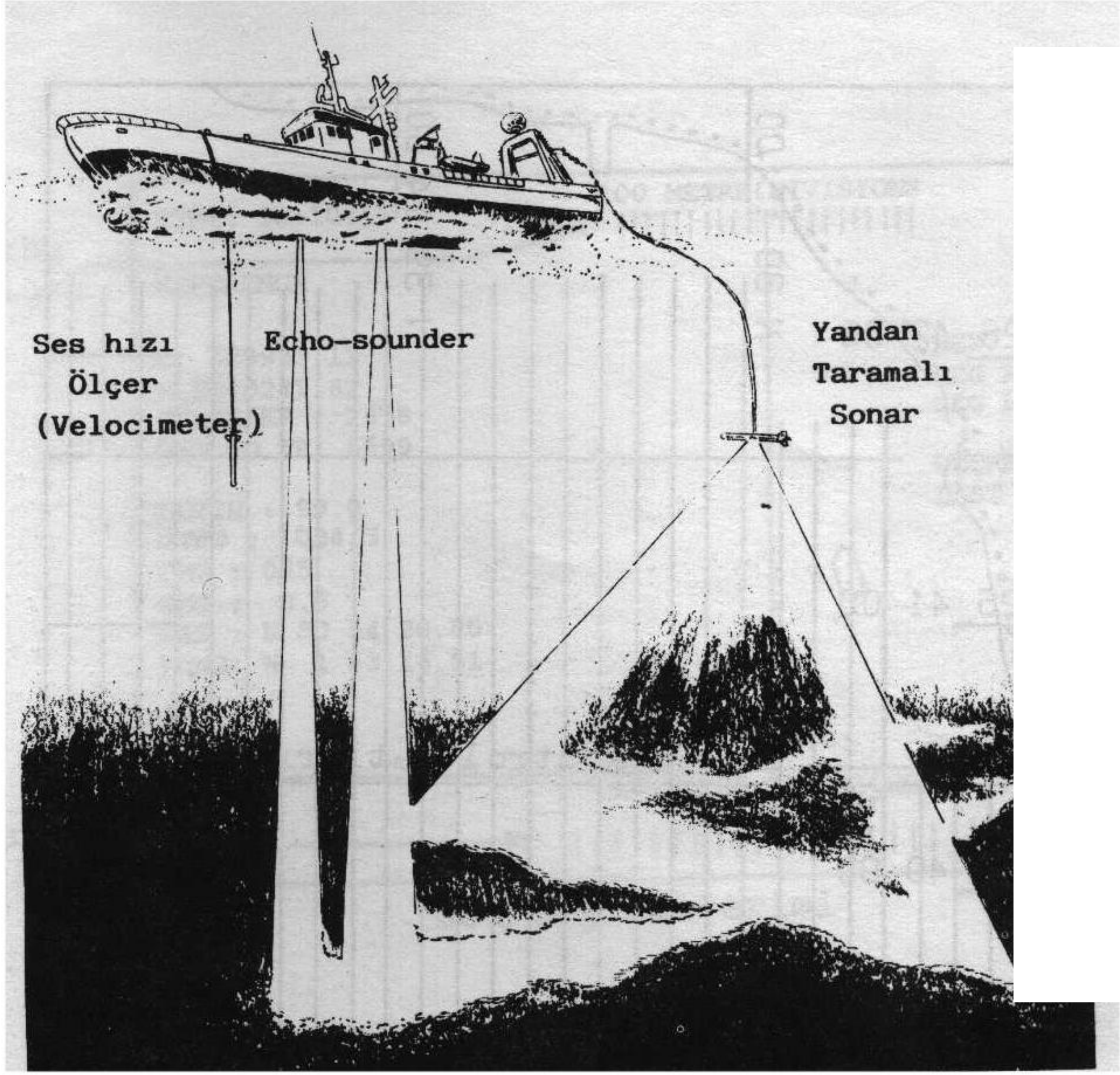


$V = \sqrt{1 / k \rho}$

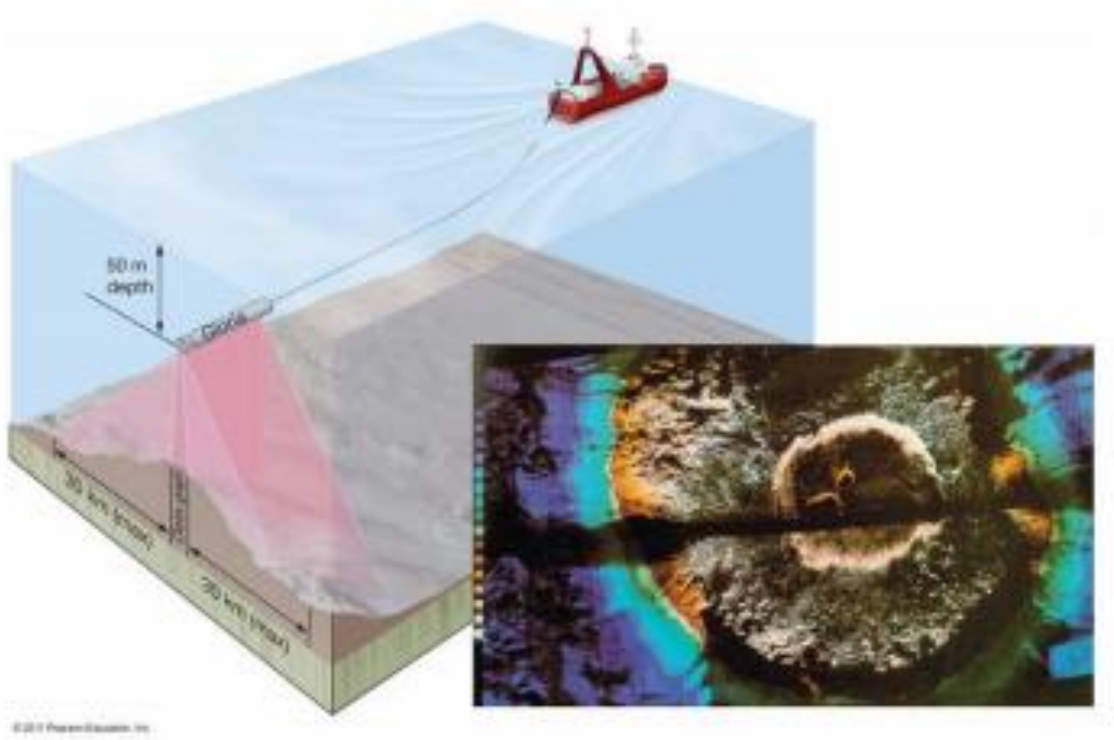
k: density of water, Li: is the permeability of water.

The k values change as the depth reaches the depth, the speed to be found according to the above correlation is not appropriate to the regional conditions.

Therefore, normal conditions (t = 0 0C water temperature, s = 035% salinity and h = 0m or p = 760 mm Hg pressure) are corrected according to the conditions of sound velocity environment.

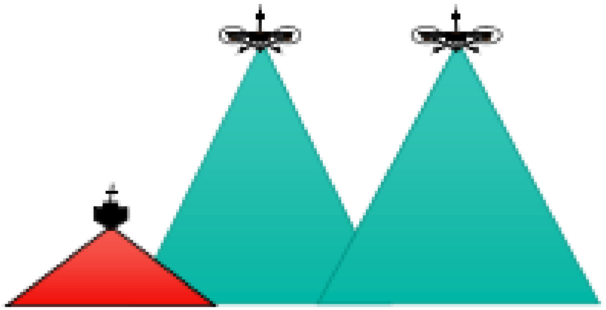


