GEOSCIENCE AND REMOTE SENSING TECHNOLOGY
ISSN: 2963-7767 (Online) Journal homepage: https://www.geo-rest.org

Received October 20, 2022, Accepted November 13, 2022, date of publication December 25, 2022, date of current version December 25, 2022.
Digital Object Identifier 10.57265/georest.v1i2.8

SITUATION DETAIL MAPPING OF THE FACULTY OF MATHEMATICS AND NATURAL SCIENCES, UNIVERSITAS NEGERI PADANG USING TOTAL STATION

Riko Maiyudi[1*], Adhitya Baron[1]
[1]Department of Mining Engineering, Universitas Negeri Padang, 25131, Indonesia.
[*]Corresponding author: rikomaiyudi@ft.unp.ac.id Orcid ID:

ABSTRACT
Detailed Situation Mapping is one of the efforts to provide geospatial information to assist campuses, in this case Padang State University, especially the Faculty of Mathematics and Natural Sciences. Meanwhile Detailed Situation Mapping is a process of measuring and mapping the topography of the earth's surface on a large scale. The situation map contains elements of natural and man-made features on the earth's surface complete with elevation values represented by contour lines. In the measurement process, mapping survey tools are used. One of the tools used is a total station. To make a detailed map of a place, in this case FMIPA UNP, you need location coordinates that are scattered at various points. In order for the resulting maps to be in accordance with geospatial conditions in the field, various applications such as surpac, autocad, arcgis, and so on are used. In the measurement of the horizontal control frame, the closed polygon method was used, while for the measurement of the vertical control frame, the precision flat measurement method was used. For the measurement of detail points, the extrapolation method is used. Meanwhile, for the measurement of high points, the trigonometric method is used using a total station. The type of research used is quantitative research with a descriptive approach. The quantitative research method is a type of research whose specifications are systematic, planned and clearly structured from the start to the creation of the research design. The detail positioning method is carried out for situation mapping at the State University's Faculty of Mathematics and Natural Sciences by measuring the three-dimensional (x, y, z) position of the details determined by the azimuth component (angle, direction and height difference from the tie point). Because of the large amount of detail that is being measured, measurements are made using a fast technique, called tachymetry.

INDEX TERMS ***Mining, Situation Detail Mapping, Total Station***

I. INTRODUCTION

1.1. Background

The most basic thing in planning is the availability of size data or map data for the location of development activities. Measurement of the location of the activity itself must be accurate because it can affect the shape and cost of the planned construction. The measurement data can be obtained from survey activities and land plot measurements that will be planned. This survey and measurement activity is the application of soil surveying which aims to obtain information on determining the position of 3-dimensional abscissa, ordinate and height coordinate points with the general notation (X, Y, Z) by using a flat measuring tool or a measuring tool other.

Many types of sophisticated modern measuring instruments such as Total stations, Geodimeters, Ecosonders, Laser meters, and others. However, the use of Global Positioning System (Global Positioning System/GPS) and spatial data processing and analysis technology or Geographic Information System (GIS) is a significant advance and is very helpful in topographic measurements which require a lot of time and higher costs. Even with the existence of this mapping technology, the concept of soil surveying is the basis and forerunner of this sophisticated measurement method.

Apart from GPS, there is also a Total Station, which is a modern electronic device used in conducting measurement surveys that aim to measure angles, distances and heights. The total station is a refinement of the theodolite flat

Published by: EarthCare

measuring instrument which has quite good accuracy in recording and retrieving data in the field. The reading of the coordinates given by the total station is the data from the results of this study, namely:

1. What level of accuracy is obtained from the results of detailed situation measurements using a total station?
2. How accurate is the result of mapping the details of the situation with the actual situation?
3. How to make detailed situation mapping pictures from measurement data using a total station?

1.2. Formulation of the problem

As for the formulation of the problem in polygons? because it is used as a basic framework for mapping an area. (Source: Bekasi Raya Putra, 2020).

