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Development and Design of a Flyover Using Auto CAD Civil 3D Software

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ABSTRACT
As road traffic continues to rise and the availability of ground-level space diminishes, constructing a flyover emerges as the most practical solution. A flyover is essentially a bridge that allows one road to pass over another, often with additional connecting roads to facilitate smoother transitions. Its primary aim is to significantly improve the current traffic conditions and ensure a more seamless and efficient movement of vehicles.
With the growing population leading to an increase in the number of vehicles, road intersections are frequently becoming congested, disrupting the regular traffic flow. Constructing a properly designed flyover can effectively address these congestion issues, particularly at busy junctions, thereby streamlining the overall traffic management system and saving valuable time.
This dissertation focuses on the planning and design process of a flyover and intersection using AutoCAD Civil 3D software. Widely used by civil engineering professionals, AutoCAD Civil 3D offers powerful tools for designing infrastructure with high precision and efficiency. The software provides a three-dimensional visual representation, enabling better visualization and understanding of the project. By utilizing various features of AutoCAD Civil 3D such as terrain modeling, corridor design, and volume calculations engineers can design complex structures with reduced errors and generate essential reports for the designated project area. The ultimate objective of this study is to design a flyover that enhances traffic flow efficiency by applying accurate geometric design standards, all within a reduced timeframe.

Keywords-AutoCAD Civil 3D, DEM File Format, Flyover Road, Volume Report

I. INTRODUCTION

1.1 General

Transportation is a non-separable part of any society. It exhibits a very close relation to the style of life, the range, and location of activities and the goods and services which will be available for consumption. People depend upon the natural resources to satisfy the needs of life but due to non-uniform surface of the earth and due to difference in local resources, there is a lot of difference in standard of living indifferent societies. So there is an immense requirement of transport of resources from one particular society to another. These resources can range from material things to knowledge and skills like movement of doctors and technicians to the places where there is a need for them. Transportation has always played an important role in influencing the formation of urban societies. Although other facilities like availability of food and water played a major role, the contribution of transportation can be seen clearly from the formation, size and pattern, and the development of societies, especially urban centres.

Transportation engineering deals with the application of technology and scientific principles to the planning, functional design, operation and management of facilities for any mode of transportation in order to provide the safe, efficient, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods transport. Advances in transportation have made possible changes in the way of living and the way in which societies are organized and therefore have a great influence on the development of civilizations. Transportation is responsible for the development of civilizations from very old times by meeting the travel requirements of people and transport requirements of goods. Such a movement has changed the way people live and travel. In developed and developing

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nations, a large fraction of people travel daily for work, shopping, and social reasons.

1.4 Overview of AutoCAD Civil 3D Software

1.4.1 AutoCAD Civil 3D 2016 Software

AutoCAD CIVIL 3D SOFTWARE is an engineering software application used by civil engineers and other professionals to plan, design, and manage civil engineering projects. AutoCAD Civil 3D is software that provides civil engineers, designers, drafters, technicians, and surveyors with targeted solutions for a broad range of project types, including land development, transportation, and environmental developments.

The AutoCAD Civil 3D software is a solution that creates civil engineering design and documentation. With the implementation of AutoCAD Civil 3D, it is better to understand project performance, maintain consistency in processes and data, and give a faster response to changes. Civil 3D software is used to create three-dimensional (3D) models of land, water, or transportation features. Civil 3D is well known in the civil engineering community and widely used in a variety of infrastructure projects both large and small.

1.4.2 AutoCAD Civil 3D Applications

The civil engineering projects fall under the three main categories of land development, water, and transportation projects; and can include construction area development, road engineering, river development, port construction, canals, dams, embankments, and many others. Civil 3D software is used to create 3D models of land, water, or transportation features while, maintaining dynamic relationships to source data such as corridors.