Side Scan Sonar



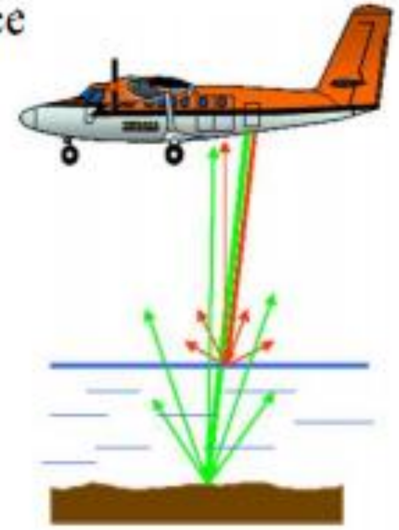
Airborne LIDAR

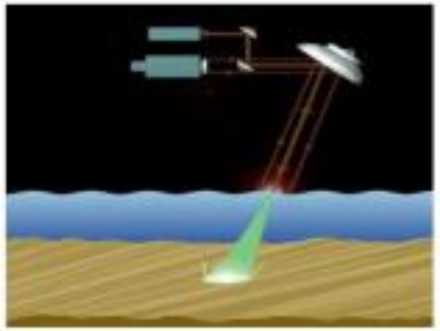
- **Airborne laser scanning technology** to survey both land and coastal waters in a single approach, employing a technique known as Airborne LIDAR Bathymetry (ALB) or Airborne LIDAR Hydrography (ALH) which uses state-of-the-art LIDAR Technology to measure sea bed depths and topographic features rapidly and accurately.



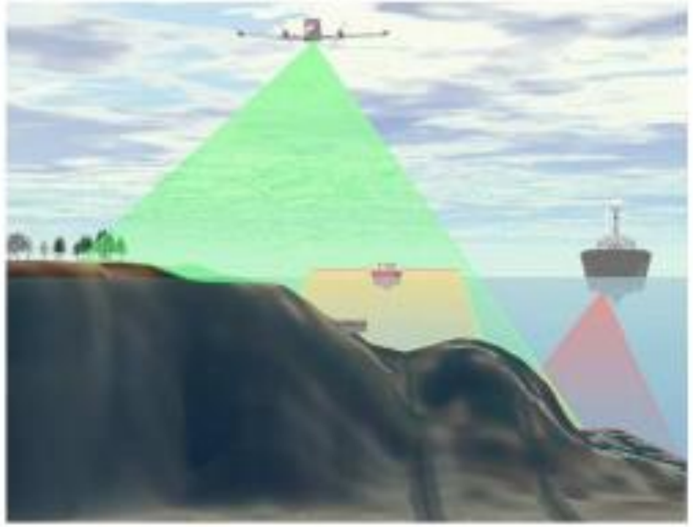
Green pulses (532 nm) reflected from bottom

