Surveying for Civil Engineering

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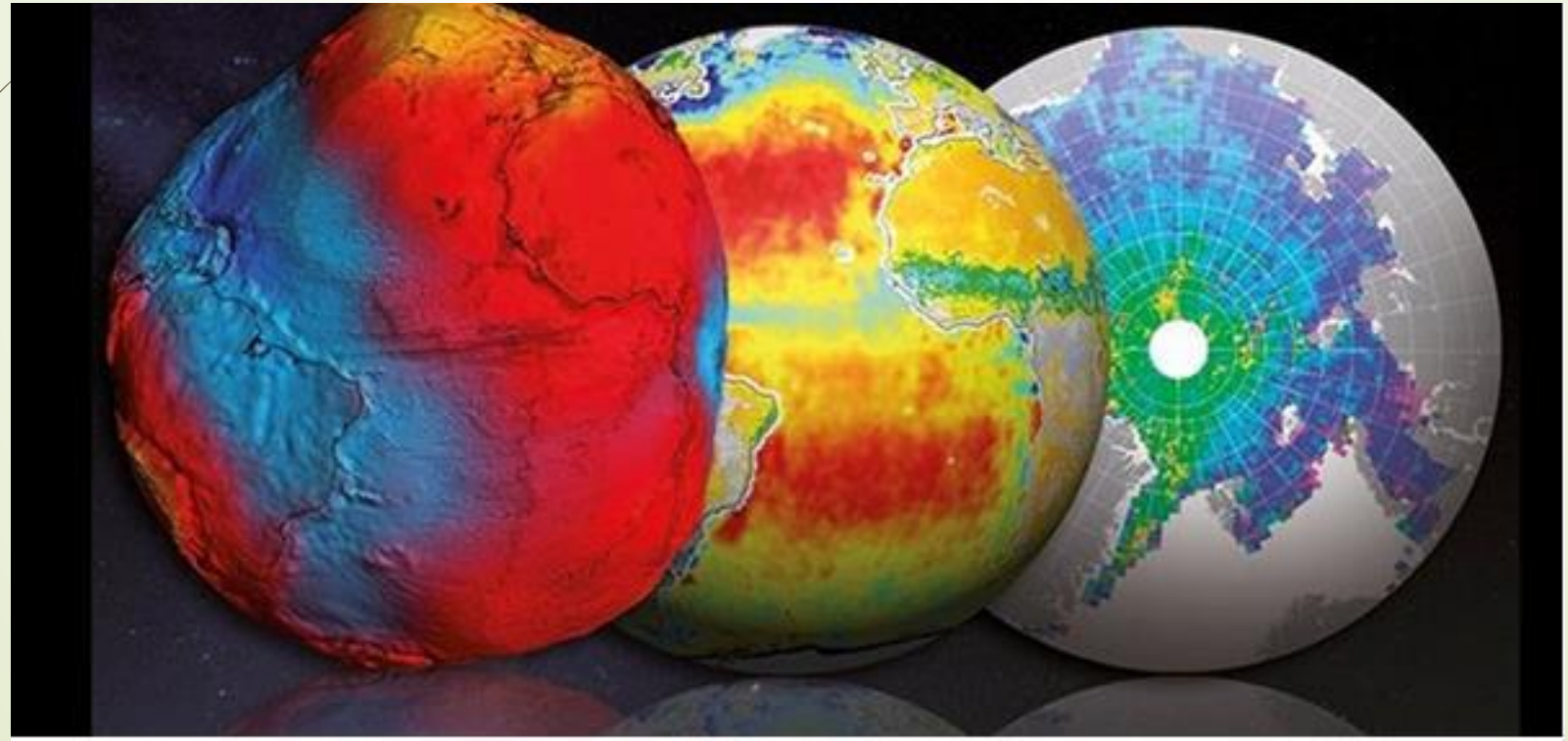
Working Fields for Surveying Engineers

- It is also called as Geomatics Engineering or Geodesy and Photogrammetry Engineering
- Making maps with right projections

