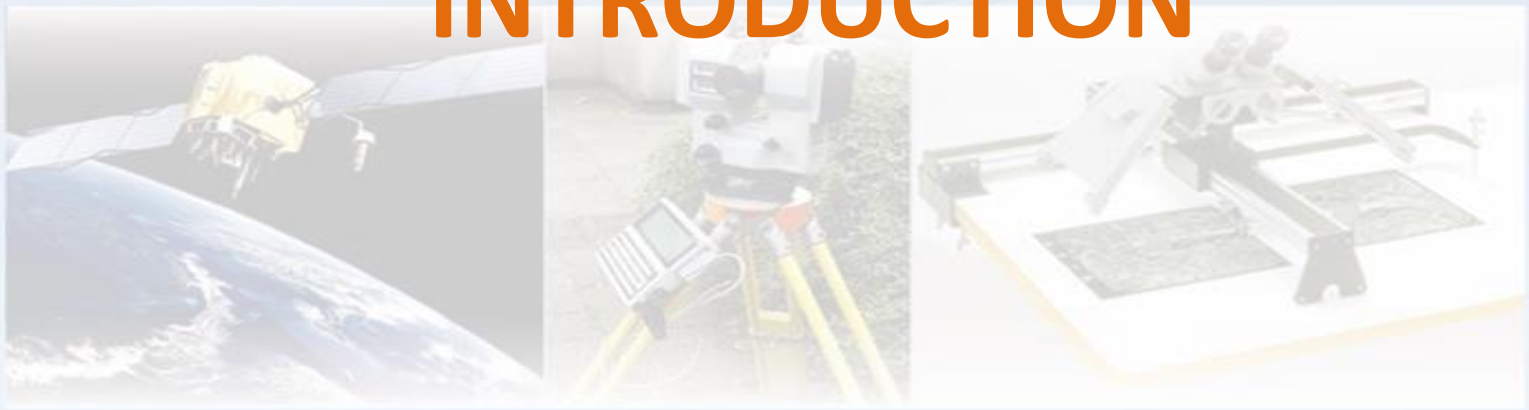
# CHAPTER 1

# INTRODUCTION



Surveying 1 / Dr. Najeh Tamim

CHAPTER 1

# INTRODUCTION

# 1.1 DEFINITION OF SURVEYING

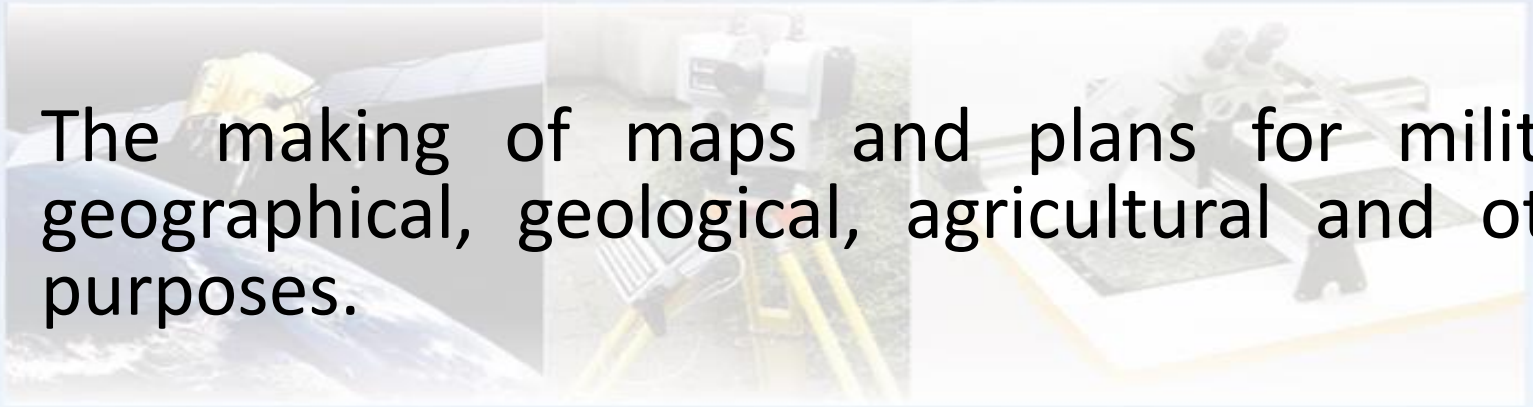
- In brief, surveying may be defined as earth measurements:
  - Lengths: distances in the horizontal direction and elevations in the vertical direction.
  - Angles: both horizontal and vertical angles.
  - Coordinates
- A more technical definition, surveying may be defined as the art and science of making and analyzing measurements made on, above or below the surface of the earth, and the processing of these measurements into some positional form such as maps and coordinates.