The Horizontal Control Framework (KKH) is a basic mapping framework that shows the horizontal position (X,Y) between one point relative to another point on the earth's surface in a flat plane. To get the horizontal position of the KKH, many methods can be used, one of which is the polygon method (Source: Tianjemeduson, 2012).

The polygon method is used to determine the horizontal position of many points where one point to another is connected by distance and angle so as to form a series of angles of points (polygon). In determining the horizontal position with this method, the position of a point whose coordinates are unknown is determined from a point whose coordinates are known by measuring all distances and angles in the polygon
(Source: S. Basuki, 2006)

1.3. Purpose and Objectives

a. Make a situation map from measurement with total station.
b. Knowing the comparison of the results of the mapping with the actual. Direct measurements taken in field. Therefore, determining the height using a total station measuring instrument to obtain height difference data is still the main choice for reasons of accuracy of the total station level measuring instrument itself having high accuracy and is more accurate.
c. How to make detailed situation mapping pictures from measurement data using a total station?

II. LITERATURE REVIEW

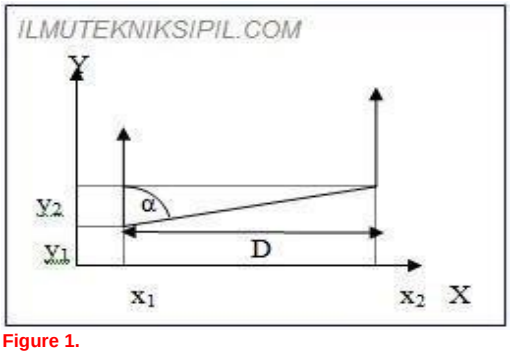


Figure 1.

Polygon

A polygon is a series of points connected by straight lines so that these points form a series (network) of points or polygons. In the work of making maps, a series of polygon points is used as a map framework, which is a network of points that have a certain location on the ground which has been marked with stakes, where all man-made objects such as bridges, highways, buildings and natural objects such as lakes , hills, and rivers will be oriented. The position of objects in mapping work is usually expressed by the Cartesian coordinate system perpendicular (X, Y) on a flat plane (map), with the X axis indicating the east-west direction and the Y axis indicating the north-south direction. The coordinates of the polygon points must be quite accurate considering that the accuracy of the location and size of the objects to be mapped is highly dependent on the accuracy of the map frame. (Source: June 8, 2012 by Ksatria Budi)

Closed Polygon

A closed polygon is a polygon where the starting point and ending point have the same position or coincide, so this polygon is a closed series. Based on its function, polygons are divided into :
1. Polygons for the purposes of a map framework, the condition is that they must have good enough points, in the sense that they cover all areas.
2. Polygons that serve as help points to retrieve field details.

To make it easier to understand the angles that exist in polygon measurements, it is necessary to explain the following :
1. The interior angle is the difference between two different directions (directions).
2. Azimuth is the calculated angle to magnetic north, and this direction coincides with the Y axis on the map.
The elements to look for in measuring polygons are all distances and angles (Di, βi). These two elements are sufficient to paint the polygon on the map, if we are not bound by the existing coordinate system and do not pay attention to the orientation of the polygon. In order for the polygon to be oriented (certain orientation), it is necessary to know one side of the direction angle (azimuth). (Source: June 8, 2012 by Ksatria Budi)

Closed polygons are polygons whose start and end points meet at the same point. In closed polygons, angle corrections and coordinate corrections can still be performed even without a tie point. (Source: I. Young, 2008)

A closed polygon is a measurement framework that forms a polygon that closes a polygon. What is meant by closing is if you start from point 1 then go to point 2 and so on it will return to point 1 again. So that it will form a polygon. The function of returning to the starting point is used to correct the angles on each of the polygons. (Source: MulkanSumaryanto, 1980)