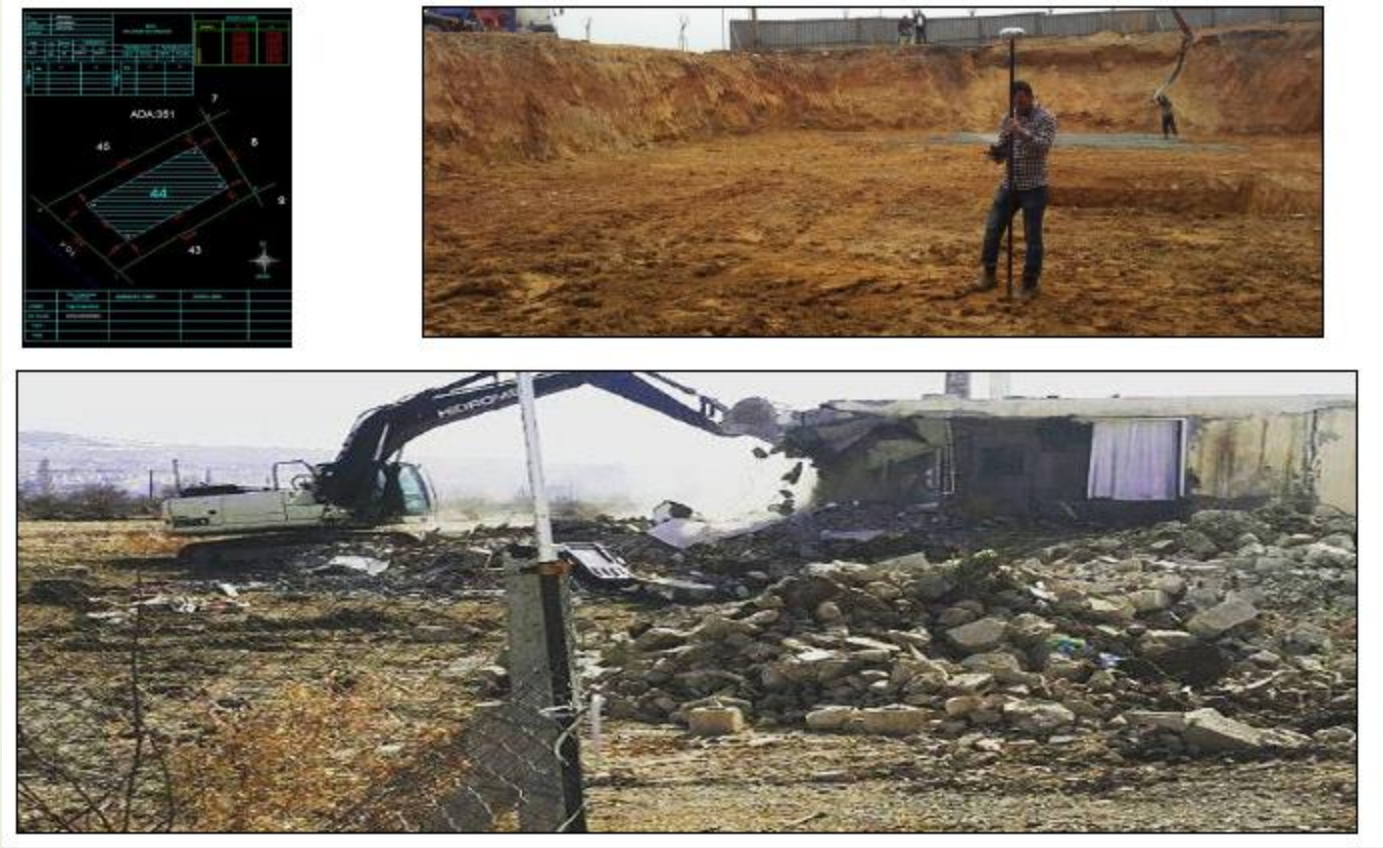


Working Fields for Surveying Engineers

- Controlling the paths for underground tunnels

Working Fields for Surveying Engineers

- To do projects for building, road, railway etc. applications



Working Fields for Surveying Engineers

- To determine the deformation of big buildings, dams and bridges.

Working Fields for Surveying Engineers

- To determine paths for power lines

Working Fields for Surveying Engineers

- To monitor earthquakes and tectonic plate movements

Working Fields for Surveying Engineers

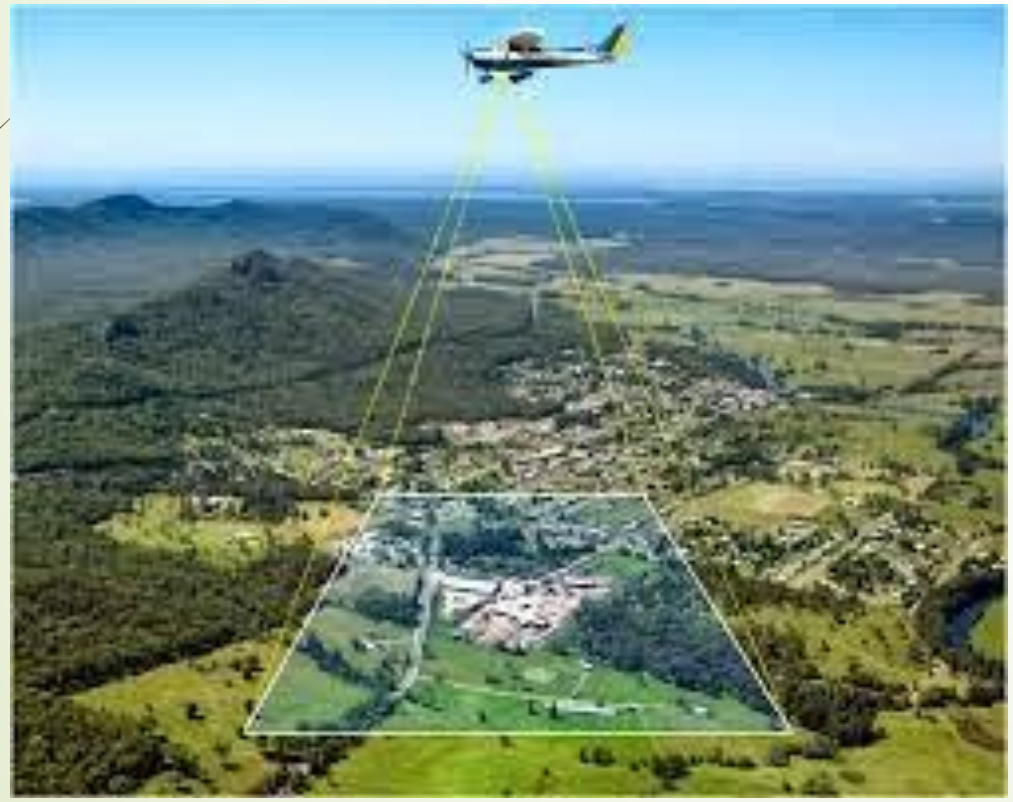
- To monitor landslides and to make risk maps

