ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Available online at
https://jurnalteknik.unisla.ac.id/index.php/CVL

https://doi.org/10.30736/cvl.v2i2

Determination Of The Zero Point Of Building Construction In Area C Of Kadiri University With Polygon Mapping

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ARTICLE INFO

Article History :
Article entry : 2022-01-25
Article revised : 2022-02-02
Article received : 2022-03-11

Keywords :
Coordinates, Elevation, Land Surveying, Polygon, Theodolite.

IEEE Style in citing this article :
W.M.Y. Jannah, Z.B. Mahardana, R.P. Nugraha, O. Wardani, M. S. Asih, D.I. Mariana, D. Setiawan, "Determination Of The Zero Point Of Building Construction In Area C Of Kadiri University With Polygon Mapping", CIVILA, vol. 7, no. 1, pp. 13–24, 2022.

ABSTRACT

Area C of Kadiri University is an empty land located west of the campus area. The land is planned to construct buildings C, D, and E as a projected study area. In carrying out infrastructure development, it is necessary to have a mapping framework to coordinate building plans. Determining the zero point of action requires a land survey to determine the strategic position and the need for excavation or fill. The method used is a closed polygon with vertical and horizontal theodolite shooting tools. The results of the field details showed several projections of the building plan column from survey data on the location of the P1 device with coordinates 319^{0}0'43" elevation 123.93 MASL to the northern azimuth value, location P2 with coordinates 291^{0}35'48" elevation 125.07 MASL to azimuth P1, location P3 with coordinates 302^{0}23'58" elevation 124.179 MASL to azimuth P2, location P4 with coordinates 29^{0}40'50" elevation 123.96 MASL to azimuth P3 and location P5 at coordinates 193^{0}56'47" elevation 124.48 MASL to azimuth P4. The land measurement survey data can be projected as a reference image of development and a determinant of zero point (beginning) in acting.

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

1. Introduction

Area C of Kadiri University is an empty land located to the west of the campus area. On this land is planned the construction of infrastructure buildings where learning. Infrastructure building is a medium that is used as a support for all activities on Earth [1]. In implementing infrastructure development, there needs to be a mapping framework as a determinant of the position of the building plan and the assumption of the development cost budget plan from aspects of strategic value and land conditions [2]. A map is an image of the Earth's surface with signs and symbols as a projection reading of land conditions [3]. The map image contains the coordinate values and contours of the location of the item according to the situation of the horizontal line of the horizon with a vertical value above sea level so that it can be used as a reference in laying building items, [4][5]

A detailed study of map data as the initial stage of infrastructure development is needed for coordination in determining the zero (beginning) point of action. The goal is to determine the needs of strategic positions and the requirements of excavations and excavations before buildings are erected [6]. The role of coordinates and contour state of ground surface needs to be known as an evaluation in the ease of access of buildings and land [7]. Proses making coordinate maps and contours of land need to use the science of soil measurement. Soil Measurement Science is the science studied to measure the Earth's surface as a mapping of the coordinates and contours of land [8].

Land measurement research conducted on land development plans in area C of Kadiri University uses the closed polygon method. Closed polygons are a soil measurement method that has a binding correction back to the Azimut initially [9]. The tool used is the Theodolite aircraft with vertical crosshairs and horizontal. The vertical shot function of theodolite aircraft determines the contours of ground-level conditions. At the same time, the horizontal viewfinder is a reference in determining the coordinate point of the land [10]. The study results are in the form of detailed calculations of building location plans with map image projections to be used as a reference in determining the building's zero point coordinates and elevation.

2. Research Method

The research conducted is to take measurements of soil in area c of Kadiri University as a reference in the place of building items. In soil measuring applications, information regarding the condition of the Earth's surface can be known using appropriate calculation tools and methods [11].

2.1 Tools

The tool used is a theodolite aircraft with vertical and horizontal shot lines. Theodolite is a whisperer mounted on a stand with vertical movement to know the difference in height and move horizontally as a determinant of coordinate direction [12]. In using the theodolite aircraft as soil measurement research are as follows:

A. Determination of Tool Place Point
   The conclusion of the place point of the tool must follow the frame used. The location will be notated as P1, P2 through P5.