N-IR (1064 nm) laser pulses reflected from water surface





Simultaneous costal zone survey, both land and water under one approach

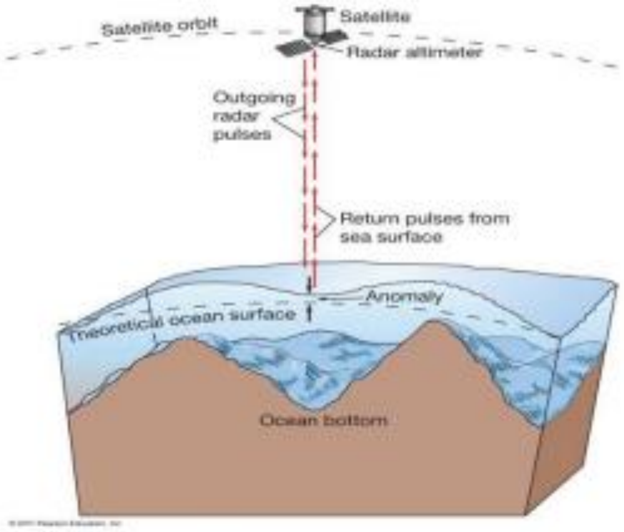


Aerial Photography

- Photo Bathymetry was used to measure water depth for shallow water with depth not more than 30m
- Refraction of light passing from water to air layers should be corrected first.
- Both single aerial photo and overlapping photos can be used.
- Covered area is limited by camera focal length
- Depth limitation is the most serious disadvantage.

Satellite Radar Altimetry

satellite measurements
of sea floor
features is based on
gravitational
bulges in sea surface
caused by underwater
topography change