Working Fields for Surveying Engineers

- To control industrial products and mechanical parts

Working Fields for Surveying Engineers

- To make maps by using aerial photos, unmanned aerial vehicles (UAV)

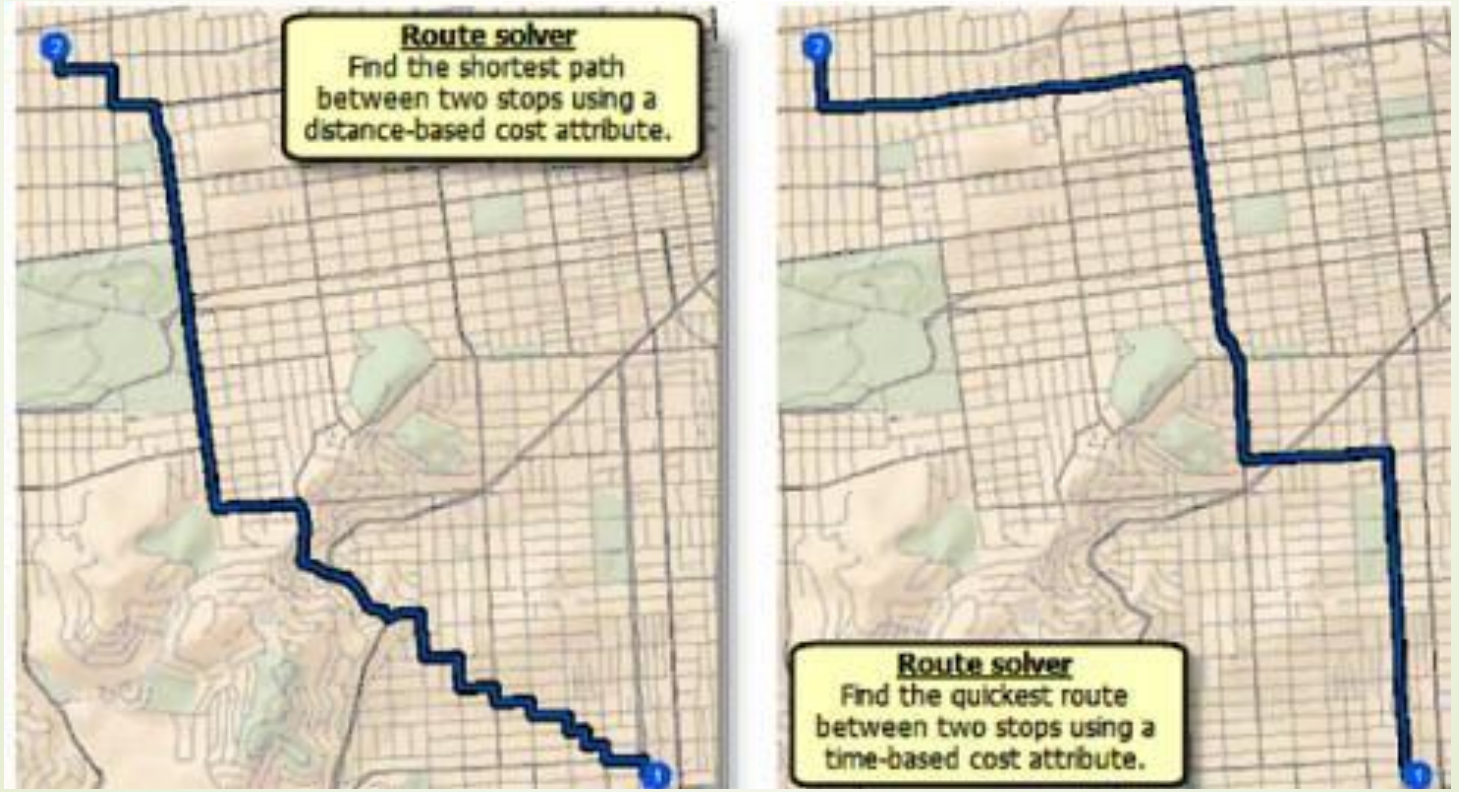


Working Fields for Surveying Engineers

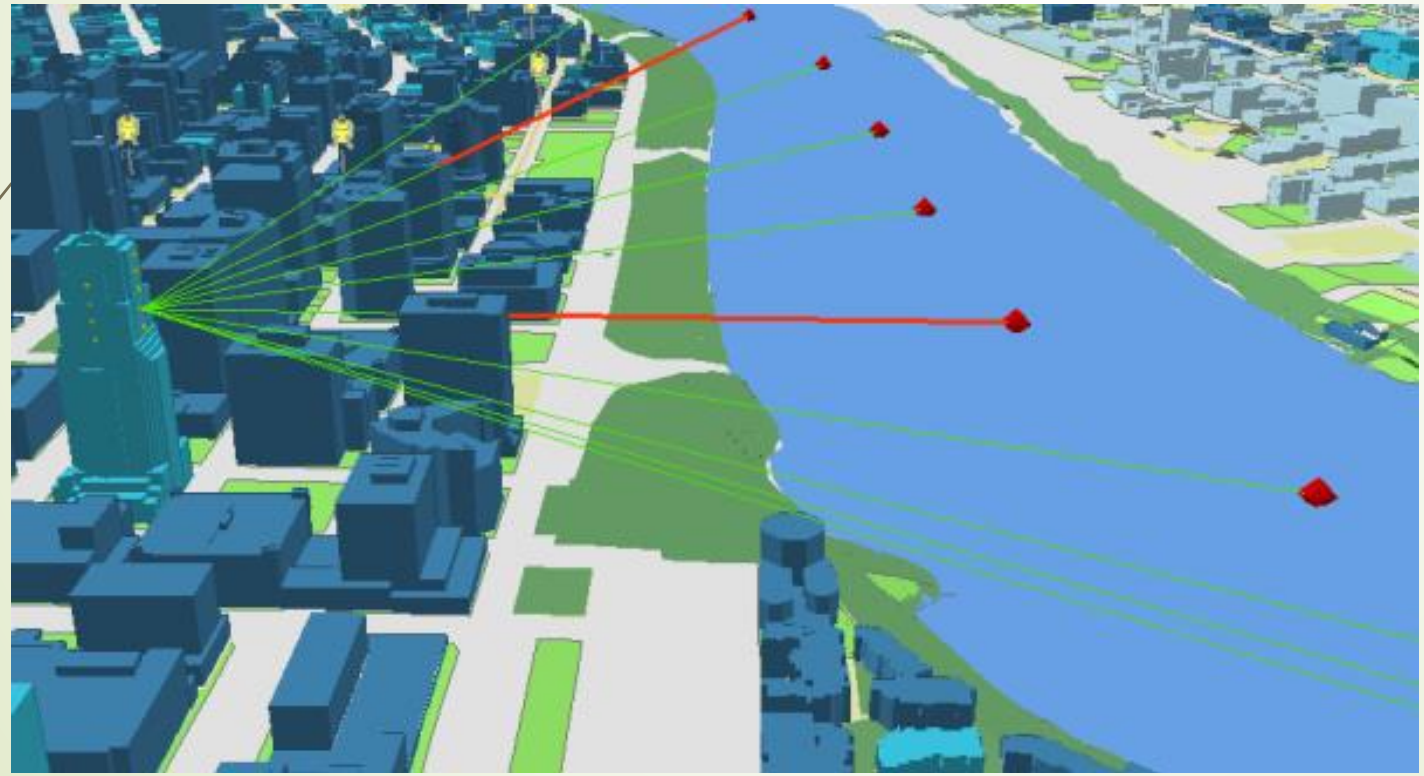
- Restoration of historical monuments.

Working Fields for Surveying Engineers