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Source : field documentation

Figure 1. Tool location installation documentation

Determining a mark helps lay tools and a reference point for shooting inland research [13]. In identification, the tool's location is five parts according to more than three positions' provisions [14].

B. Tools Setting

The tool's setting follows standard operating procedure (sop), where the initial stage is to install a tripod with the foot between the mark and align the caste of the tool.

Source : field documentation

Figure 2. Tool setup documentation

Setting the tool according to standard operating procedure (sop) will maintain the tool's stability in achieving the accuracy of vertical point dimension shots and horizontal development plans [15].

C. Tool Height Measurement

Measuring the height of the theodolite aircraft from ground level as a standard measurement of different sizes of ground surface contours [16].

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Source : field documentation

Figure 3. Measurement of the height theodolite aircraft

The height of the theodolite aircraft is used to determine different location elevations.

D. Shooting

a) Determine the direction of the horizontal azimuth angle at 0°0'0'' at the north point of the compass.

Source : field documentation

Figure 4. Documentation of the initial determination of the shot

The shot pointing north of the wind can be used as an Azimut reference in-ground measuring research shots [17].

b) Aiming for the following path

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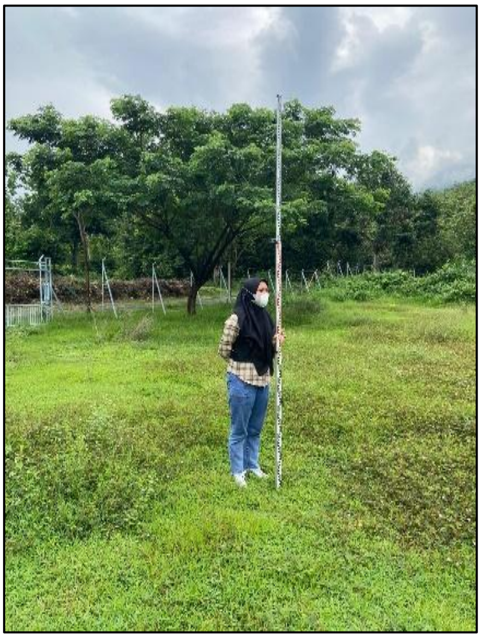
ISSN (*Print*) 2503-2399

Source : field documentation

Figure 5. Next stake shot documentation

A shot to the next stake must consider the scope of view as a determinant of polygon angles, contours, and distances [18].

c) Specify the location details of building items



Source : field documentation

Figure 6. The documentation specifies details of the location of building items

The exact point of the building item is a reference to the development implementation plan [19]. In reading the detailed shot, pay attention to the coordinates of the plan, contours, and distance from the measuring sign.

2.2 Land Measurement Calculation

Calculations used in soil measurement can use the closed polygon method [20][21]. Closed polygons are geometric frameworks of continuous tool paths [22]. The polygon skeleton is shaped like a zigzag pattern and directional contours from starting point to end close at a

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

specified location [23]. The polygon skeleton is shaped like a zigzag pattern and directional silhouettes from starting fact to end close at a specified location.

A. Coordinate calculation

The determination of coordinated values is used as a reference in the horizontal point of a building item [24]. The calculations used are as follows:

a) The polygon requirement is closed [25].
- (n-2) x 180° for the inner corner.
- (n+2) x 180° for the outer corner.

b) Calculation of angle correction:
- $\Delta\beta = f\alpha / n$

With an angular error limit value = 30”

Keterangan:

Δβ = angle correction
Fα = corner error
N = number of polygon points

c) Counting azimuths

The function of Azimut measurement is to define early Azimut and to know the size control [26]. To calculate the azimuth at the following points is with the formula:
- Azimut ($\boldsymbol{\alpha}$) = $\boldsymbol{\alpha}$ early azimut – Δβ + 180°.

d) Distance correction

Distance value (d) is obtained from the measurement of the angle projection. If the more significant the angle, the result of the measure will be greater than the distance of the point [27]. The following formula can calculate distance correction:

- $\Sigma (\Delta x) = \sigma\, d \sin \boldsymbol{\alpha}$ azimut
- $\Sigma (\Delta y) = \sigma\, d \cos \boldsymbol{\alpha}$ azimut

Information:

Σ (Δx)	=	the sum of distances to the x-axis
Σ (Δy)	=	the amount of distance to the y axis
Σ d sin $\boldsymbol{\alpha}$ azimut	=	sum from distance x sin $\boldsymbol{\alpha}$ azimut
Σ d sin $\boldsymbol{\alpha}$ azimut	=	the sum of the distance x sin $\boldsymbol{\alpha}$ azimut

The distance cover error (fl) is as follows:

- (fl) = fx2 + fy2

Information:

Fx	=	abscissing cover error
Fx	=	ordinate closing error

- Maximum error limit (Level III) = 0,08 d + 0,05

Information:

Σ d	=	the sum of distances between the dots of all points

e) Coordinate value per plane point.

