‘SURVEYING – II’ EXPERIMENTS  
CLASS: - Second Year Civil Engineering

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Time Allotted for each Practical Session = 02 Hrs.
Vision of Civil Department

The department of Civil Engineering strives to produce qualified engineers, researchers and professionals to serve the society with sustainable development.

Mission of Civil Department

- To provide quality education and prepare competitive graduates for successful career in Civil Engineering.
- To develop research opportunities that creates competent professionals who are trained in the design and development of environment friendly Civil Engineering system.

Program Educational Objectives

I. Graduates of Civil Engineering Program will be prepared to take the challenges in the field of Civil Engineering.

II. To provide Graduates with a sound Knowledge in mathematical, scientific and Civil Engineering fundamentals required to solve engineering problems and also to pursue higher studies.

III. To train students with good scientific and engineering breadth in Construction industry & many field of Civil Engineering.

IV. To build the confidence of students leading to professional and ethical integrity, effective communication skill, leadership, so that they can apply engineering knowledge for betterment of society.

V. To provide a good competitive learning environment so that graduates of Civil Engineering will be ready to meet the needs of Indian and multinational construction industries.

Program specific outcomes

The students are able to demonstrate:

1. The knowledge of planning and designing of the system components for building planning, transportation, water resources, estimating, costing and scheduling the construction processes.
2. The fundamental knowledge of analysis and design of various structures with an understanding of associated safety, quality and economy.
3. The knowledge of field data collection and material characterization to provide constructive and creative engineering solutions that reflect social and environmental sensitivities.
EXPERIMENT NO: I – SETTING OUT SIMPLE CIRCULAR CURVE BY ORDINATES FROM LONG CHORD METHOD

AIM:
To set out the simple curves in between two center line of roads which are meet at one point by long chord method.

INSTRUMENTS REQUIRED:
1. Chain
2. Ranging rods
3. Arrows and hammer

DESCRIPTION:
Curve is defined as an arc provided between intersecting straight to change in direction. The provision of a curve makes the change of direction not only easy and smooth, but also safe and comfortable, the straight or the tangent are the lines connected by the curve and they are tangential to the curve, the curvature is usually provided by simple curve.

SIMPLE CURVE:
A simple curve is consists of a single arc of a circle. It is tangential to both the straight lines.

PRINCIPLE:
The angle between the target and the chord is equal to the angle which that chord subtends in opposite segment.
**GIVEN DATA:**
Chainage of curve, angle of intersection (Δ) and radius of curve (R)

**PROCEDURE:**
1. First extent the center line of the cross roads i.e., extend the two straight, fix the point of intersection V.
2. Measure the intersection angle Ø with the help of theodolite. Then deflection angle is calculated by Δ = 180 - Ø
3. Choose the suitable radius of curvature R.
4. Then fix the points, point of curve T on back tangent and point tangency T on forward tangent by fixing the distance, R tan Δ/2
5. Then directly measure the distance between the two tangent points T₁ and T₂ to get the length of the long chord (L)
6. To calculate the length of the long chord from the formula L = 2R sin Δ/2
7. Then the length of the curve is equal to R Δ/2
8. To get the change point T₁, deduct the length of tangent distance of back tangent from the chainage of intersection point V.
9. To get the chainage of point T₂, add the length of curve to chainage of point T₁.
10. Find the mid point of the long chord “C”. Then from this mid point of long chord, fix the mid point of curve “Δ”, by fixing the mid ordinate length R – R² – L²/4 towards the point V.
11. Fix the other points on the curve on either side of the mid ordinate by fixing the corresponding length R² – X² – (R–O₀) from the long chord. Where x is the distance of corresponding ordinates from the mid ordinate. O₀ is the length of the mid ordinate.

**CALCULATION:**

**RESULT:** By offset from long chord method the simple circular curve was plotted on the ground.
AIM: Setting out of simple circular curve by offsets from chord produced method

INSTRUMENTS REQUIRED: Ranging rods, Chain or Tape, Arrows and pegs.