Radar Altimeter

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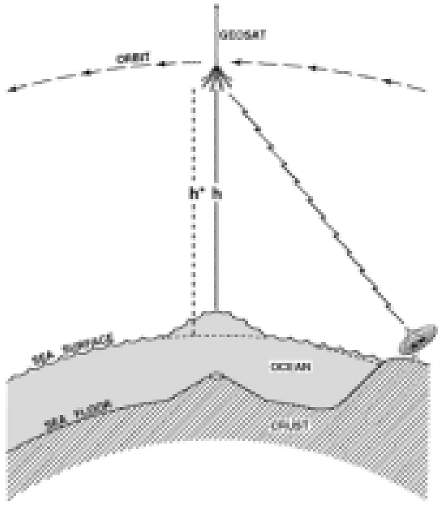
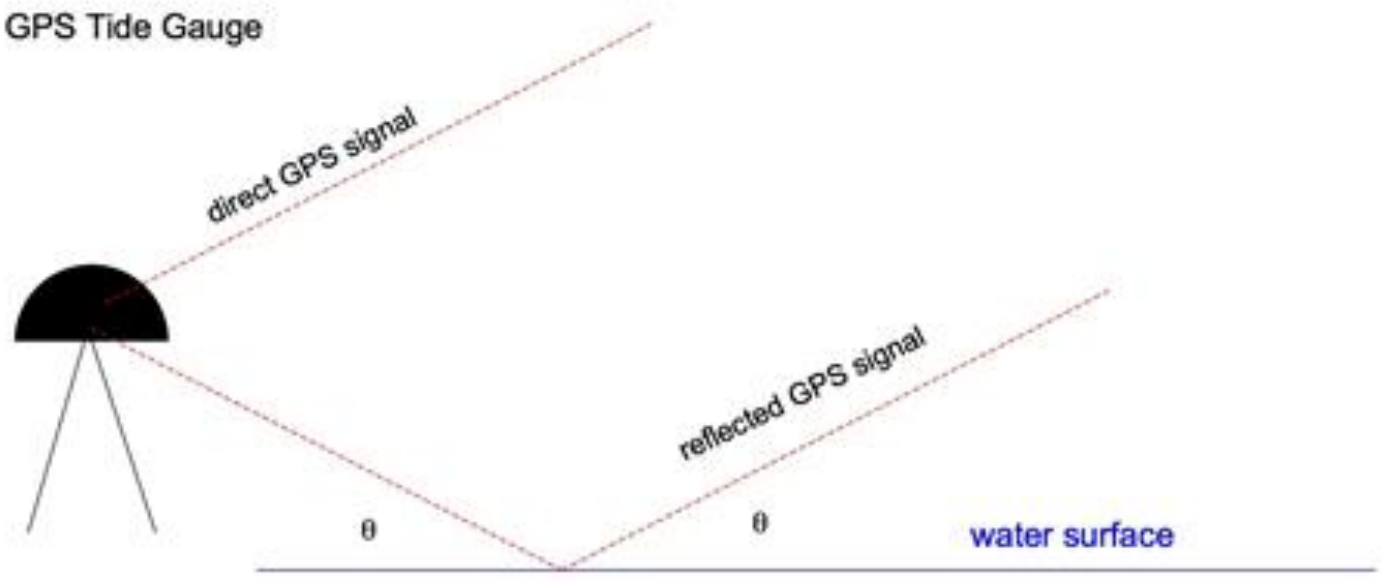
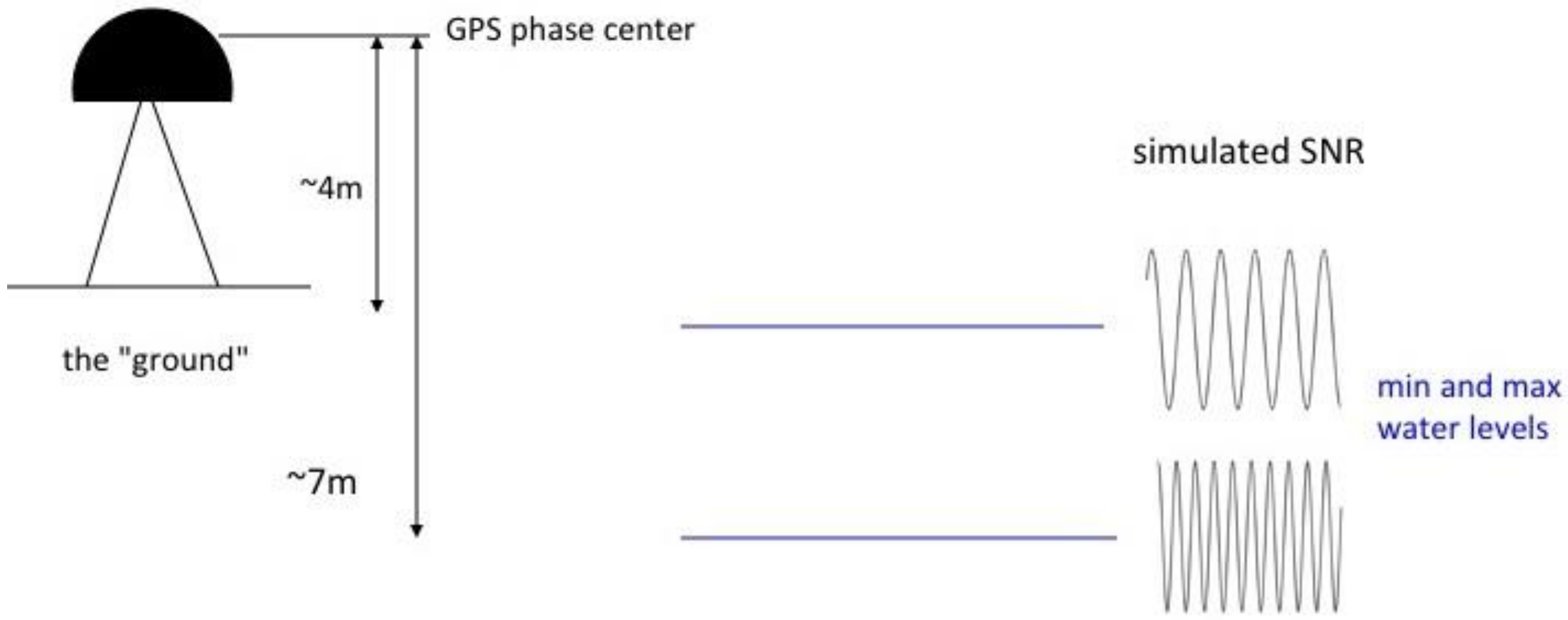
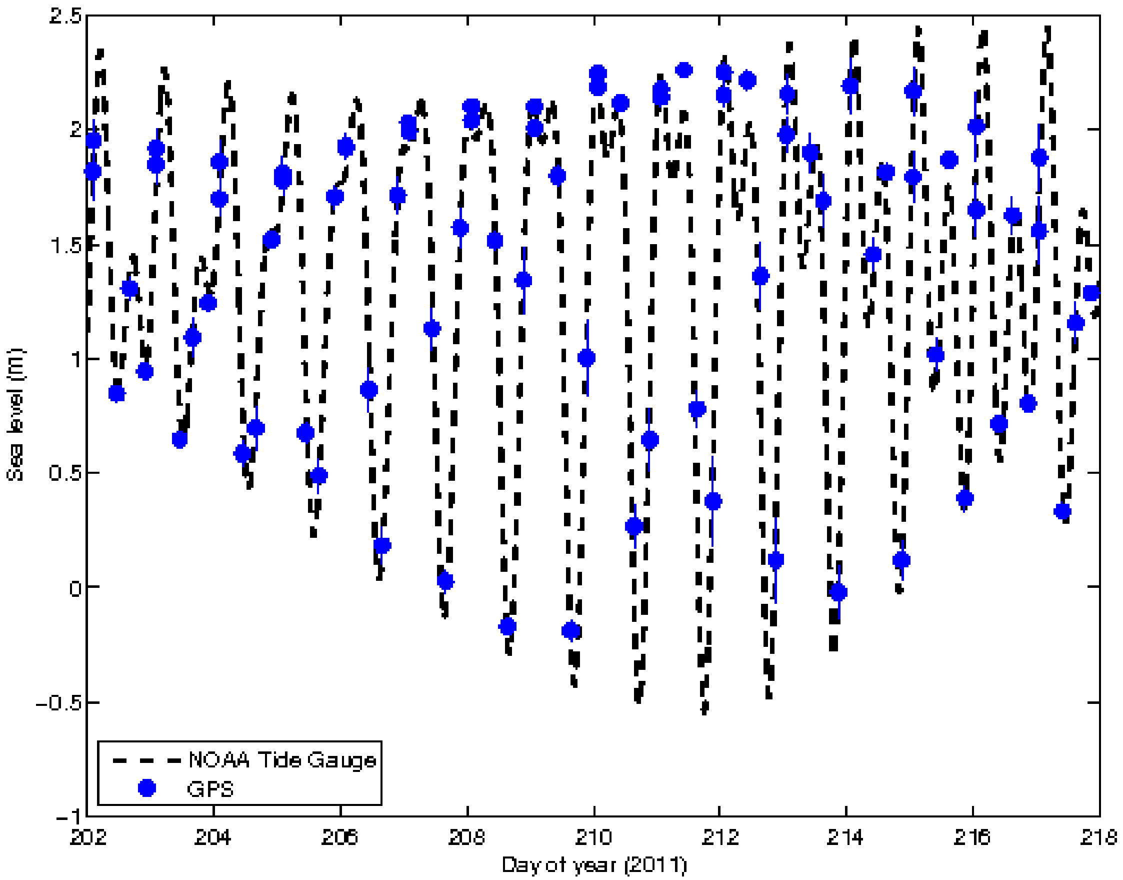
Applications of Satellite Altimetry