The coordinates per point of the plane's location are the main point in determining the location or existence of a research object [8]. The formula used is as follows:

- X2 = x1 + d sin $\boldsymbol{\alpha}$ Azimut
- Y2 = y1 + d cos $\boldsymbol{\alpha}$ Azimut

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Information:

X2 ; y2	=	coordinates
X1 ; y1	=	the initial coordinates that have been determined
D sin **α** azimuth	=	distance x sin **α** azimut
D cos **α** azimuth	=	distance x cos **α** azimut

B. Contour

Contouring is a condition of the Earth's surface in which the ground surface has different heights [28], [29]. The contour value from the mapping survey by the following calculation methods: [30]

$$V = H \times (A1+A2/2)$$

Information:

V = Volume of soil (m^3)
A = Cut Area (m^2)
H = Elevation / Interval between contours (m)

3. Results and Discussions

The following chapter determines field mapping details by analyzing coordinate and contour calculations using the polygon method.

Table 1. Closed Polygon Coordinates

No. Point	**Measurable**			**Corrected**			**Azimuth**			**Distance (d) (m)**	**d sin a (Δ)**	**d cos a (Δ)**	**Polygon Coordinates**	
	°	'	"	°	'	"	°	'	"				**X**	**Y**
							α the beginning							
							92	51	19				early	early
P1	281	9	23	281	9	21					7,752	-53,137	123,70	123,70
			-2				-188	18	2	53,7	11,8698	0,395		
P2	267	28	8	267	28	6					-52,354	-5,289	143,32	70,96
			-2				-455	46	8	52,62	11,8698	0,395		
P3	261	43	7	261	43	5					-8,096	54,637	102,84	66,07
			-2				-717	29	13	54,69	11,8698	0,395		
P4	273	3	18	273	3	16					24,959	0,236	106,61	121,10
			-2				-990	32	29	24,96	11,8698	0,395		
P5	176	36	14	176	36	12					-31,610	1,576	143,44	121,73
			-2				-1167	8	41	31,65	11,8698	0,395		
													123,70	123,70
n	5									217,62				
Σ S	1260	0	10							∑(Δx)	-59,349	-1,977	Early – Finished = 0	
FA			10							Fx	59,349	1,977		
Σ	1260	0	0											

Source: Calculation Result.

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Table 1. displays the coordinate point of placement of the ground measuring instrument as a framework in determining the position of the building in area C of Kadiri University. The location of the tool with P1 notation is at Coordinates X 123.7 and Y 123.7 of the northern azimuth value of $92^0$51'19" as far as 53.7 m. Location of P2 in coordinates X 143.322 and Y 70,958 of the importance of azimuth -$188^0$18'2" as far as 52.62 m, Location of P3 at coordinates X 102.838 and Y 66,065 from azimuth -$455^0$46'8" distance 54.69 m, Location P4 on coordinates X 106,611 and Y 121,097 azimuth -$717^0$29' 13" distance 24.96 m, and tool point P5 at coordinates X 143.440 and Y 121.729 of the azimuth value P4 -$1167^0$8'41" as far as 31.65 m. From the primary data, the validity of the calculation is corrected as follows:

- Error Limit Control :
  Area measurement = Flat.
  Error limit = $30''\sqrt{5} = 1'7'' > f\alpha = 10''$,

Research measuring soil in area C of Kadiri University with 5 points of location of polygon skeleton shows that most of the location's ground surface conditions are flat. The closing error value has a validity value above average, so the calculation qualifies (VALID).

- Distance Cover Error Limit :
  Distance closing error (fl) = $\sqrt{59{,}349^2 + (1{,}977^2)}$ = 59,382 m
  Eror limit max level III = $0{,}08\sqrt{217{,}62 + 0{,}05}$ = 1,180 m > 59,382 m.