Published by: EarthCare

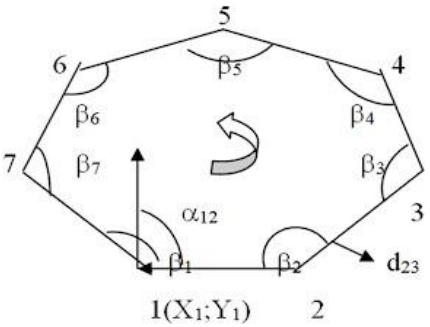


Figure 2. Closed Polygon Interior Corner

Keterangan gambar : (n-2) x 180°
β = besarnya sudut.
α_{12} = azimuth awal.
$X_1;Y_1$ = koordinat titik A.
n = jumlah titik sudut
d_{23} = jarak antara titik 2 dan titik 3.

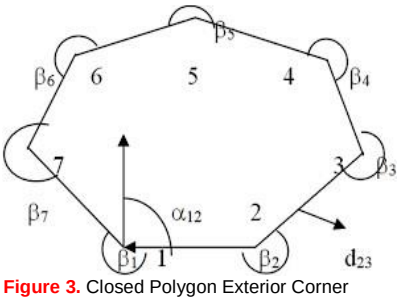


Figure 3. Closed Polygon Exterior Corner

Keterangan gambar: (n+2) x 180°
β = besarnya sudut.
α_{12} = azimut awal.
n = jumlah titik sudut.
d_{23} = jarak antara titik 2 dan titik 3.
(Sumber : C. Nurjati, 2004).

A closed polygon shape produces a polygon or n terms, where n is the number of polygon points. Therefore the geometric requirements of a closed polygon are:
a.Syarat sudut:
Sudut Dalam = (n-2) . 180°
Sudut Luar = (n+2) . 180°
b.Syarat absis
As for the procedure the calculation is the same as the calculation procedure for perfectly bound polygons. The positions of polygon points determined by calculating their coordinates are called numerical solutions or calculated polygons. (Source: Ulyo Purwohardjo, 1986).

Situation Mapping

Situation Mapping is intended to create an overview of a portion of the earth's surface (an area/region) which contains information on natural and manmade elements expressed by certain symbols and depicted at a certain scale on a flat plane through a certain projection system (Source: Spada Uns , 2020).

Mapping is a measurement process. Calculations, and depictions of the earth's surface using certain methods and or methods so that the results are in the form of softcopy or hardcopy maps in vector or raster form (Source: Yoel Priatama, 2015).

Measurement of land plots can be done by terrestrial, photogrammetric, or ther methods. Terrestrial measurements are measurements using a theodolite measuring instrument and a total station. The photogrammetric mapping is mapping through aerial photographs. Photogrammetric mapping cannot be separated from terrestrial measurement references, starting from determining control base points to measuring land boundaries (Source: Chatarina Widyani, 2015).

Building mapping is one of the applications of using a contour map. This mapping can be used to determine the characteristics of the slope of the land surface by knowing the height difference between contour lines. In addition to this, you can also know the desired area, such as the area of a building. This can be known by calculating the difference in distance between firing points. A snippet of a contour map shows the difference in height between the base level of an area and the height of the ground surface around the area (Source: Humayri sidqi, 2015).

Situation mapping is a composite of profile polygons. Situation mapping can be interpreted as a depiction of geometric data on the surface of the earth to a flat plane with a certain scale. The process of measuring a situation requires a basic framework for measurement in the form of a flat base frame and a high base frame (Source: Francis Suniarmo, 2015).

The basic horizontal framework can be done in several ways, including binding to the front, binding to the back, triangulation, polygons, or a combination of these methods. While the high base frame can use a flat level. From this flat framework, geometric data can be collected from the details that are measured (Source: Tribhuwana Aulia, 2018).

