CVE 303: SURVEYING

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SURVEYING

The process of getting the relative position of man-made features and artificial features. is Surveying. Important in road construction, pipe-laying e.t.c

There are two- main categories of surveying

- Geodetic survey
- Plane survey.

Plane survey - Assuming the whole earth is flat / plane surface - over short distances.

Transferring the level of a window from a point to another.

Geodetic Survey - Takes into cognisance the curvature of the earth's surface.

Branches of Surveying

Topographical Survey

2 Engineering Survey
3 Cadastral Survey.
4 Aerial Survey
5 Mining Survey
6 Hydrographic Survey.

The topography of an area is important In the building of any structure and also pipelines.
Engineering Survey covers all areas of engineering work.
Cadastral also deals with measurement
Aerial Survey – assists topographical, mining and cadastral survey. It uses aircrafts or photogrametry.
Mining Survey is important in planning mining
Hydrographic Survey – The planning of river beds e.t.c, useful in construction of dams and bridges.

Read up – Chain Survey

1200 mm × 1200 mm } Asbestos
4ft by 4ft

Measurements

Pipelines, road constructions — Km

Km, m, mm

S.I metric units are used officially, but other measurement systems can be used

e.g The Imperial

Area — m^2, 1hectre' → m^2 1hectre = 10000 m^2

Volume — m^3

Angles — 0° deg min sec
o ' ''

[Radians]

mass — Kg

Temperature — °C, K

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09/03/2020. Engineering Survey and Photogrammetry.

What is Surveying?

The acts of setting out to know more about the earths surface through the representation of locations with vertical and horizontal surfaces.

Taking measurements of the surface of the earth; with the use of scales. To manipulate measurements for convenience.

An inclination between two lines — Angle

General Categories/groups of Surveying.

- Plane Surveying:
- Geodetic Surveying

Plane Engineering Surveying operates based on taking the shape of the earth as flat.

195 Km²

Geodetic surveying — Takes into the account the shape of the earth.

When an area is greater than 195km², it is advisable to use geodetic Surveying

Classification of Surveying

3 criteria for classification of Surveying.

(A) Nature, use or purpose

(B) Method used in carrying out the Surveying

(C) Instrument used in Surveying

(A) Nature

- Topographic Survey
- Cadastral Survey – property survey.
- City Survey
- Hydrographic Survey
- Astronomical survey

Use / Purpose

- Engineering Survey
- Military Survey
- Mining Survey
- Geological Survey
- Archeological Survey – Antiquities.

Instruments

- Chain Survey
- Compass Survey etc.
- Theodolite Survey
- Tavimetry Survey
- Automatic level survey

- compass
- Plane Table
- Tacheometric Theodolite
- Aerial Photogrammetric

Principles of Surveying operations

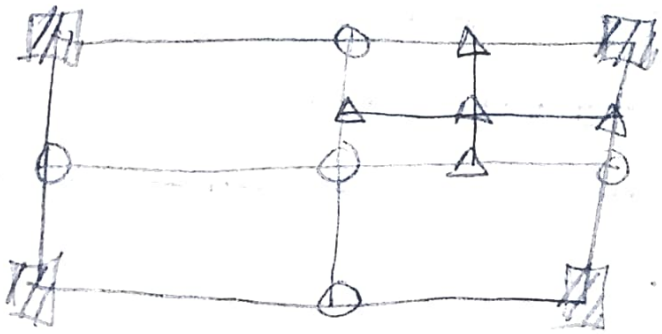
(1) Start work/ Survey on a known point - Because you need a point of reference

(2) Link different points together: 1-2, 2-3, 3-4 e.t.c.

(3) End on a known point

Techniques in Surveying

1. Know the type of instrument to use.
2. Use the best instruments for primary jobs - The foundational work
3. Work from whole to parts
   - (5) Primary pillars
   - (6) Secondary pillars
   - (7) Tertiary pillars



(4) Work in triangles

Stages of Surveying

1. Reconnaissance Survey – familiarization survey
2. Preliminary Survey
3. Location Survey

(A) Visit the site
Familiarize yourself
Gather relevant information as to topographic details
Write a report – Inception Report

(B) Visit the site again – with surveyors who take measurements, data and other information and put them in their field book. A preliminary report is then written

traversing
levelling

Excavation – Soil

Blast – Rocks

(C) Location Survey – visit the site again, take specific measurements due to corrections from preliminary survey.

A final survey report is then written.