1.4.3 User Interface of AutoCAD Civil 3D

The AutoCAD Civil 3D user interface enhances the standard AutoCAD environment with additional tools for creating and managing civil design information. Standard AutoCAD features, such as the command line and the design space work the same way in AutoCAD Civil 3D as they do in AutoCAD.

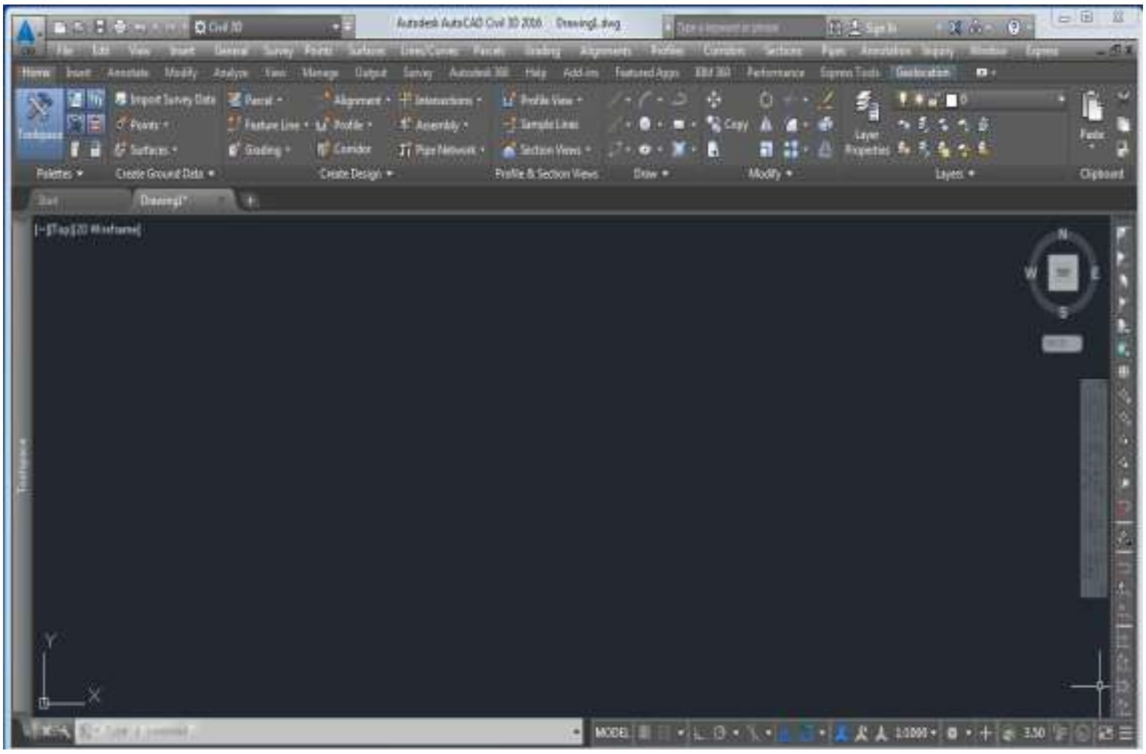

Figure 1.1:- AutoCAD Civil 3D Interface

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1.4.4 Ribbon

The AutoCAD Civil 3D Ribbon is the primary user interface for accessing commands and features. Commands available from the ribbon a reorganized into a series of panels. The ribbon is typically turned on (displayed) by default and can be displayed or turned off by using the Ribbon and Ribbon close commands.