Situation and detail mapping is the mapping of an area or measuring area which includes presentation in horizontal and vertical dimensions together in a map image. To present the situation map image, it is necessary to carry out the following measurements:
a. Fundamental point measurement.
b. Horizontal frame measurement.
c. Measurement of frame height (height difference)
d. Measurement of detail points (direction, height difference and distance to selected detail points according to scale requests)

Basically the working principle required for mapping an area is always carried out in two stages, namely:
1. Implementation of the basic framework as an effort to spread tie points

2. Retrieval of detailed point data which is representative of the physical description of the earth that will appear on the map. These two processes end with the delineation and contour stages (Source; Wongsotjitro Soetomo, 2008).

In mapping the measurement field is very influential and is determined by the framework and type of measurement. The shape of the framework that is designed does not have to be a polygon, but can be a combination of existing frames.
a. Horizontal Measurements There are two kinds of measurements made for the horizontal position, namely the measurement of the main polygon and the measurement of the branched polygons.
b. Height Difference Measurement Situation measurement is determined by two types of height measurement, viz - Measurement of the main flat properties. -Measurement of branched flat properties.
c. Detailed Measurements During field measurements, the data taken for detailed measurements are:
- The height difference between the frame tie point and the relevant detail point. -Optical distance or flat distance between frame points and detail points.
- The angle between the side of the framework and the direction of the starting point of the relevant detail, or the angle of the magnetic direction from the direction of the relevant detail point (Source: Y.Bayu, 2011).

There are two methods of measuring the situation itself, namely:
1. Offset Method In this method the main tool used is a ribbon / chain and tools for making elbows (prisms)
2. The offset method consists of two ways, namely:

a. Right angle method (plumb line)

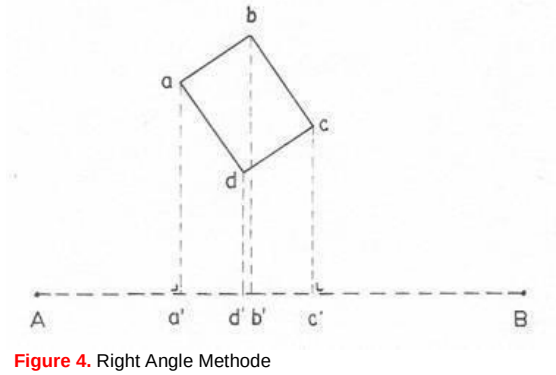


Figure 4. Right Angle Methode

The detail points are projected at right angles to the AB measurement line. Then the distances are measured by measuring the distances aa', bb', cc', dd', the positions of points a, b, c and d can be relatively determined.

b. Binding Method (Interpolation) Detail points are tied with a straight line on the measuring line. There are two ways:
1. Fastening at any point.
Find any line on the AB measuring line with points a', a", b;, b", c', c". Make sure that the triangles a'a"a, b'b"b, c'c"c are equilateral or isosceles triangles. By measuring the distance Aa', Aa", Ab', Ab", Ac', Ac", Bc", Bc', Bb", Bb', Ba', Ba", a'a, a"a, b'b, b"b, c'c, c"c then the positions of points a, b, c can be determined. 1. Side extension

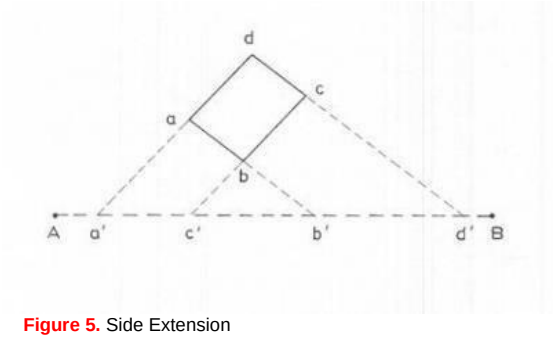


Figure 5. Side Extension

1. The Simple Trilateration Method
2. Polar Tool Method: compass theodolite (eg To) or repetition theodolite.
3. With elements of Azimuth

