International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 07 | July 2018 www.irjet.net p-ISSN: 2395-0072

GEOMETRIC DESIGN OF RURAL ROAD USING AUTOCAD CIVIL 3D

Nisarga K[1], Vinoda Amate[2]

[1]*M.Tech, Transportation Engineering, Mvjce college, Bengaluru, Karnataka, India*
[2]*Assistant Professor, Dept. of Civil Engineering, Mvjce college, Bengaluru, Karnataka, India*

Abstract - *Rural roads are also known as low volume roads the preponderance of the population of India is living in rural areas. It is essential to plan and design the road with safe, efficient, economic and easy for the movement of traffic and collect the details of different studies. Survey is carried out to give best possible alignment. In the furtherance of transportation facilities in the rural areas will faster the development of these areas and overall country. Geometric design plays a major role in every road and it is weighty in the road alignment. AutoCAD Civil 3D is a software application used by civil engineers and professionals to plan and design the projects. This paper lavishes on a total geometric design of rural road using AutoCAD civil 3D software. AutoCAD civil 3D associate design and production drafting, greatly reducing the time it takes to implement design changes and assess multiple set of circumstances. The main aim of this project is to exemplify the proposed road alignment in a comfortable way using AutoCAD civil 3D. Tabular columns for curves, profile section will generate automatically. Gradually Volume Report sheet is generated. By using total station survey can be carried out rapidly and can truncate the time. Total station is a nifty for importing the points in AutoCAD civil 3D which is in the form of x, y, z co-ordinates that is latitude, longitude and elevation. These co-ordinates of the ground will generate and helps to design the alignment in the AutoCAD***.***

Key Words: **Geometric design, Total Station, AutoCAD civil 3D.**

1. INTRODUCTION

In the present trend, geometric design is an important component and having a great effect while aligning a new road. Geometric design is a backbone of any alignment of road. It deals with cross sectional elements, sight distance considerations, horizontal alignment and vertical alignment details, intersection elements and it is relaying on the important factors such as design speed, topography or terrain, traffic factors, design hourly volume and capacity, environmental and other factors. While aligning a new road, it should be short, easy, safe and economic and it is expected to be comfort and safe for the movement.

Rural road is a road network with a low volume traffic and low design speed which provides market access to farms, employment and connects different communities. Rural roads are classified into other district road (ODR) and village road (VR). These roads are able to reach the group of villages in rural area of the country and to provide connectivity. It is owned by local authorities.

AutoCAD Civil 3D is a software application used by civil engineers and professionals to plan and design the projects for building constructions, road engineering projects, water include construction of dams, ports, canals, embankments etc. AutoCAD civil 3D associate design and production drafting, greatly reducing the time it takes to implement design changes and evaluate multiple situations. A change made in one place immediately updates an entire project, helping you complete projects faster, smarter and more accurately.

Civil 3D provides to create 3D models of the project and helps to adopt for both small and large scale projects. It helps to imagine the things in 3D visualization, reduces the time and budget. It also inherits many benefits of using civil 3D.

Total station is a combination of electronic distance measurement (EDM), an electronic digital theodolite, and a computer in one unit used to measure horizontal angles, vertical angles and sloping distances of the objects. It takes a part by providing all the three co-ordinates of the observed points that is northing, easting, and elevation. These points are further transferred into AutoCAD civil 3D.

2. STUDY AREA LOCATION

The study area is located in Mysore district of Mysore taluk from Doddamara gowdanahalli to Handanahalli – Hunsuru. Length of stretch is 5.3km. Project area passes through plain terrain and rolling terrain. Existing study area consists of asphalt road and Soil road. The alignment comprises of significant horizontal curves which would require geometric corrections.

Figure 1 – Satellite image of selected area of the project

3. DATA COLLECTION

Collecting the data and quantifying the information from a survey in the field or the study area in a systematic path in order to get proper and scrupulous picture of an area of interest, also to analyze and evaluate the outcomes and retort to the research problems.

