INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 3)
Available online at: www.ijariit.com

Geometric design of highway using Civil 3D

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ABSTRACT

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. 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 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 sets of circumstances. Although there are a number of factors influences the design of the highway, the suitable geometric design having the objective of giving optimum efficiency in traffic operation with contentment safety measures at a reasonable cost.

Keywords— *Design speed, Topography and cross-section elements*

1. INTRODUCTION

In our modern age, transportation plays a very important role. Geometric Design deals with a visible feature of the highway. Safety is the main factor of the road design, Sufficient and essay to move. Geometry is deal with a horizontal and vertical curve, sight Distance, gradient, and intersection also major indicate.

The old day all the drawing draw manually in help of tools. When the geometric design is done manually means it take a time consuming, very cost errors, the design should not be proper and it's only the 2D view is there.

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 the construction of dams, ports, canals, embankments etc. The AutoCAD Civil-3D friendly used for design and making drafting, greatly dropping the time it takes to appliance design changes and evaluates multiple situations. A change makes in one place immediately updates an entire project, helping your far-reaching projects earlier, 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.

2. LITERATURE REVIEW

Raghuveer et al (2018) explained the geometric design of highway considering various geometric elements such as alignment, profile, cross- section etc and concluded that horizontal curve at grade separation is more dangerous and causes 30% of more accidents.

Ali Aram (2010) studied its particularly significant at radius below 200m, two-lane highway safe factor on a horizontal curve, that section is the high crash rate in a horizontal curve that section is the similar length and traffic composition.

Golakati (2015) carried out study between Chhatra and bhorpur consider the geometric feature of the road such as horizontal radius, superelevation, K-value, visibility etc and carries out regression analysis for his study be to conclude that geometric feature has to be given more important while designing a road.

Shah and Shinkar (2016) carried out planning and design of purposed bypass road used civil 3D and carries out capacity analysis by projection traffic volume data for 15 years and concluded that high design precision and saving in time were achieved by using Autodesk Civil 3D.

Hiazimuddin et al (2017) carried out a study on geometric design of highway using MX ROAD and achieved high design precision and accuracy for given set of data.

Neeraj and Kazal (2015) carried out a study on geometric design of highway. Their study was mainly emphases on the importance of planning and design of geometric feature of the highway during the initial alignment itself taking into consideration the future growth of traffic flow and possible of the road being upgraded to higher categories.

Neeraj and Kazal (2015) emphasized on the importance of planning and designing of geometric features of the highway during the initial alignment itself taking into consideration the future growth of traffic flow and possibility of the road being upgraded to a higher category1 or to a higher2 design speed

standard at a later stage as it is very expensive and rather difficult to improve the geometric1 elements of a 1highway in stages at a later date

Anitha and Dhanya (2013) carried out to study in this paper is based on the safety of the geometry of the highway. Were curves are state and end, their curves are insufficient length and radius is caused an accident. In multiple horizontal curves are provided in alignment which should be safe and speed properly maintained. It Takes 30 sites visited in Kerala state and takes the data of its.

Nisarga and AmateH (2018) studied geometric design of rural road using AutoCAD civil 3d. They explained that 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 & one Place change firstly or immediately all project should be updated, project compilation fastly helping for us, more accurate and smarter.

3. STUDY AREA AND LOCATION

The project road section passes through Chandur railway Taluka of Amravati District, State of Maharashtra. The section of SH 297 starts from Km 32/000 at Chandur railway and ends at km 49/000 near Talegaon. Length is 17.000 km.

Chandur railway–Talegaon section of SH 297 is an intermediate-Lane road, 7.0 m bituminous carriageway predominantly with earthen shoulders. The entire stretch passes through BC soil and Murum soil Type area, distressed sections at stretches are found along the entire project road length. Major settlements are Chandurrailway, ShendurjanaKh, Talegaon. The land use pattern along the project road is built up and Agricultural. Available ROW along the project road is 20.0 m to 24.0 m (18.0 to 24.0 min Built-up Area).

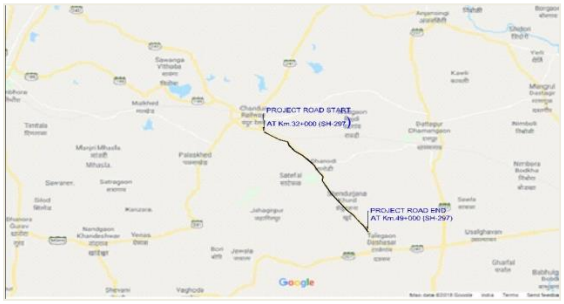

Fig. 1: Study Area location

4. 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 a proper and scrupulous picture of an area of interest, also to analyze and evaluate the outcomes and retort to the research problems.