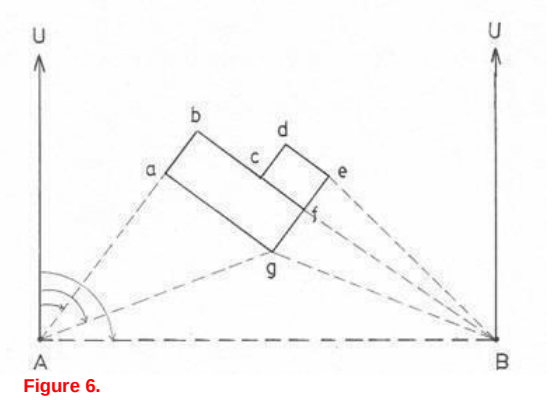


Figure 6.

With elements of angle and distance - Angle measurements are made from the basic point of the technique - Flat distance measurement is done with a measuring tape or EDM.

In determining the boundary point, a minimum of three measurement data is required using at least two fixed reference points (Source: F. Prakasa, 2016).

III. METHODE

3.1 Practicum Time and Place

a. Practicum implementation time To complete project assignments This is given 1 month.
- Week 1, determination of points and installation of screws on all points., and Measurement of closed polygons.
- Week 2, Detailed measurement of the situation.
- Week 3, Continue to measure the details of the situation.
- Week 4, Making maps, journals, and power points for presentations. Place of implementation of the practicum.

b. The place where this practicum was carried out was at the Faculty of Mathematics and Natural Sciences (FMIPA), Padang S.

3.2 Practicum Equipment

a. total stations
b. Polygon prism

c. Prism details
d. tripods
e. Measuring tape
f. Measuring pen
g. Umbrella tate University (UNP).

3.3. Preparation

a. Prepare the equipment needed for the practical implementation of measurements.
b. Make sure the equipment to be used is in good condition and not damaged.
c. Prepare safety equipment so that serious problems do not occur in work accidents.

3.4 Practical Steps

a. Field observation and determination of BM points.

- Determining the location of the points that will be used as BM in the UTM Geomap
- Installation of screws at predetermined points so that the points are not lost and the coordinates do not change.

b. Closed polygon

- The initial coordinates used are taken from the predetermined rectorate. - From the rectorate, measurements are carried out through the BM points that are tied to each other up to one of the BM FMIPA points and back again to the first point in the rectorate.
- After the coordinates of one of the points are obtained, then proceed with measuring closed polygons around FMIPA using a total station.
- Put the total station on BM 1, polygon prism on BS (Back Side), and detail prism on FS (Front Side).
- Aim for BS first, then aim for FS. After getting the coordinates, move the total station to the targeted FS. The initial BM is set to BS, then shoot again as before.
- Do the same for each point around FMIPA that has been determined before, until you return to the starting point.

c. Situation detail mapping

- Choose one of the BM points in the middle of the location to be used as the initial reference detail point.
- Take measurements to get coordinates in the same way as closed polygon measurements.
- For details, place poles at the corners of the building, shoot at every corner of the building, so that the resulting map will be similar to the real thing.
- If the BM point does not reach the building, then an auxiliary point is used. - Do the same for every building, road and gutter.

d. Situation mapping

- Arrange the coordinates that have been obtained, enter them into excel.
- Enter coordinate data in the arcgis application for map making.
- The generated maps are personal maps, group maps, session maps, and the combined whole session (UNP) map.

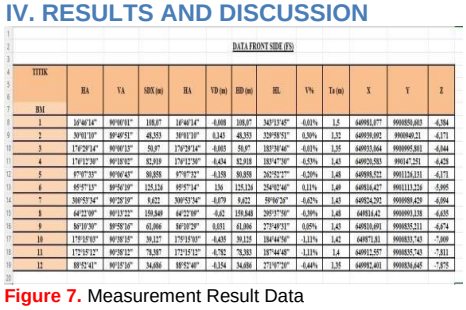
e. Place of implementation of the practicum The place where this practicum was carried out was at the Faculty of Mathematics and Natural Sciences (FMIPA), Padang State University (UNP).

