श्री अमोलक जैन विद्या प्रसारक मंडळाचे

श्रीमती शां. कां. गांधी कला, अमोलक विज्ञान व प. हि. गांधी वाणिज्य, महाविद्यालय कडा,

ता. आष्टी जिल्हा बीड ४१४२०२

भूगोल विभाग

प्रा. उध्दव एकनाथ चव्हाण

प्रात्यक्षिक भूगोल

Surveying:

- Definitions, Principle, Various types of Surveying, Based on methods and instruments.
- Classifications, Uses, Necessity and use of various Scales.
- Different types of Ranging, Tapes, Chains, Linear Measurements, Approximate, Direct, Optical and Electronic Methods, Chain Surveying, Minor Instruments for setting out right angle.

Surveying:

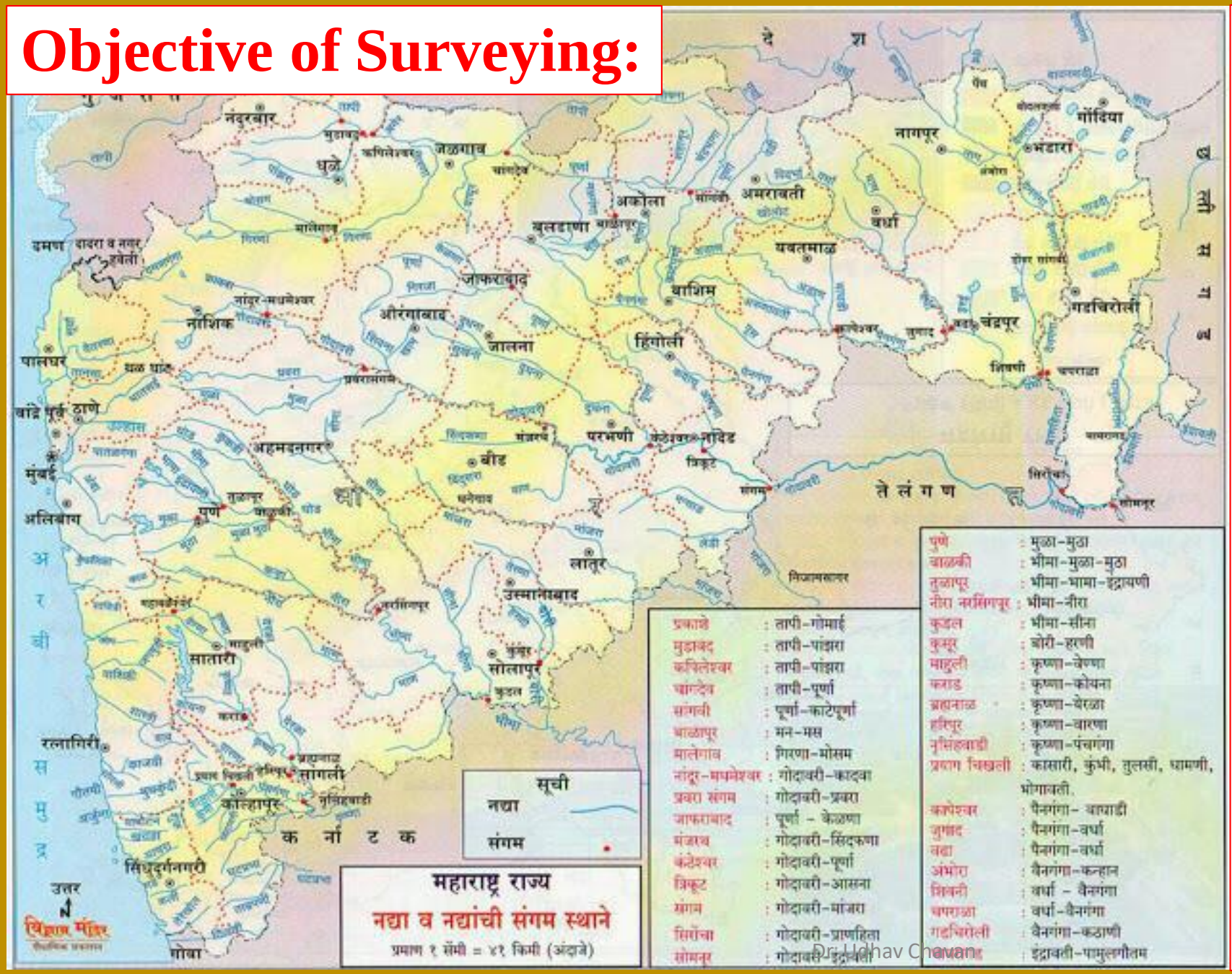
"Surveying is the art and science of determining the relative positions of various points or stations on the surface of the earth by measuring the horizontal and vertical distances, angles, and taking the details of these points and by preparing a map or plan to any suitable scale."

Surveying:

Objective of Surveying:

The object of surveying is to prepare a map or plan to show the relative positions of the objects on the surface of the earth. The map or plan is drawn to some suitable scale.

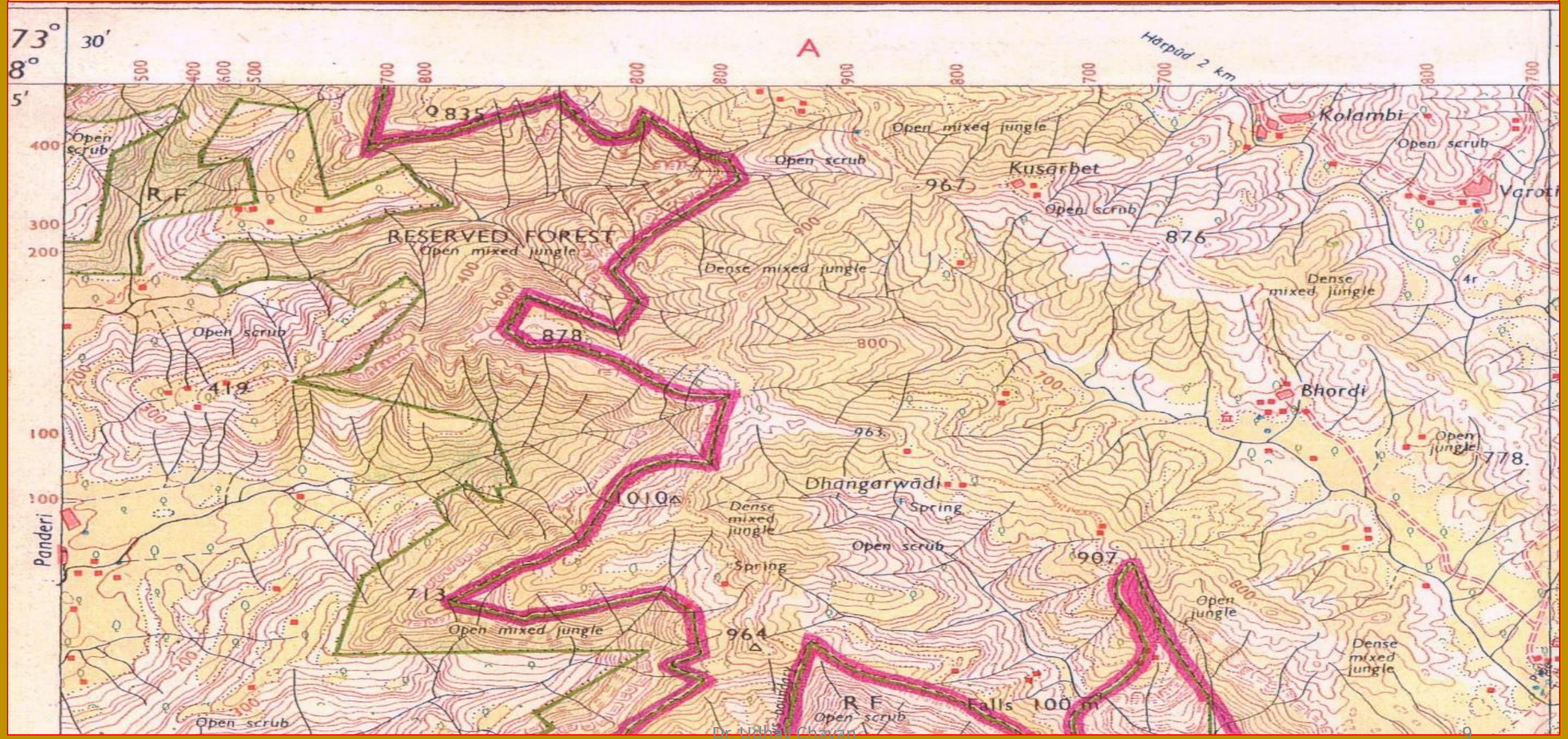
Objective of Surveying:



Uses of Surveying:

- The surveyingmay be used for purposes:
- To prepare a topographical map which shows hills, valleys, rivers, forests, villages, towns etc.
- To prepare a cadastral map which shows the boundaries of fields, plots, houses and other properties..
- To prepare an engineering map which shows the position of engineering works such as buildings, roads, railways, dams, canals.

Topographical Maps

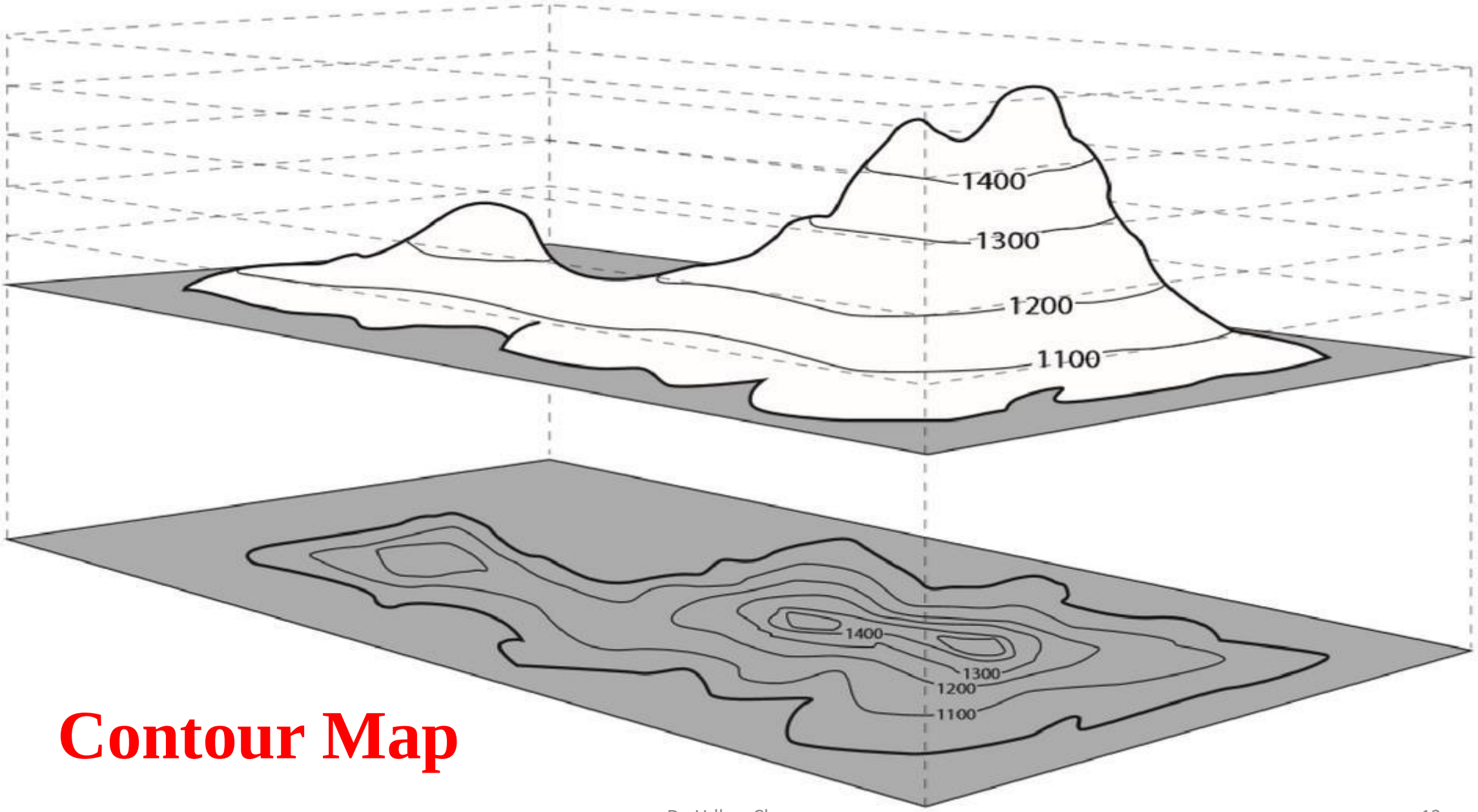


Cadastral Map:

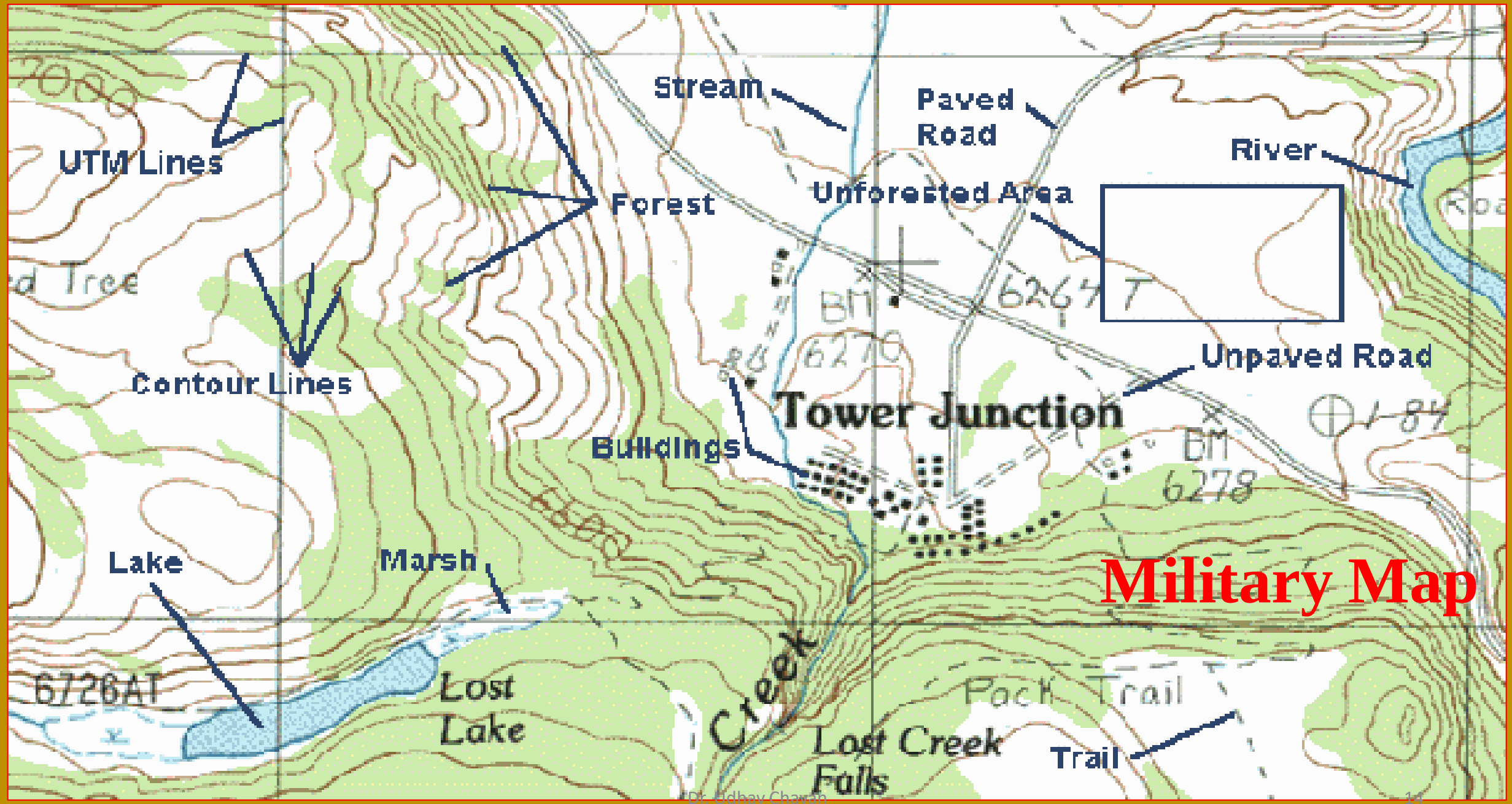
Engineering Map:

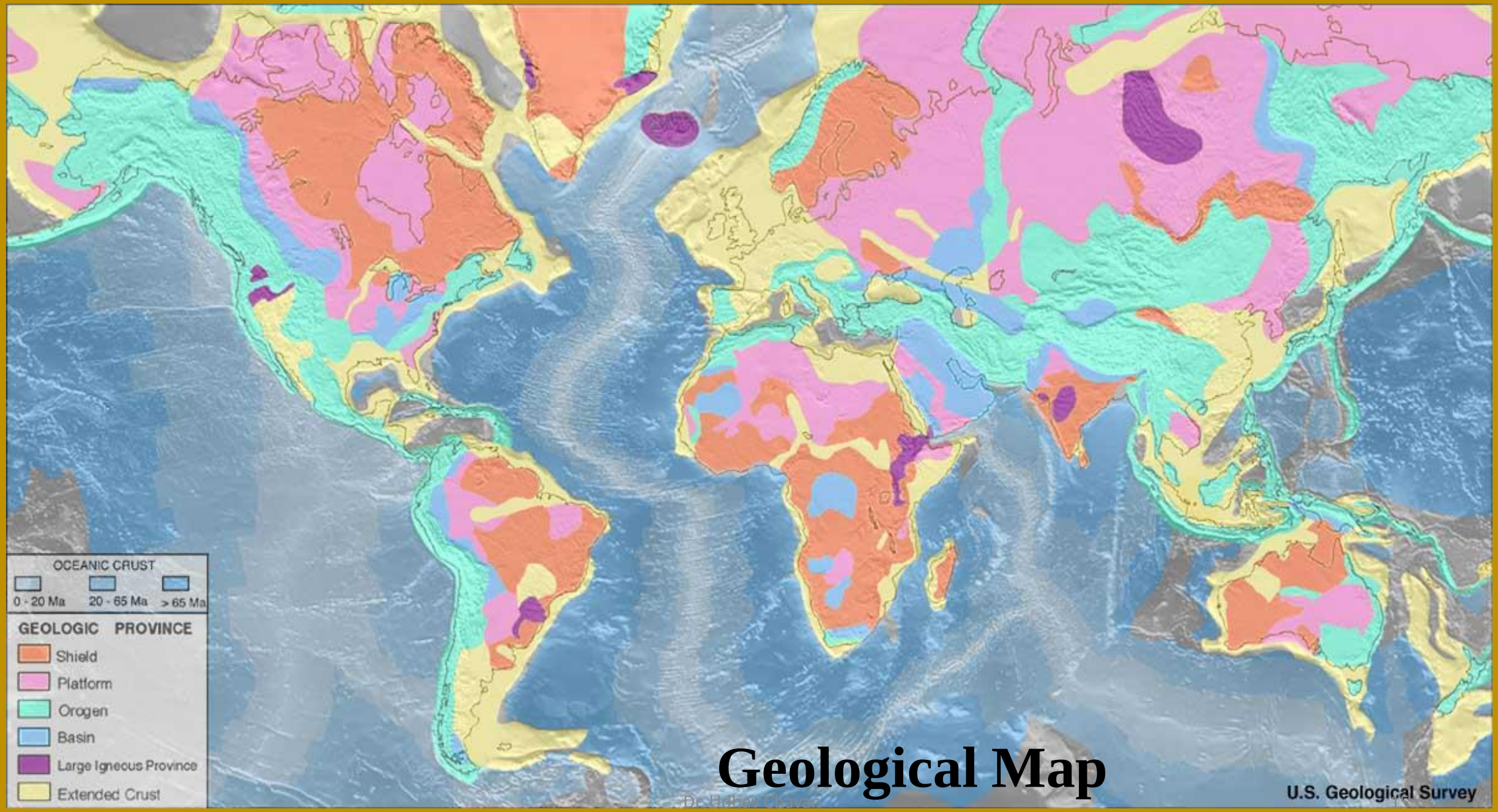
Uses of Surveying:

- To prepare a contour map to Know the topography of the area to find out the best possible site for roads, railways, bridges, reservoirs, canals, etc.
- Surveying is also used to prepare military map, geological map, archaeological map etc.
- For setting out work and transferring details from the map on the ground.

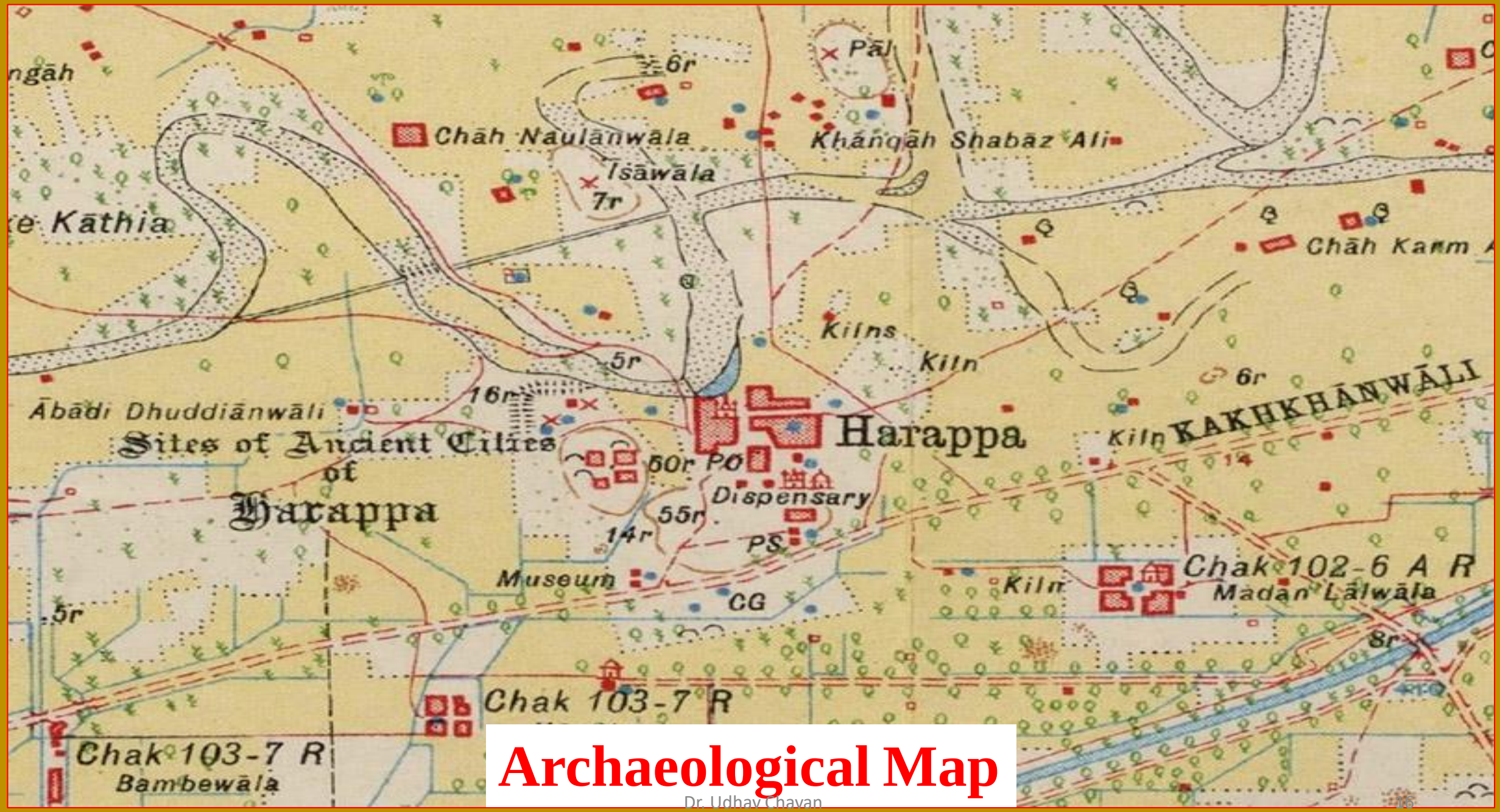


Contour Map


Stream
Paved Road
River
UTM Lines
Forest
Unforested Area
Contour Lines
Unpaved Road
Tower Junction
Buildings
Lake
Marsh
Military Map
Lost Lake
Creek
Lost Creek Falls
Trail



Geological Map



Archaeological Map

Primary Divisions of Surveying:

- We know that the shape of the earth is spheroidal. Thus the surface is obviously curved.

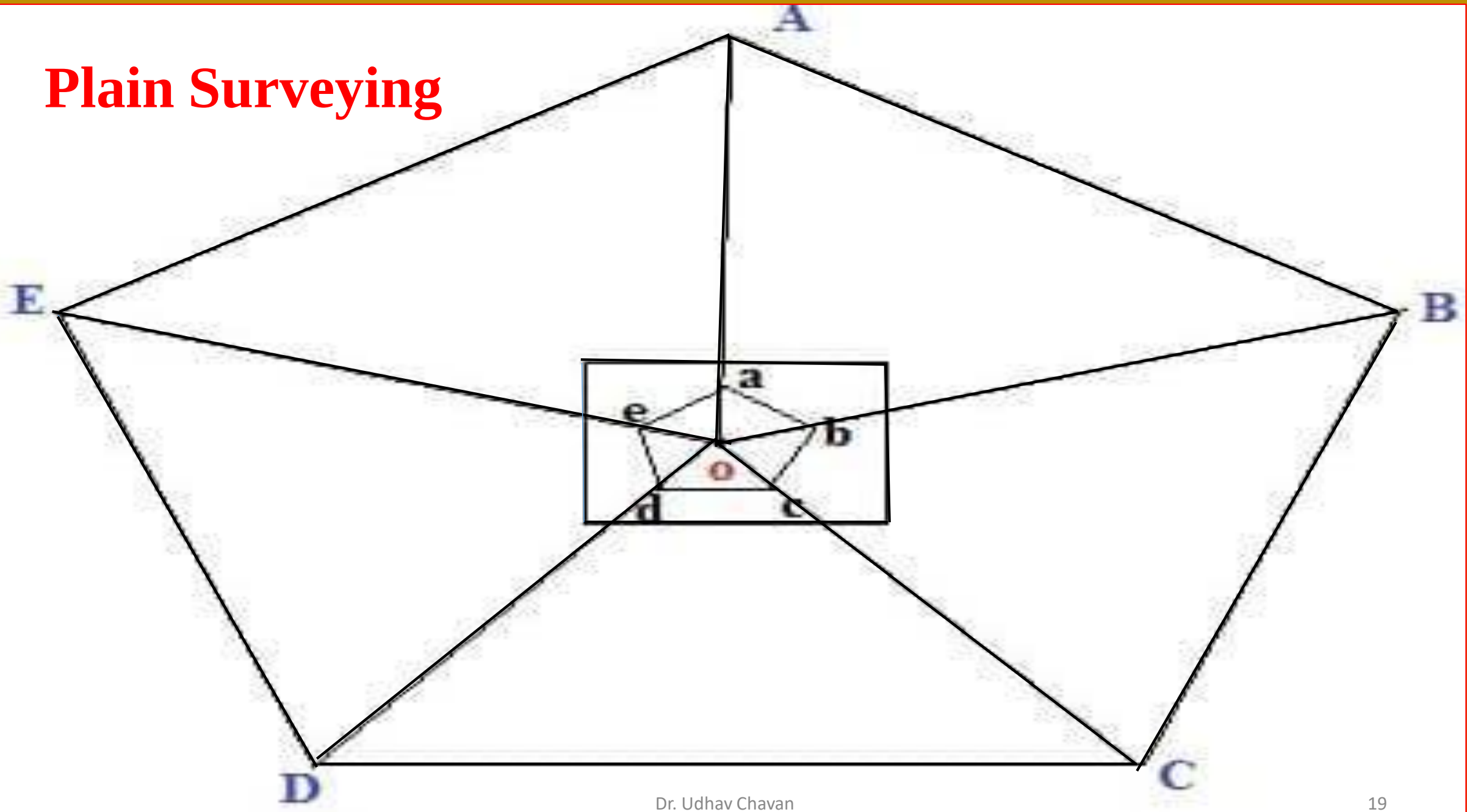
- Surveying is primarily divided into two types considering the curvature of the Earths surface.