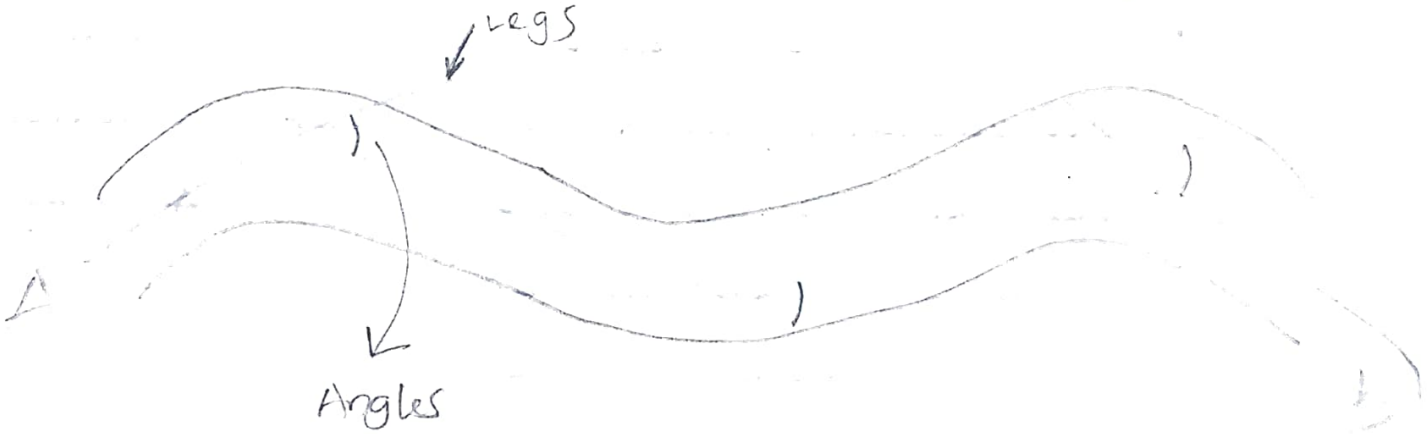
Methods employed in Surveying

1. Traversing
2. Triangulation
3. Levelling
4. Photogrametry

The plan - placed on the horizontal plane

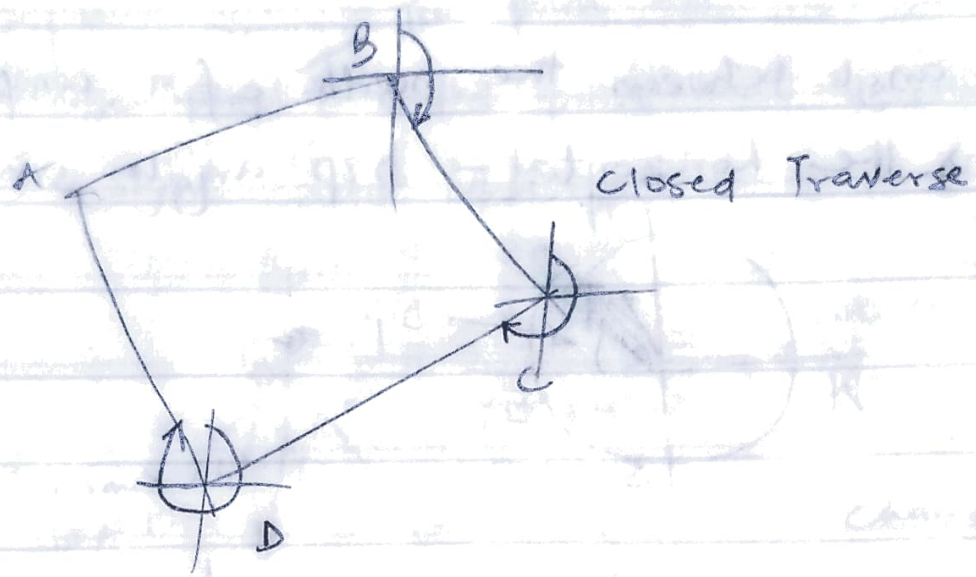
Elevations - Vertical plane.

Traversing - Getting a leg and an angle



Open traverse - occurs on roads, not coming back to the original locations.

Closed traverse -



Closed Traverse

02/02/2021

Page 39 - Map drafting

North - True north

Grid north

Magnetic north

Maps must contain proper explanatory notes.

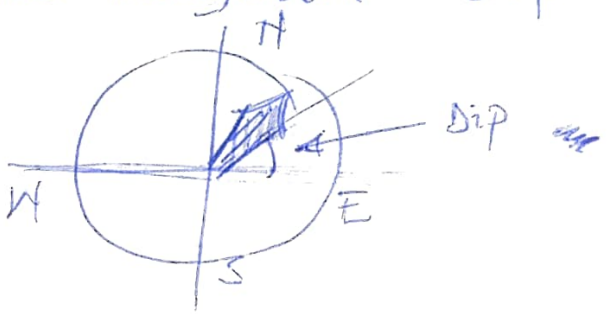
Contour lines.

