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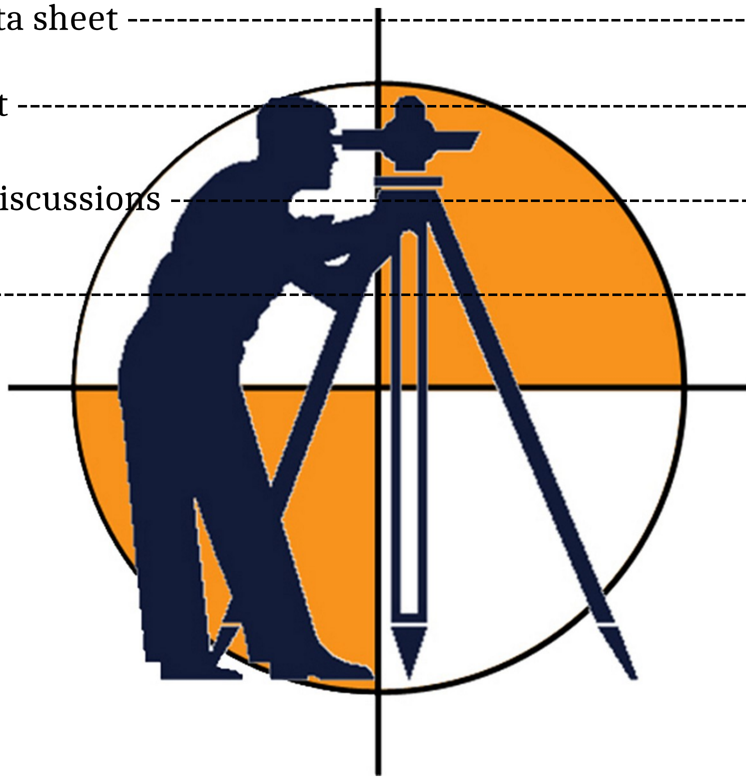
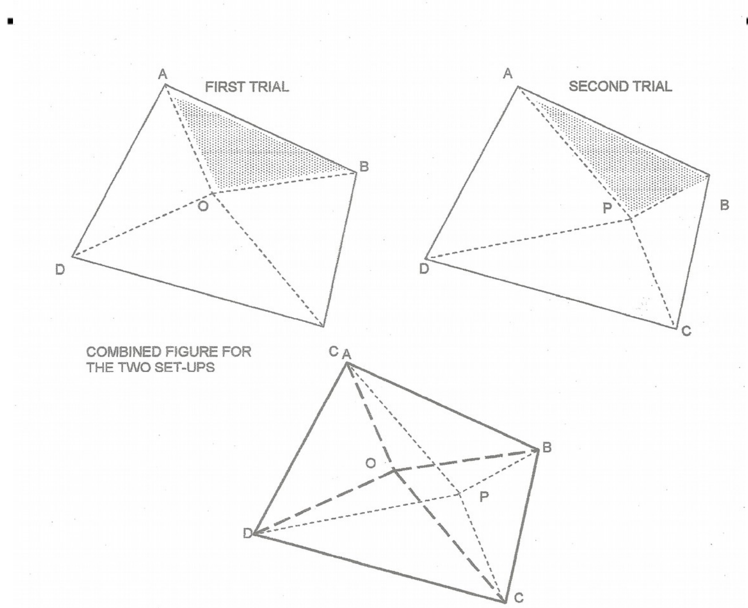


Introduction

In survey, traverse is defined as the field operation of measuring the lengths and directions of a series of straight lines connecting a series of points on the earth. Each of these straight lines is called a traverse leg, and each point is called a traverse station. Almost all surveying requires some calculations to reduce measurements into a more useful form for determining distance, earthwork volumes, land areas, etc. A traverse is developed by measuring the distance and angles between points that found the boundary of a site.

A radial traverse uses 1 fixed reference point to create a traverse relative to that fixed point. In other words, you begin at point A and capture the points around the perimeter of A. You are always standing at the same fixed point but you are capturing multiple vertices.

Radial traversing is ideal for quickly establishing a large number of points in an area, especially when a total station instrument is employed. They not only enable the angle and distance observations to be made quickly, but they also perform the calculations for azimuth, horizontal distance, and station coordinates in real time. Radial methods are also very convenient for laying out planned construction projects with a total station instrument.