- Plane Surveying:
- Geodetic Surveying:

❖Plain Surveying:

- The plain surveying is that type of surveying in which earth surface is considered as a plane and the curvature of the earth is ignored.
- In such surveying a line joining any two stations is considered to be straight.
- The triangle formed by any three points is considered as a plane triangle, and the angles of the triangle are considered as plain angles.
- Surveying is carried out for a small area of less than 250 km^2. It is carried out by local or state agencies like Land Record Department, Irrigation Department, Railway Department.

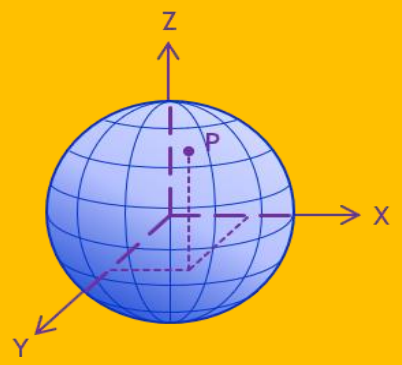
Plain Surveying



❖Geodetic Surveying:

- The geodetic Surveying is that type of surveying in which the curvature of the earth is taken into account.
- It is generally extended over larger areas.
- The line joining any two stations is considered as curved line.
- The triangle formed by any three points is considered to be spherical and the angles of the triangle are considered to be spherical angles.
- Geodetic surveying is conducted by the survey of India Department and is carried out for a larger area exceeding 250 $km^{2.}$

Plain Surveying

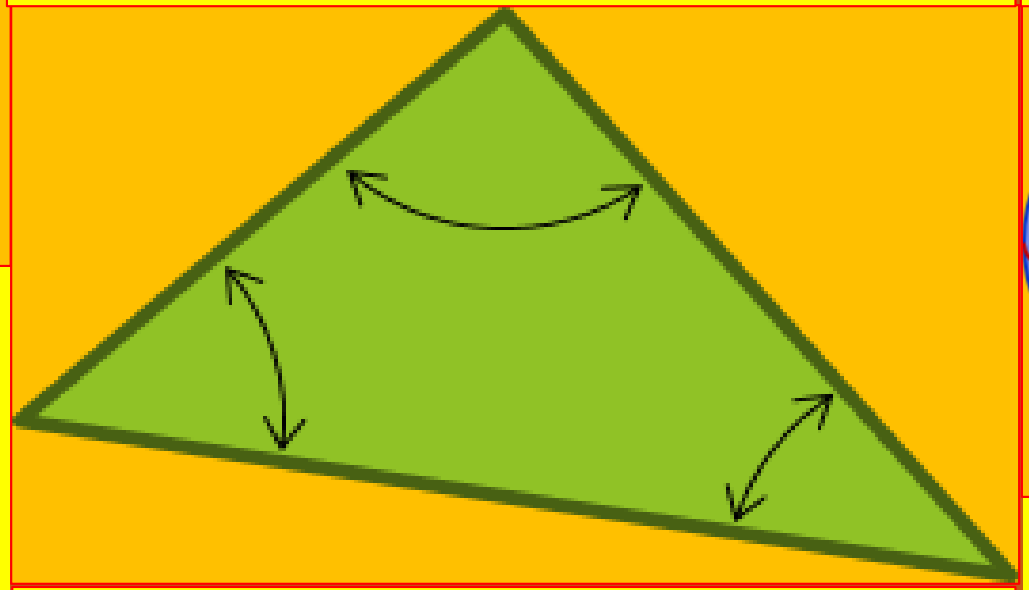


Two Dimensional

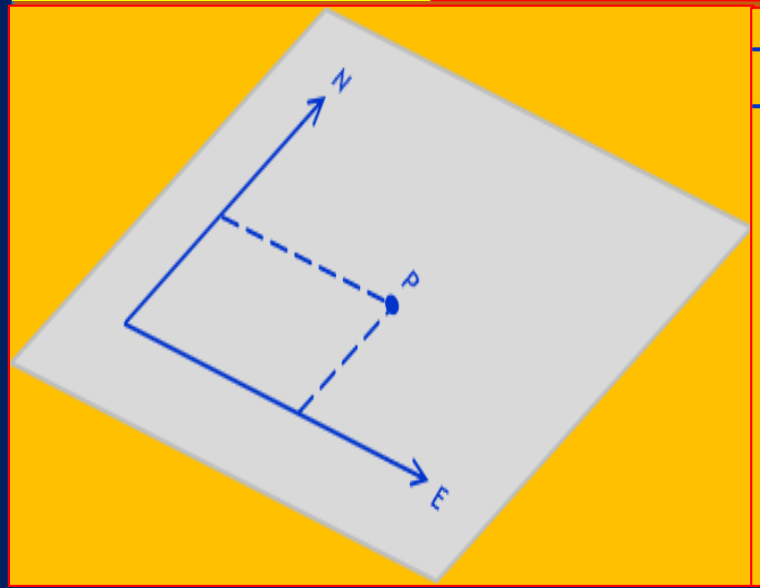
Σ(angles) =

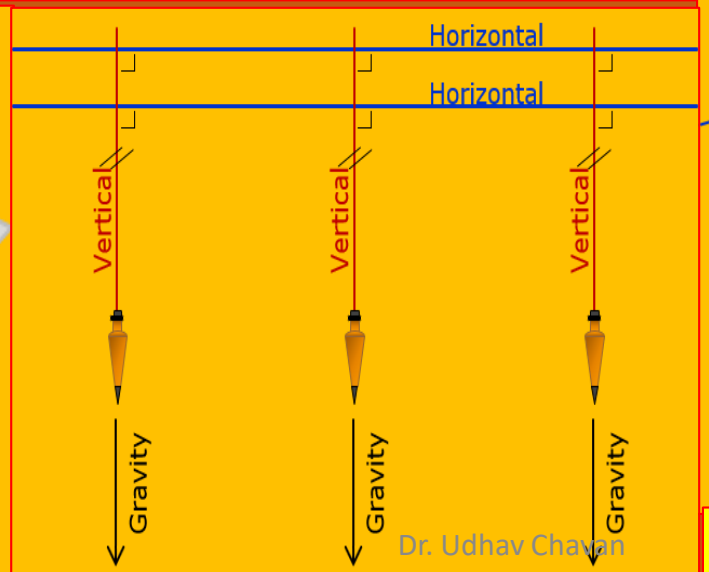
180°00’00”

Plane Triangle

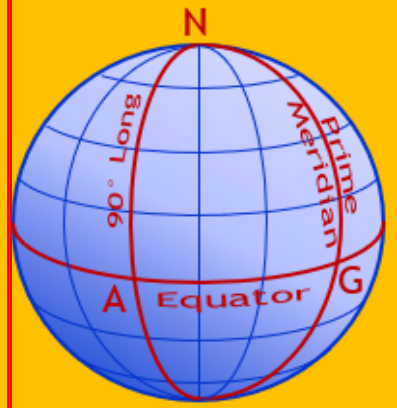


Vertical Lines in Plane Surveying

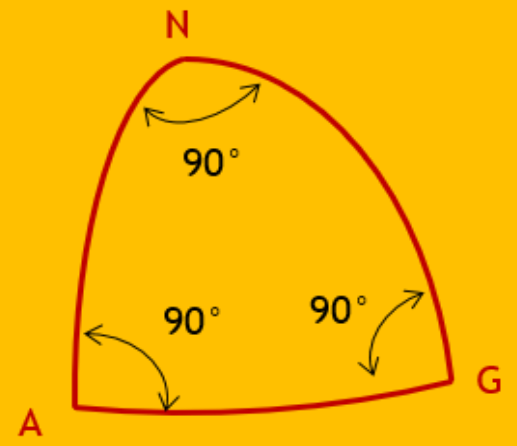




Geodetic Surveying

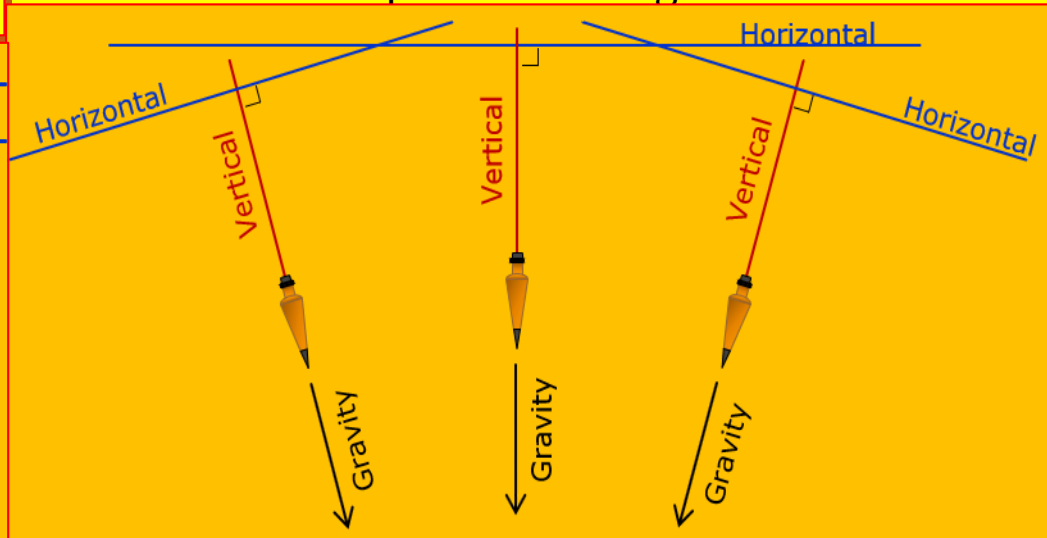


Three Dimensional



Σ(angles) = 270°00’00”

Spherical Triangle



Vertical Lines in Geodetic Surveying

Plain Surveying Vs Geodetic Surveying

No.	Plain Surveying	Geodetic Surveying
1	The earth surface is considered as plain Surface.	The earth surface is considered as Curved Surface.
2.	The Curvature of the earth is ignored	The curvature of earth is taken into account.
3	Line joining any two stations is considered to be straight	The line joining any two stations is considered as spherical.
4.	The triangle formed by any three points is considered as plain	The Triangle formed by any three points is considered as spherical.
5.	The angles of triangle are considered as plain angles.	The angles of the triangle are considered as spherical angles.
6.	Carried out for a small area < 250 km^2	Carried out for a small area > 250 km^2

Fundamental Principles of Surveying

- Two basic principles of surveying are:
- Always work from whole to the part,
- To locate a new station by at least two measurements

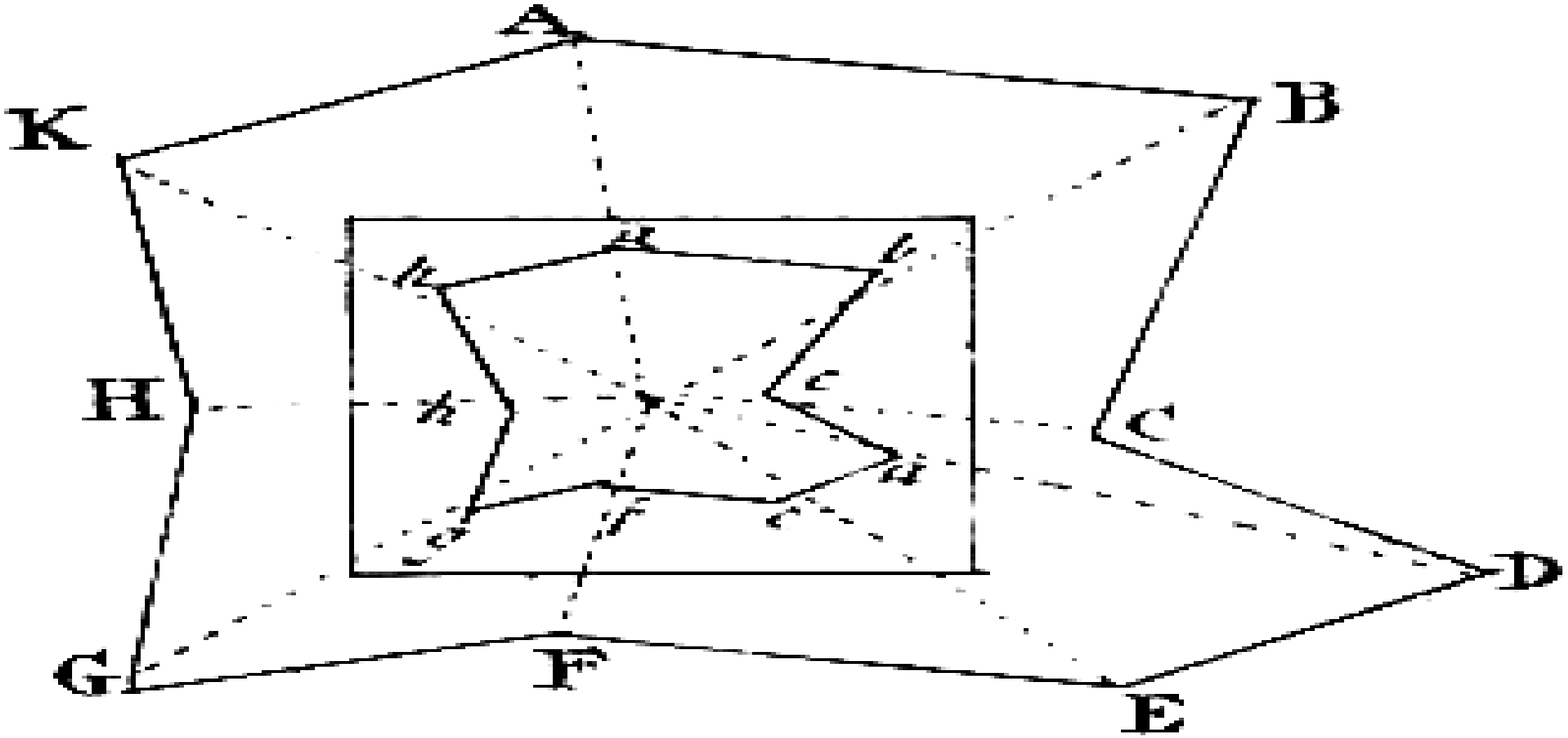
(Linear or Angular) from fixed reference points.

Fundamental Principles of Surveying

Always work from whole to the part:

- According to the first principle, the whole survey area is first enclosed by main stations (i.e.. Control stations) and main survey lines.
- The area is then divided into a number of divisions by forming well conditioned triangles.

Work from Whole to the Part



Fundamental Principles of Surveying:

- The main survey lines are measured very accurately with precise survey instruments.
- The remaining sides of the triangle are measured.
- The purpose of this method of working is to control accumulation of errors.
- During measurement, if there is any error, then it will not affect the whole work, but if the reverse process is followed then the minor error in measurement will be magnified.