- To make decision maps for deciding the shortest and quickest paths



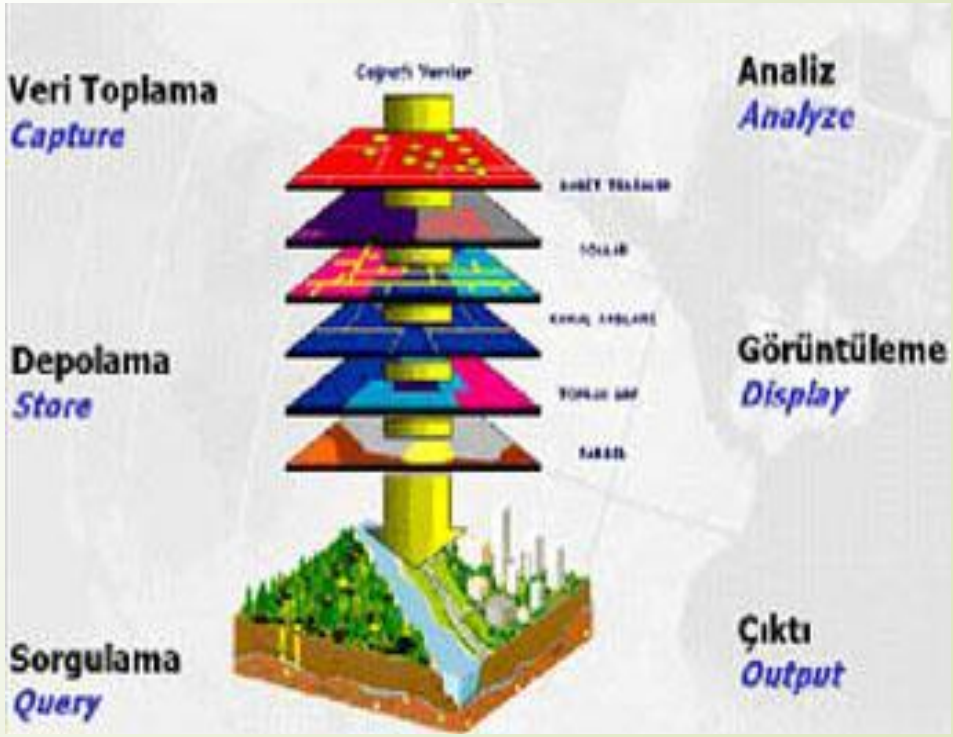
- Choosing an office with the best view



Definition of Surveying Engineering

It is the art of

- Measuring physical and spatial parameters of objects belong to the space and earth, and gathering these data
- Evaluation and analysis of measurements
- Storing the results in the databases
- Presenting the results .