Vertical and horizontal angles. - useful in geometric design of roads.

Traversing - horizontal angles.

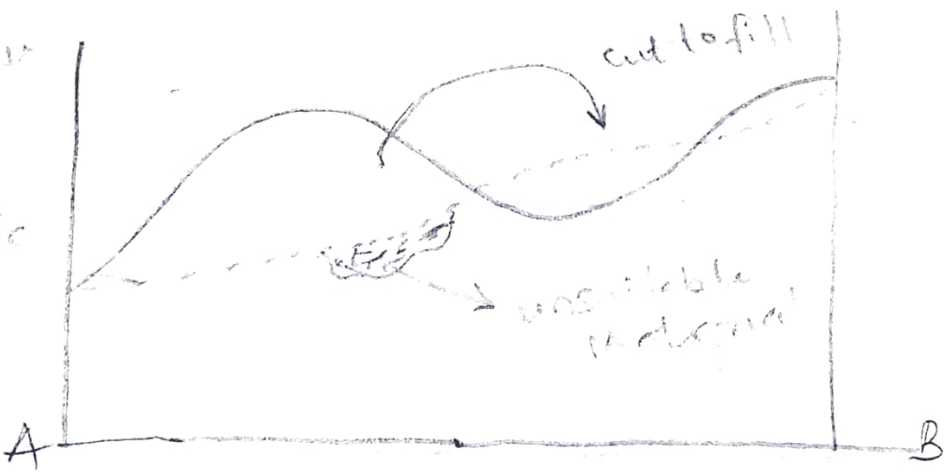
Compass Survey - direction of survey lines are determined by a compass. - Search the area and remove metallic objects to prevent local attraction.

The angle between the needle of a compass and the horizontal – Dip angle.



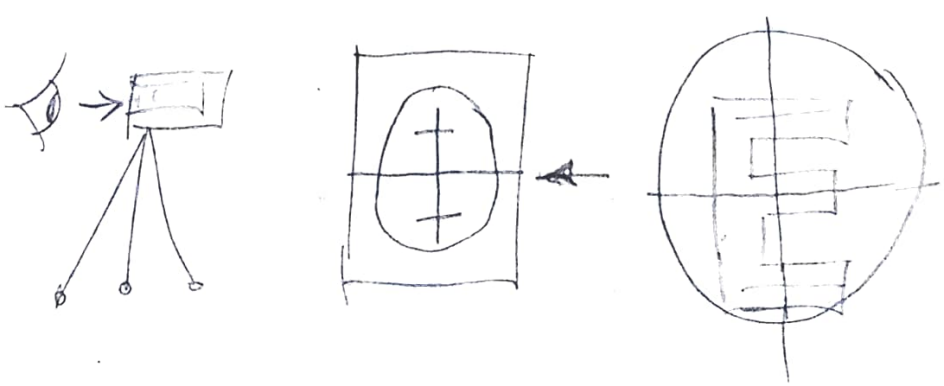
Fore sight
Back sight
Intermediate Sight

After top soil → Formation level / Subgrade



Unsuitable material – is below/inside the subgrade and it has to be replaced.

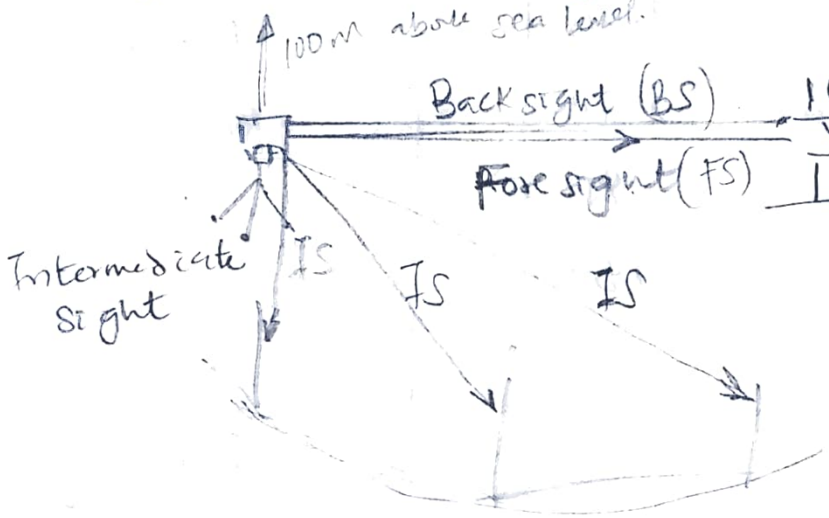
Cut to fill / Cart away is above the subgrade



Change point - The point where the instrument is changed.