Fundamental Principles of Surveying

- To locate a new station by at least two measurements (Linear or angular) from fixed reference points.
- According to the second principle the points are located by linear or angular measurement or by both in surveying.
- If two control points are established first, then a new station can be located by linear measurement. Let A & B are control points, a new point C can be established.

Fundamental Principles of Surveying

- Following are the methods of locating point C from such reference points A & B.
- The distance AB can be measured accurately and the relative positions of the point can be then plotted on the sheet to some scale.

A. Taking linear measurement from A and B for C.

B. Taking linear measurement of perpendicular from D to C.

C. Taking one linear measurement from B and one angular measurement as ∠ ABC.

- Taking two angular measurement at A & B as angles ∠CAB and ∠ABC.
- Taking one angle at B as ∠ABC and one linear measurement from A as AC.

Fundamental Principles of Surveying

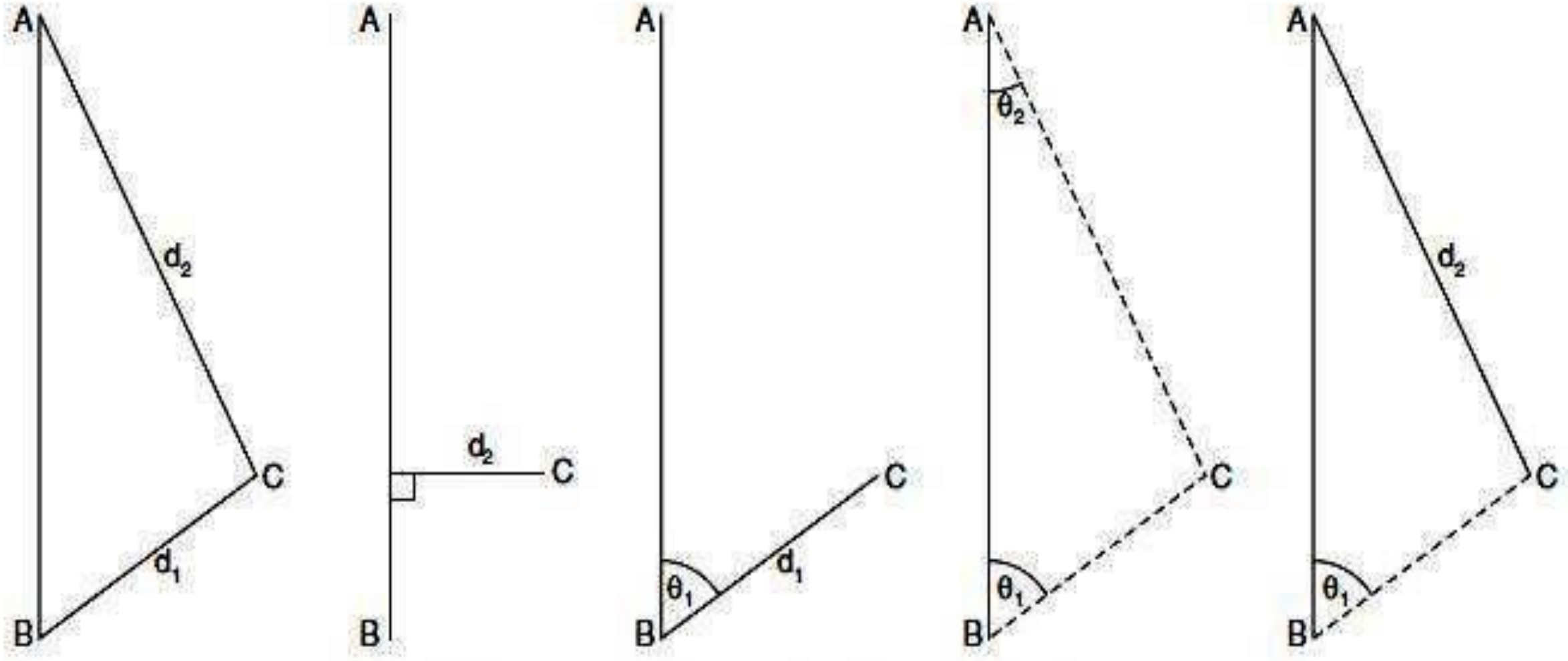


Fig. 11.3. Locating point C w.r.t. points A and B

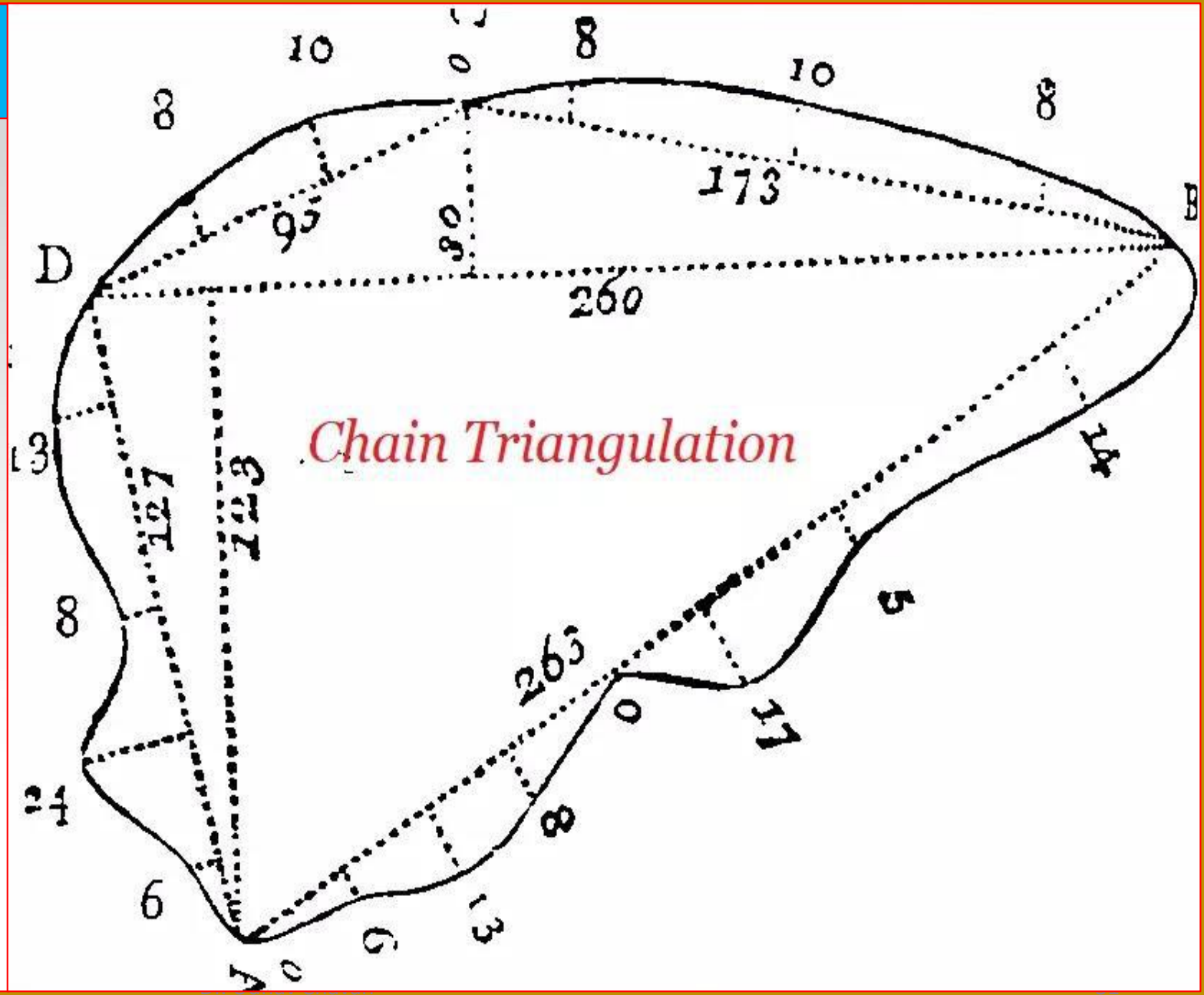
Classification of Surveying

- Survey can be classified into various categories depending on methods used and nature of the field.
- Classification Based on Instruments.

1. Chain Survey:

- This is the simplest type of surveying in which only linear measurements are made with a chain or a tape. Angular measurements are not taken.

Chain Survey

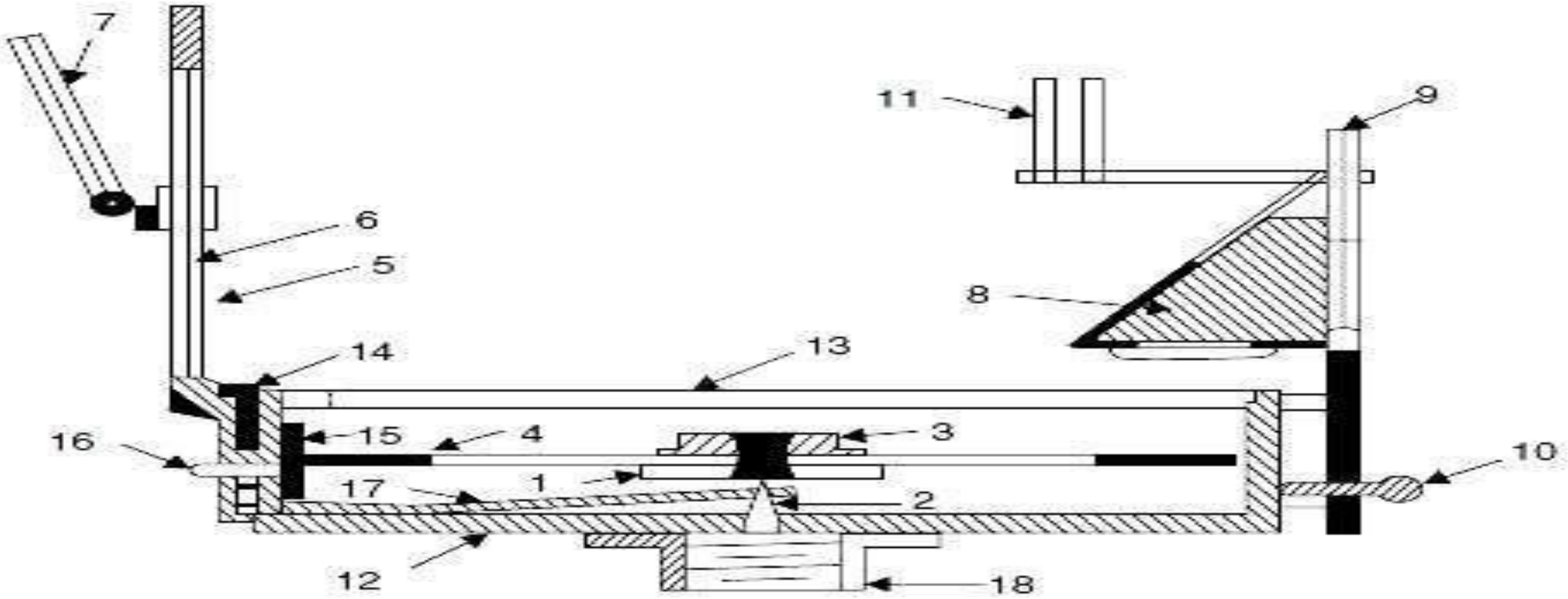


Classification of Surveying

2. Compass Survey:

- In Compass Survey, the angles are measured with the help of a magnetic compass.
- **Chain and compass survey:**
- In this survey linear measurements are made with a chain or a tape and angular measurements with a compass.

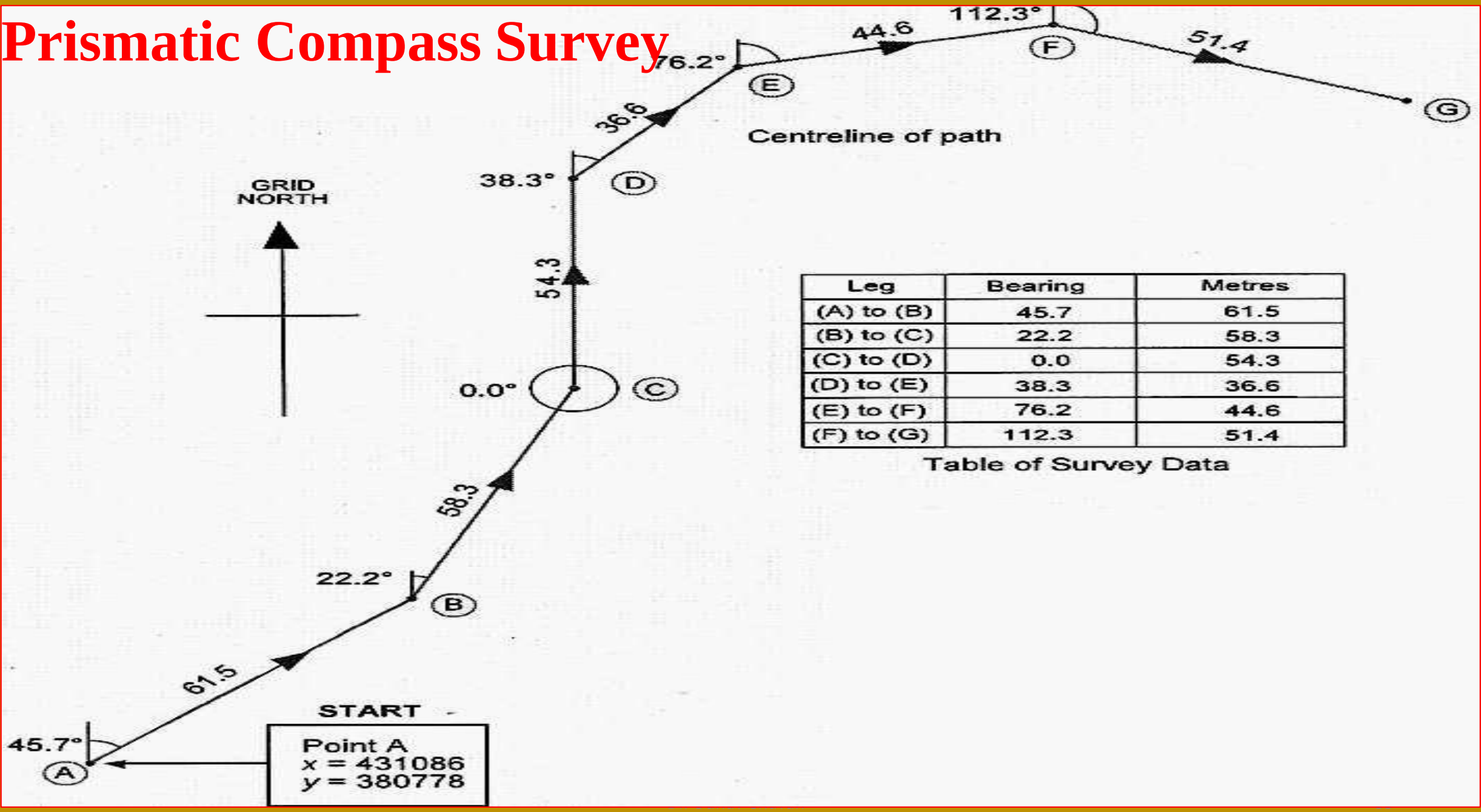
Compass Survey



1. Needle
2. Pivot
3. Agate cap
4. Graduated disc
5. Slit metal frame
6. Horse hair
7. Mirror
8. Reflecting prism with cap
9. Eye vane
10. Focussing stud
11. Dark sunglasses
12. Box
13. Glass cover
14. Lifting pin
15. Light spring
16. Brake pin or knob
17. Lifting lever
18. Support to fit on tripod

Fig. 13.1. Prismatic compass

Prismatic Compass Survey



Leg	Bearing	Metres
(A) to (B)	45.7	61.5
(B) to (C)	22.2	58.3
(C) to (D)	0.0	54.3
(D) to (E)	38.3	36.6
(E) to (F)	76.2	44.6
(F) to (G)	112.3	51.4

Table of Survey Data

Classification of Surveying

3. Plane Table Surveying

- It is a graphical method of surveying in which field works and plotting both are done simultaneously.