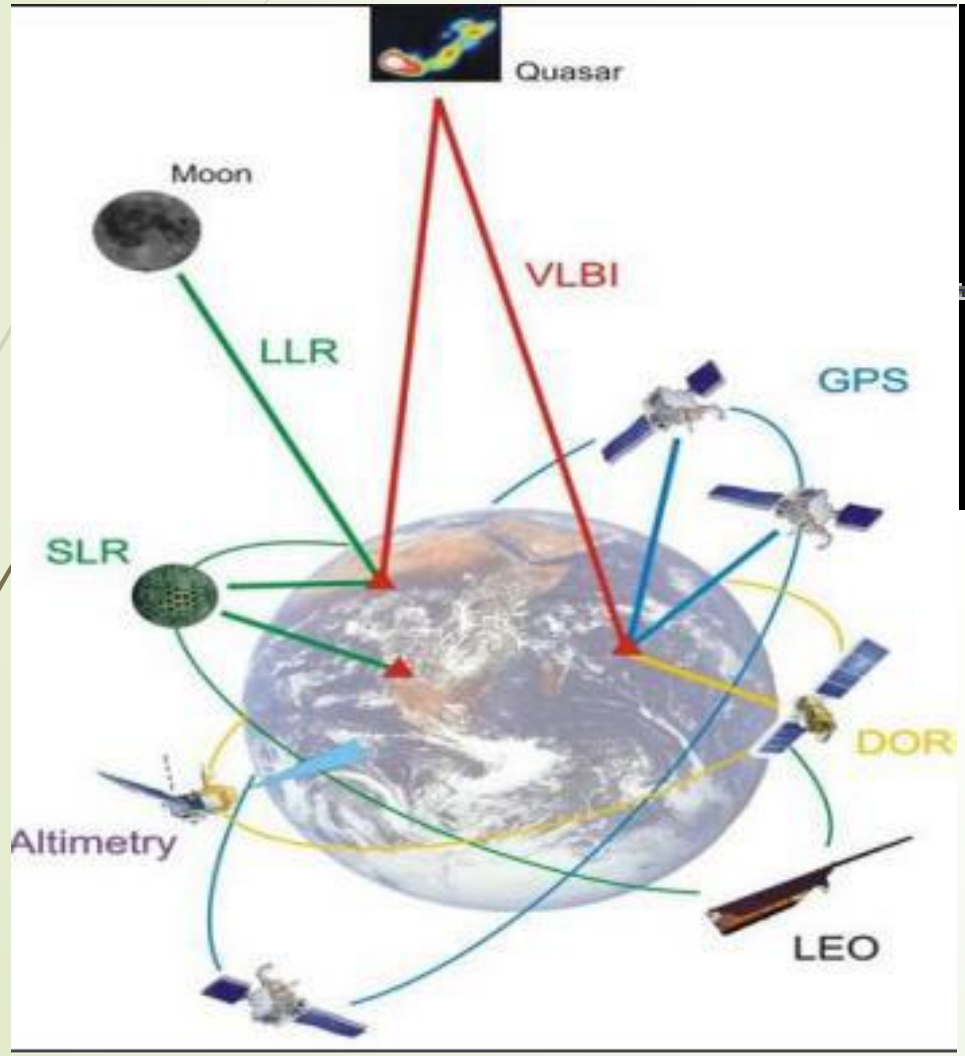
Works with

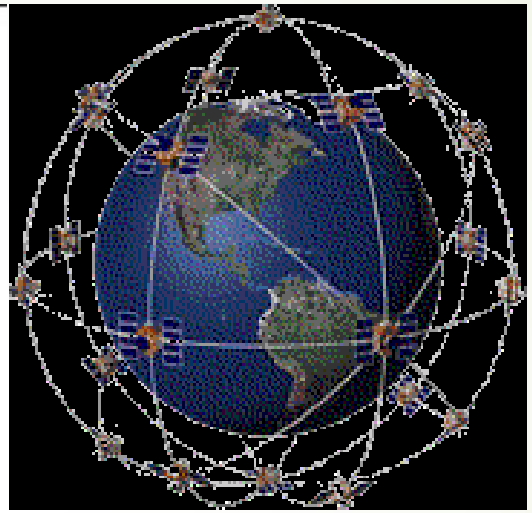
- It is a multidisciplinary area that works with Civil engineers, Geology, Forestry, Computer Engineering,etc.
- Also take advantage of
  - Maths
  - Physics
  - Computer science
  - ect.

Methods used in Surveying

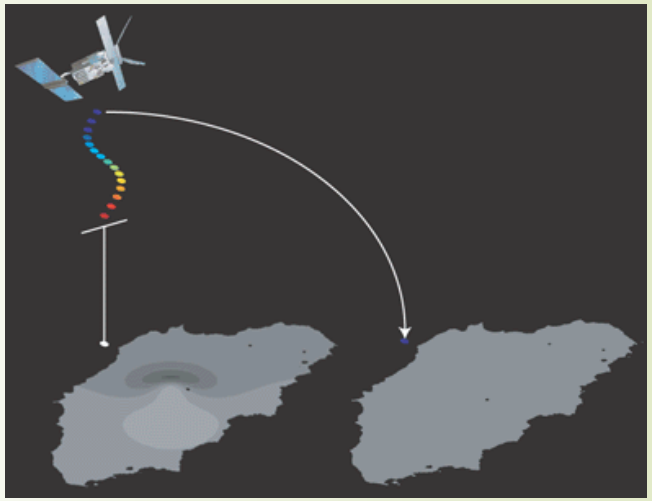
- Electromagnetic,Laser and optical measurements

Methods used in Surveying





GPS



InSAR

Ground Measuring Instruments used in Surveying

Fields of Surveying Engineering

- Geodesy
- Surveying
- Cartography
- Remote Sensing
- Photogrammetry
- Land managment