# 1.2 DEFINITION OF A SURVEYOR

The International Federation of Surveyors defined the surveyor as a professional person with the academic qualifications and technical expertise to practice the science of measurement; to assemble and assess land and geographic related information; to use that information for the purpose of planning and implementing the efficient administration of the land, the sea and structures thereon; and to instigate the advancement and development of such practices.

# 1.3 IMPORTANCE AND USES OF SURVEYING

- Locating and describing property boundaries for area measurement, dispute resolution between neighbors, etc.
- The preparation of plans associated with the work of the civil engineer, architect, builder and town planner.
- The making of maps and plans for military, geographical, geological, agricultural and other purposes.

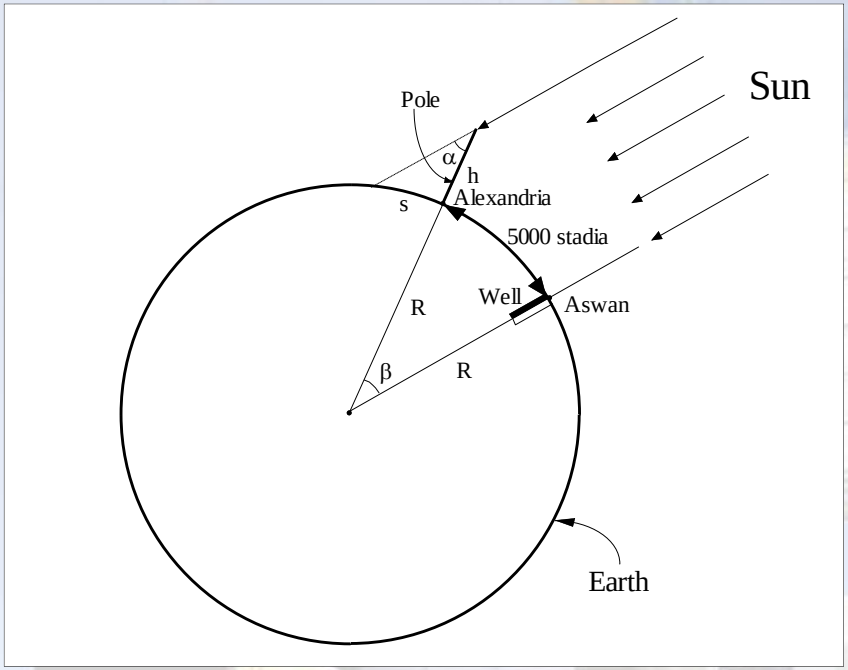


# 1.4 HISTORICAL CONNECTION BETWEEN CIVIL ENGINEERING AND SURVEYING

The tasks of civil engineering and surveying are very closely connected. Most projects need:

- A map for the design (e.g. a new road).
- Staking out on the ground.
- Guidance of the contractor through the construction phase.
- Long-term monitoring (the case of a dam).