- Navigation
- Prediction of Seafloor Depth
- Planning Shipboard Surveys
- Plate Tectonics
- Undersea Volcanoes
- Petroleum Exploration
- Lithospheric Structure

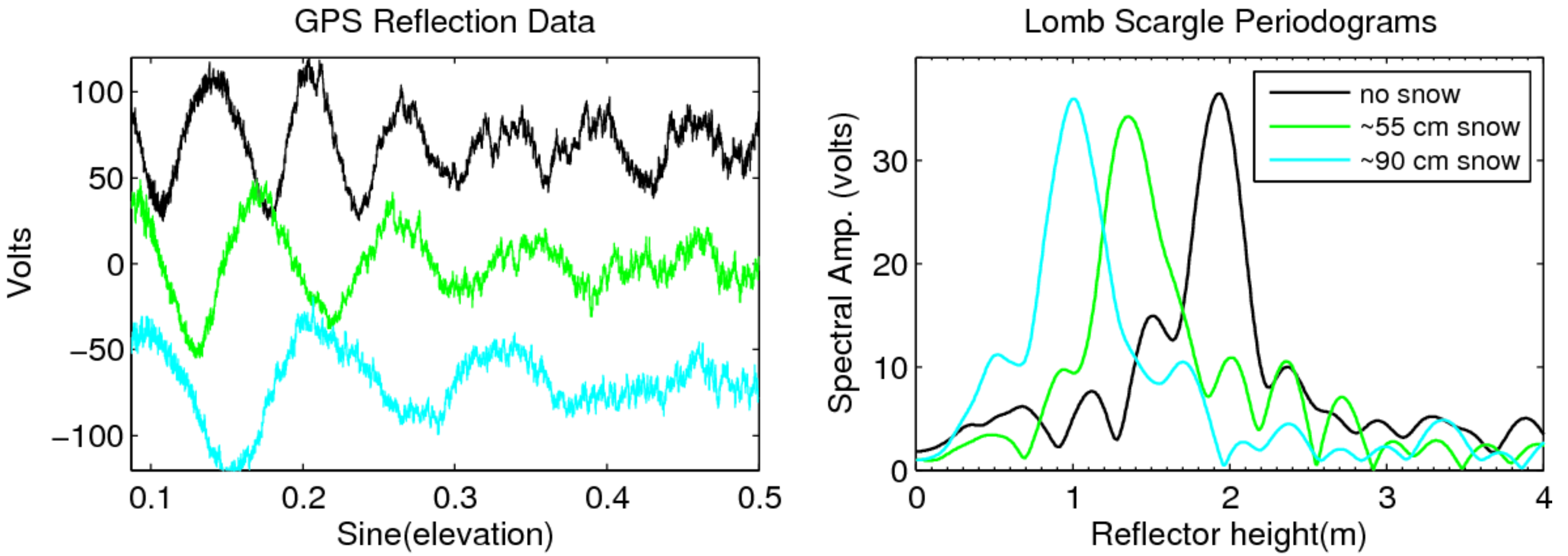



GPS Tide Gauge
direct GPS signal
reflected GPS signal
θ
θ
water surface


GPS phase center
~4m
the "ground"
~7m
simulated SNR
min and max
water levels



2.5
2
1.5
1
0.5
0
−0.5
−1
202
204
206
208
210
212
214
216
218
Day of year (2011)
Sea level (m)
NOAA Tide Gauge
GPS


GPS Reflection Data
Volts
100
50
0
−50
−100
0.1
0.2
0.3
0.4
0.5
Sine(elevation)
Lomb Scargle Periodograms
Spectral Amp. (volts)
no snow
~55 cm snow
~90 cm snow
30
20
10
0
0
1
2
3
4
Reflector height(m)

Tunnel Boring Method: TBM

Due to the intensive urbanization and intensive construction in the living areas, more effective evaluation of the underground has become necessary and in parallel to this, tunnel construction techniques have been developed for different topography and ground conditions.

- Tunneling navigation techniques, orientation of excavation machinery, monitoring of tunnel stability and measuring instruments used in tunneling Works are given in this part of the lecture.