Surveying

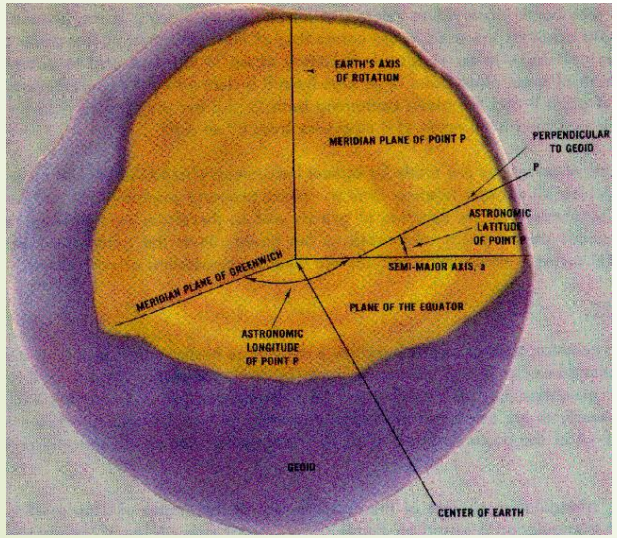
- It is the art of measuring horizontal and vertical distances between objects, of measuring angles between lines, of determining the direction of lines, and of establishing points by predetermined angular and linear measurements.
- Surveying has to do with the determination of the relative spatial location of points on or near the surface of the earth.
- Along with the actual survey measurements are the mathematical calculations. Distances, angles, directions, locations, elevations, areas, and volumes are thus determined from the data of the survey.
- Survey data is portrayed graphically by the construction of maps, profiles, cross sections, and diagrams.

Importance of Surveying

- Map the earth above and below sea level
- Prepare navigational charts for use in the air, on land, and at sea
- Establish property boundaries of private and public lands
- Develop data banks of land-use and natural resource information
- Determine size, shape, gravity, and magnetic fields of the earth
- Prepare charts of moon and planets

Types of Surveys

- Geodetic Surveying : It is the type of surveying that takes into account the true shape of the earth. These surveys are of high precision and extend overlarge areas.
- Plane Surveying : It is the type of surveying in which the mean surface of the earth is considered as a plane, or in which its spheroidal shape is neglected, with regard to horizontal distances and directions.



Different methods of Surveying

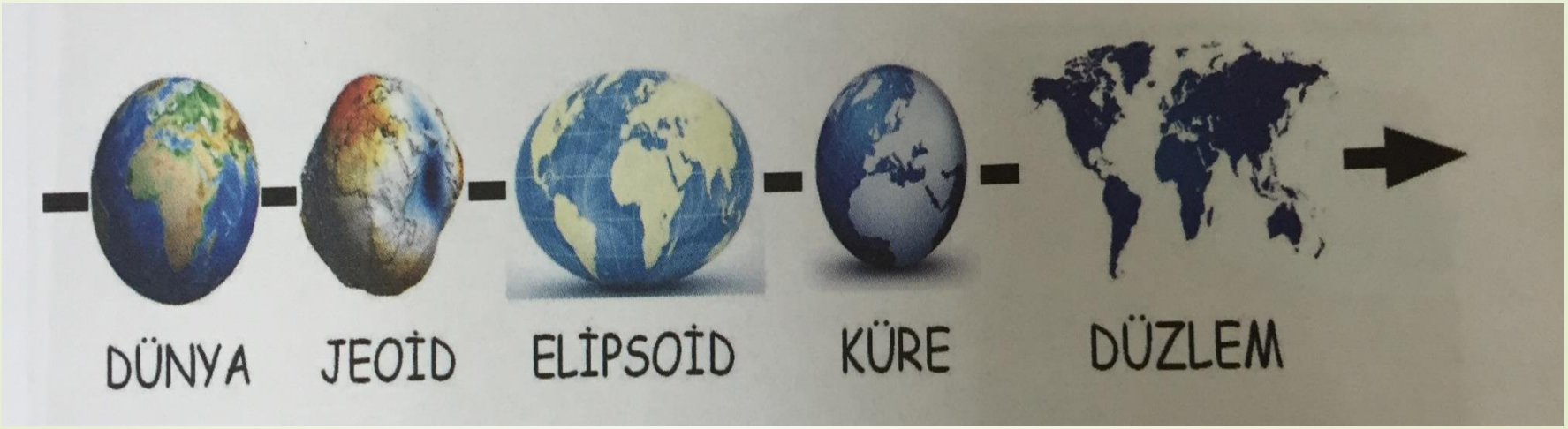
- *Control Survey: Made to establish the horizontal and vertical positions of arbitrary points.*
- *Boundary Survey: Made to determine the length and direction of land lines and to establish the position of these lines on the ground.*
- *Topographic Survey: Made to gather data to produce a topographic map showing the configuration of the terrain and the location of natural and man-made objects.*
- *Hydrographic Survey: The survey of bodies of water made for the purpose of navigation, water supply, or sub-aqueous construction.*
- *Mining Survey: Made to control, locate and map underground and surface works related to mining operations.*

Different methods of Surveying

- *Construction Survey: Made to lay out, locate and monitor public and private engineering works.*
- *Route Survey: Refers to those control, topographic, and construction surveys necessary for the location and construction of highways, railroads, canals, transmission lines, and pipelines.*
- *Photogrammetric Survey: Made to utilize the principles of aerial photogrammetry, in which measurements made on photographs are used to determine the positions of photographed objects.*
- *Astronomical survey: generally involve imaging or "mapping" of regions of the sky using telescopes.*