# 1.5 THE FIGURE OF THE EARTH AND ITS RELATION TO SURVEY MEASUREMENTS



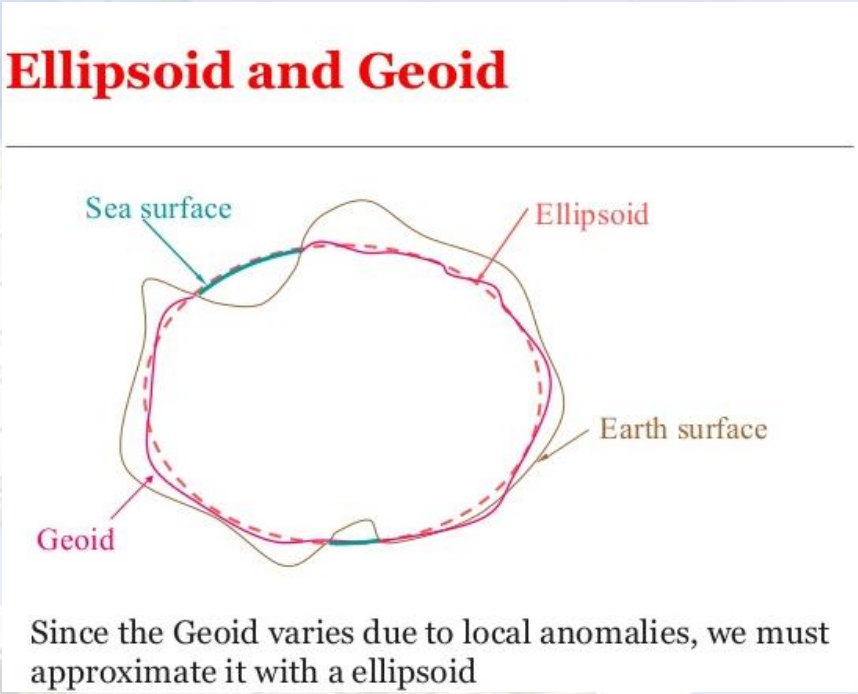
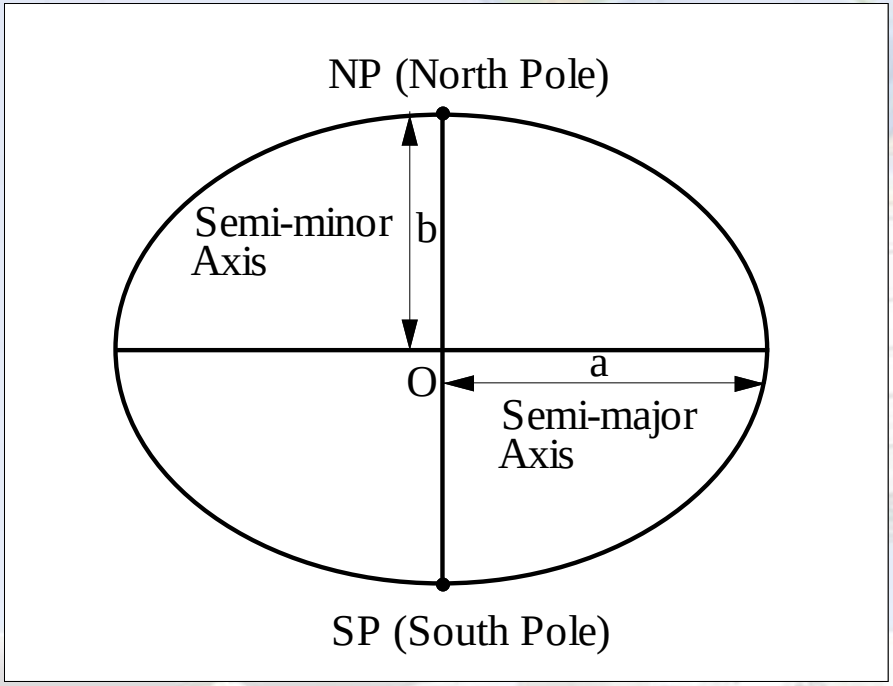