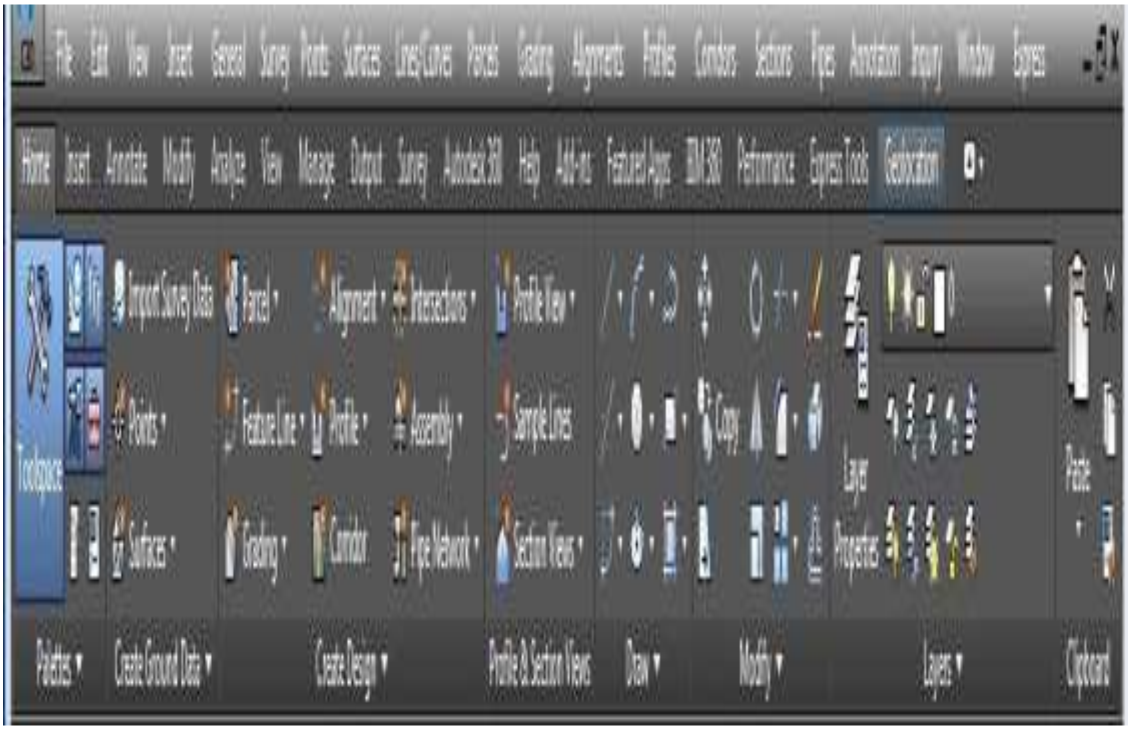

Figure 1.2:-Ribbon

1.4.5 Features of AutoCAD Civil 3D

Civil 3D was originally created to be an add-on for AutoCAD but as its popularity and demand grew, it was further evolved and developed into a stand-alone product built on the AutoCAD platform. Civil 3D offers a familiar design environment and many AutoCAD-compatible shortcuts; and with true DWG (drawing) file support, Civil 3D allows us to store and share design data with existing AutoCAD users.

With Civil 3D projects, changes to drafting and annotation are automatically reflected throughout the model for quick and efficient visualizations that remain in sync as we make design changes at any stage of the process. Civil 3D offers many other beneficial tools and features that can enhance our projects such as Corridor Modelling, Earthwork Calculations, Grading, Pipes, Production Drafting, Point Clouds, and much more.

1.4.6 Uses of Civil 3D Software

Civil 3D is used by civil engineers to create digital models of infrastructure projects early in the design process. For example, the Department of Transportation for a small county may use Civil 3D to create a detailed digital model that lays out and details how they plan to reduce roadway congestion and accidents by widening roads and adding traffic signals.

In the case of an internationally recognized consulting firm, Civil 3D may be used to develop a proposal for the design and construction of a new airport that communicates their plan clearly to various stakeholders using intelligent 3D models, multiple lawyers, view frames, plan and profile views, real-time information, and even 3D models published directly from Civil 3D into Google Earth. Ultimately, Civil 3D issued to explore, design, analyze, and optimize civil engineering projects. This, in turn, helps to improve infrastructure designs and build projects safely, on time, and on budget.