3.1 Surveying

Surveys are carried out before starting the project such as Map study, Reconnaissance survey, Preliminary survey, Final location. Map study is to have a rough idea of the field. Reconnaissance survey is to visit the site and scrutinize the main features of the area but not in detail. The data derived from the reconnaissance surveys are normally utilized for planning and programming the detailed surveys and investigations and few possible alignments can be chosen for any alteration or changes. In Preliminary surveys, survey specialists and party performs field surveying duties using total station and collects all data which are necessary like latitude, longitude, elevation and other required measurements and data in the alternate alignments proposed. At last, final locating the centre line of the ground.

3.2 Traffic Volume count

To decide the number of lanes and roadway width, pavement design, economic analysis traffic surveys are conducted. The main focus of traffic survey is to determine of vehicle composition in traffic stream which helps to design geometric features of the road.

Cumulative ESAL applications over 10 years @ 6% growth rate,

$$N = \frac{T_0 \times 365 \times (1+r)^n - 1 \times L}{r}$$

Where,

T_0 = ESAL per day = number of commercial vehicles per day in the year of opening × VDF

L = Lane distribution factor = 1 for single lane / intermediate lane

Assuming a uniform annual growth rate "r" of 6% over the design life (n) of 10 years

Cumulative ESAL applications (N) over the design life can be computed by substituting the values,

$$= \frac{317.39 \times 365 \times (1+0.06)^{10} - 1 \times 1}{r}$$

= 1526960

Therefore, ESAL = 152696

ESAL	152696
Category	T9

For Cumulative ESAL applications >1,500,000 – 2,000,000 Traffic comes under category T9 as per IRC: SP- 72 -2015 "Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads".

4. DESIGN OF FLEXIBLE PAVEMENT FOR 10 YEARS AS PER IRC: SP: 72-2015

Data,

1. Single lane two carriageway = 1
2. PCU = 4514
3. No. of commercial vehicles as per last count (P) = 153 CVPD
4. Traffic growth rate per annum (r) = 5%
5. Design life (n) = 10 years
6. Vehicle damage factor (F) = 3.50
7. CBR of subgrade soil = 8%
8. Lane distribution factor (D) = 1
9. Initial Traffic in the year of completion of construction in terms of the number of commercial vehicles per day (A)

$A = P(1+r)^x$

= 161

Calculation of MSA is given by formula,

$$N = \frac{365 \times [(1+r)^n - 1]}{r} \times A \times D \times F$$

N = 2.59 msa (Say 3 msa)

For traffic category "T9" obtained from traffic analysis, Design crust for 3 msa based on pavement design catalogues for gravel/ gravel bases and sub-bases as per code is tabulated as below.

Table 1 - Design Crust for 3.00 MSA

PAVEMENT LAYERS	DESIGNED CRUST
BC	20
DBM	50
Granular Base	225
Granular Sub base	150
Total	**445**

5. TOTAL STATION

Total Station is a combination of Electromagnetic Distance Measuring (EDM), Theodolite and Micro processor used to measure horizontal angles, vertical angles and sloping distances of the objects. It gives high accuracy, easy to work and tasks can be completed in time. For each point or station, codes are created and entered and surveying is started at different stations. Northing, easting, elevation of the ground co-ordinates were obtained along the proposed alignment. These co-ordinates enroll for map making and plotting contour and cross section in AutoCAD civil 3D. At end of the work/ the details stored in the instrument is downloaded to computer further used for AutoCAD civil 3D.

notepad data - Notepad

File Edit Format View Help

PtID	East	North	Height	Code	Attrib.1
SP	1000	1000	100	-	-
2	1000.0002	1009.9104	100.3369	NP	
3	992.6834	998.3504	99.9006	EP	
4	974.1278	1013.0057	100.8606	EP	
5	1000.5806	1000.9652	100.1208	EP	
6	993.7926	1009.895	100.1924	EP	
7	953.742	1019.3372	101.7651	EP	
8	1001.1712	999.9335	100.6809	OTBM1	
9	1006.3032	997.9615	100.6774	OTBM2	
10	1007.9241	997.3293	100.3009	AK	
11	1005.157	990.193	99.8904	AK	
12	998.4505	992.7736	99.7686	AK	
13	997.8652	991.0944	99.6994	CR	
14	995.9522	991.4642	99.7551	CR	
15	993.7629	991.7443	99.7568	CR	
16	993.3548	1000.1262	99.9136	CR	
17	997.1182	1000.1046	99.9498	CR	
18	1000.6988	999.1462	100.0898	CR	
19	1004.4801	1004.4452	100.3308	CR	
20	1006.3272	1005.3139	100.4521	CR	
21	1007.7357	1006.7081	100.4687	CR	
22	1014.9314	998.5888	100.3322	CR	
23	1013.3778	996.8933	100.3615	CR	
24	1012.2174	995.4209	100.3202	CR	
25	1000.0068	1015.8366	100.7319	CR	
26	1001.856	1016.0783	100.8289	CR	
27	1003.7095	1016.1435	100.6668	CR	
28	997.6817	1004.3743	100.0792	OKM	
29	996.357	1002.0638	100.0085	VDARS	
30	996.3747	1008.783	100.1895	VDARS	