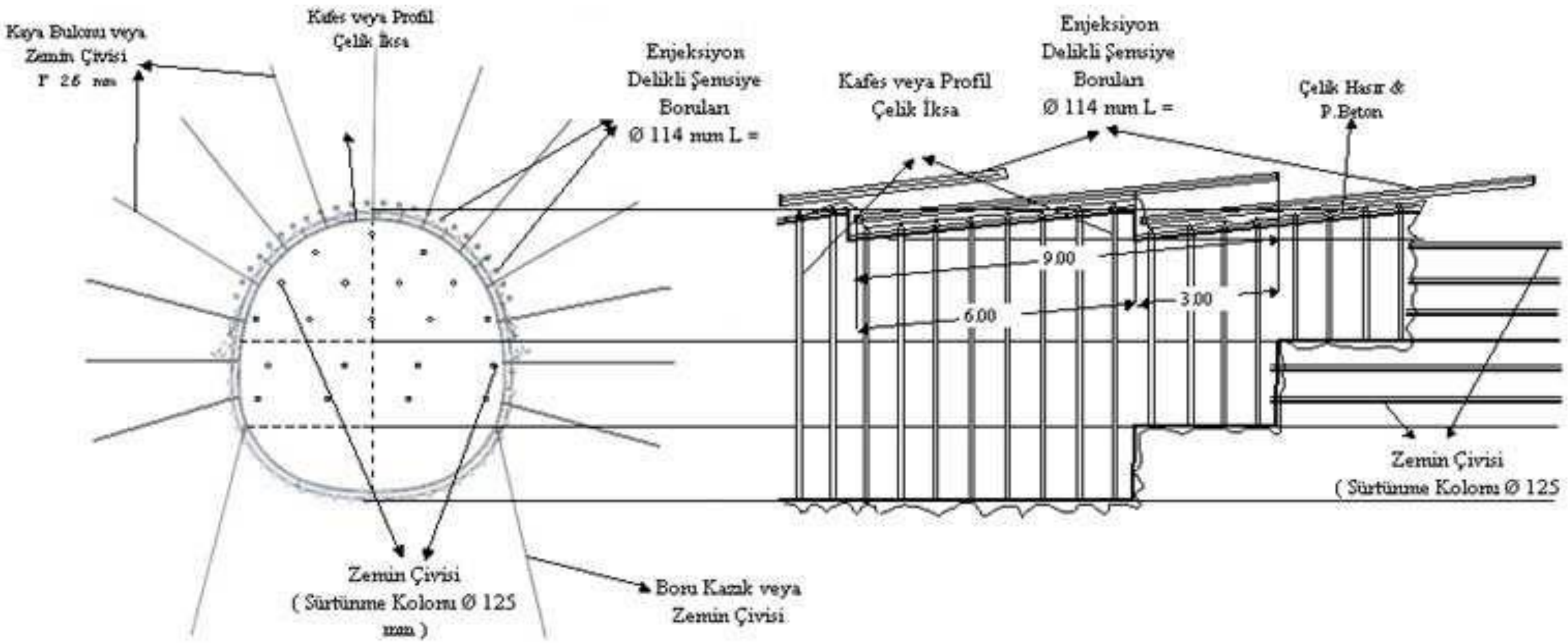
ESTABLISHING THE GEODETIC NETWORK FOR TUNNEL APPLICATIONS

- Establishment of a triangulation network covering the tunnel construction area
- Polygon network between triangulation points
- Creation of a leveling network
- Measurement of topography and preparation of maps
- Tunnel design
- Measurements for Tunnel (Shaft, Portal, Approach Tunnel) construction.
- Stake out measurements of the project and other necessary measurements.

Today, tunnel applications are divided into three groups in terms of measurement techniques.

1-) New Austrian Tunneling Method (NATM)
2-) TBM tunneling method
3-) Immersed Tube method