Objectives:

1. To acquire the knowledge in getting the area of a rectilinear field by staking a central station.
   (NOTE: Select a station where all corner points of the rectilinear field are visible from.)
2. To learn how to read the horizontal angle of a transit.
3. T improve skills in the analysis of the area of triangles.
4. To develop the ability to lead or to follow the designated/desired task of one's party or group and to be fully responsible in the performance of the assigned task.

Instruments:

Optical Theodolite

A theodolite is a precision instrument used for measuring angles both horizontally and vertically. Theodolites can rotate along their horizontal axis as well as their vertical axis.

Chalk

A soft, white, porous sedimentary carbonate rock, a form of limestone composed of the mineral calcite.

Tape

Used to measure horizontal distances as well as slopes. Usually in 30m, 50m or 100m in length.

Range pole

Are used to mark areas and to set out straight lines on the field. They are also used to mark points which must be seen from a distance, in which case a flag may be attached to improve the visibility.

Procedures:

A. Determination of the area of a rectilinear field by radial traversing.

1. The professor assigned the corners of a rectilinear filed to be observed. Drive on each corner hubs or mark each corner with a chalk if on pavement.
2. Set-up the transit at a central location where all corner points will be visible and call it point O.
3. The tapemen must measure and record all the radial distance of the central point from each corner of the rectilinear field in the field notes provided for in this manual.
4. Level the bubbles of the transit. Set the horizontal Vernier to zero reading. Tighten the upper clamp.
5. Sight the first corner of the field and tightened the lower clamp.
6. Release the upper camp. Rotate the transit in a clockwise manner and sight the next adjacent corner of a rectilinear field.
7. Read and record the first horizontal angle of the outer Vernier between the first and the two adjacent corners.
8. Rotate the transit to the sight on the third corner of the field.
9. Read and record the next central horizontal angle of the rectilinear field.
10. Follow the same procedure until you reach the first corner.
11. The sum of the central angle after measuring a closed central angle traverse must be 360°.
12. Transfer the instrument into another central point where all corner points of the field will also be visible and repeat exactly the same procedure for the second trial of this field work.

Computations:

The computation of sample field notes is done in accordance with the steps listed hereunder:

Computation of the first triangular area

Area of each triangular field:

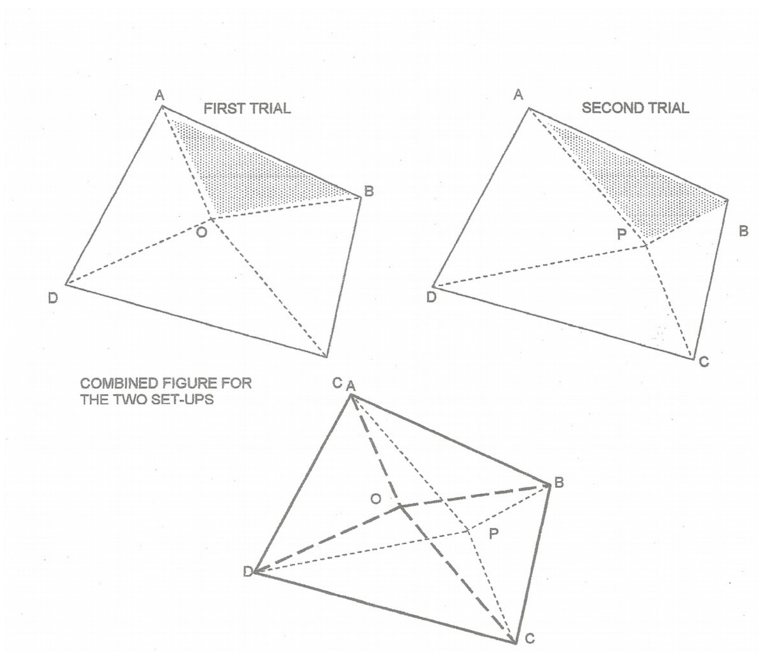
$$A_{Triangle} = \frac{1}{2} ab \cdot sin\theta$$

Total area is the sum of all the areas formed.

$$A_{Total} = A_1 + A_2 + \ldots + A_n$$

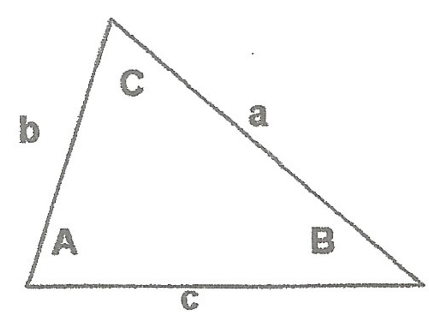
For the most probable value of the area of the rectilinear field, solve for the mean area of the two trials:

$$Most\ Probable\ Area = A_{mean} = \frac{A_{total\,1} + A_{total\,2}}{2}$$



Principle:

The area of a rectangle given two adjacent sides is equal to one half of the product of these two sides and the sine function of the included angle between them.



$$A_{Triangle} = \frac{1}{2} ab \sin\langle C$$

Preliminary Data Sheet:

PRELIMINARY DATA SHEET

FIELD WORK 9 — **DETERMINATION OF THE RECTILINEAR AREA BY RADIAL TRAVERSING**

DATE: 08-12-15 **GROUP NO.** 4
TIME: 12 – 4:30 pm **LOCATION:** Intramuros Walls
WEATHER: 29° **PROFESSOR:** Engr. Ira Balmonis

STATION OCCUPIED	A1	A2	A3	A4
O	a = 4.77	a = 6.66	a = 5.73	a = 5.31
	b = 6.66	b = 5.73	b = 5.31	b = 4.77
	θ = 94° 50'	θ = 124°49'	θ = 79°11'	θ = 61°10'
	Area = 15.83	Area = 15.67	Area = 14.94	Area = 11.09

TOTAL AREA = 57.53 m^2

STATION OCCUPIED	A1	A2	A3	A4
P	a = 3.98	a = 8.46	a = 5.93	a = 3.32
	b = 8.96	b = 5.93	b = 3.32	b = 3.98
	θ = 79° 39'	θ = 97°38'	θ = 94°49'	θ = 87°59'
	Area = 16.56	Area = 29.86	Area = 9.81	Area = 66

TOTAL AREA = 57.83 m^2

MOST PROBABLE AREA OF A RECTILINEAR FIELD = 57.68 m^2

B. COMPUTATIONS:

C. SKETCH

SIGNATURE OF STUDENT

SIGNATURE OF PROFESSOR

PRELIMINARY DATA SHEET

FIELD WORK 9 **DETERMINATION OF THE RECTILINEAR AREA BY RADIAL TRAVERSING**

DATE: 08-12-15 **GROUP NO.** 4
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TOTAL AREA = 57.53 m²

STATION OCCUPIED	A1	A2	A3	A4
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	b = 8.46	b = 5.93	b = 3.32	b = 3.98
	θ = 79° 39'	θ = 97°38'	θ = 94°49'	θ = 87°59'
	Area = 16.56	Area = 24.86	Area = 9.81	Area = 66

TOTAL AREA = 57.83 m²

MOST PROBABLE AREA OF A RECTILINEAR FIELD = 57.68 m²

B. COMPUTATIONS:

C. SKETCH

SIGNATURE OF STUDENT

SIGNATURE OF PROFESSOR

Computations:

Station O:

$\theta_1 = 94°50'$

$\theta_2 = 219°39' - 94°50' = 124°49'$

$\theta_3 = 298°50' - 124°49' - 94°50' = 79°11'$

$\theta_4 = 359°60' - 94°50' - 124°49' - 79°11' = 61°10'$

$A_1 = \frac{1}{2}(4.77)(6.66)\ SIN\ 94°50' = 15.83 m^2$

$A_2 = \frac{1}{2}(6.66)(5.73)\ SIN\ 124°49' = 15.67 m^2$

$A_3 = \frac{1}{2}(5.73)(4.77)\ SIN\ 61°10' = 11.09 m^2$

Total Area = $57.53 m^2$

Station P:

$\theta_1 = 79°39'$

$\theta_2 = 177°17' - 79°39' = 97°38'$

$\theta_3 = 272°1' - 79°39' - 97°38' = 94°44'$

$\theta_4 = 359°60' - 79°39' - 97°38' - 94°44' = 87°59'$

$A_1 = \frac{1}{2}(3.93)(8.46)\ SIN\ 79°39' = 16.56 m^2$

$A_2 = \frac{1}{2}(8.46)(5.93)\ SIN\ 97°38' = 24.86 m^2$

$A_3 = \frac{1}{2}(5.93)(3.32)\ SIN\ 94°44' = 9.81 m^2$

$A_4 = \frac{1}{2}(3.32)(3.78)\ SIN\ 87°59' = 6.6 m^2$

$57.83 m^2$

Most propable Area $= \frac{57.53 + 57.83}{2} =$ **$57.68 m^2$**

Final Data Sheet

Field Work 9 **Determination of the Rectilinear Area by Radial Traversing**

Date: Aug. 12, 2015 Group No.: 4
Time: 1:00pm Location: Intramuros Walls
Weather: 29° C Professor: Engr. Ira Balmoris