Change point is the point that has receives both the Fore sight and backsight

Pg 65



Change point - Also a point where we have new height of instrument.

16/02/2021

* Direct Levelling - Simple
  Differential
  Longitudinal/Profile
  Reciprocal
  Borrow pit/cross-sectional.

Station A.

A Height of Instrument = 100 + 2.150 = 102.150

B 102.150 - 1.695.

Error - 0.030 / 100

Station	BS	IS	FS	HI	RL	Remarks
A	2.150			102.150	100.000	TBM
B		1.675			100.475	
C		2.100			100.050	
D		1.450			100.700	
E		2.500			99.650	
A'			2.120		100.030	

Error = $\frac{100.03 - 100}{100} \times 100$

Rise and Fall method

Station	BS	IS	FS	Rise	Fall	RL	Remarks
A	2.150					100.000	
B		1.675		0.475		100.475	
C		2.100			0.425	100.050	
D		1.450		0.65		100.7	
E		2.500		~~1.05~~	1.05	99.650	
A'			2.120	0.38		100.030	

2.150 − 1.675 = 0.475 (Rise)

0.475 + 100 = 100.475

B − C (1.675 − 2.100) = −0.425 (fall)

100.475 − 0.425

C − D = 2.100 − 1.450 = (0.65) + 100.050
= 100.7

D − E = 1.450 − 2.50 = −1.05 + 100.7

E − A = 2.500 − 2.120 = 0.38 + 99.650

The number of Backsight = no of foresight

When the error is ≤ 10% (okay).

Areas and volumes

- Triangulation.
- Graphical method. 1 : 100

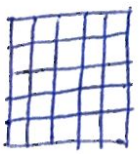
1cm on paper = 100 cm on earth

1cm on paper = 1m on earth.

- Mathematical method

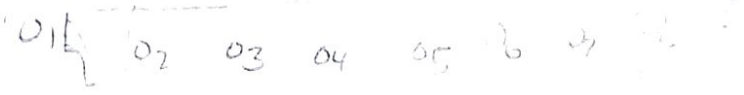
Simpson's rule

Trapezoidal rule.



0.2m × 0.2m
= 0.04m²

Count the no of complete holes (39 × 0.04)
= 1.56m²



$$\text{Area}_1 = \frac{1}{2}(O_1 + O_2)\,d$$

$$\text{Area } 2 = \frac{1}{2}(O_2 + O_3)\,d$$

~~Total Area = $\frac{1}{2}(O_3 + O_4)$ d~~ l/s → m³/s

Area $= \sum_{i}^{11} O_n d$. $\frac{1}{2} d \left(O_1 + O_{11} + 2(\right.$

$= \frac{1}{2} d (O_1 + O_2 + O_3 + O_4 + \ldots)$.

Simpson's rule has more ordinates.

Area $= \frac{d}{3} [O_1 + O_{11} + 4(\text{even ordinates}) + 2(\text{other ordinates})]$

CVE 304

Surveying for Engineers II

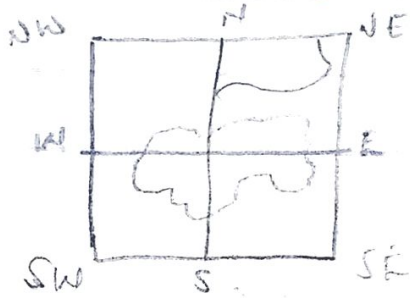
18-05-2021.

- Contour & Contour lines.

line joining points of the same height above or below a reference point

Characteristics of contour lines

① They close on themselves



1 : 100

1 cm on paper ⇒ 1m on the land.

② They do not intersect

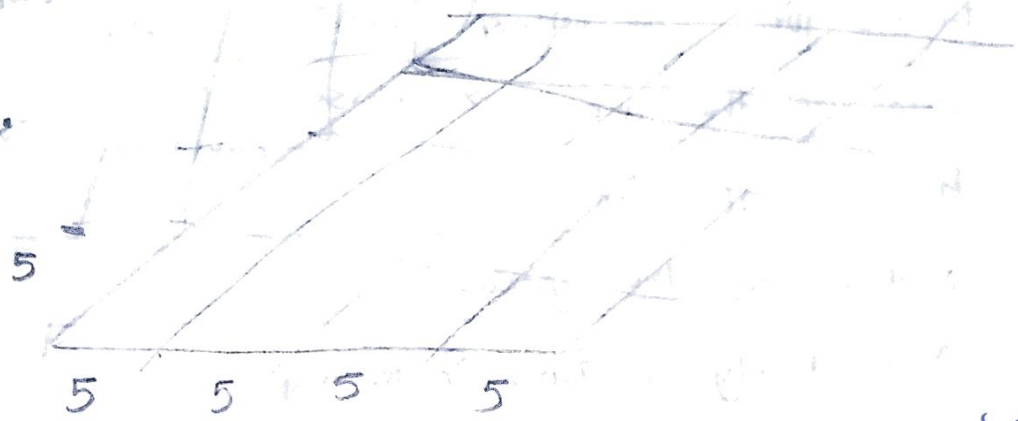
③ They indicate uniform slopes

④

The vertical distance between any two consecutive contour lines - Contour interval ~~distance~~