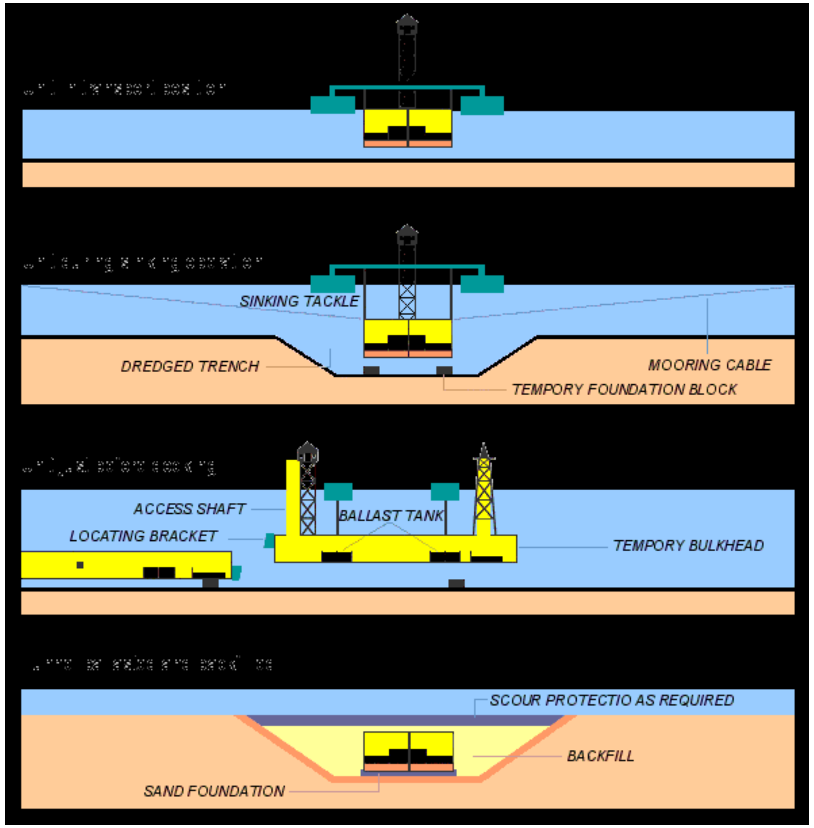
NATM


Kaya Bulonu veya
Zemin Çivisi
r 26 mm
Kafes veya Profil
Çelik İksa
Enjeksiyon
Delikli Şemsiye
Boruları
Ø 114 mm L =
Kafes veya Profil
Çelik İksa
Enjeksiyon
Delikli Şemsiye
Boruları
Ø 114 mm L =
Çelik Hasır &
P.Beton
9.00
6.00
3.00
Zemin Çivisi
(Sürtünme Kolonu Ø 125
Zemin Çivisi
(Sürtünme Kolonu Ø 125
mm)
Boru Kazık veya
Zemin Çivisi

TBM

Tunneling machine which contains the necessary technology for tunnel boring and construction. The model of the TBM is determined by the type of tunnel interior covering floor and project conditions.

IMMERSED TUBE



- The excavation and preparation of the tube settlement at the bottom of the sea and the location of the tubes immersed are monitored simultaneously via acoustic positioning systems (APS).
- Necessary corrections are made through hydraulic pistons.
- For this purpose, sound detecting devices are placed on the tubes in order to detect the sound waves sent by the Echosounder.

- When the acoustic sensor receives the signal sent by the Echosounder, it recognizes it and indicates its position.
- Corrections are made by considering the location information from other acoustic sensors.
- The necessary corrections are made by divers or specially designed remote controlled submarines.
- The position of the Echosounder is determined by RTK-GPS measurements.

MODERN MEASURING INSTRUMENTS USED IN UNDERGROUND MEASUREMENTS

Angle - Distance Measuring Instruments

Motorized Total Station

ATR (Automatic Target Recognition) System Total Station

Machine Orientation Systems

Automatic Cross Section

Optical Plumbing

Laser Plumbing

Gyroscope

ANGLE AND LENGTH MEASURING INSTRUMENTS

Electronic theodolites used in classical applications for horizontal and vertical angle measurements

Total stations capable of measuring angle and length

ATR system, motorized total stations can be used for measuring the reflectorless length beside the classical total staion.

MOTORİZE TOTAL STATION

With the development of the ATR system, it can automatically monitor the reflector and measure the angle-length at the desired points.

These devices can be used as a machine orientation system in tunnel applications, automatic sectioning and surface scanning features and they provide great advantages in underground measurements.

CONSTRUCTION OF PERMANENT STATIONS IN TUNNELS

- Polygon Points
- Deformation Points

Polygon Points: The cantilever walls are installed as polygons. The consoles on which the polygons are located consist of three parts as stated below.

Consistently stable wall base on the wall
Console elevation placed in the fixed part
Pin screw for mounting on

Deformation Points: These points are mounted on the ceiling and side walls. The bulbs are placed on the ceiling and the side walls.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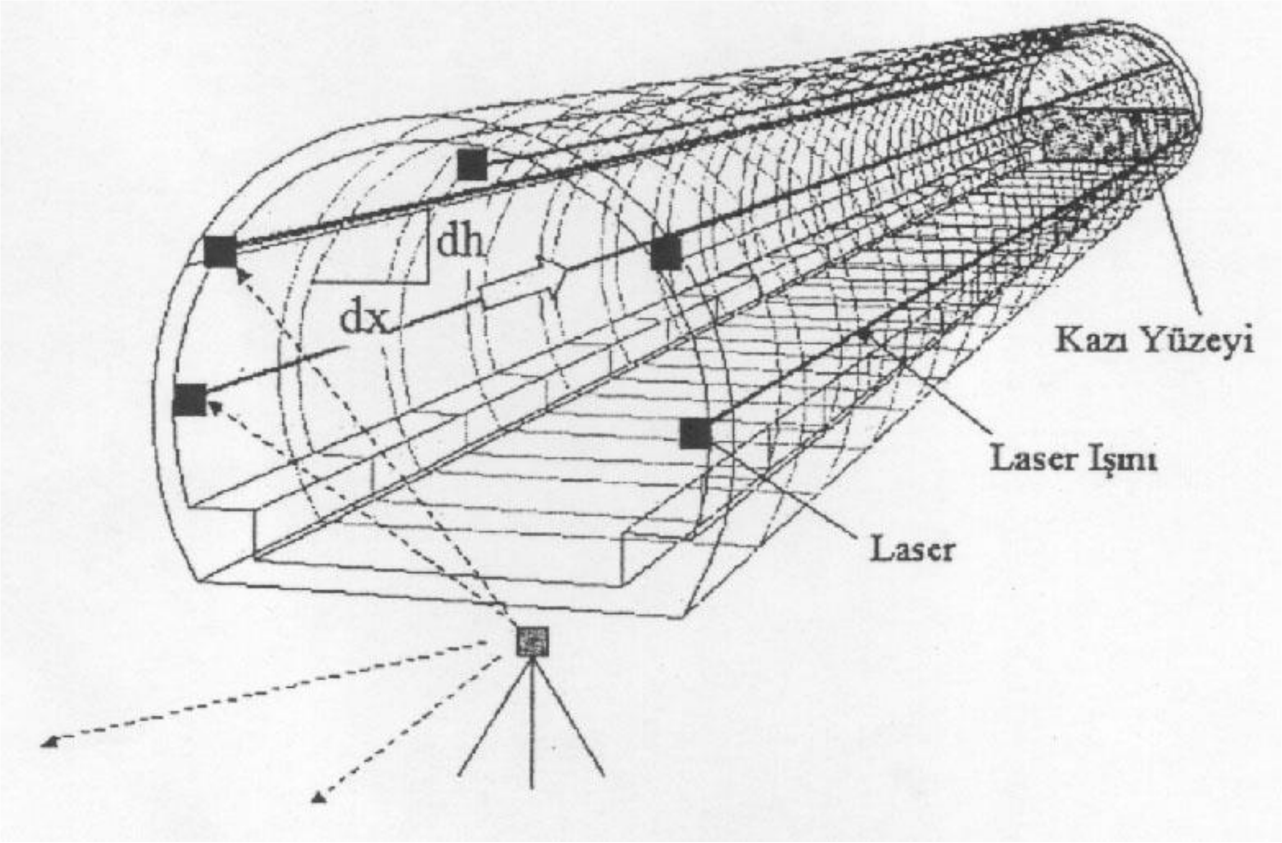
LASER DEVICES AND TUNNEL EXCAVATIONS