PROCEDURE:
1) Locate the tangent points T1 and T2 & find their chainages. Calculate the length (c).
2) Cut T1 A1 equal to the length of the first sub chord (C1) already calculated along the tangent T1V.
3) With T1 as centre and T1A1 radius, swing the chain or tape such that the arc A1A= calculated offset O1, thus fixing the first point A on the curve.
4) Keep the chain along T1A and pull it straight in the forward direction of T1A until the length AB2 becomes equal to second C2 (i.e the length of normal chord).

5) With A as centre and AB2 as radius, swing the chain such that the arc B2B = calculated offset O2, thus fixing the second point B on the curve.

6) Continue the process repeating the point (4) and (5) until that end the curve is reached.

**CALCULATION:-**

**CHECK:-** The last point so fixed must coincide with the previously located points T2 (the last curve tangent point ) if not, find out the closing error. If it is small (say with in 2m) it should be distributed to all the points by moving them sideways by an amount proportional to the square of their distances from the point T1, otherwise the whole curve should be set out again.

**RESULTS:-** By offsets from chord produced method the simple circular curve was plotted on the ground.
EXPERIMENT NO: IV – SETTING OUT SIMPLE CIRCULAR CURVE – RANKINE’S METHOD

AIM:
To set out the simple curve by Rankine’s method of Deflection angles by using Single theodolite method.

INSTRUMENTS REQUIRED:
Theodolite, Ranging rods, Chain or Tape, Arrows and pegs.

PRINCIPLE:
The deflection angle to any point on a circular curve is measured by one – half the angle subtended by the arc from point of curve to that point. It is assumed that the length of the arc is approximately equal to its chord.

GIVEN DATA:
Chaining of curve, angle of intersection (Δ) and radius of curve (R)

PROCEDURE:
1. Prepare a table of deflection angles for the first subchord, normal chord and last subchord.
2. Set up a theodolite over T₁. Direct the telescope to bisect the point of intersection (V), with both plates clamped to zero.
3. Release the vernier plate and set angle Δ₁ on the Vernier. The line of sight is thus directed along chord T₁A.
4. Point the zero end of the tape at T₁ and an arrow held at a distance C₁ along it and swing the tape around T₁ till the arrow is bisected by the cross hairs to fix point A.
5. Set the deflection angle Δ₂ = Δ₁ + Δ₂
Where,
\[ \varphi_2 = \frac{C_2}{1718.9 \times \text{min.}} \text{, so the line of sight is along } T_1 V. \]

6. With zero end of the tape pinned at A and an arrow held at distance \( AB = C_2 \) along it and swing the tape around A till the arrow is bisected by the cross hairs thus fixing the point B.
7. Repeat steps 5 and 6 till the last point \( T_2 \) is reached.

**CALCULATION:**

**CHECK:**
The last point so located must coincide with the point of tangency \( (T_2) \) fixed independently by measurements from the point of intersection.

**RESULT:** By Rankine’s method the simple circular curve was plotted on the ground.
EXPERIMENT NO: V – TACHEOMETRY – SUBTENSE SYSTEM

AIM :-
To determine the distance between any two points using a substance bar.

INSTRUMENTS REQUIRED:

PRINCIPLE:-
Subtense method is an indirect method of distance determination. This method essentially consists of measuring the angle subtended by two ends of a horizontal rod of fixed length, called subtense bar.

PROCEDURE :-
1. Two targets of subtense bar are connected at its ends by invar wires with slight tension to minimize the effect of variations in temperature.

2. The subtense bar is mounted on tripod and centered over the required station.

3. The bar is leveled by centering a circular level bubble using three leveling screws.

4. The bar is then oriented perpendicular to the line to be measured by sighting through a small telescope attached to the midpoint of the bar.
5 Theodolite is set over an instrument station (P) exactly and all the temporary adjustments are done. The reading of 0°0’0” is set at vernier A by using upper clamp and tangent screw and the zero reading is placed along the line from P to one of the targets of subtense bar.

