CHAPTER 2: DISTANCE MEASUREMENT (FIELD)

OBJECTIVES OF THE UNIT

At the end of this unit, the reader must be in good stead to:

- Use different distance measuring instruments like tapes, distance measuring wheel and laser range finder,
- Measure distance in the field using the pacing method,
- Calculate perimeter and area based on the measurements taken from different methods,
- Choose the most appropriate method and instrument when measuring distance for different purposes.

RATIONALE FOR THE UNIT

This unit is designed to develop students' knowledge and skills needed for one to competently measure the distance in real property using different methods and instruments. Students will work in groups to measure the distance of different properties and there after calculate area and perimeter of the same.

ASPECTS AND ISSUES

The dictionary definition of distance is the length of the space between two points. With reference to Figure 2, our two points are BA ISAGO University Gaborone Campus and the Central Business District that are 3km from each other. Vlok, Harmse and de Jager (2009) posit that distance can also be measure in terms of time. In this case, if we are to use the example of Figure 2, instead of describing BA ISAGO University as located 3km from the CBD, one can say the location of BA ISAGO University is a 5-minute drive from the CBD. How is distance measured by planning real estate professionals? Property measurement (distance) is done either in the field (on the ground) and/or in the office (on maps). Let us proceed to discuss the common distance measurement techniques and instruments that are used in the real estate industry. In the field, distance measurements can be obtained by many different methods but the commonly used are pacing, taping, digital measuring wheel (odometer) and electronic distance measurement (EDM). The choice of measurement technique and tools to be used depend on the accuracy of the result needed, cost, required skills, availability of equipment and characteristics of the subject property.

THE PACING METHOD

One can measure distances roughly by pacing. This means one count the number of normal steps that will cover the distance between two points along a straight line. Pacing is particularly useful in reconnaissance surveys, for contouring using the grid method and for quickly checking chaining measurements. To be accurate, one should know the average length of their step when one walk normally. This length is called their normal pace. Always measure their pace from the toes of the foot behind to the toes of the foot in front. Refer to Figure 15 below for a diagrammatic illustration.

Figure 15: Example of pacing measurement (Primary Data, 2024)

PACE FACTOR (PF)

The first thing one is supposed to do when using the pacing method is to calculate their pace factor. To measure the average length of their normal pace (the pace factor):

- Take 100 normal steps on horizontal ground, starting with the toes of their back foot from a well-marked point, A, and walking along a straight line.

- Mark the end of their last step with peg B, at the toes of their front foot.
- Measure the distance AB (in metres) with, for example, a tape and calculate their pace factor PF (in metres) as follows:

Example
If for 100 paces, one measure 75 m, then their pace factor is calculated like this:
PF = 75 m /100 = 0.75 m.
Now that one knows how to calculate the pace factor, let us proceed to discuss how one uses the same in calculating distance. Please refer to Figure 16.

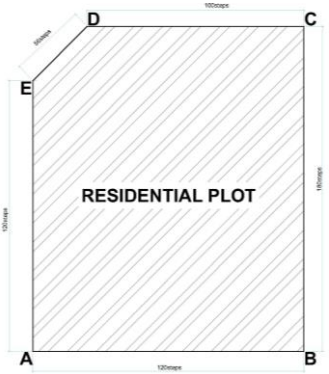

Figure 16: Pacing Example. (Designed by Authors)

To calculate the distance from A to D, one is supposed to do the following:
Add steps AB, BC and CD to get the total number of steps (N)
Multiply the N by their pace factor PF (in metres) to get a rough estimate of the distance in metres, as follows: Distance (m) = N x PF.
To measure ABCD, pace distances AB = 120 steps; BC = 180 steps; CD = 100 steps and DE = 55. ABCDE = 120 + 180 + 100 + 56 = 456 steps.
If PF = 0.75 m,
therefore, ABCDE = 456 x 0.75 m = 342m

ADVANTAGES OF THE PACING METHOD
It is simple hence there is no need for specialised skills;
It is cheap since there is no need of specialized equipment.

DISADVANTAGES OF THE PACING METHOD
Error increases as the terrain becomes more difficult (slope, vegetation, obstacles).

- Requires practice to take a consistent pace.
- It can be time consuming when measuring large properties.
- It only measures distances that is you cannot measure distance and angles at the same time.
- It requires being able to walk the route hence it is not very useful for measuring distance in rough terrain, across swamps, or in any other terrains where an individual could not walk the distance or walk in a straight line (Field & Long, 2018).

THE TAPING METHOD

This is a traditional method of measuring distance between two points. Taping is carried out by two persons. Tapes are popular for making rough measurements or when the accuracy of a chain is not needed. The tapes are classified based on the materials of which they are made of, such as Cloth or linen tape, Fibre Tape, Metallic Tape, Steel tape and Invar Tape. Figure 17 shows an example of a fibre tape.

Figure 17: Fibre tape (Image taken by Authors)

ADVANTAGES OF THE TAPING METHOD

1. Non-metallic tapes are usually lighter and easier to use,
2. They require less maintenance and are not as easily damaged by moisture,
3. Inexpensive.

DISADVANTAGES OF THE TAPING METHOD

1. Tapes will stretch under tension and therefore are not very accurate.
2. Need multiple people,

3. Must have a clear, travelable route,
4. High precision requires temperature and tension correction.

THE DIGITAL MEASURING WHEEL/ ODOMETER

It is a wheel fitted with a fork and handle. The wheel is graduated and shows a distance per revolution. There is a dial that records the number of revolutions. Thus, the distance can be computed. The distance is calculated by multiplying the number of revolutions by the wheel's circumference. The smoother the path the wheel travels, the more accurate the measurement. This method is particularly useful for curved lines. Odometer wheels can also be used to verify other measurements. Figure 18 shows a digital measuring wheel.