**FIGURE 1.1:** Eratosthenes method for measuring the earth's perimeter.




f: flattening = (a-b)/a
a = 6378135 m, b = 6356750.5 m,
f = 1/298.26,

**FIGURE 1.3:** Ellipsoid of revolution.

Earth as it is

↓

Geoid

Coincides with MSL (very complicated non-mathematical surface)

↓

Ellipsoid (Spheroid)

If ($A > 500\ km^2$)

↓

Sphere

If ($50\ km^2 < A < 500\ km^2$)

↓

Plane

If ($A < 50\ km^2$)

# 1.6 TYPES OF SURVEYING

- According to the size of the survey area:
  - Geodetic Surveying
  - Plane Surveying.
- According to method of surveying:
  - Ground Surveying
  - Remote Surveying

- According to the purpose of surveying:
  - Cadastral Surveying
  - Topographic Surveying
  - Hydrographic Surveying
  - Route Surveying
  - Construction Surveying
  - Mine Surveying
  - Military Surveying, etc.

# 1.7 UNITS OF MEASUREMENT

| Metric System | English System |
|---|---|
| **Length Measurements:** | |
| centimeter (cm), meter (m) & kilometer (km)<br>1 meter = 100 cm<br>1 kilometer = 1000 m | inch (in, "), foot (ft, '), yard (yd) & mile<br>1 foot = 12 inches<br>1 yard = 3 ft<br>1 mile = 5280 ft |
| **Area Measurement:** | |
| $m^2$, donum, hectare (ha) and $km^2$<br>1 donum = 1,000 $m^2$<br>1 hectare = 10,000 $m^2$<br>1 $km^2$ = 1,000,000 $m^2$<br>= 1000 donums<br>= 100 ha<br>1 Egyptain Acre = 4200.83 $m^2$<br>= 24 قيراط | $ft^2$, acre<br>1 acre = 43560 $ft^2$ |
| **Volume Measurement:** | |
| $cm^3$, liter, $m^3$<br>1 $m^3$ = 1,000,000 $cm^3$<br>1 $m^3$ = 1,000 liters | $in^3$, $ft^3$, $yd^3$<br>1 $ft^3$ = 1728 $in^3$<br>1 $yd^3$ = 27 $ft^3$ |

# *Units of Angle Measurement:*

- The Sexagesimal System (النظام الستيني). (D)
- The Decimal or Centesimal System (النظام العشري أو المئوي). (G)
- The Radian System (نظام الراديان). (R)