3.5 Calculaton Process

a. Direct Distance Calculation. The distance used is the average distance between polygon points.
b. Polygon Calculations. (Horizontal Frame of Control) The method used to calculate the control frame horizontal is the Bouwditch method.
c. Flat Angle Calculation. To calculate the height difference between points, use the formula:
bt front sign (A) – back sign bt (B) Point height by formula: HB = HA+ ΔhAB
The calculation of the height difference closing error correction is carried out if the polygon used is a closed polygon.
d. Situation Detailed Calculations Using the Polar Coordinate Method. Detailed calculations for both planimetric and spotheight situations are carried out in the same way, namely:
   1) Calculation of distance, horizontal angle and height difference by extrapolating polar coordinates using the tachymetry method.
   2) Detailed positioning
      a) From the standpoint of the tool at 1 Optical distance (D1_a)= A x (ba –bb) x cos2helling Horizontal angle (βa) = reading pir.horz.2 – reading pir.horz. a v = D1_a. tan helling Height difference(Δh1a)= ta1+ v – bta 2. Calculation of the detailed azimuth of the situation based on the azimuth of one side of the polygon and the horizontal angle of the measuring results. The formula used is: αa = α12 + 360o – βa (if side 1 to 2 azimuth is used)
   3) Calculation of detailed point coordinates (Xa, Yes, Za) from the coordinates of the tool's establishment (X1, Y1, Z1).
      Xa = X1 + D1_a sin α1a Yes = Y1 + D1_a cos α1a
      Za = Z1 + Δh1a

Situation Map Depiction The session map depiction uses a scale of 1:1700. Depiction of group maps using a scale of 1:950. personal map depiction using a scale of 1:400 with A4 paper size.

IV. RESULTS AND DISCUSSION



DATA FRONT SIDE (FS)

TITIK BM	HA	VA	SDX (m)	HA	VD (m)	HD (m)	BIL	V%	Ta (m)	X	Y	Z
1	16°46'34"	89°00'11"	108,07	16°46'34"	-0,008	108,07	343°13'45"	-0,01%	1,5	669981,077	9980859,683	-6,384
2	30°01'10"	89°49'51"	48,353	30°01'10"	0,143	48,353	329°58'51"	0,30%	1,32	669939,092	9980849,21	-6,371
3	17°29'14"	89°00'13"	50,97	17°29'14"	-0,003	50,97	183°30'46"	-0,01%	1,35	669933,864	9980895,501	-6,044
4	174°12'30"	89°10'02"	52,910	174°12'30"	-0,454	52,910	183°47'30"	-0,53%	1,43	669920,583	9980147,251	-6,428
5	87°07'25"	89°06'45"	80,858	87°07'32"	-0,158	80,858	262°52'27"	-0,20%	1,48	669888,522	9980126,131	-6,171
6	95°57'15"	89°56'10"	125,126	95°57'14"	136	125,126	254°02'46"	0,11%	1,49	669816,427	9980111,256	-5,995
7	300°53'34"	90°25'10"	9,622	300°53'34"	-0,079	9,622	59°06'26"	-0,82%	1,43	669824,292	9980988,429	-6,094
8	64°22'09"	90°13'22"	110,860	64°22'09"	-0,42	110,848	295°37'50"	-0,38%	1,48	669816,42	9980980,138	-6,635
9	86°10'20"	89°58'16"	61,006	86°10'25"	0,031	61,006	273°49'31"	0,05%	1,43	669810,691	9980855,211	-6,674
10	175°15'03"	90°38'15"	39,127	175°15'03"	-0,435	39,125	184°44'56"	-1,11%	1,42	669871,83	9980833,743	-7,069
11	172°15'12"	90°38'12"	78,387	172°15'12"	-0,782	78,383	187°44'48"	-1,11%	1,4	669912,557	9980855,743	-7,811
12	89°52'41"	90°15'10"	34,086	89°52'40"	-0,154	34,086	271°07'20"	-0,44%	1,35	669892,401	9980836,645	-7,875