4.1 Topography

Fig. 2: LiDAR Survey Equipment

Topographic data was collected with the help of LiDAR technology. A LiDAR is a machine which is mounted on a vehicle and connected to GPS which collects all data which are necessary like latitude, longitude, elevation and other required measurements.

4.2 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 vehicle composition in traffic stream which helps to design geometric features of the road.

A detailed traffic survey for the project road has been conducted in the year 2018, hereinafter called, "Base Year". For the purpose of pavement design, commercial vehicles of gross vehicle weight more than 3 tones have been considered. Such vehicles consisted of buses, LCVs, 2 axle trucks, 3 axle trucks and multi-axle trucks.

Table 1: Base year traffic volumes

Type of commercial vehicles	No.
LCV	217
Bus	102
2 Axle trucks	151
3 Axle trucks	61
MAV	17
Total	**548**

An annual traffic growth rate of 5.00% is considered.

5. METHODOLOGY

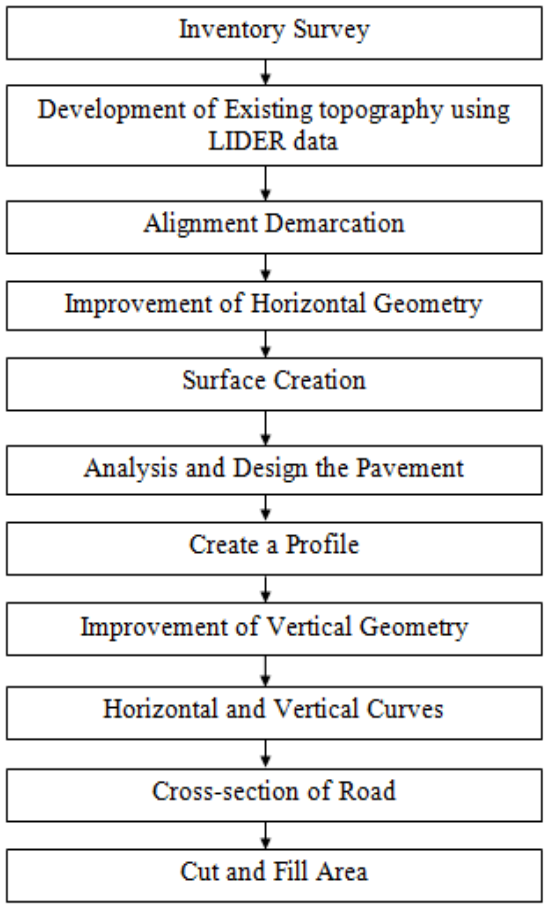

Fig. 3: Methodology

Details regarding the proposed study methodology along with the use of Autodesk Civil 3D software are presented below.

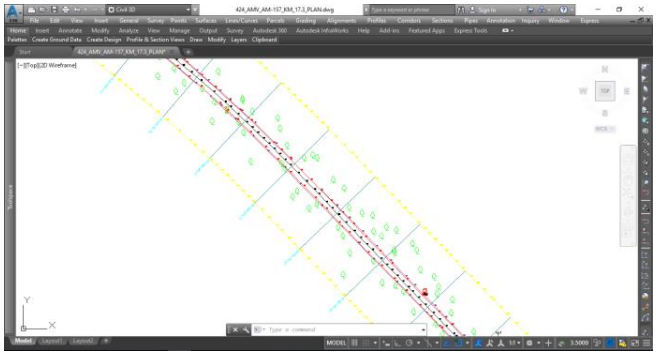

Fig. 4: Topography using LiDAR

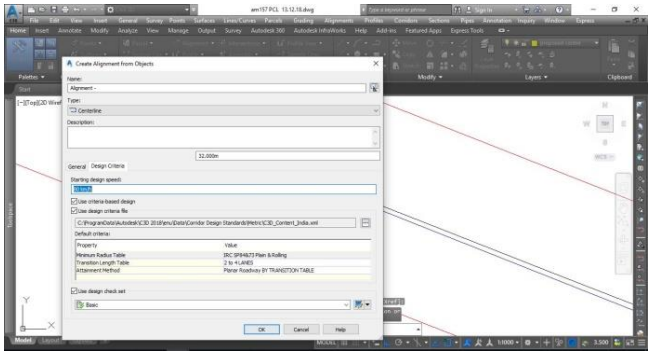

Fig. 5: Alignment Demarcation

A vehicle travelling a straight portion to a curve of finite radius, it is suddenly subjected to outward centrifugal force. In order to avoid shock to the passenger, the transition curve has to be introduced. Minimum transition length for different speeds and radius is taken from Table no. 9 of IRC 38-1988 for designing horizontal curve.