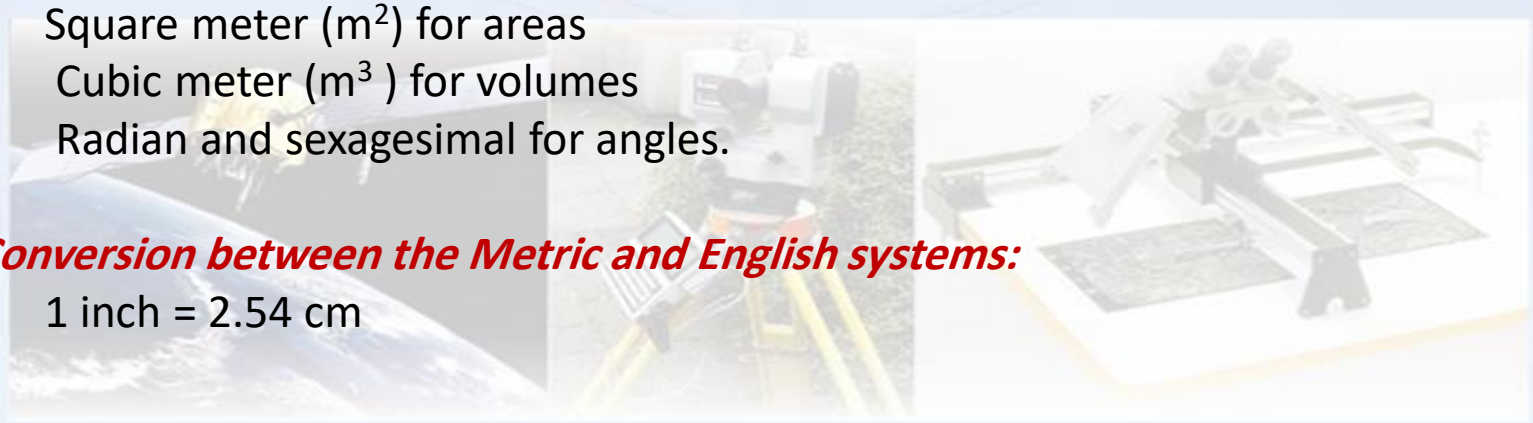
***International system of units:***

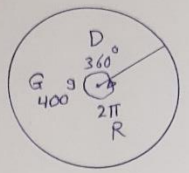
For simplicity, the following international units are used.

- Meter (m) for distances
- Square meter ($m^2$) for areas
- Cubic meter ($m^3$ ) for volumes
- Radian and sexagesimal for angles.

***Conversion between the Metric and English systems:***

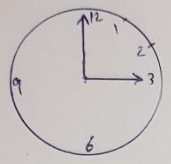
1 inch = 2.54 cm





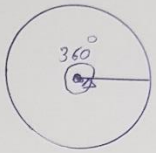

$1^h = 60^m$

$1^m = 60^s$




$9^h : 17^m\ 38^s$

$9 + \frac{17}{60} + \frac{38}{60 \times 60} = 9.2939^h$




$360^\circ$

$1^\circ = 60'$

$1' = 60''$

$\theta = 91^\circ\ 23'\ 48''$

$= 91 + \frac{23}{60} + \frac{48}{3600} = 91.3967^\circ$

---

$400^g$ , $1^g = 100^c$ , $1^c = 100^{cc}$

$389^g\ 14^c\ 92^{cc}$

$360^\circ \sim 400^g \sim 2\pi$

$\pi = 3.1415926544$

$\neq 3.14$

$\neq \frac{22}{7}$ ✗

$91.3967^\circ = 91.3967 * \frac{400}{360} = 105.5519^g = 105^g\ 55^c\ 19^{cc}$

$= 91.3967 * \frac{2\pi}{360} = 1.595$ radians

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$100' = \frac{100 * 12 * 2.50}{100} = 30.00$ m ✗

$100' = \frac{100 * 12 * 2.54}{100} = 30.48$ m ✓

# EXAMPLES:

**1) How many kilometers are there in a mile?**

**SOLUTION:**

1 mile = 5280 ft = 5280 x 30.48 cm $= \dfrac{5280 \text{ x } 30.48}{100 \text{ x } 1000} = 1.609344 \text{ km}$

**2) How many acres are there in a hectare?**

**SOLUTION:**

1 hectare = 10000 $m^2$ = 10000 x $\left(\dfrac{100}{30.48}\right)^2 ft^2$ = 10000 x $\left(\dfrac{100}{30.48}\right)^2$ x $\dfrac{1}{43560} = 2.471$ acres

**3) Change the angle 1.5 radians into its equivalent values in both the sexagesimal and centesimal systems.**

**SOLUTION:**

•Sexagesimal system:

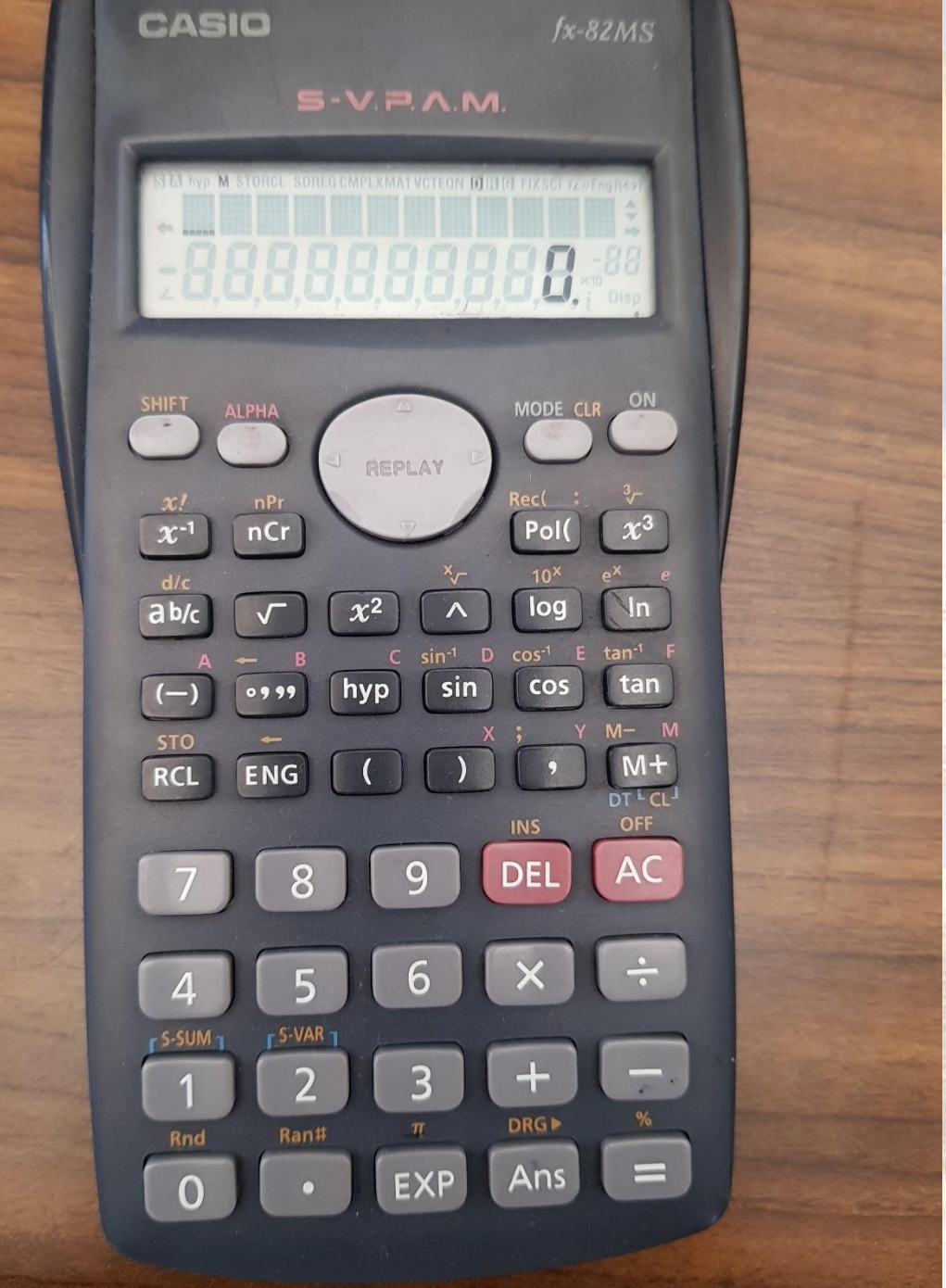
$2\pi = 360°$

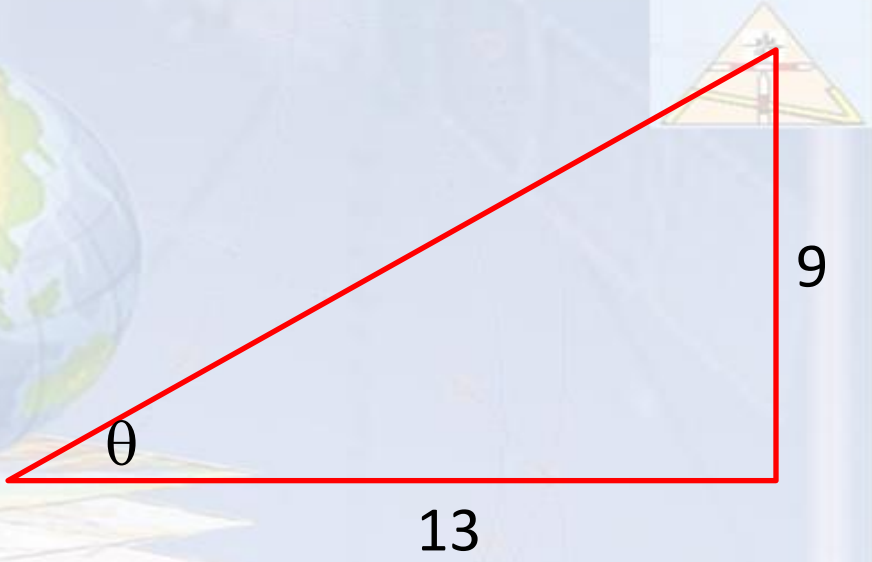
1.5 radians = ? $\Rightarrow \theta = \dfrac{1.5 \text{ x } 360}{2\pi} = 85^\circ\ 56'\ 37''$

•Centesimal system:

$2\pi = 400^g$

1.5 radians = ? $\Rightarrow \theta = \dfrac{1.5 \text{ x } 400}{2\pi} = 95^g\ 49^c\ 30^{cc}$




$$\theta = \tan^{-1}\frac{9}{13} = 34.6952°$$

$$= 34° \; 41' \; 43''$$

# 1.8 SCALE OF SURVEYS

- A map or plan might be defined as a reproduction, at a reduced ratio, of an orthographic projection of the terrain onto a reference horizontal datum plane.

- Factors affecting the choice of scale:
  - Size of area to be mapped (inversely proportional)
  - Size of the drawing paper (directly proportional)