Figure 7. Measurement Result Data

Published by: EarthCare

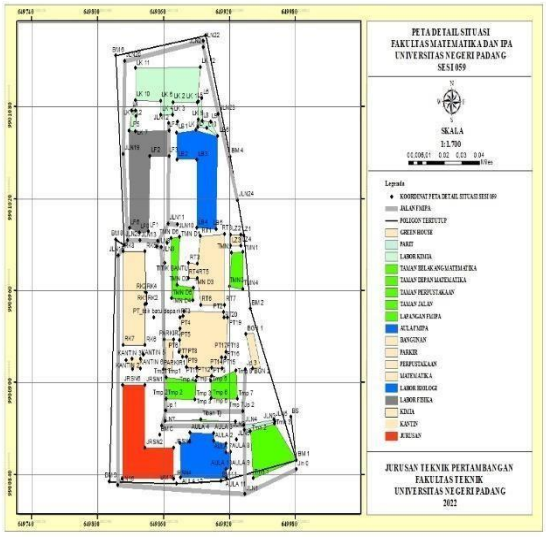


Figure 8. Situation Detailed Map of the Faculty of Mathematics and Natural Sciences

Conclusion

1. Situation mapping practice aims to find the area of a buildig or land without taking direct measurements. Based on the practicum that has been carried out, a two-dimensional picture of a plateau can be made by using the practicum result data. After doing the calculations, it is found that the area of the building being sought is 33,815 m2
2. A closed polygon is a basic measurement framework that forms a polygon that closes a polygon. What is meant by closing is if you start from point 1 then go to point 2 and so on it will return to point 1 again. So that it will form a polygon. The function of returning to the starting point is used to correct quantities
3. In a closed polygon we have 11 BM points scattered on the edge of the math and science faculties area
4. In mapping our situation we have 169 points spread within and outside the faculties of mathematics and natural sciences
5. In this practicum with the theme of detailed situation mapping and closed polygons, we use a total station as a tool and in making maps we use the Arcgis 10.8 2019 application
6. The scale we use in creating the session map is 1:1700

Suggestion

1. This practicum is indeed not perfect, so accuracy and cohesiveness are needed in this measurement or practicum.
2. My suggestion is that the campus should do the mapping every 2-3 years. So that the map of Padang State

University will always be updated

REFERENCES

[1] Amir, Zulfahmi. 1998. *"Dasar dasar Pengukuran Terristris dan Pemetaan Situasi"*.Padang.Universitas Andalas.

[2] Arif, Ir Irwandy. 2016. "*Geoteknik Tambang"*. Gramedia Pustaka Utama.

[3] Basuki, S. 2006. *"Ilmu Ukur Tanah"*. Yogyakarta: Universitas Gadjah Mada Press.

[4] Basuki, Slamet. 2011. *"Ilmu Ukur Tanah"*. Gadjah Mada University Press, Yogyakarta.

[5] Cahya, Doni Muslim, Yuwono Yuwono, and Akbar Kurniawan.2021.*"Analisis Perbandingan Nilai Koordinat Wall Station Sebagai Titik Kontrol Posisi Tambang Bawah Tanah dengan Pengamatan Poligon Tertutup dan Pengikatan Ke belakang (Studi Kasus: Tujuh Bukit Underground Project, PT. Bumi Suksesindo)." Geoid* 16.1 (2021): 57-67.

[6] Fauzi, Mohammad Ruly. 2015. *"Penggunaan Total Station dalam Perekaman Data Arkeologi di Indonesia."* (2015): 113.

[7] Hernandi, A. 2011. *"Kerangka dasar pemetaan"*. Bandung: Institut Teknologi. Bandung.