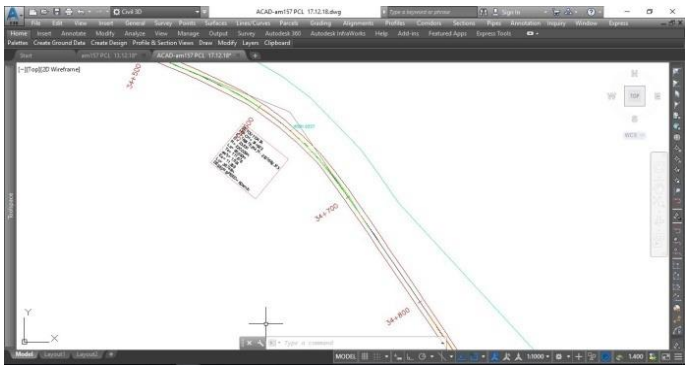

Fig. 6: Setting out Horizontal Geometry

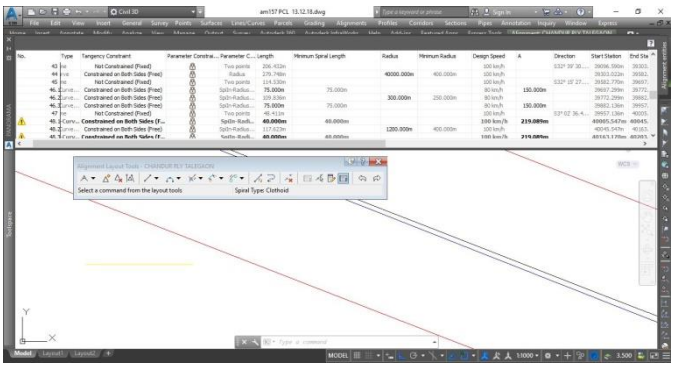

Fig. 7: Horizontal Geometry Editor

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.

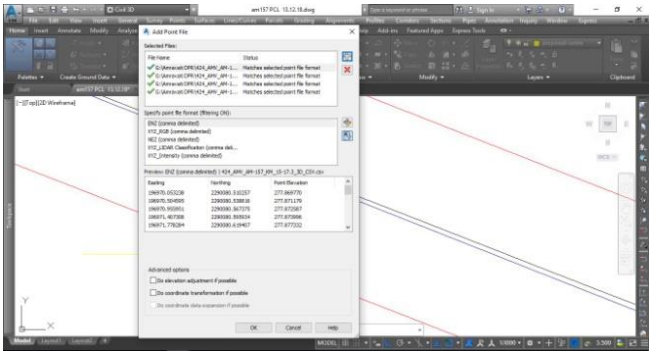

Fig. 8: Adding Surface file

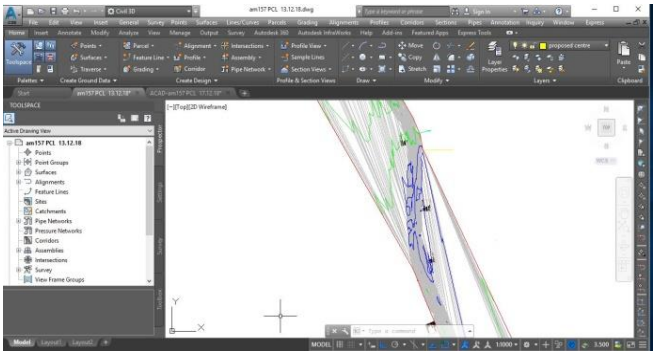

Fig. 9: Surface Created using point file

Select the surface then its open a Function bar above screen selected the superelevation function but the value in curve table in IRC 38-1988.