  - Purpose of map.

# Examples on Map Scales

- Architectural works, building works, location drawings: 1/50, 1/100 and 1/200.
- Site plans, civil engineering works: 1/500, 1/1,000, 1/1250, 1/2,000 and 1/2,500.
- Town surveys, highway surveys: 1/1250, 1/2,000, 1/2,500, 1/5,000, 1/10,000, 1/20,000 and 1/50,000.
- Mapping: 1/25,000, 1/50,000, 1/100,000, 1/200,000, 1/500,000 and 1/1,000,000.

# 1.9 BASIC TRADITIONAL GEOMETRIC PRINCIPLES OF SURVEYING

Two principles:

- Working from The whole to the part.

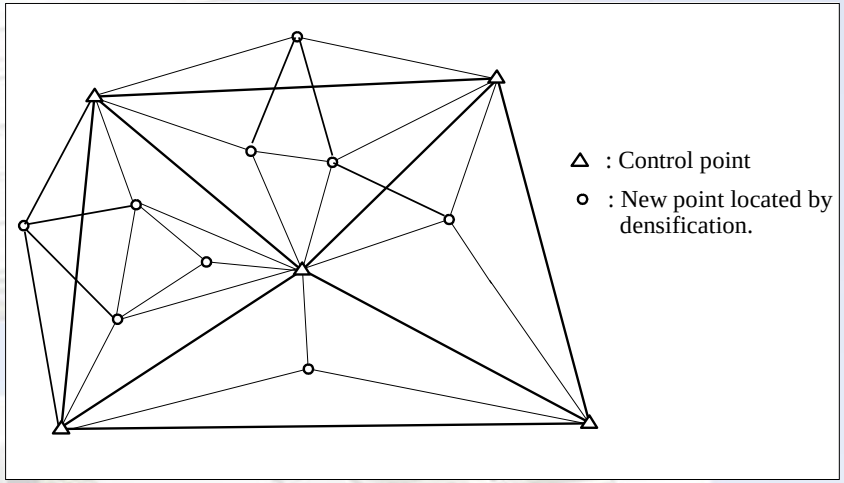



**FIGURE 1.4:** Working from the whole to the part.

- To locate a new point relative to a known line, two independent measurements are needed.
- These principles do not necessarily apply on GPS.