The least horizontal distance between two consecutive contours - Horizontal Equivalance

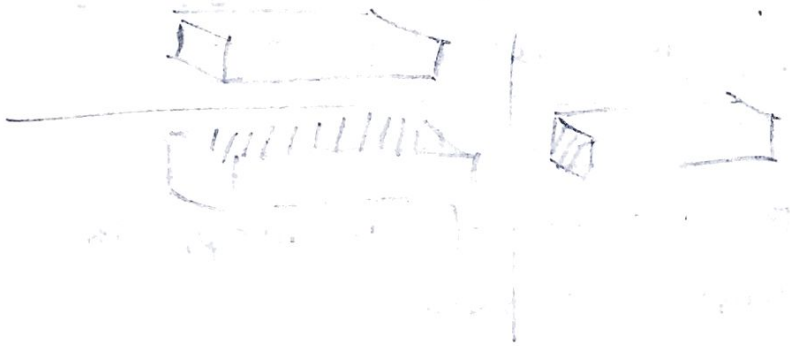
- Simply supported beam
- Cantilever beam
- Continuous



CP 114 - Not exceeding elastic limit

CP 110 - Pre load

BS 8110 - Sizing



Cantilever = 7

Simply supported = 20

continuous = 26

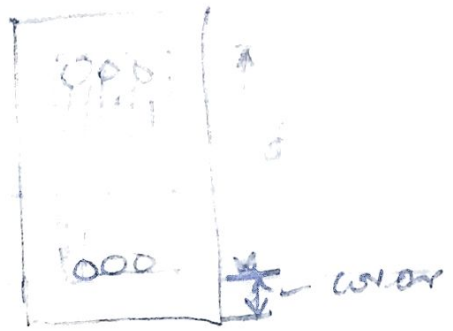
Preliminary sizing

Span - effective depth ratio

$$\frac{\text{Span}}{\text{Effective depth}} = \frac{3.9}{26} = 0.15 \ (d)$$

$$D = d + \text{cover} + \frac{\phi}{2}$$

$$150 + 25 + 6$$



Factors for deciding contour interval

1. Scale of the map → Inversely proportional to the contour interval.
2. Purpose of map
3. Nature of the ground
4. Availability of time & money

The contour interval will be large if one is not interested in details.

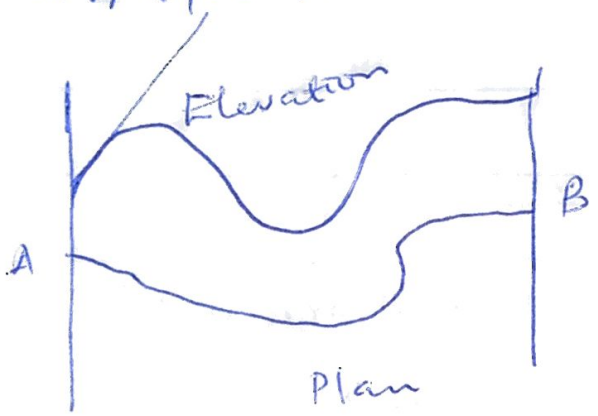
The smaller the scale of a map, the larger contour interval.

The contour interval is inversely proportional to the flatness of the ground.

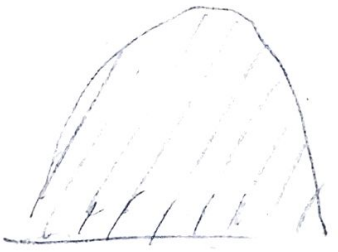
$$C.I = \frac{10}{\text{no of } \cancel{\text{contour}} \text{ cm/km}}$$

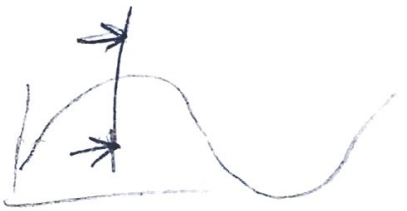
1:50,000

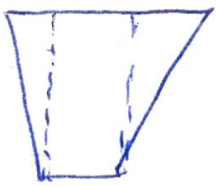
24/06/2021.