6 Upper clamp is loosened and the telescope is tilted to bisect the other target of subtense bar to determine the horizontal angle of $\theta$.

7 The length of subtense bar is taken as “s”.

**CALCULATION:-** The horizontal distance between O and the subtense bar is determined as follows:-

$$D = \frac{1}{2} s \cot \frac{\theta}{2}$$

**RESULT:-** Horizontal distance between two points P & Q on a base line by subtense bar method is,__________ m.
EXPERIMENT NO: VII– STUDY OF NAUTICAL SEXTANT AND MEASUREMENT OF ANGLE BY NAUTICAL SEXTANT.

INTRODUCTION: The SEXTANT is one of the most economical instrument for an Auxiliary member to use in determining positions of objects both ashore and afloat with a high degree of accuracy. The Three-Arm Protractor is used in conjunction with the SEXTANT in plotting positions on a chart, i.e., laying-out angles on a chart. In their ATON/CU support role, Auxiliary members need to understand the use and application of the SEXTANT and Three-Arm Protractor for determining and plotting position data.

THEORY:

The Sextant is an instrument for measuring angles. The Sextant is oriented vertically (held vertical), for determining a vertical angle. The Sextant is oriented horizontally (held horizontal) for determining a horizontal angle. There are several models and manufacturers of Sextants. The most economical Sextant available is the Davis Mark 3, which cost in the neighborhood of $30.00 Other higher quality model/manufacturer Sextants sell in the thousand dollar range. For Auxiliary members participating in ATON/CU activities, the Davis Mark 3 Sextant is sufficient for general use. However, the Davis Mark 15 Sextant is a somewhat more sophisticated Sextant, containing a Micrometer Drum and Vernier, and provides a higher degree of precision in reading angles. Some Auxiliary members prefer the Davis Mark 15 Sextant. As such, for the purposes of this Study Guide, information on both the Davis Mark 3 and the Davis Mark 15 Sextants will be included.
EXPERIMENT NO: VIII- DETERMINATION OF ELEVATIONS AND DISTANCES BY TRIGNOMETRICAL OBSERVATIONS.

AIM: - Determination of elevation of point by trigonometric levelling.

THEORY: - Trigonometrical leveling is the process of determining the difference of elevation of station from observed vertical angles and known distances, which are assumed to be either horizontal or geodetic length at mean sea level. The vertical angles may be measured by means of an accurate theodolite and the horizontal distances may either be measured (in case of plane surveying) or computed (in case of geodetic observation).

Height and Distances:

Case- I:- Base of the object accessible: - The horizontal distance between the instrument and the object can be measured accurately.

Let P= instrument station.
Q=Point to be observed
A=centre of the instrument
Q’ = projection of Q on horizontal plane through A
D= AQ’ = horizontal distance between P & Q
h’= height of the instrument at P
h=QQ’
S= Reading on staff kept at B.M, With line of sight horizontal.
α=angle of elevation from A to Q From triangle AQ′, h=Dtanα

R.L. of Q=R.L. of instrument axis +Dtana If the R.L. of P is known,
R.L. of Q=R.L. of P+h′+Dtanα

If the reading on the staff kept at the B.M. is S with the line of sight horizontal.
R.L. of Q=R.L. of B.M+S+Dtanα

Case- II:- Base of the object inaccessible: - if the horizontal distance between the instrument and the object can be measured due to obstacles etc., two stations are used so that they are in the same vertical plane as the elevated object.

Base of the object inaccessible

Instrument axes at the same level:-

Let h=QQ’, α1 = angle of elevation from A to Q, α2 = angle of elevation from B to Q S = staff reading on B.M taken from both A and B, the reading being the same in the both the cases. b = horizontal distance between the instrument stations, D = horizontal distance between P&Q

From triangle AQ′, h=Dtanα1 ------------------------------(1)

From triangle BQQ’, h=(b+D) tanα2 -------------------------------(2)
PROCEDURE:-

1) Set up the theodolite at P and level it accurately with respect to the altitude bubble.