The distance cover at the location is below the criterion value in error correction. The maximum error limit of level III is 59.38 m. at a maximum limit of 1.18 m., so the calculation is not qualified (INVALID).

Table 2. Calculates Different Heights

Post	Tool height (m)	Target	Angle				Measurement (mm)						Distance (m)	Δh (m)	Elv (MASL)
			H			V	Front			Back					
			°	‘	“	°	Ba	Bt	Bb	Ba	Bt	Bb			
P1	1,39	P2	270	49	17	90	1620	1360	1100				83,50	0,08	123,70
		P5	179	57	23	90				1440	1283	1125			
P2	1,36	P3	265	4	16	90	1975	1703	1430				107,40	0,53	124,23
		P1	284	30	23	90				1439	1175	910			
P3	1,32	P4	276	24	27	90	1330	1205	1080				77,00	-0,16	124,07
		P2	270	49	17	90				1620	1360	1100			
P4	1,33	P3	265	4	16	90	1975	1703	1430				86,00	0,42	124,49
		P5	179	57	23	90				1440	1283	1125			
P5	1,39	P1	284	30	23	90	1439	1175	910				77,90	-0,03	124,46
		P4	276	24	27	90				1330	1205	1080			

Source: Calculation Result

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

The calculation of the difference in height in **Table 2** displays the ground level height in area C of Kadiri University. Positions of the device noted as P1 are at a ground-level elevation of 123,7 MASL with reference points P2 and P5 for a distance of 83,50 m. P2 height of 124,70 MASL with references P3 and P1 far as 107,40 m, P3 is elevation 124,70 MASL references P4 and P2 as far as 77 m, P4 is at the height of 12,60 MASL with references P5 and P3 as far as 86 m, and P5 is at an elevation of 123,90 MASL with references to P1 and P4 as far 77,90 m.

Table 3. Field Details

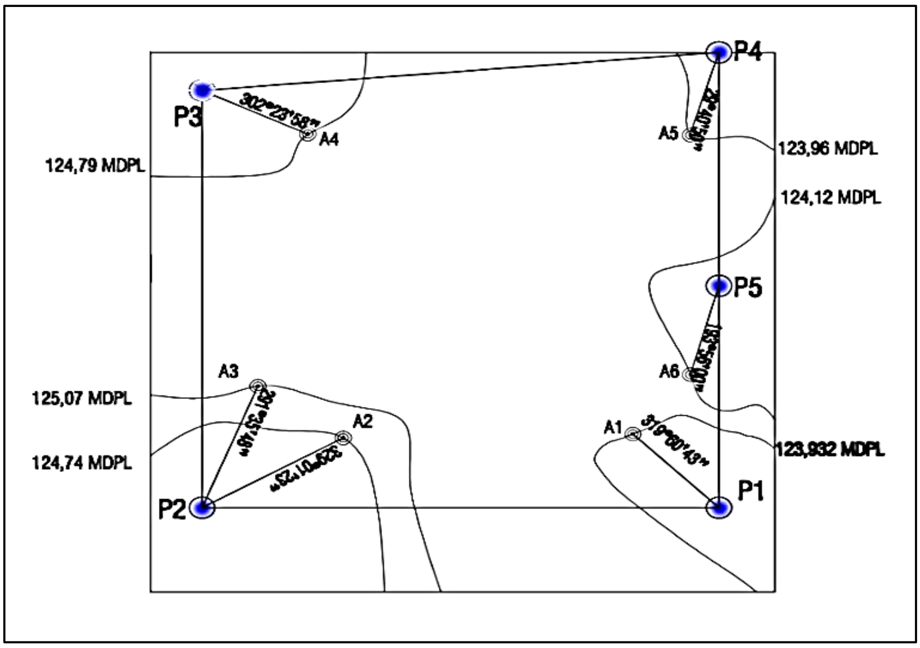
Pos	Azimut Front signs			Back signs ±180			Towards sign			In distance	Slope angle	Height different	MASL	Information
	°	'	"	°	'	"	°	'	"	Meter	°	+		
P1	**284**	**30**	**23**	**104**	**29**	**12**				**53,7**	**90**		**123,70**	**Direction of P2**
1398							260	21	17	13,19	90	0,24	123,94	Column 4 Building F
							319	0	43	9,63	90	0,23	123,93	Column 2 Of Building C (south)
							2	25	30	10,63	90	0,24	123,94	Column 2 of Building C (east)
P2	**270**	**49**	**17**	**90**	**49**	**7**				**52,62**	**90**		**124,70**	**Direction of P3**
1365							291	35	48	11,84	90	0,37	125,07	Column 2 Building E (west)
							329	1	23	11,1	90	0,04	124,74	Column 2 of Building E (south)
P3	**265**	**4**	**16**	**84**	**59**	**21**				**54,69**	**90**		**124,70**	**Direction of P4**
1375							302	23	58	11,4	90	0,09	124,79	Column 2 of Building E (north)
							15	40	13	10,3	90	0,47	125,17	Column 7 Building F (east)
P4	**276**	**24**	**27**	**96**	**30**	**2**				**24,96**	**90**		**123,60**	**Direction of P5**
1293							29	40	50	11,66	90	0,36	123,96	Column 1 building C
P5	**179**	**57**	**23**	**359**	**56**	**6**				**31,65**	**90**		**123,90**	**Directions P1**
1332							193	56	47	11,52	90	0,25	124,15	Column 6 building C
							317	57	30	4,56	90	0,22	124,12	Column 3 of Building C