Geometric Design - { Horizontal Alignment Design
Vertical Alignment design }.





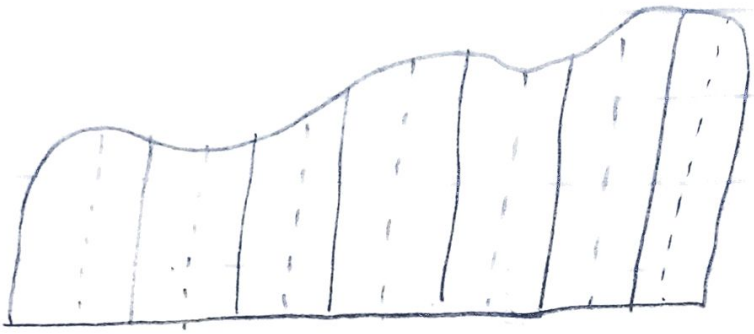


10-3

$\frac{1}{2}(a+b)h$

$$\frac{\phi}{2}\left[A_3 + A_1 + 2(A_2)\right]$$

$\frac{a+b}{2}$



Mid-Ordinate - The Middle ordinates

Sum of the mid ordinates X Common distance

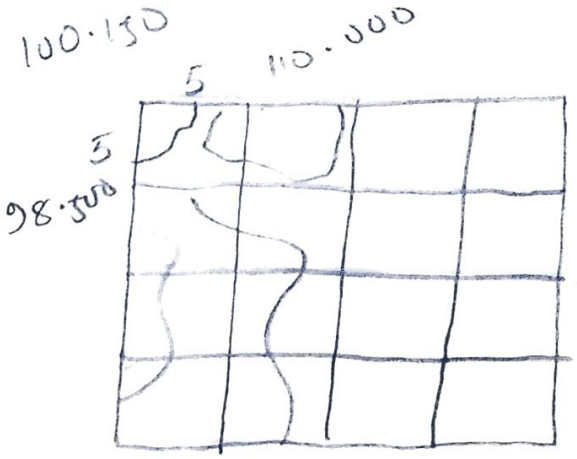
Average Ordinate method

Pg 26 Av. Ordinate X Length of base

- The trapezoidal rule

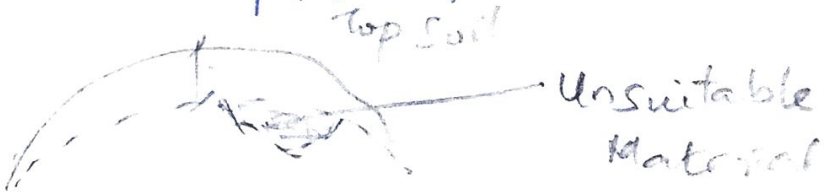
- Simpson's rule - have closer offsets.

- More accurate than trapezoidal



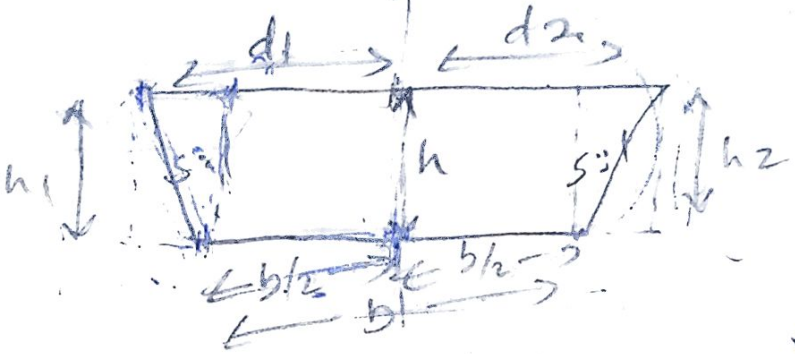
Top soil - is discarded completely

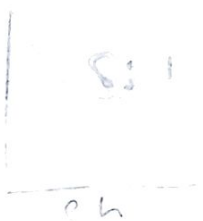
Unsuitable material - below the sub grade level and should be replaced.

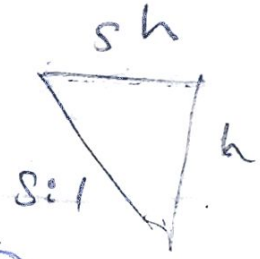


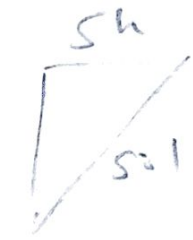
pg 33
34

Measurements from cross section.