Station Occupied	A1	A2	A3	A4
O	a = 4.77	a = 6.66	a = 5.73	a = 5.31
	b = 6.66	b = 5.73	b = 5.31	b = 4.77
	θ = 94°50’	θ = 124°49’	θ = 79°11’	θ = 61°10’
	Area = 15.83	Area = 15.67	Area = 14.94	Area = 11.09

TOTAL AREA = 57.53 m^2

Station Occupied	A1	A2	A3	A4
P	a = 3.98	a = 8.46	a = 5.93	a = 3.32
	b = 8.46	b = 5.93	b = 3.32	b = 3.98
	θ = 79°39’	θ = 97°38’	θ = 94°49’	θ = 87°59’
	Area = 16.56	Area = 24.86	Area = 9.81	Area = 6.6

TOTAL AREA = 57.83 m^2

MOST PROBABLE AREA OF A RECTILINEAR FIELD = 57.68 m^2

B. Computations:

Station O

θ_1 = **94°50’**
θ_2 = 219°39’ - 94°50’
= **124°49’**
θ_3 = 298°50’ – (124°49’ + 94°50’)
= **79°11’**
θ_3 = 359°60’ – (79°11’ + 124°49’ + 94°50’)
= **61°10’**

A_1 = ½ (4.77)(6.66)(sin94°50’)
= 15.83 m^2
A_2 = ½ (6.66)(5.73)(sin124°49’)
= 15.67 m^2
A_3 = ½ (5.73)(5.31)(sin79°11’)
= 14.94 m^2
A_4 = ½ (5.31)(4.77)(sin61°10’)
= 11.09 m^2
TOTAL AREA = 57.53 m^2

Station P

θ_1 = **79°39’**
θ_2 = 177°17’ - 79°39’
= **97°38’**
θ_3 = 272°1’ – (97°38’ + 79°39’)
= **94°44’**
θ_3 = 359°60’ – (79°39’ + 97°38’ + 94°44’)
= **87°59’**

A_1 = ½ (3.98)(8.46)(sin79°39’)
= 16.56 m^2
A_2 = ½ (8.46)(5.93)(sin97°38’)
= 24.86 m^2
A_3 = ½ (5.93)(3.32)(sin94°44’)
= 9.81 m^2
A_4 = ½ (3.32)(3.98)(sin87°59’)
= 6.6 m^2
TOTAL AREA = 57.83 m^2

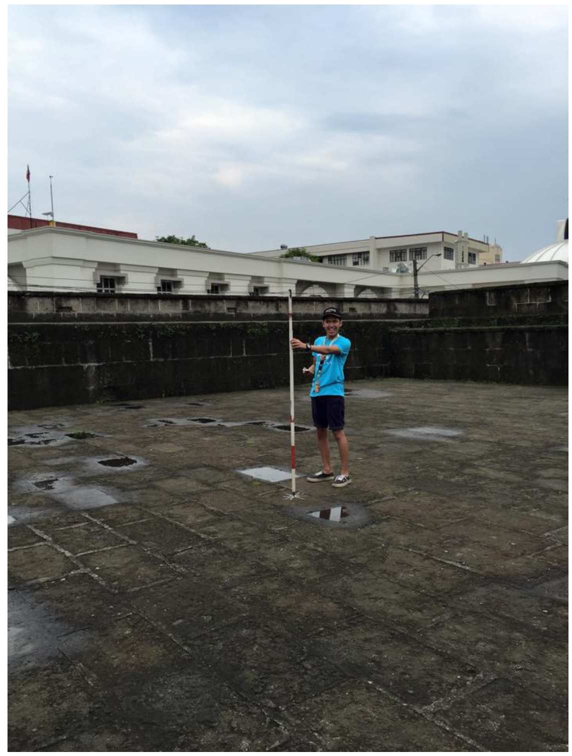
MOST PROBABLE AREA ¿ $\frac{57.53+57.83}{2}=57.68\,m^2$

PICTURES

Equipment set-up. Setting the horizontal Vernier to zero reading.

Measuring the radial distance of the central point to each corners of the rectilinear field.