4. Theodolite Survey:

- In theodolite survey the horizontal angles are measured with the theodolite more precisely than compass and the linear measurements are made with a chain or tape.

Plane Table Surveying

Plane Table Surveying

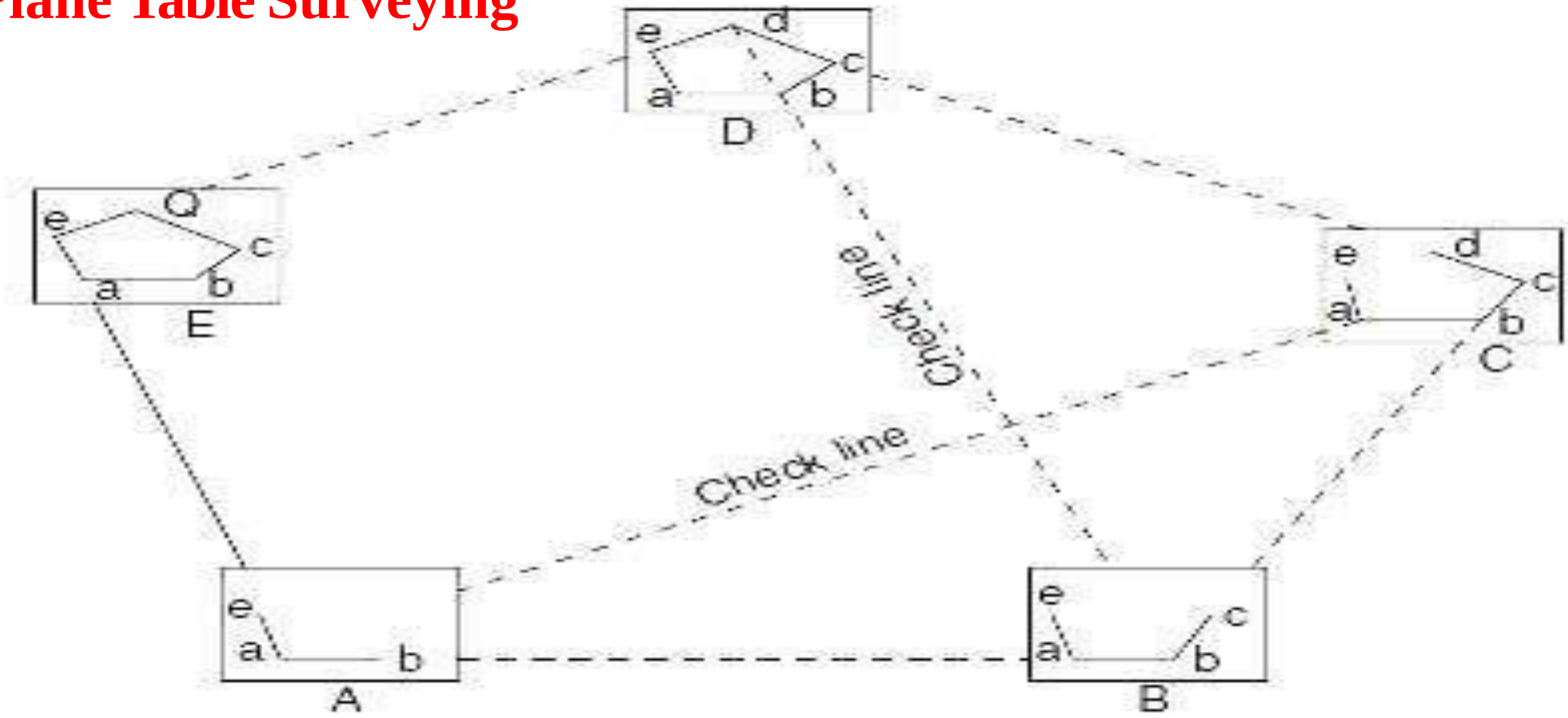


Fig. 14.9. Plane table traversing

Classification of Surveying

❖Classification Based on methods.

1. Triangulation:

➢Triangulation is basic method of surveying, when the area to be surveyed is large, triangulation is adopted. The entire area is divided into network of triangles.

2. Traversing:

➢A Traversing is circuit of survey lines. It may be open or closed. When the linear measurements are done with a chain and a tape and the directions or horizontal angles are measured with a compass or a theodolite respectively the survey is called traversing.

Triangulation

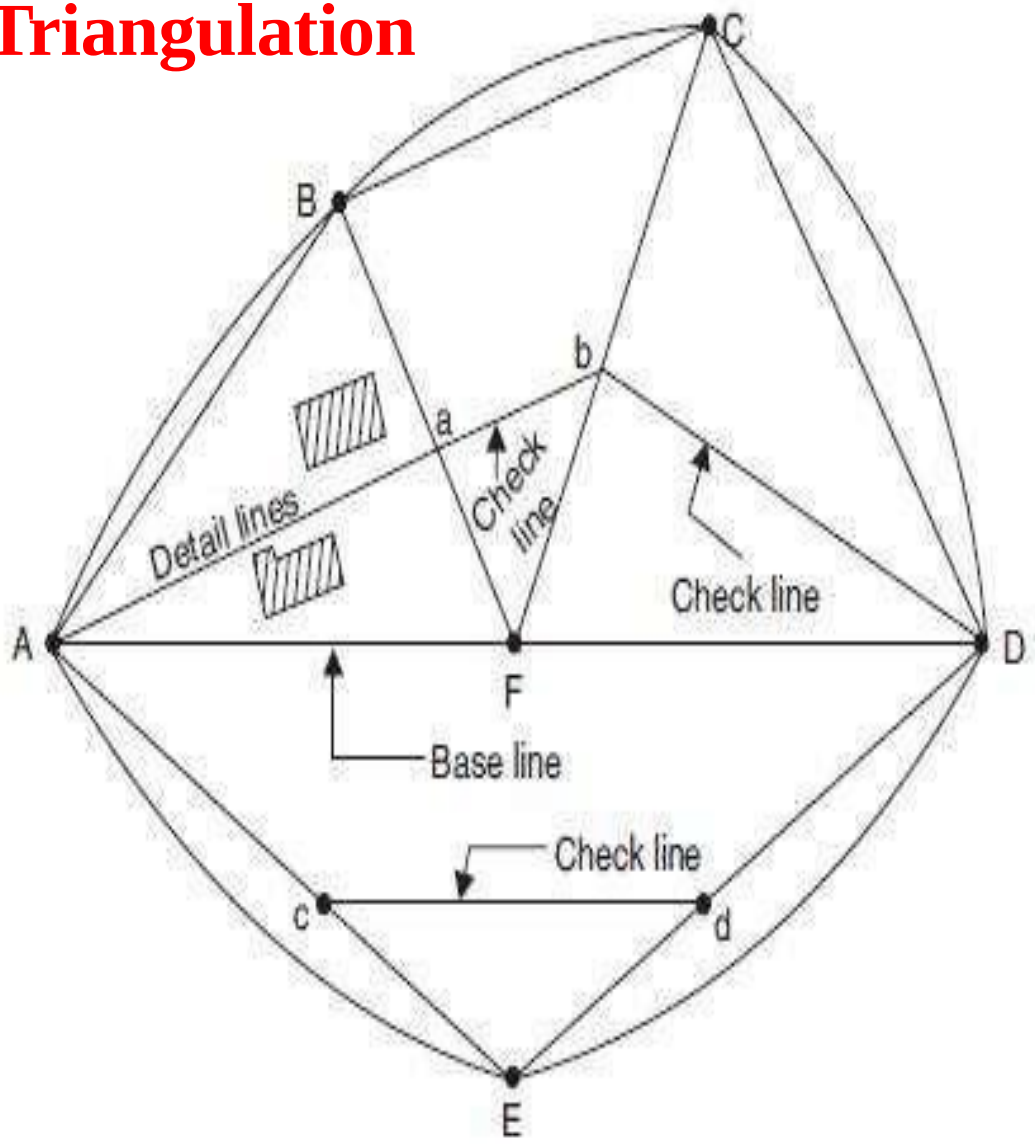
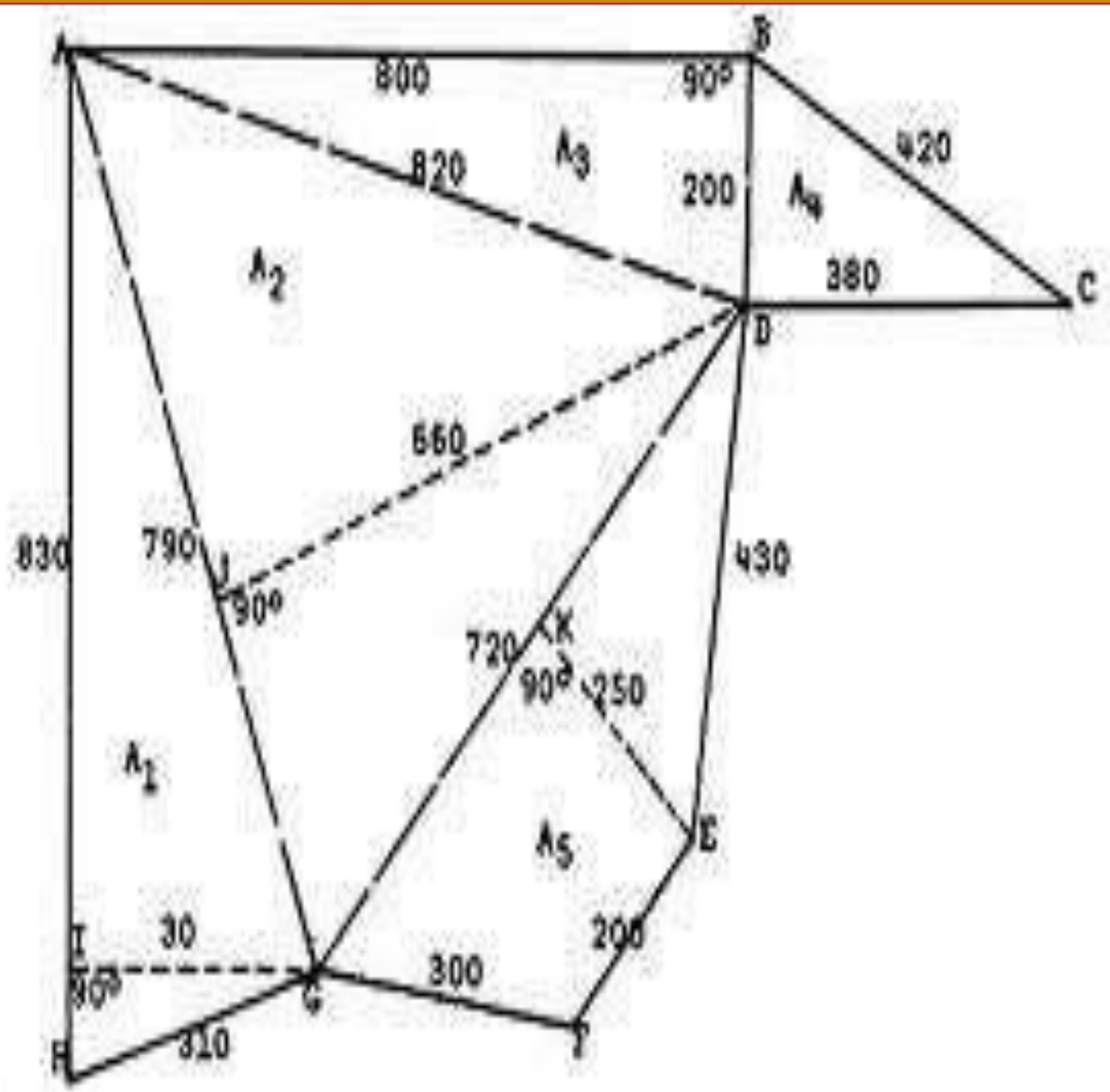
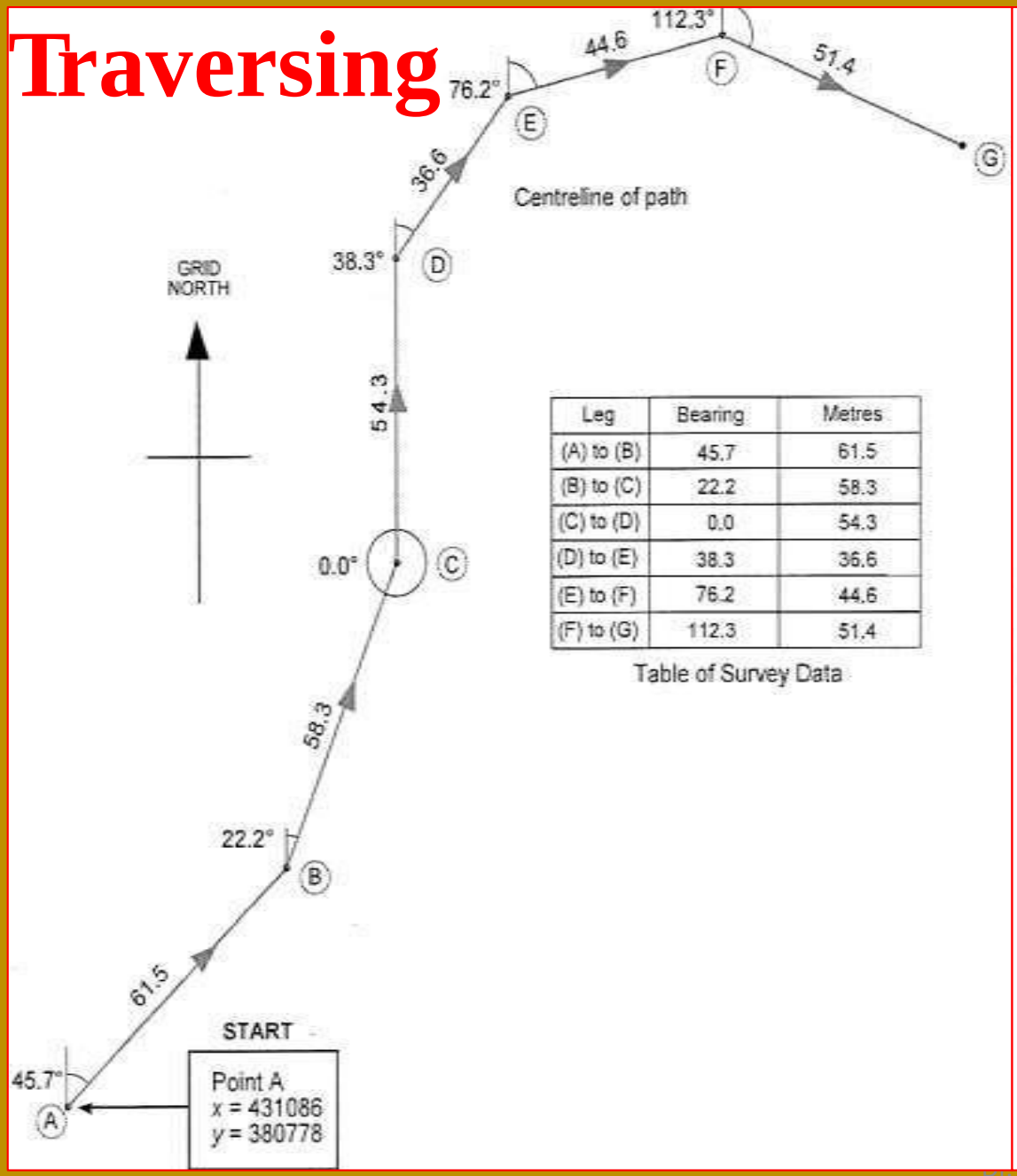