$\frac{1}{2}bh$

$h_1 = h = h_2$

$\therefore d_1 = d_2 = \frac{b}{2} + 5h$

Area of Trapezium $= \frac{1}{2}(a+b)h$

$a = b$

$b = d_1 + d_2$

$= \frac{1}{2}\left[b + (d_1 + d_2)\right]h$

$= \frac{1}{2}\left[b + 2\left(\frac{b}{2} + 5h\right)\right] \times h$

$= \frac{\left[b + b + 25h\right]}{2} \times h$

$\frac{2b + 25h}{2} \times h$

$\frac{2b}{2} + 25h$

$\frac{2(b+5h)}{2}$

$b + 5h$

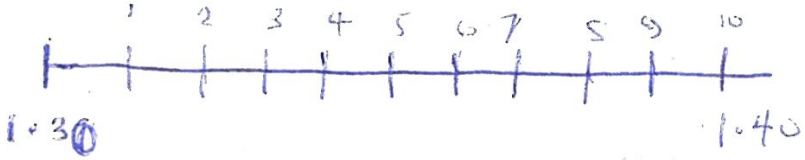
Area $= (b + 5h)h$

Surveying → Setting out

Setting out - The opposite of surveying in which measurements both horizontally and vertically taken on the surface of the earth to paper surface with the aid of scale.

The marking out of lines of excavation on the ground for the guidance of the contractor and the labour.

Traversing & Levelling



Chainage - 15 m

Stations	BS	IS	FS	HI	RL	Remarks
A	1.258		1.672	101.~~258~~	100.00	TBM
B		1.394			99.864	
C	1.267	~~1.191~~	1.194	101.331	100.064	CP
D		1.158			100.173	
E	2.140	~~1.042~~	1.042	102.429	100.289	CP
F		1.815			100.614	
G	1.830	~~2.365~~	1.365	102.894	~~101~~.064	CP
H		1.265			101.629	
I		0.97			101.924	
J	1.98	~~0.68~~	0.68	104.194	102.214	CP
K		1.613			102.567	

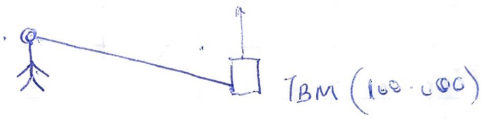
1.003+

Put the staff first on the TBM

BS = 1.258

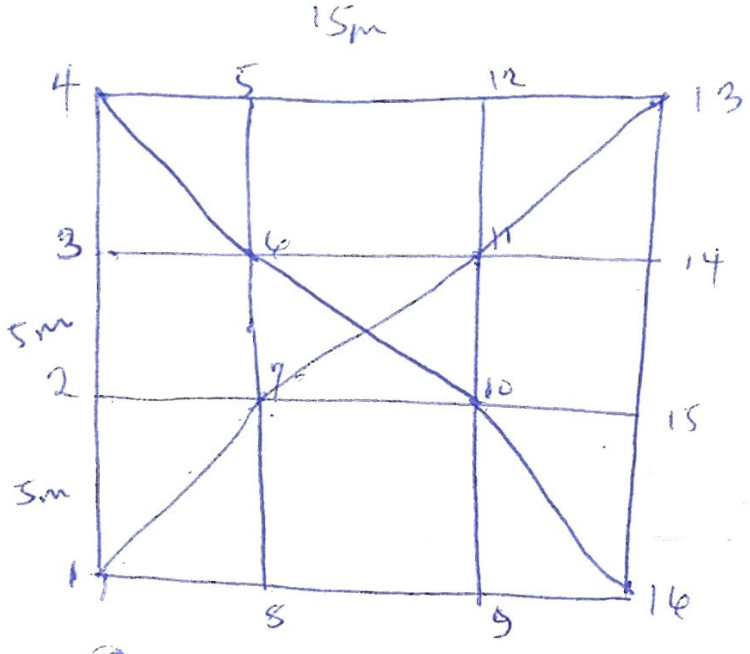
FS = 1.672.

(iii)



Stations	BS	IS	FS	HI	RL	Remarks
L		1.468			102.726	
M	1.538		1.239	104.493	102.955	CP
N		1.412			103.081	
O		1.450			103.043	
P	1.520		1.390	104.623	103.103	CP
Q		1.349			103.274	
R		1.176			103.447	
S	1.519		1.034	104.623	103.559	CP
T		1.28			103.828	