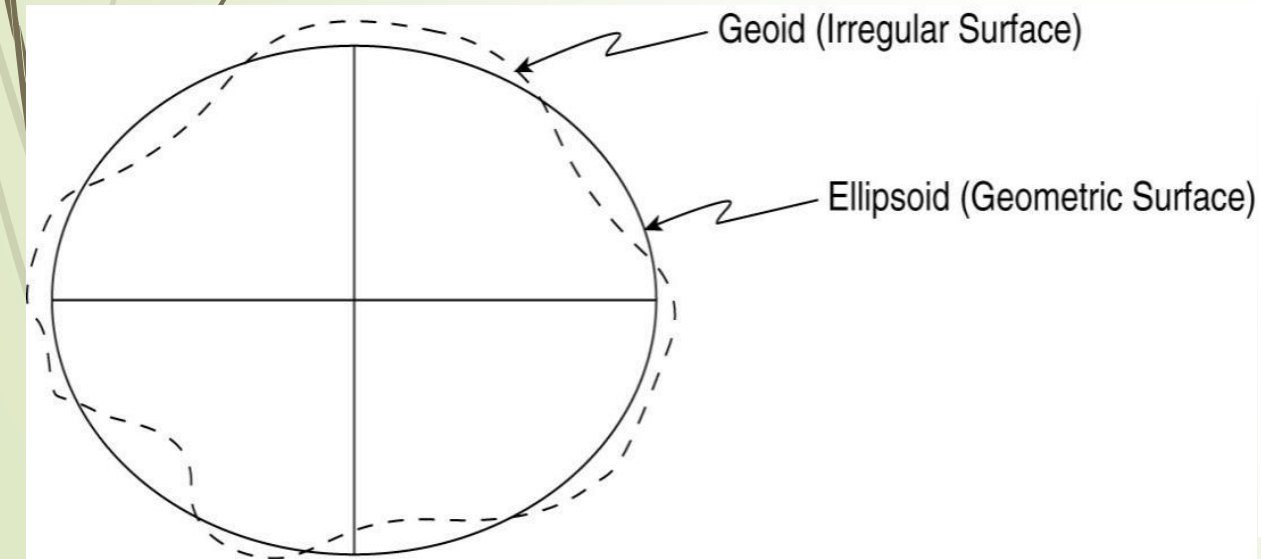
Shape of the earth

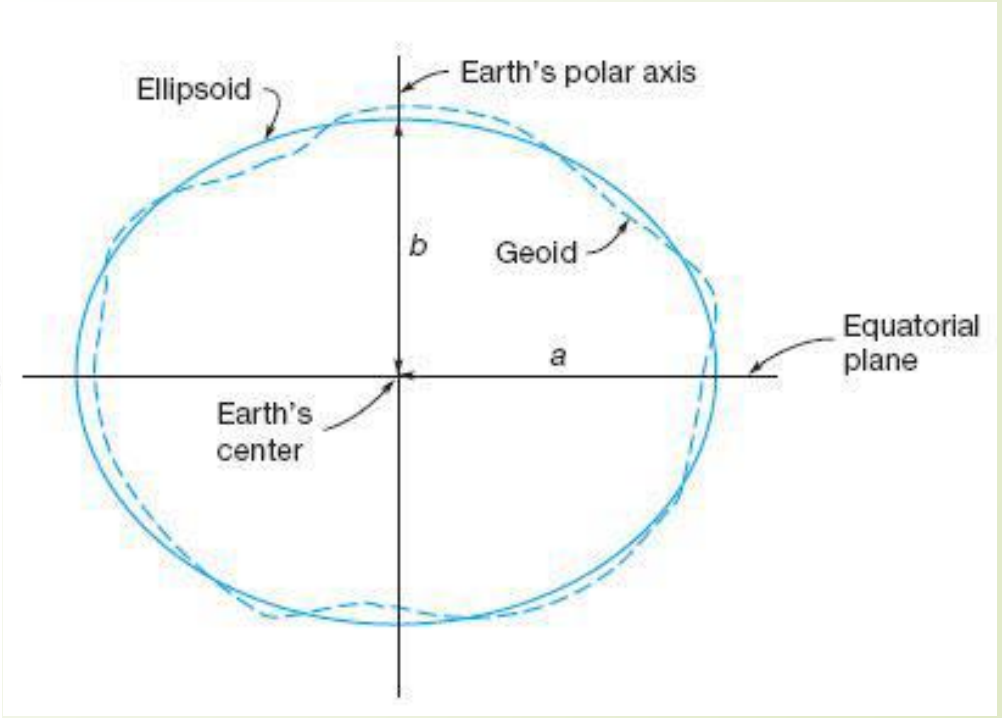
- GEOID: is a surface coinciding with mean sea-level (MSL) in the oceans, and lying under the land.
- It is an equipotential gravitational surface located approximately at mean sea level, which is everywhere perpendicular to the direction of gravity. Because of variations in the Earth's mass distribution and rotation of the Earth, the geoid has an irregular shape