Fig. 12.11. Network of triangles



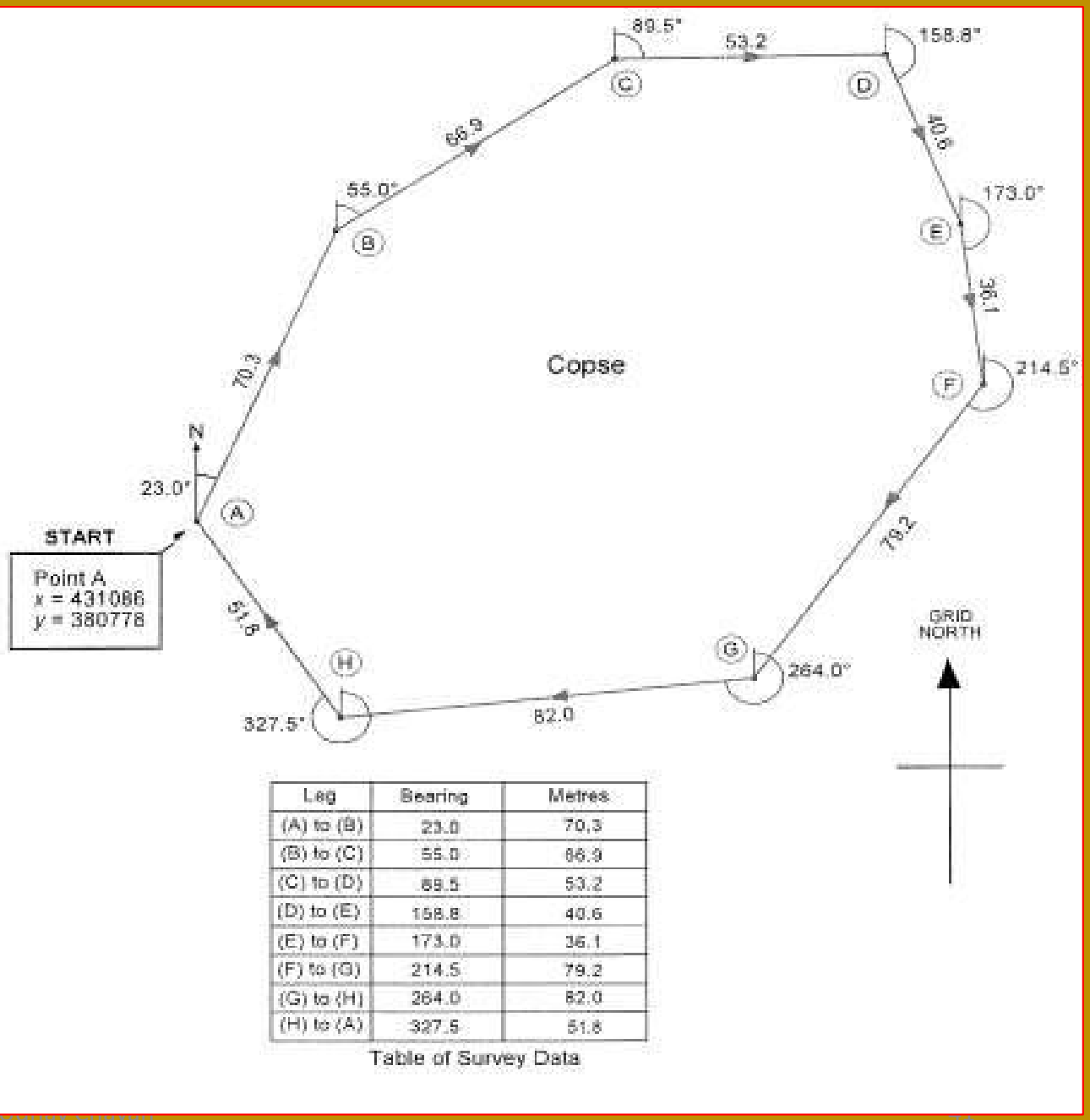
Traversing



Centreline of path

Leg	Bearing	Metres
(A) to (B)	45.7	61.5
(B) to (C)	22.2	58.3
(C) to (D)	0.0	54.3
(D) to (E)	38.3	36.6
(E) to (F)	76.2	44.6
(F) to (G)	112.3	51.4

Table of Survey Data



Leg	Bearing	Metres
(A) to (B)	23.0	70.3
(B) to (C)	55.0	66.9
(C) to (D)	89.5	53.2
(D) to (E)	158.8	40.6
(E) to (F)	173.0	36.1
(F) to (G)	214.5	79.2
(G) to (H)	264.0	82.0
(H) to (A)	327.5	51.8

Table of Survey Data

Plan and Maps

- One of the basic objective of surveying is to prepare Plans and Maps.

1. Plan:

- A plan is the graphical representation to some scale, of the features on, near or below the surface of the earth as projected on a horizontal plane.
- The horizontal plane is represented by plane of drawing sheets on which the plan is drawn to some scale However the surface of the earth is curved it cannot be truly represented on a plane without distortion.
- In plane surveying the area involved are small, the earth's surface may be considered as plane and hence plan is constructed by orthographic projections. A plan is drawn on a relatively large scale.

Plan and Maps

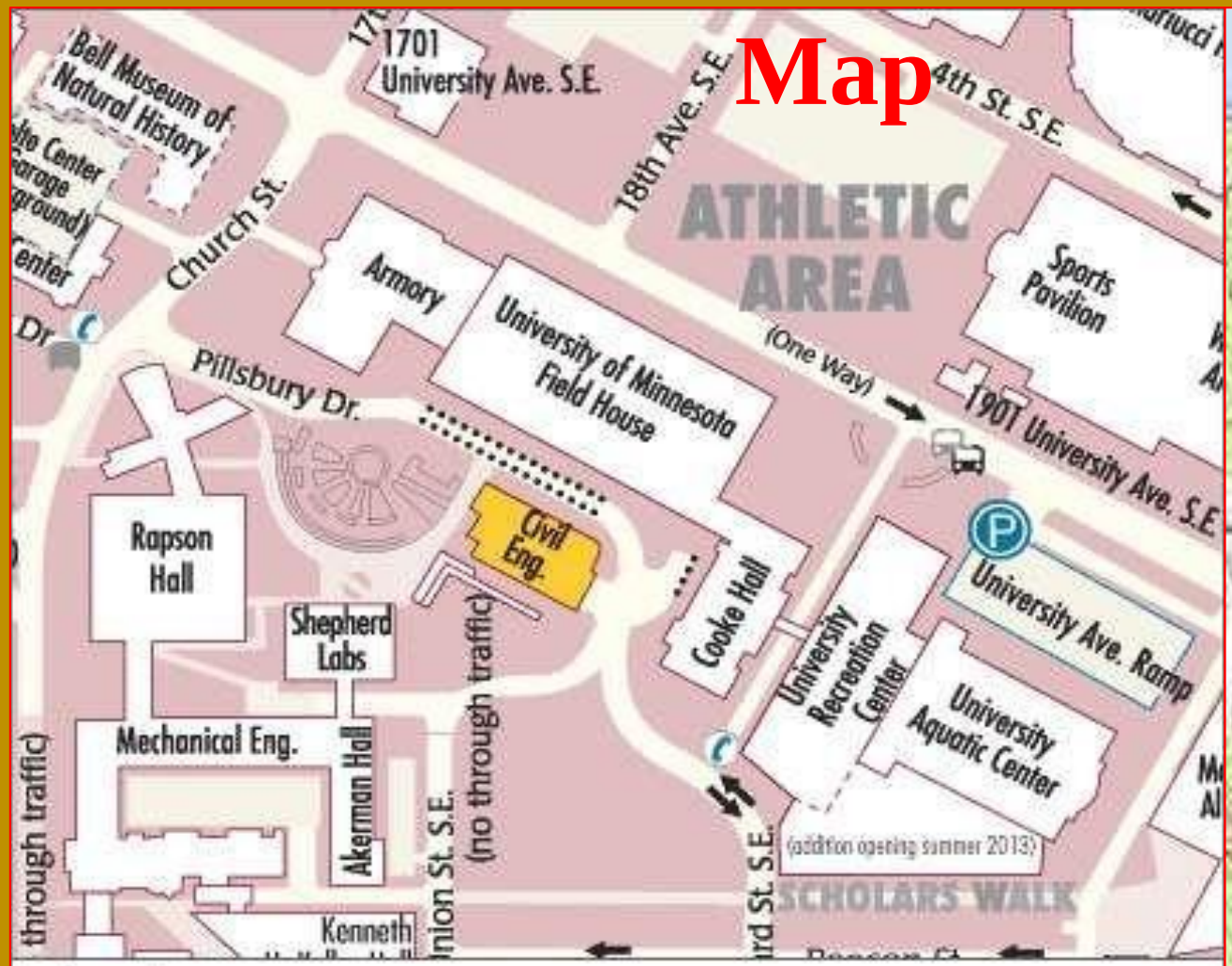
2. Map

- If the scale of the graphical projection on a horizontal plane is small, the plan is called a map. Thus graphical representation is called a plan if the scale is large while it is called a map if the scale is small.
- On plan, generally only horizontal distances and directions or angles are shown. On topographical map, however the vertical distances (elevations) are also represented by contour lines.

Master Plan


RESIDENTIAL ENTRY & EXIT
OFFICE BUILDING
OFFICE ENTRY & EXIT
DROP OFF
RESIDENTIAL BUILDING
PARK & OPEN SPACE
18M WIDE ROAD
1
2
3
4
5
6
7
8

Map


Bell Museum of Natural History
1701 University Ave. S.E.
18th Ave. S.E.
4th St. S.E.
ATHLETIC AREA
Church St.
Armory
University of Minnesota Field House
Sports Pavilion
Pillsbury Dr.
(One Way)
1901 University Ave. S.E.
Rapson Hall
Civil Eng.
Cooke Hall
University Recreation Center
University Aquatic Center
University Ave. Ramp
Shepherd Labs
Mechanical Eng.
Akerman Hall
(addition opening summer 2013)
SCHOLARS WALK
(no through traffic)
through traffic)
Kenneth
Legend:
Freshman Admissions Welcome Center
Transfer & International Admissions Welcome Center
Information centers
Major intercampus bus stops with connections to intracampus circulators
Meter parking
Public parking
Public parking (events only)
Code blue emergency telephones


SPILLWAY 697
Pilarcitos Lake
28
BM 704

Plan and Maps

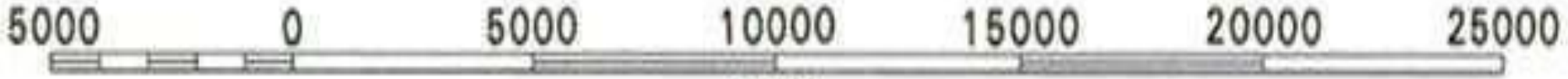
❖ Scale

- It is basic requirement for the preparation of plan or map Scale is used to represent large distances on paper.
- The ratio by which the actual length of the object is reduced or increased in the drawing is known as the **"Scale"** for example.
- If 1 cm. on a map represents a distance of 10 meters on the ground, the scale of the map is said to be 1 cm = 10 meters.