Figure 2 - Co-ordinates of the points

6. AUTOCAD CIVIL 3D

Autocad civil 3D is a tedious process but after several rehearsal it will be easy, needs a training, taken a lot of practices to become fluent, and prepared to get this technique right. Below flow chart shows the general review of AutoCAD civil 3D design procedure.

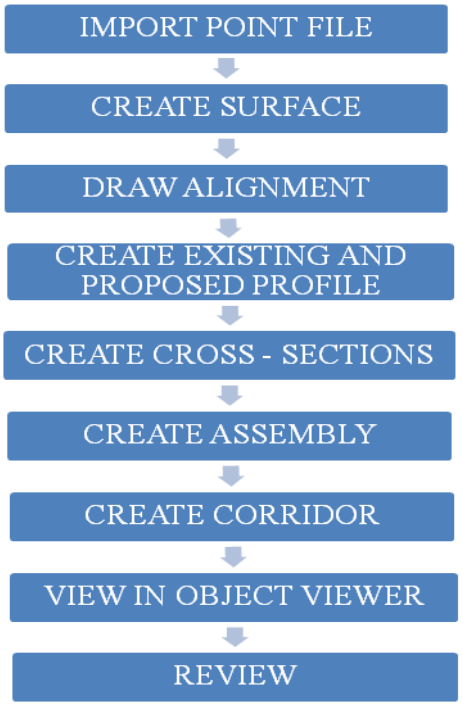

Figure 3 - Flow Chart of AutoCAD Civil 3D

Select the file of the survey points which is saved in notepad or in excel sheet to import the points to AutoCAD civil 3D. Create the surface for the existing ground surface, create alignment for the profile and select criteria based design, create corridor to run corridor in 3D view, develop sample lines and assembly to create cross sections and to generate volume report. All these can be viewed in object viewer.

The below figures shows the design procedure;