2) Direct the telescope toward Q and bisect it accurately. Clamp both the planes. Read the vertical angle $\alpha_1$.

3) Transit the telescope so that the line of sight is reversed. Mark the second instrument station R on the ground. Measured the distance RP accurately. Repeat steps (2) and (3) for both face observation. The mean values should be adopted.

4) With the vertical vernier set to zero reading, and the altitude bubble in the centre of the run, take the reading on the staff kept at nearby B.M.

5) Shift the instrument to R and set up the theodolite there. Measured the vertical angle $\alpha_2$ to Q with both face observations.

6) With the vertical vernier set to zero reading, and the altitude bubble in the centre of the run, take the reading on the staff kept at the near by B.M.
RESULT:- The elevation of the object from the B.M is found to be---------m
STUDY OF TOTAL STATION

**General:** Total station is a combination of Electronic Theodolite and Electronic Distance Meter (EDM) in one unit. This instrument directly measures 3D co-ordinates, slope, horizontal and vertical distances. This has large internal memory of 3000 points to store field datas and can be directly down loaded to the computer from the instrument through interface cable.

**Electronic Distance Meter:** This is used to measure directly, to an acceptable accuracy, the distance between any tow intervisible points in the survey system. The technique of EDM eliminates the need for chaining or taping. Principle of EDM: The basic principle is the indirect determination of the time required for a light beam to travel between two stations and by using frequency the distance is displayed.

**Basic Functions of EDM:**

1. It generates the carrier and measuring wave frequencies.
2. It modulates and demodulates the carrier wave.
3. It measures the phase difference between the transmitted and received waves.
4. It displays the result of measurement. Result: Thus the study about the Total station is practiced.
PROJECT- I:- THEODOLITE CONTOURING

INTRODUCTION:- Contouring needs the determination of elevation of various points on the ground and at the same the horizontal positions of those points should be fixed. To exercise vertical control levelling work is carried out and simultaneously to exercise horizontal control chain survey or compass survey or plane table survey is to be carried out. If the theodolite is used both horizontal and vertical controls can be achieved from the same instrument. Based on the instruments used one can classify the contouring in different groups.

RADIAL CONTOURING: In this method several radial lines are taken from a point in the area. The direction of each line is noted. On these lines at selected distances points are marked and levels determined. This method is ideally suited for hilly areas. In this survey theodolite with tacheometry facility is commonly used.
PROJECT- II:- SETTING OUT A BUILDING PLAN ON GROUND

INTRODUCTION:- A building is set out in order to clearly define the outline of the excavation and the centre line of the walls, so that construction can be carried out exactly according to the plan. The centre line method of setting out is generally preferred and adopted.

PROCEDURE:--
1. From the plan (fig 1), the centre line of the walls are calculated. Then the centre lines of the rooms are set out by setting perpendiculare in the ratio 3:4:5. Suppose the corner points are a, b, c, d, e, f and g which are marked by pegs with nails on top.
2. The setting of the corner point is checked according to diagonals ac, bd, cf and eg.
3. During excavation, the centre points a, b, c, d, e, f, g may be removed. Therefore the centre lines are extended and the centre points are marked about 2m away from the outer edge of excavation. Thus the points A1, A2, B1, B2 and like wise, are marked outside the trench. Centre line are shown clearly by stretching thread or rope. The centre points fixed 2m away from the excavation are marked with sit out pegs.
4. From the plan details, the width of excavation to be done is also marked by thread with pegs at appropriate positions.
5. The excavation width is then marked by lime or by with furrow with spade.
6. If the plan is much too complicated and follows a zigzag pattern, then the centre pegs are kept at suitable positions according to site conditions.