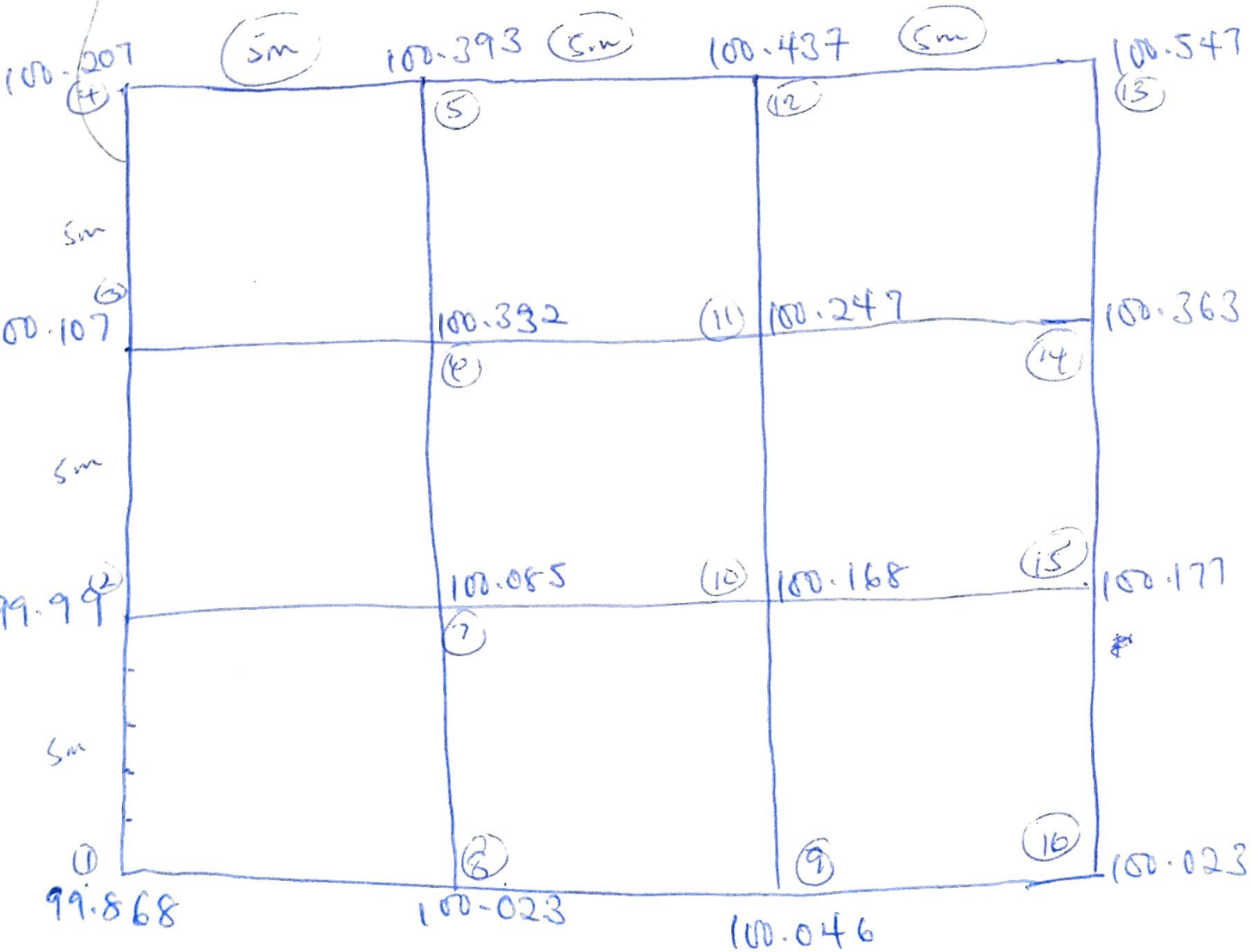
Setting Out and Contouring



Station	BS	IS	FS	HI	RL	Remarks
	1.297			101.297	100.00	TBM
1		1.429			99.868	
2		1.307			99.99	
3		1.190			100.107	
4		1.090			100.207	
5		0.904			100.393	
6		0.965			100.332	
7		1.212			100.085	
8		1.274			100.023	
9		1.251			100.046	
10		1.129			100.168	
11		1.05			100.247	
12		0.86			100.437	

BS	IS	FS	HI	RL	Remarks
13	0.750			100.547	
14	0.934			100.363	
15	1.120			100.177	
16	1.274			100.023	
		1.310		99.987	

Equivalent horizontal distance = 5m



Scale = 1 : 100 cm 1cm = 1m.

Vertical Contour interval = 2m

Equivalent horizontal distance = 5m

105
103
101
99
97
95

Scale — 1 : 10

Vertical Contour Interval = 0.1m

1cm = 0.1cm

0.1m = 1cm

1m = 10cm

1 : 10

1 cm : 50,000 cm land

paper

550 cm : x

x = (550 × 50,000)

x = 27500000 cm

$\frac{27500000}{100}$

1m = 50,000 m

275000 m

275 km.