Figure 18: Measuring wheel (Image taken by Authors)

ADVANTAGES OF A MEASURING WHEEL

1. Easy to use;
2. Do not need exercise or experience;
3. Fast to give an estimate of the distance.

DISADVANTAGES OF A MEASURING WHEEL

1. Error increases as the terrain becomes more difficult (slope, vegetation, obstacles),
2. It only measures distances that is you cannot measure distance and angles at the same time,
3. Accuracy might be compromised due to technical faults like when the power is low,
4. It requires being able to walk the route hence it is not very useful for measuring distance in rough terrain, across swamps, or in any other terrains where an individual could not walk the distance or walk in a straight line (Field & Long, 2018).

LASER DISTANCE METER RANGEFINDER

A laser distance meter uses the focusing of lenses on a distant object to estimate the distance to the object. This technique is the same as single-reflex lens cameras. A laser rangefinder is a handheld device that projects a beam of light and measures the time of reflection to calculate the distance to the object off that the beam reflects. Lasers have a maximum range of 500 m. And there is another type a laser rangefinder is a device that uses a laser beam to determine the distance to an object. The most common form of laser rangefinder operates on the time-of-flight principle by sending a laser pulse in a narrow beam towards the object and measuring the time taken by the pulse to be reflected off the target and returned to the sender. Due to the high speed of light, this technique is not appropriate for high precision sub-millimetre measurements, where triangulation and other techniques are often used. The precision of the instrument is determined by the rise or fall time of the laser pulse and the speed of the receiver. One that uses very sharp laser pulses and has a very fast detector can range an object to within a few millimetres. An example of a Laser distance meter is shown in Figure 19.

Figure 19: Handheld laser distance meter ([online] Available at: **https://www.autobuild.co.za/products/fm880/** (Accessed: 11/09/2020).

ADVANTAGES OF RANGEFINDERS

1. They are not heavy hence they are easy to use in the field;
2. High level of accuracy in the results recorded;
3. The laser distance meter can accumulate independently to calculate surfaces and volumes;
4. Capable of determination of very large distances hence not time consuming;
5. No need of many people to operate it.

DISADVANTAGES OF RANGEFINDERS

1. Only measures on flat surface;
2. Source of power battery always charging;
3. Instruments used are expensive;
4. Requires training;
5. Accuracy might be compromised due to technical faults like when the power is low.

ACTIVITIES FOR THE READER

- Point out any two (2) instruments used to measure the distance of property in the field.

- Explain any two (2) advantages of taking distance measurements using each of the following: the pacing method, the taping method, the digital measuring wheel, and the laser distance meter.
- Explain any two (2) disadvantages of measuring distance using each of the following: the pacing method, the taping method, the digital measuring wheel and the laser distance meter.

You measured the length and width of a property on the ground using the pacing and your measurements were as follows:

Length	1 000 steps
Width	750 steps
Distance covered by 200 steps	150m

a) Calculate the pacing factor,
b) Calculate the perimeter of the property,
c) Calculate the area of the property.

You measured the length and width of a property on the ground using the pacing and your measurements were as follows:

Length	1 000 steps
Width	600 steps
Distance covered by 200 steps	175m

a) Calculate the pacing factor,
b) Calculate the perimeter of the property,
c) Calculate the area of the property.

vi. You measured the length and width of a property on the ground using the pacing and your measurements were as follows:

Length	**1 000 steps**
Width	500 steps
Distance covered by 200 steps	180m

a. Calculate the pacing factor,
b. Calculate the perimeter of the property,
c. Calculate the area of the property.

You measured the length of a footpath using the pacing method and you counted 2000 steps. If your 100 steps are equivalent to 65m, Calculate:

- The Pace Factor.
- The length of the footpath in metres.

CONCLUSION

Having completed this unit, learners should be able to competently measure land and buildings using different methods and instruments as well as calculate perimeter and area with accuracy. The knowledge and skills gained will be used when designing location/locality maps which are used to measure different properties for various purposes and effectively communicate the area of the subject properties with different stakeholders.

SUGGESTIONS FOR FURTHER READINGS

dela Cruz, C., R. 1983. Fishpond engineering: A technical manual for small-and medium-scale coastal fish farms in Southeast Asia. Metro Manila, the Food and Agriculture Organization of the United Nations.

Field, H., L. and Long, J., M. 2018. Introduction to agricultural engineering technology: A problem solving approach (Fourth Edition). Springer: ISBN 978-3-319-69678-2; ISBN 978-3-319-69679-9 (eBook). https://doi.org/10.1007/978-3-319-69679-9.

Ghilani, C., D. and Wolf, P., R. 2012. Elementary Surveying: An Introduction to Geomatics (Thirteenth Edition). New Jersey, Prentice Hall.

Gomarasca, M, A. 2010. Basics of geomatics. Springer, ISBN 978-1-4020-9013-4).

Kavanagh, B., F. 2010. Surveying with construction applications (Seventh Edition). New Jersey, Prentice Hall.

Kavanagh, B., F. and Mastin, T., B. 2014. Surveying Principles and Applications (Ninth edition). New Jersey, Prentice Hall.

Minchin, M. 2016. Introduction to Surveying, Second Edition. Australia. Government of Western Australia. Online available from www.dtwd.wa.gov.au Accessed 20/07/2018.

Vlok, C., Harmse, A and de Jager, A. 2009. Geographical thinking and spatial perspectives: Study guide for EGIS01J. Pretoria, University of South Africa.