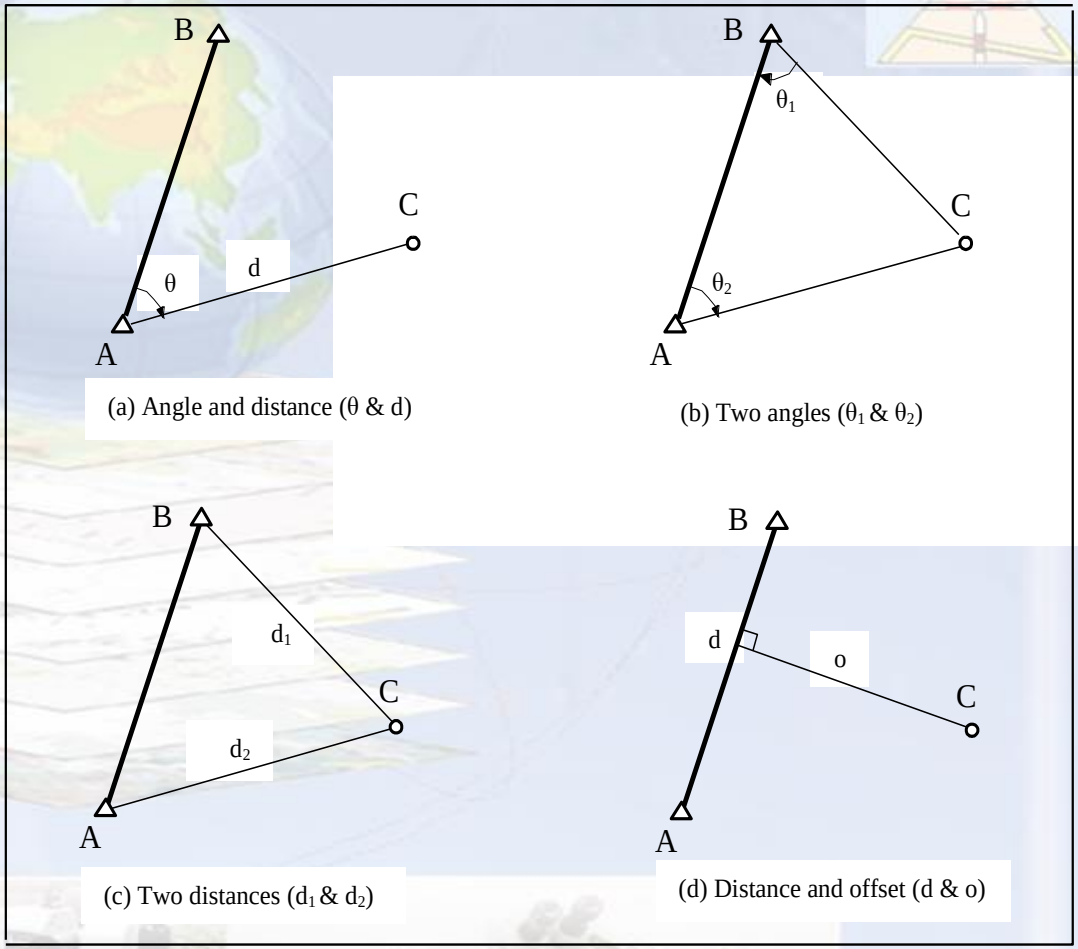



**FIGURE 1.5**: Methods of locating the position of an unknown point relative to a known line.