It is to give horizontal and vertical distance differences (dx, dh) of a certain km from the laser beam that is closest to a point to be known in the tunnel mirror.



ORIENTATION OF TUNNEL BORING MACHINE

The starting position of the TBM on the theoretical axis is determined based on the network connected to the measurement network carried in the tunnel.

In the TBM, measurement routing software is installed, tunnel axis and type section parameters to be constructed are loaded.

A total station is installed behind the TBM and connected to the measuring network.

The total station is routed to the sensor screen on the front of the TBM.

The angles and distances measured by the total station are automatically transferred to the control computer for evaluation and the position of the TBM at the moment of measurement is determined.

The horizontal and vertical correction values are determined by comparing the position of the measurement with the design path.

Again, by creating an independent measurement network, the position of the TBM is checked and the necessary corrections are made on time.

The cross-sectional measurements are taken from the completed tunnel inner surface and the current situation is evaluated.

With the completion of the tunnel drilling operation, if the deviation is present, the tunnel polygon network is re-measured and is connected to the above-ground openings through two openings and used for other applications.

Underground network to control the structure and control of the tunneling machine

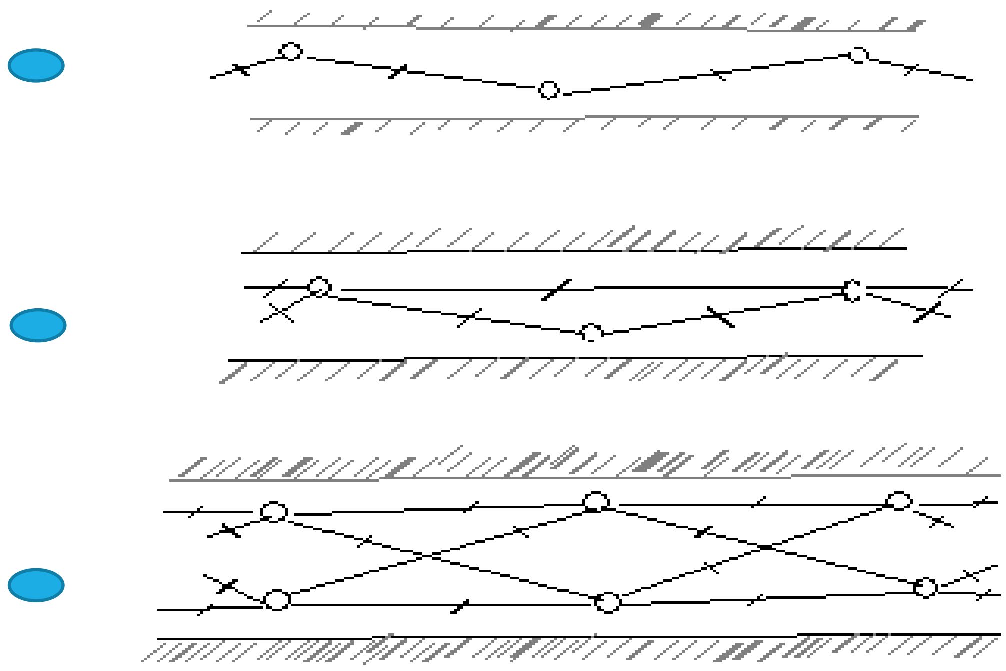


FigurE shows the different underground network options. Because of the narrow tunnel width, it is used with long-edged and narrow nets or polygon gradients. Length and direction are measured electronically.

There is no possibility of connection at the front during opening of the tunnel.

Thickness, reliability, and cost increases from option 1 to option 3.

Option 1, There is no guarantee of encounter point in the option.

Option 2, Using a gyroscope at every two points increases the precision significantly