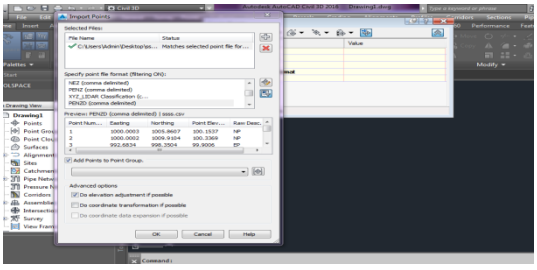

Figure 4 - Import Point File

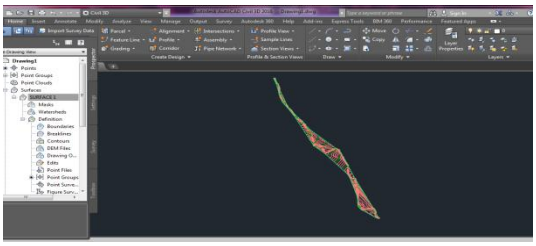

Figure 5 - Surface Creation

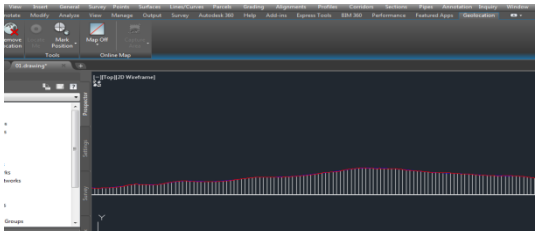

Figure 6 - Profile creation

Figure 7 - Cross sections of the road alignment

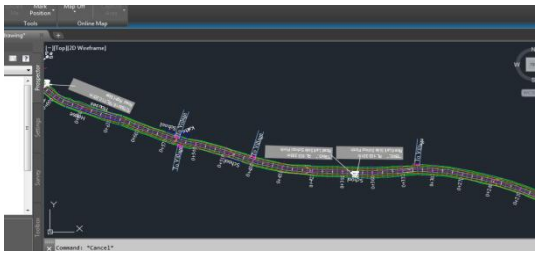

Figure 8 - Corridor creation

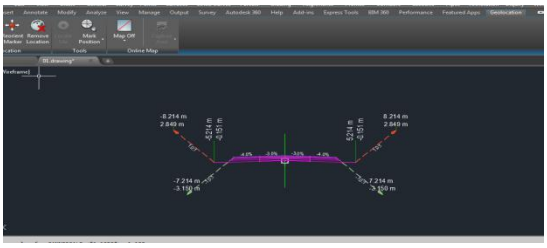

Figure 9 - Assembly creation

Figure 10 - Object viewer

Design criteria

Design standards adopted for rural roads –is adopted from IRC: SP: 20 – 2002 "Rural Roads Manual"

a) Design Speed – 50kmph

b) Road Way Width – 7.5m

c) Carriageway width – 3.75m

d) Shoulder width – 1.875m

e) Super elevation – 8%

f) Camber in shoulders – 4%

g) Camber in carriageway width – 3%

7. OUTPUT OF THE DESIGN

Drawings are the results obtained for the proposed road and simultaneously tabular column are generated automatically with details.

We will get the formation level, cross sections, curve details along with the information of depth of cut and fill (Earthwork quantity) for the entire project stretch.

8. CONCLUSION

Consequence of this observations made, investigations done, collection of traffic data, examination of the existing study area helps us to align the road which is feasible and sound in an effective way. By using total station makes survey easier and possible to truncate the time for the field survey. It eradicates manual errors like reading and recording co-ordinates. These co-ordinates enroll for map making and plotting contour and cross section in AutoCAD civil 3D. AutoCAD civil 3D helps to complete the design process in a relaxed and comfortable way within time and also it preserves lot of time and effort. This project introduces a complete geometric design of the village road using AutoCAD civil 3D.

REFERENCES

[1] S.A. Raji, A. Zava, K. Jirgba, A.B. Osunkunle, "Geometric Design of a Highway Using Autocad Civil 3d", Journal of Multidisciplinary Engineering Science and Technology (JMEST), Volume 4, Issue 6, June 2017.

[2] Ananya Augustine, Sahimol Eldhose, "3D Model for Highway Alignment", International Journal of Scientific Engineering and Research (IJSER), Volume 4, Issue 3, 2016.

[3] Dr. Md. Kamruzzaman, Tanzila Islam, Smrity Rani Poddar, "Accuracy of Handheld GPS comparing with Total Station in Land Use Survey: A case study in RUET campus", International Journal of Innovation and Applied Studies (IJIAS), Volume 7, No.1, July 2014.

[4] Yaguba Jalloh, Anuar Ahmad, Zulkarnaini Mat Amin and Kuyoro Sasaki, "Conventional Total Station versus Digital Photogrammetry in Land Development Applications" Journal of Environmental and Analytical Toxicology (JEAT), Volume 7, Issue 1, January 2017.

[5] Chen-Fu Liao, David M .Levinson, "ROAD: Interactive Geometric Design Tool for Transportation Education and Training", Journal of Professional issues in Engineering Education and Practice, Volume 139, No. 2, April 2013.

[6] Anitha Jacob, Dhanya R, Anjaneyulu. M.V.L.R, "Geometric Design consistency of multiple horizontal curves on two-lane rural highways", Elsevier, 2013.

[7] Naman Agarwal, "Design of Rural Road in Uttarakhand", International Journal of Research in Engineering and Technology, Volume 4, Issue 1, January 2015.

[8] IRC: SP: 20- 2002, "Rural Roads Manual", 2002.

[9] IRC: SP-72- 2015, "Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads", 2015.