[8] Iskandar, I. M. (2008*). "Teknik Survey dan Pemetaan untuk Sekolah Menengah Kejuruan Jilid 1"*. Jakarta: Direktorat Pembinaan Sekolah Menengah Kejuruan.

[9] Maiyudi, Riko. 2021. *Ilmu Ukur Tambang.* Padang Universitas Negeri Padang

[10] Muda, I, 2008. *"Teknik Survei dan Pemetaan Jilid 2"* . Jakarta: Direktorat Pembinaan Sekolah Menengah Kejuruan.

[11] Muljono, Budi. *"aplikasi pengukuran tanah mengunakan metode pengukuran poligon tertutup dengan memperhatikan faktor- faktor kesalahan pengukuran."* (2011).

[12] Mulkan, S.F.,Sumaryanto, 1980.*"E.,Ilmu Ukur Tanah Wilayah, Departemen Pendidikan dan Kebudayaan"*

[13] Prakasa, F. 2016. *"Laporan Akhir Pekerjaan Pemetaan Batas Lot dan Instalasi Kabel dan Pipa Bawah Tanah di Kawasan Pariwisata Nusa Dua"*. Bandung: PT. Inovasi Mandiri Pratama.

[14] Prasidya, Anindya Sricandra, Rochamukti Rizcanofana.2019.*"Pemetaan Topografi Area Longsor Di Jalan Hantar Km10 Plta Musi, Bengkulu Menggunakan Total Station Berbasis Reflektor"*. *Seminar Nasional Geomatika*. Vol. 3

[15] Purwohardjo, U. U. 1986. *"Ilmu Ukur Tanah seri A"*. Bandung: Institut Teknologi Bandung.

[16] Putra, Bekasi raya. 2020.*"Pengertian Poligon Tertutup"*. Bekasi Press.

[17] Putri, A. D. S., & Kustini, I. (2018). Penerapan Media Pembelajaran Video Tutorial Total Station Pada Mata Kuliah Pengukuran Sipat Datar Dan Praktikum Pada Mahasiswa Pendidikan Teknik Bangunan Universitas

Negeri Surabaya. *Jurnal Kajian Pendidikan Teknik Bangunan*, *2*(2/JKPTB/18).

[18] Sosrodarsono, S. dan Takasaki, M.(Editor), 1983, "*Pengukuran Topografi dan Teknik Pemetaan",* PT Pradnya Paramita, Jakarta, Bab 3 dan 4.

[19] Suhendra, Andryan. "Studi Perbandingan Hasil Pengukuran Alat Teodolit Digital dan Manual: Studi Kasus Pemetaan Situasi Kampus Kijang." *ComTech: Computer, Mathematics and Engineering Applications* 2.2 (2011): 1013- 1022.

[20] Tim Praktek Kerja Lapangan., 2013, "*Buku A Panduan Praktek Kerja Lapangan"*, Program Diploma 3 Teknik Geomatika Sekolah Vokasi Universitas Gadjah Mada, Yogyakarta

[21] Tribhuwana, Awliya. 2018. *"Perbandingan Pengukuran Luas Area antara Theodolit dan Global Positioning System (GPS). LOGIKA, Desember 2018, XXII(3):58-64".* Cirebon: Universitas Swadaya Gunung Jati.

[22] Tistro, R., Purbaningtyas, D., Ardy, M., & Turangan, D. (2020). Pengukuran dan Pemetaan Kampus Politeknik Negeri Samarinda.*Jurnal Inersia*, *8*(1), 1-12

[23] Wardana, I, M. 2013. *"Pembuatan Peta Situasi Lokasi 6 di Dusun Purwosasono Desa Beluk Kecamatan Bayat Kabupaten Klaten Jawa Tengah. (Laporan Praktek kerja Lapangan".* Semester VI TA 2012/2013). Universitas Gadjah Mada, Yogyakarta.

[24] Wongsotjitro, Soetomo 2008. *"Ilmu Ukur Tanah".* Kanisius, Yogyakarta.