Geoid and Elipsoid

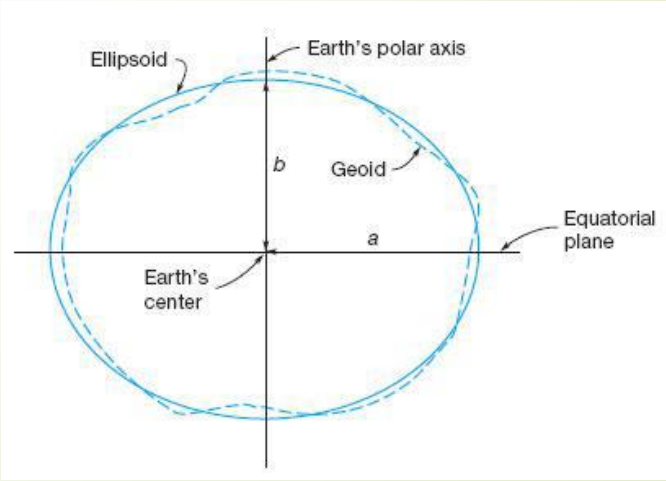
ELLIPSOID: It is a mathematical surface obtained by revolving an ellipse about the Earth's polar axis. The dimension of ellipse are selected to give a good fit of the ellipsoid to the geoid over a large area and are based upon surveys made in the area.





Geoid and Elipsoid

- A two-dimensional view, which illustrates the geoid and ellipsoid, is shown in figure.
- As illustrated, the geoid contains nonuniform undulations and is therefore not readily defined mathematically .
- Ellipsoids, which approximate the geoid and can be defined mathematically, are therefore used to compute positions of widely spaced points that are located through control surveys. Figure:3 (C.D. Ghilani, P.R. Wolf, 2008)



Geoid and Elipsoid

- Geoid has an irregular surface. Its surface does not follow the surface of ellipsoid. Sometimes it is below the ellipsoid and other times above it. Wherever the mass of earth's crust changes, the geoid's gravitational potential also changes, resulting in a nonuniform and unpredictable geoid surface.
- The surface of the earth has been approximately duplicated by the surface of an oblate ellipsoid, that is, the surface developed by rotating an ellipse on its minor axis. An ellipse was originally chosen that most closely conformed to the geoid of the area interest, which was usually continental in scope.

Geoid and Elipsoid

- If the solid earth was perfectly a spheroid, the geoid would be a perfect spheroid, but the irregularities in the shape and density cause the geoid to depart from the spheroidal form by amounts of 100 meters.
- For areas of limited size , the surface of our vast ellipsoid is actually nearly flat .The reference base for fieldwork, except leveling, and computations is assumed to be a flat horizontal surface. The direction of plump line (and thus gravity) is considered parallel throughout the survey region , and all angles are presumed to be a plane angles. In surveying lesson, focus on plane surveying.

UNITS OF MEASUREMENT

Units of Length

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

UNITS OF MEASUREMENT

- Unit of Angular Measurement

1) Sexagesimal System

- This system uses angular notation in increments of 60 by dividing the circle into 360 degrees; degrees into 60 minutes; and minutes into 60 seconds. Each unit has a corresponding symbol: degrees are indicated by (°) minutes by ('); and seconds by (").

1 Degree	10	60 minutes	3600 second
1 Minute	1 '	1/60 degree	60 seconds
1 Second	1 "	1/360 degree	1/60 minute

- 1° = 60'= 3600" 1' = 60"

UNITS OF MEASUREMENT

- As an example of preferred notation of angles with sexagesimal system;
- 380 28' 43".6
- Notice that minutes and seconds equal to or greater than 60 are carried over to the next larger unit and that degrees and minutes do not have decimals. decimal seconds are acceptable.
- For performing certain mathematical operations with angles, it is sometimes easier to convert to decimal degrees first, perform the necessary math, then convert back to degrees, minutes, and seconds.

degrees – minutes – seconds	**decimal degrees**
87° 58 '48"	87.980

- 87 + (58/60) + (48/3600) = 87.980

UNITS OF MEASUREMENT

- Unit of Angular Measurement

2) Hundreds System – Grad System (gons)

- 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)
- Notation;

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

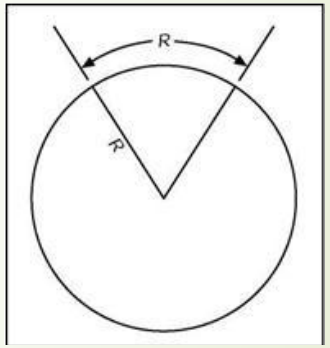
- 133.1932 g (133.1932 grad) 133g 19c 32cc

UNITS OF MEASUREMENT

- Unit of Angular Measurement

3) Radian

- A radian is the defined as the angle between radius lines from either end of an arc of radius length.



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

UNITS OF MEASUREMENT

- Relation of angular units;

$$\frac{b}{2\pi r} = \frac{a^0}{360^0} = \frac{a^g}{400^g}$$

$$\frac{b}{r} = \frac{a^0}{\rho^0} = \frac{a^g}{\rho^g}$$

$$\rho^g = \frac{200^g}{\pi} \qquad \rho^0 = \frac{180^o}{\pi}$$

$$\rho^c = \frac{200^g x 100^c}{\pi} \qquad \rho' = \frac{180^o x 60'}{\pi}$$

$$\rho^{cc} = \frac{200^g x 10000^{cc}}{\pi} \qquad \rho'' = \frac{180^o x 3600''}{\pi}$$

Kaynaklar

- Mualla Yalçınkaya, 2018, «Mühendisliğe Giriş» ders notları.
- *Fundamentals of Surveying: Sample Examination, George M. Cole PE PLS*
- *Basic Surveying, Raymond E Paul (Author), Walter Whyte*
- ITU DEPARTMENT OF GEOMATICS ENGINEERING