SCALE 1:100 000

KILOMETRES

MILES



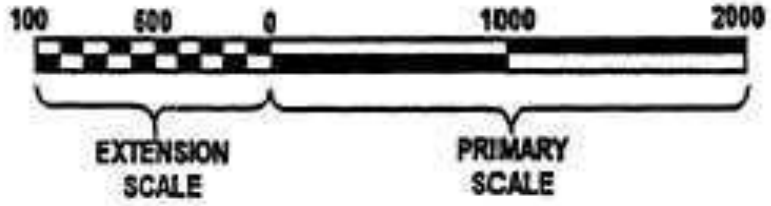
FEET

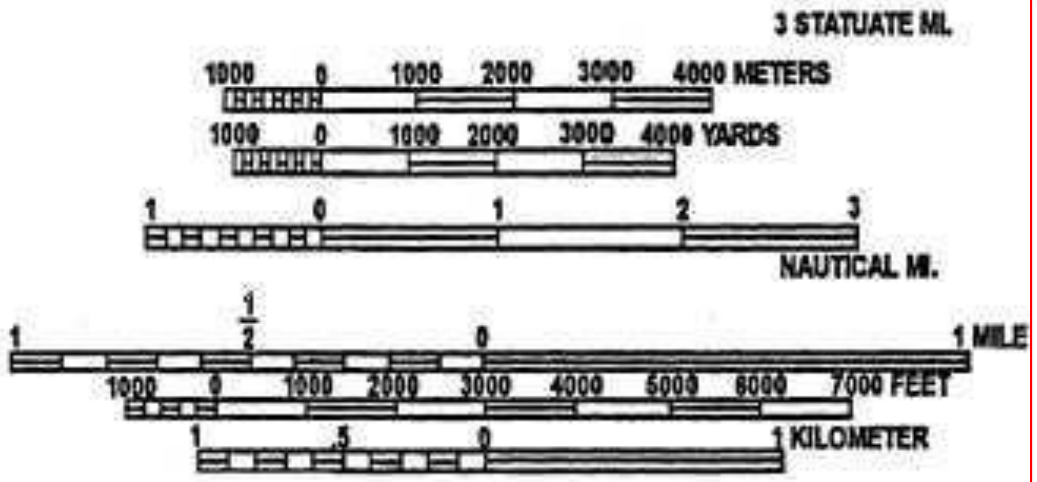
CONTOUR INTERVAL 50 METRES

NATIONAL GEODETIC VERTICAL DATUM OF 1929

FRACTIONAL METHOD		EQUATION METHOD
1/1	FULL SCALE	12" = 1'-0"
2/1	ENLARGE SCALE	24" =1'-0"
1/2	REDUCED SCALE	1/2" = 1'-0"

GRAPHIC METHOD





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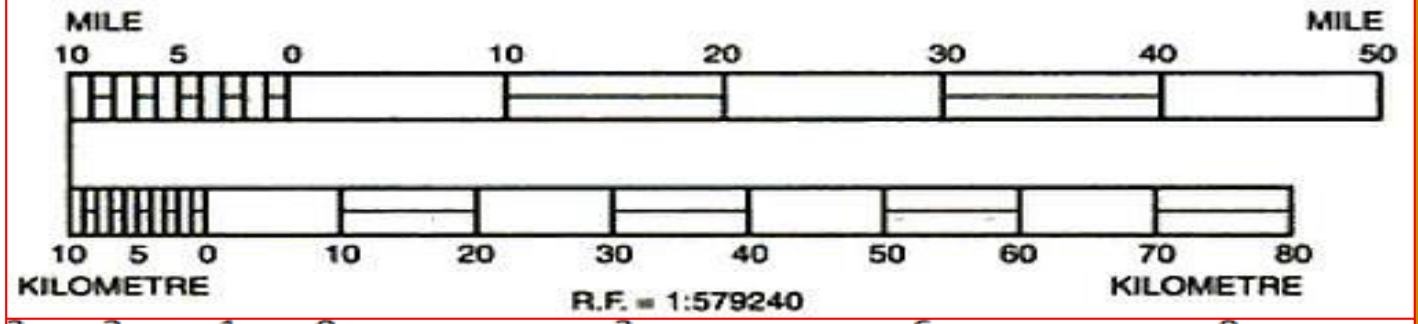
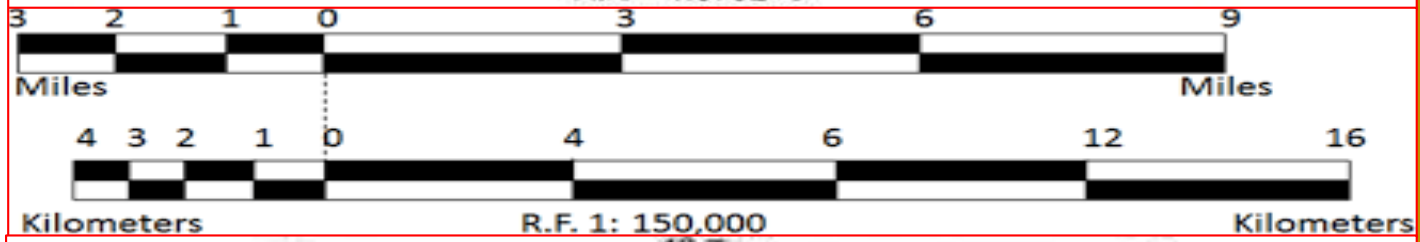




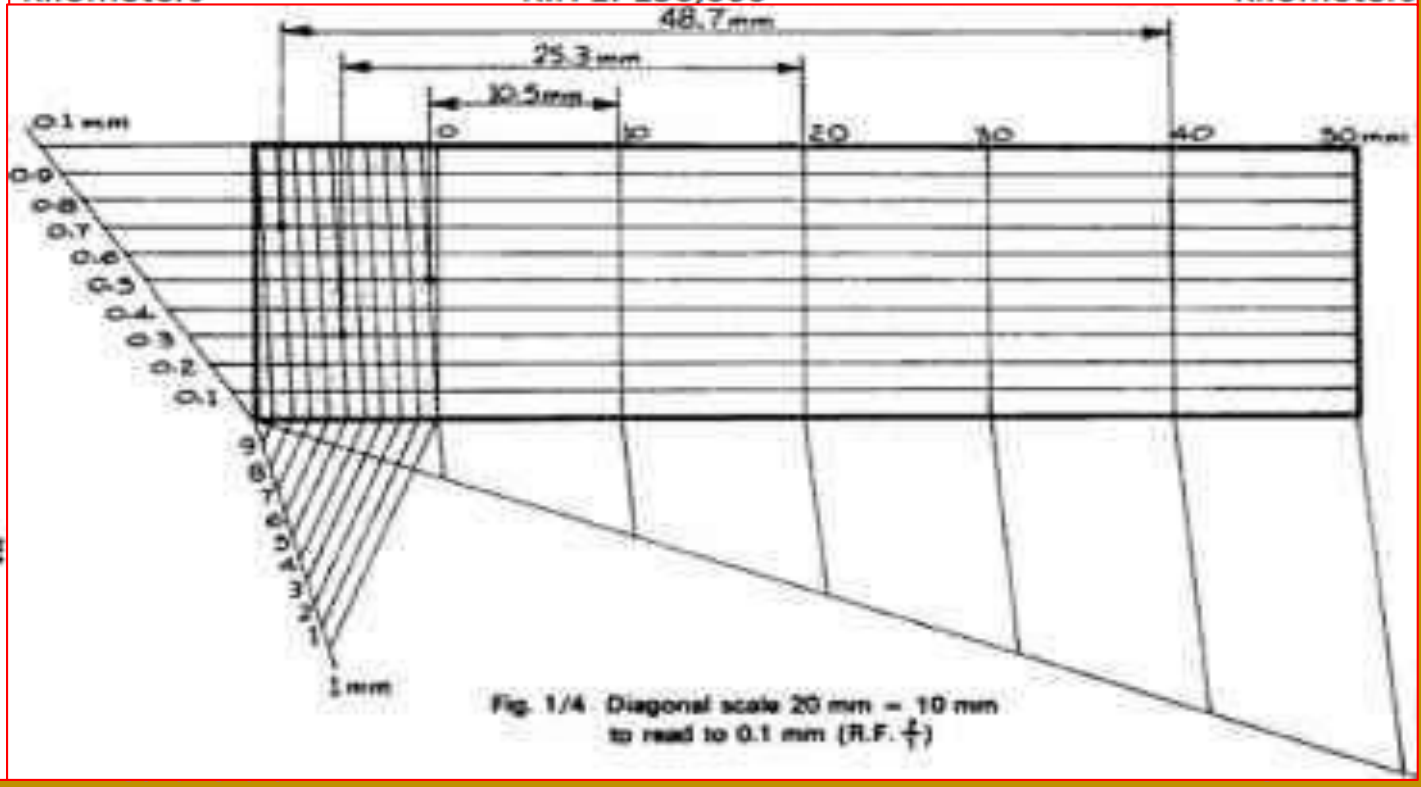


Fig. 1/4 Diagonal scale 20 mm – 10 mm to read to 0.1 mm (R.F. $\frac{2}{1}$)

Representative Fraction

- The ratio of the distance on the drawing to the corresponding actual length of the object on the ground is known as the representative fractions. i.e..

$$\text{R.F} = \frac{\text{Distance of the Object on Drawing (Map)}}{\text{Corresponding Actual distance of object on Ground}}$$

But Both the distances are in same unit. For example, If a scale is

1) 1 cm = 10 m, 2) $\text{R.F.} = \frac{1}{10 \times 100}$ 3) R.F.= 1:1000

•

MAP SCALES

Verbal Scale: 1 in. = 1,485 mi; 1 cm = 940 km

Representative fraction: $\frac{1}{94{,}000{,}000}$

1 in. = 585 mi
1 cm = 370 km

$\frac{1}{37{,}000{,}000}$

1 in. = 250 mi
1 cm = 160 km

$\frac{1}{16{,}000{,}000}$

1 in. = 20 mi
1 cm = 13 km

$\frac{1}{1{,}300{,}000}$

Small scale

Large scale

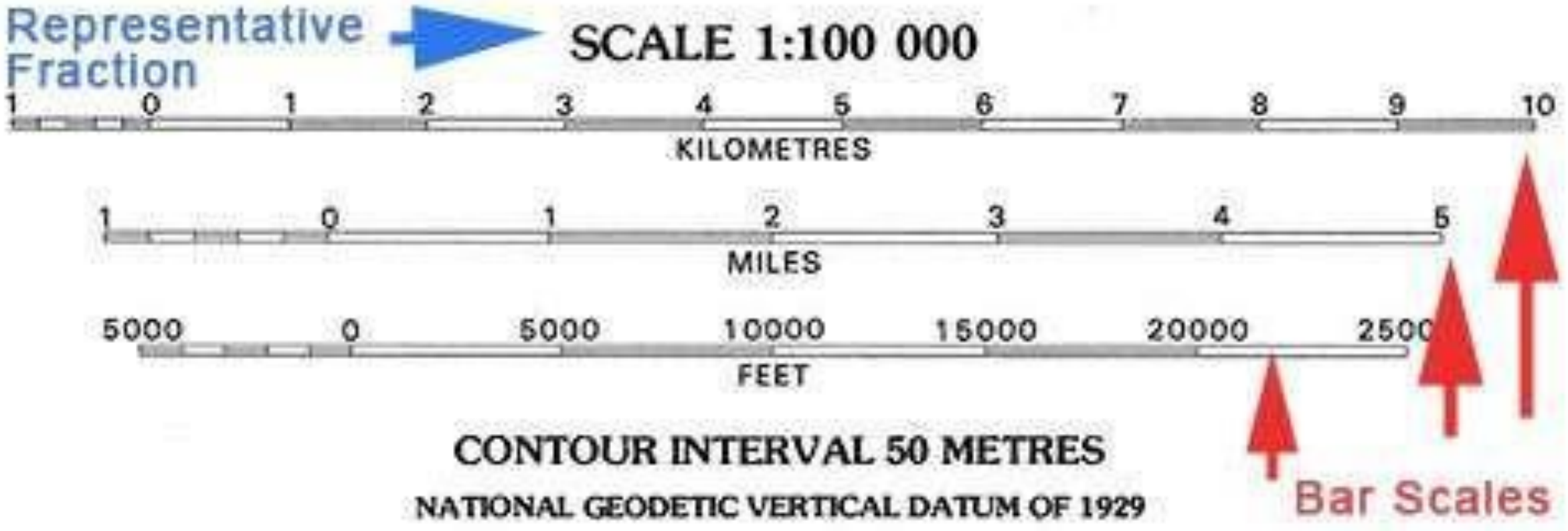
Three Types of Scale

- There are three different ways to write scale.

Word Scale	• 1 cm = 250 km
Linear Scale or Bar Scale	0 5 10 Kilometers
Ratio Scale or Representative Fraction Scale	• 1:25 000 000

Graphical Representation of Scale

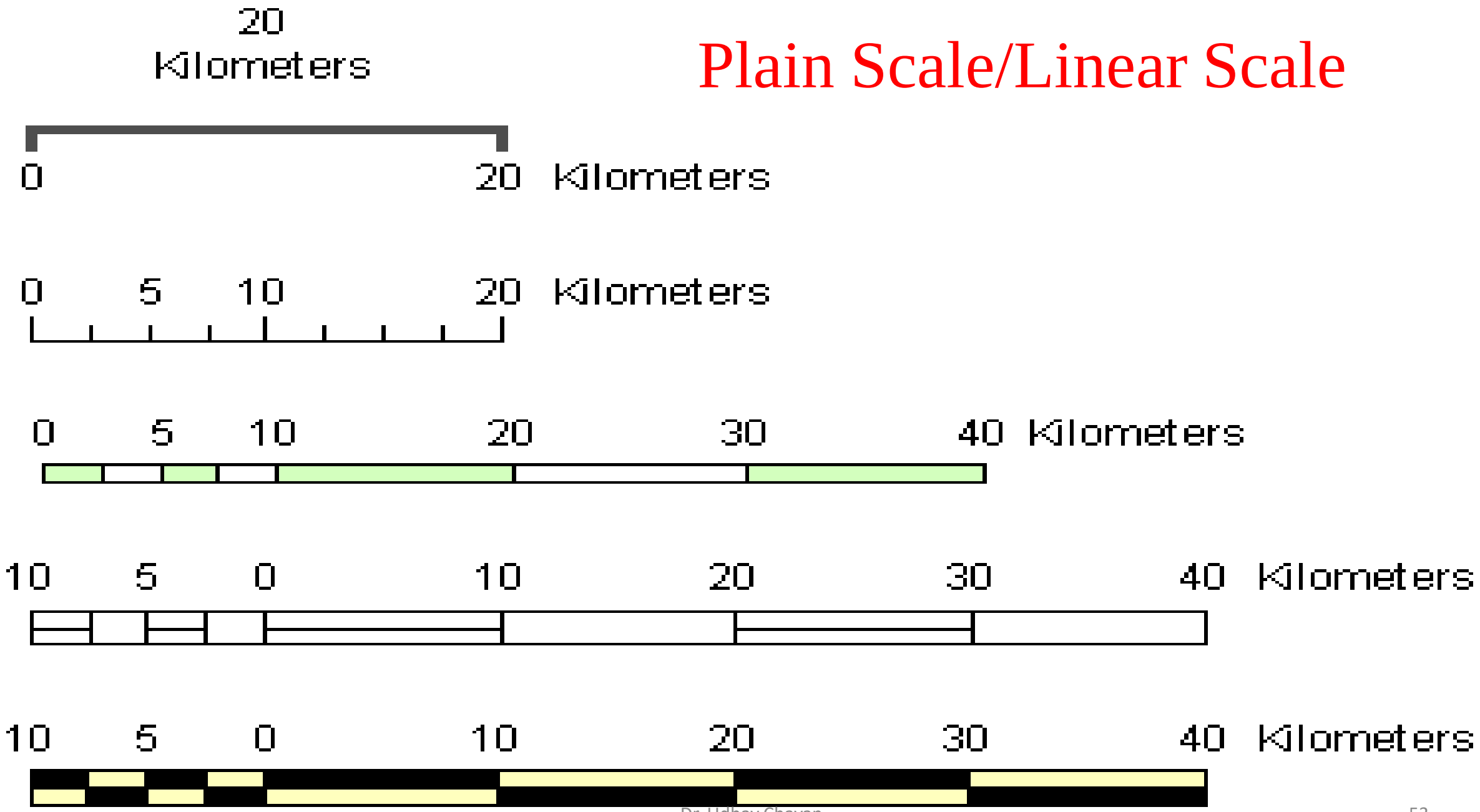
- Graphical representation of scale on maps has the advantage that if the paper shrinks, the scale will also shrink accordingly and the distance representation will not be disturbed.