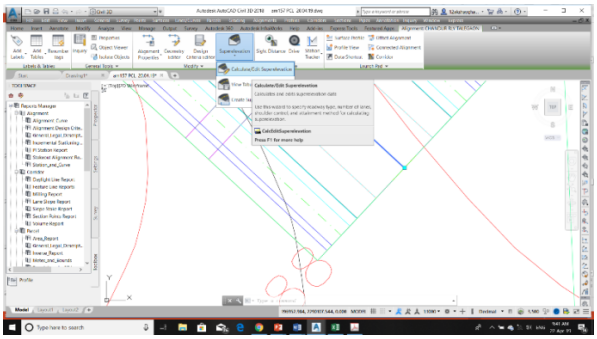

Fig. 10: Create Super Elevation

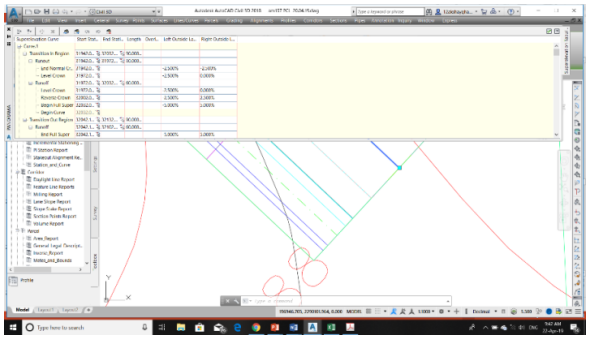

Fig. 11: Super Elevation Editor

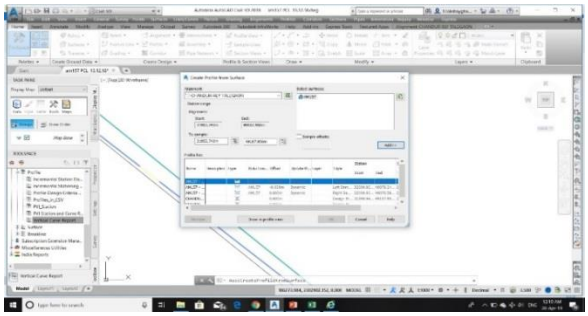

Fig. 12: Profile Creation Table

Select surface which creates in point group, then create a vertical profile in AutoCAD Civil 3D. Which create existing ground conduction.

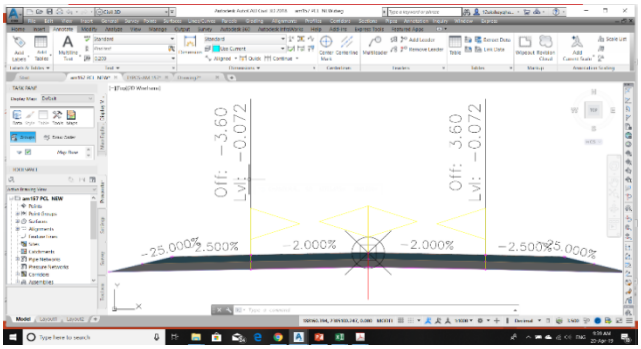

Fig. 13: Level of Vertical Profile

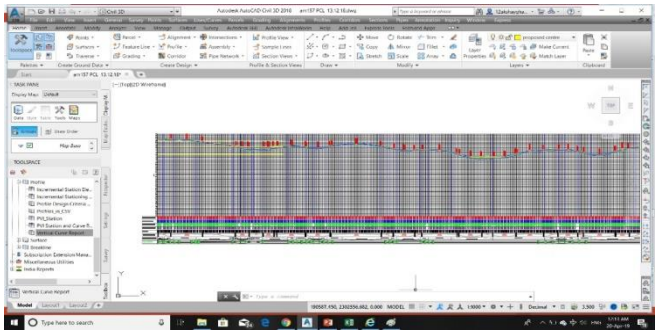

Fig. 14: Create an Assemble

5. ANALYSIS AND DESIGN OF FLEXIBLE PAVEMENT

Initial Traffic in the year of completion of construction in terms of the number of commercial vehicles per day (A)

$$A = P * (1 + r)\text{^}x$$
$$= 548 * (1 + 0.05)\text{^}2$$
$$= 604 \text{ CVPD}$$

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

Where,

N= The cumulative number of standard axles to be catered for in the design in terms of msa (Million standard axle)

A= Initial Traffic, in the year of completion of construction, in terms of the number of commercial vehicles per day

r = Annual growth rate of commercial vehicles

D = Lane Distribution Factor = 0.5

n = Design life in year=15yrs

F = Vehicle damage factor

$$N = \frac{365 * [(1 + 0.05)15 - 1] * 604 * 0.5 * 4.0}{0.05}$$

$$N = 9.5\, msa\ (say\ 10msa)$$

Table 2: Design Crust for 10.00 MSA for 10% CBR

Pavement Layers	Designed crust(mm)
BC	40
DBM	50
GRANULAR BASE	250
GSB	200
Total thickness	**540**

With the help of crust thickness obtained above, the proposed profile will be marked and Vertical Geometry of the road under consideration will be improved as per IRC SP-23-1993.

6. CONCLUSION

- AutoCAD Civil 3D helps to complete the design process in a relaxed and comfortable way within time and also it preserves a lot of time and effort.
- Collection of traffic data, the examination of the existing study area helps us to align the road which is feasible and sound in an effective way.
- The *spiral* transition curve fulfils the necessity of an ideal transition curve.
- All curve are the plot in IRC Standard in the project.
- Horizontal curves are maximum 1800M and minimum 120M, Spiral Curve Maximum 15000 M and Minimum 4500.

7. REFERENCES

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