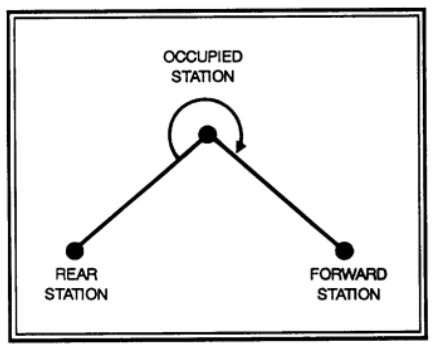
Measuring the horizontal angles by rotating the theodolite clockwise from the starting point.



Research and Discussions

In a traverse, three stations are considered to be of immediate significance. These stations are referred to as the rear station, the occupied station, and the forward station. The rear station is that station from which the persons performing the traverse have just moved or a point to which the azimuth is known. The occupied station is the station at which the angle-measuring instrument is set up. The forward station is the next station in succession and is the immediate destination of the party. During the traverse, the horizontal angles, vertical angles, and distances are measured.

Figure 5-1. **Stations of immediate significance**



- **Horizontal Angles.** Horizontal angles are determined from instrument readings made at the occupied station by sighting the instrument on the rear station and turning the instrument clockwise to the forward station. When measuring horizontal angles, the instrument is always sighted at the lowest visible point of the station markers designated the rear and forward stations. Horizontal angles are used in determining azimuths.

- **Vertical Angles.** Vertical angles are determined from instrument readings made at the occupied station to the height of instrument on the station marker at the forward station. When the distance between two successive stations in a traverse exceeds 1,000 meters, the vertical angle must be measured reciprocally. This reciprocal measurement procedure is used to eliminate errors caused by curvature and reflection. Vertical angles are used in determining the difference in height between stations.

- **Distance.** The distance between the occupied station and the forward station is measured by using electronic devices, horizontal taping, or trig-traverse procedures. The distance is used in conjunction with the horizontal and vertical angles to determine coordinates and height.

In certain situations, it may be most convenient to determine the relative positions of points by radial traversing. In this procedure, some point O, whose position is assumed known, is selected from which all points to be located can be seen. If a point such as O does not exist, it can be established. It is also assumed that a nearby azimuth mark, is also available.

Radial traversing is ideal for quickly establishing a large number of points in an area, especially when a total station instrument is employed. They not only enable the angle and distance observations to be made quickly, but they also perform the calculations for azimuth, horizontal distance, and station coordinates in real time. Radial methods are also very convenient for laying out planned construction projects with a total station instrument. In this application, the required coordinates of points to be staled are determined from the design, and the angles and distances that must be observed from a selected station of known position are computed.

Sources of Errors in Traversing

Some sources of error in running a traverse are:

1. Poor selection of stations, resulting in bad sighting conditions caused by alternate sun and shadow, visibility of inly the rod’s top, line of sight passing too close to the ground, lines that are too short, and sighting into the sun.
2. Errors in observations of angles and distances.
3. Failure to observe angles an equal number of times direct and reversed.

Mistakes in Traversing

Some mistakes in traversing are:

1. Occupying or sighting on the wrong station.
2. Incorrect orientation.
3. Confusing angles to the right and left.
4. Mistakes in note taking.
5. Misidentification of the sighted station.

All horizontal angles will be measured to the right (clockwise) from the backsight. All backsights will be to a prism secured to a tribrach and tripod. The foresight may be a prism pole, unless the foresight is associated with densification of the existing control survey. In this case a prism attached to a tribrach and tripod should be used. The surveyor should verify the angular conditions given above are satisfied.

Conclusion:

In the previous field work, we have encountered different methods in getting areas where as different instruments and techniques are used. In this field work, we used radial traversing using theodolite by determining the horizontal angles from a central point inside a rectilinear plane to each corners of the plane and measuring the radial distances from the central point. We should always remember to set the vertical angle into fixed angle of 90° and the horizontal Vernier should also be set to zero as the initial reading from the starting point on one corner. A total of 360° angle reading will be measured after having a complete turn up to the starting point of angle measurement. Always turn the theodolite clockwise from the backsight to have a positive angle reading. Errors may occur if the horizontal Vernier was not set to zero and the total measurement of the horizontal angle would not result to 360°. Errors would also occur during the measurement of radial distance if the tape measure sagged. Remember to position the theodolite where all the corners or points of the rectilinear plane can be seen.

Radial traversing may be used to determine the required information associated with photogrammetric control marks, densification of the existing control, and existing monuments, including right-of-way reference pins, right-of-way monuments, property corners, a and property controlling corners. Radial traversing may also be used in conjunction with a secondary traverse.