Types of Scales

1. Plain Scale/Linear Scale
2. Verbal Scale
3. Graphical Scale
4. Diagonal Scale

Plain Scale/Linear Scale

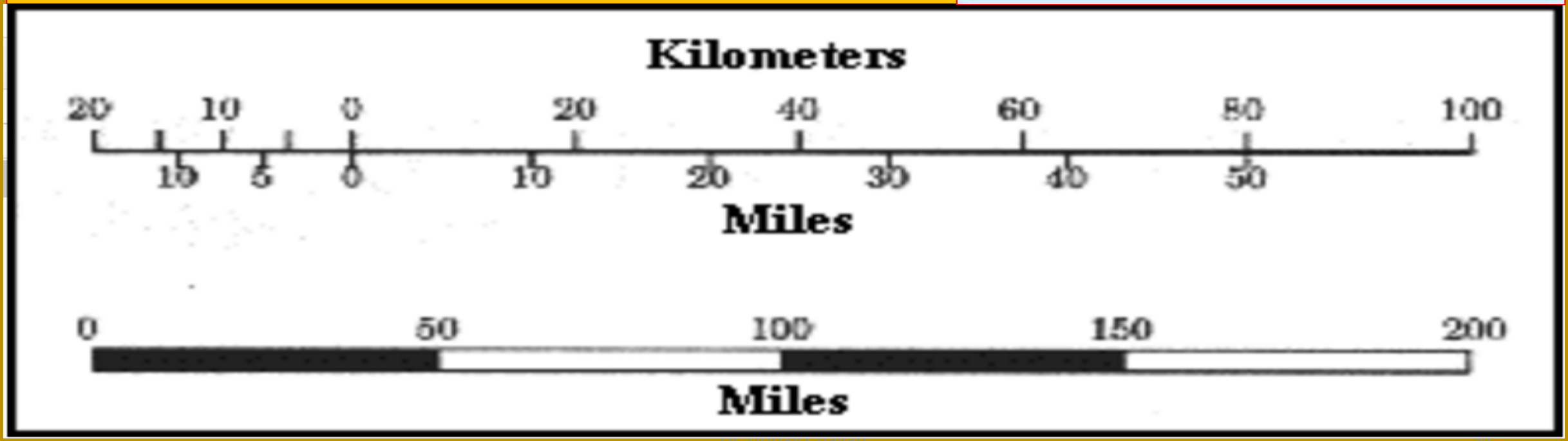


Verbal scale definition:

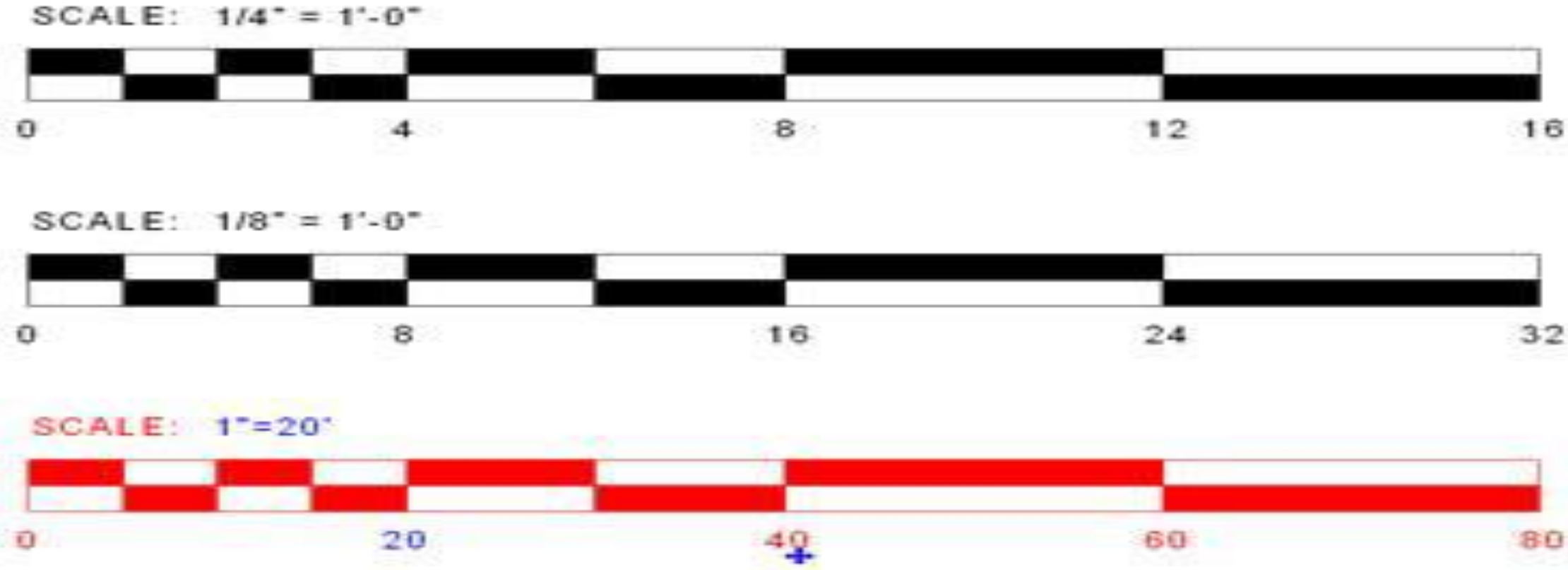
A verbal scale also referred to as a “word statement” or “scale expression”, is where the response options are presented to the respondent using words, whether spoken or written.

1 inch equals 1 miles

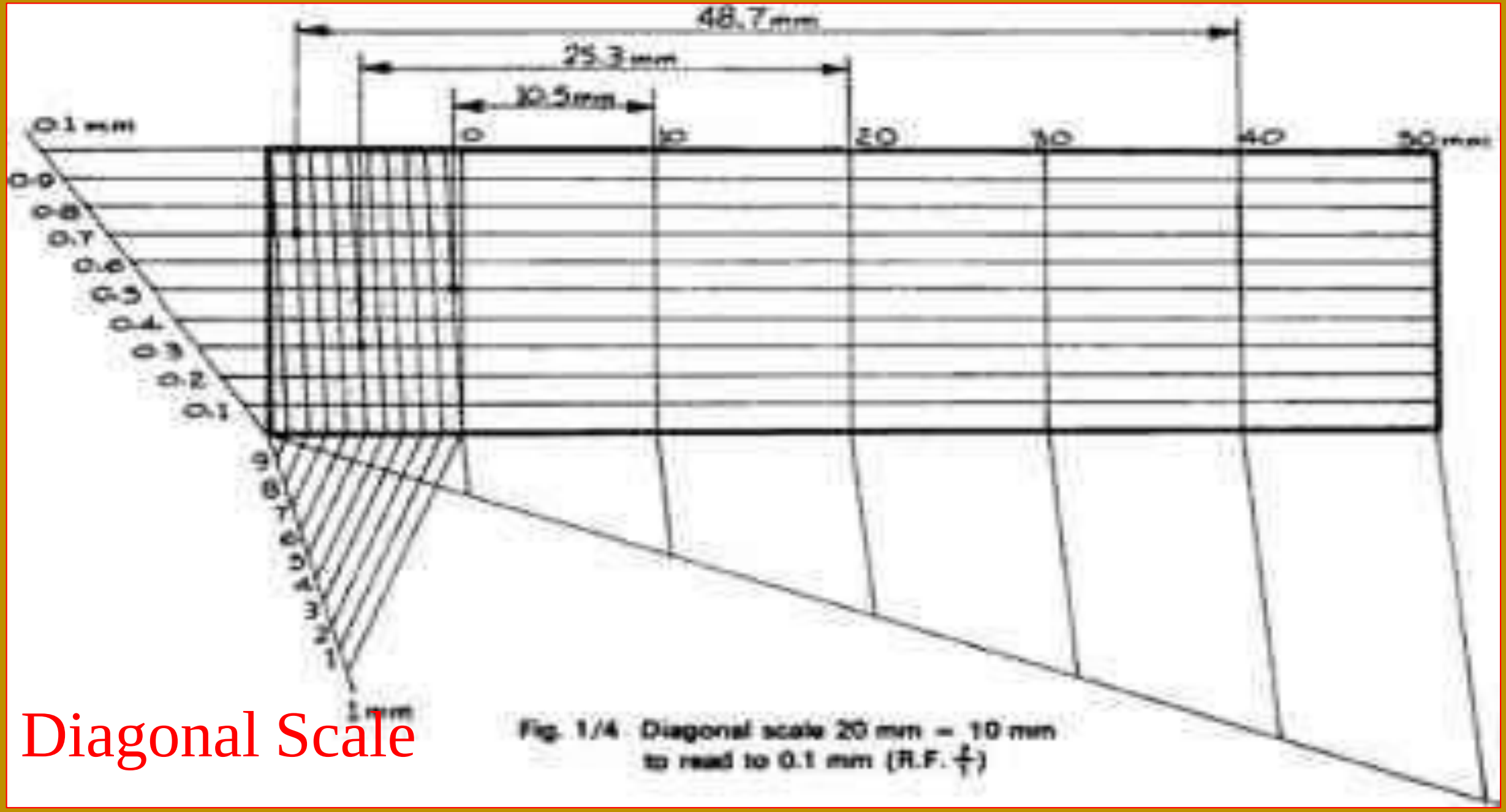
1:63,360



Graphical Scale



ALL OF THE ABOVE GRAPHIC SCALES ARE INSTANCES OF ONE FAMILY.



Diagonal Scale

Fig. 1/4 Diagonal scale 20 mm – 10 mm to read to 0.1 mm (R.F. $\frac{1}{1}$)

Scale of a Map

- Scale of a map is the ratio of the distance drawn on the map to the corresponding distance on the ground. As the area involved are rather large, it is essential to select a suitable scale for representing the area on a map. Selection of the scale depends upon the purpose, size and the required precision of plotting.

Size of Scale	Representative Franction (RF)
Large Scale	1:25,000 or larger
Medium Scale	1:1,000,000 to 1:25,000
Small Scale	1:1,000,000 or smaller

Type of Survey	*Scale*	*RF*
1. Building sites	1 cm = 10 m or less (1 : 1000 or less)	$\frac{1}{1000}$ or less
2. Town planning schemes and reservoirs	1 cm = 50 m to 100 m (1 : 5000 to 1 : 10000)	$\frac{1}{5000}$ to $\frac{1}{10000}$
3. Cadastral maps	1 cm = 5 m to 500 m (1 : 5000 to 1 : 50000)	$\frac{1}{500}$ to $\frac{1}{50000}$
4. Location surveys	1 cm = 50 m to 200 m (1 : 5000 to 1 : 20000)	$\frac{1}{5000}$ to $\frac{1}{20000}$
5. Topographic surveys	1 cm = 250 m to 2500 m (1 : 25000 to 1 : 250000)	$\frac{1}{25000}$ to $\frac{1}{250000}$
6. Geographic maps	1 cm = 5000 m to 160000 m (1 : 500000 to 1 : 16000000)	$\frac{1}{500000}$ to $\frac{1}{16000000}$
7. Route surveys	1 cm = 100 m (1 : 10000)	$\frac{1}{10000}$
8. Longitudinal sections		
(*i*) Horizontal scale	1 cm = 10 m to 200 m (1 : 1000 to 1 : 20000)	$\frac{1}{1000}$ to $\frac{1}{20000}$
(*ii*) Vertical scale	1 cm = 1 m to 2 m (1 : 100 to 1 : 200)	$\frac{1}{100}$ to $\frac{1}{200}$
9. Cross-sections (Both horizontal and vertical scales same)	1 cm = 1 m to 2 m (1 : 100 to 1 : 200)	$\frac{1}{100}$ to $\frac{1}{200}$

Units of Measure

- The system of units in India in the recent years in M.K.S. and S.I. but all the records available in surveying done in the past are in F.P.S. units therefore, for an engineer it becomes necessary to know the conversion of units from one system to another, a few are listed below.

System	Length	Mass	Time
F.P.S.	foot	pound	second
C.G.S.	centimetre	gram	second
M.K.S.	metre	kilogram	second

Unit	Relative to previous	Feet	Millimetres	Metres
thou (th)		1/12 000	0.0254	0.000 0254
inch (in)	1000 thou	1/12	25.4	0.0254
foot (ft)	12 inches	1	304.8	0.3048
yard (yd)	3 feet	3	914.4	0.9144
chain (ch)	22 yards	66	20 116.8	20.1168
furlong (fur)	10 chains	660		201.168
mile (ml)	8 furlongs	5280		1 609.344
league (lea)	3 miles	15 840		4 828.032
fathom (ftm)	2.02667 yards	6.08	1 853.184	1.853184
cable	100 fathoms	608		185.3184
nautical mile	10 cables	6080		1 853.184
link	7.92 inches	66/100	201.168	0.201 168
rod	25 links	66/4	5 029.2	5.0292


Thank You!