Source : Calculation Result

The calculation results from **Tabel 3** show the environmental condition of the land area C of Kadiri University as a plan for the construction of learning facilities Of buildings C, D, and E. From the point of location of the P1 tool projection column of building C in the south of the middle is located at the coordinate point 319^{0}0'43" as far as 9.63 m with elevation from ground level 123.93 MASL. From the effectiveness of the P2 projection column of the central-western Building E is located at coordinate 291^{0}35'48" as far as 11.84 m at an elevation of 125.07 MASL, the projection of the column of building E in the south of the middle is located at 329^{0}1'23" as far as 11.10 m hill 124.74 MASL. From the location of the P3 point projection column of Building E in the north of the middle is located at coordinate 302^{0}23'58" distance 11.4 m elevation 124.79 MASL. From the point of location of the P4 projection of the column of Building C in the south-north corner is located at the coordinate point 29^{0}40'50" as far as

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

11.66 m at an elevation of 123.96 MASL and from the point of location of the P5 projection of the middle eastern building C column projection is located at the coordinate point $193^0$56'47" as far as 11.52 m with elevation from ground level 124.48 MASL.



Source: Calculation Result

Figure 7. Polygon Skeleton and Contour of Land Area C Kadiri University

Figure 7 shows the projection of the polygon skeleton and the contours of the C land area of Kadiri University from the processing of soil measuring data. Processed data and images can be used as a reference in determining the starting point in the implementation of development.

5.1 Conclusion

The results of the image projection from the calculation of mapping the contour line of the construction land in area C, Kadiri University, with reference to the location point of the P1 tool, the projection of the column C Building, the south-central part, is located at the coordinates point $319^0$0'43" as far as 9.63 M with an elevation from the ground surface. 123.93 MASL. From the P2 tool point, projection of the column for the west-central part of Building E is located at coordinates $291^0$35'48" as far as 11.84 M at an elevation of 125.07 MASL, the projection of the column for the south-central part of Building E is located at 32901'23" as far as 11.10 M with a height of 124,74 MASL. From the location of the tool point P3 the projection of the column of Building E in the north-central part is located at coordinates 302023'58" at a distance of 11.4 m with an elevation of 124.79 MDPL. From the point location P4, a column of Building C in the north-south corner is located at the coordinates point of $29^0$40'50" as far as 11.66 m at an elevation of 123.96 MDPL. From the point location P5, the projection column C building in the middle east is located at this coordinate point. $193^0$56'47" as far as 11.52 m with an elevation of 124.48 MASL. So that land survey data can be used as a determinant of the zero point in implementing development.

5.1 Suggestion

The distance closing calculation in the study gets a value of 59,382 m, while the maximum error value of level III is 1.18 m. calculated distance cover stated not according to the criteria. This is caused by changes in the stability of the theodolite aircraft, which is characterized by a bubbling movement. Practitioners and academics are advised to always keep the theodolite plane stable in mapping the land.

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