1.6.4 Selection of Site for Flyover Construction

The following points are the guiding factors for the selection of suitable sites.

a) The roads are crossing perpendicular to each other.

b) The site should have more traffic congestion.
c) The availability of men and materials are to be as certained

1.7 Objectives
The study has been undertaken with the following main objectives:-

1. To utilise the geometric features of AutoCAD Civil 3D, viz. Alignments, Horizontal and Vertical profiles, Assemblies and Corridors, for the designing purpose.
2. To design a Flyover Road above an intersection using the Civil 3D software.
3. To utilize the software for getting the reports.

II. LITERATURE REVIEW

Anitha et al. (2013) Investigated the geometry of highways, particularly focusing on curve design at the start and end of segments. Found that insufficient curve length and radius are major causes of accidents. Field data were collected from 30 sites in Kerala. Concluded that multiple horizontal curves should be safely aligned with proper speed limits to ensure road safety.
Hameed et al. (2013) Concluded that shoulder width greater than 2.25 m enhances safety. Found that the accident rate on highway curves is four times higher than on tangents. Horizontal curves combined with gradients and low-friction surfaces significantly increase crash risks. Noted minimal speed reduction even on curves with radii below the minimum design specifications. Crash risk becomes especially significant at radii below 200 m.
Liao, Chen, and Fu (2014) Studied the impact of a web-based tool called ROAD on understanding geometric design concepts. Found that using ROAD helped students better grasp geometric elements compared to traditional teaching methods. Emphasized that while tools are helpful, understanding of core design equations remains essential.
Golakati (2015) Investigated the geometric features such as horizontal radius, superelevation, K-value, and visibility using regression analysis. Concluded that geometric characteristics must be prioritized during road design as they significantly influence road performance and safety.
Neeraj et al. (2015) Studied pavement widening formulas for horizontal curves to prevent off-tracking. Developed a fuel consumption model based on geometric elements like grades, curve lengths, surface types, and conditions. The model predicts fuel usage while traveling at cruising speed.
Vikas Golakoti (2015) Analyzed road geometric factors in plain terrain and rural areas. Found that elements like extra widening, radius, sight distance, K-value, and super elevation directly impact accident rates. Concluded that identification of critical geometric factors is essential for future road design improvements.
Patel et al. (2015) Investigated accident-prone intersections in Himmatnagar. Suggested improvements to intersection design and proposed rapid flyover construction techniques to reduce traffic delays and enhance aesthetic value during construction.
Raji et al. (2017) Studied complete geometric design using AutoCAD Civil 3D. Demonstrated that the software significantly reduces design time while increasing precision. Compared manual and software-based designs, favoring the latter for ease and accuracy.
Rangaswamy et al. (2017) Designed a flyover at a major traffic intersection (Pipeline Junction). The structure included two trestle portions and one obligatory span with minimum vertical clearance of 6.00 m. The design addressed traffic congestion due to ongoing construction.
Raghuveer et al. (2018) Investigated geometric design components such as alignment, profile, and cross-section. Found that horizontal curves at grade separations are particularly hazardous, contributing to 30% higher accident rates.
Nisarga et al. (2018) Studied rural road geometric design using AutoCAD Civil 3D. Concluded that geometric alignment is crucial for effective design. Demonstrated that changes at one point in the design can update the entire project, enhancing precision and saving time.
Kumar et al. (2018) Examined traffic issues at flyover-improved junctions and proposed solutions such as adjusting cycle phases and utilizing under-bridge areas. Found that the flyover diverted 30–35% of traffic and reduced time delays by 30%.
Nisarga et al. (2018) Further studied rural road design using AutoCAD Civil 3D, focusing on visualizing alignments through tabulated curve and profile data. Demonstrated the use of Total Station for accurate coordinate collection and efficient road alignment generation in AutoCAD.
Mandal et al. (2019) Investigated geometric road design using AutoCAD Civil 3D. Highlighted the software's ability to integrate design and drafting, significantly reducing revision time and improving efficiency. Concluded that optimized geometric design enhances traffic operations and safety at a reasonable cost.

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III. RESEARCH METHODOLOGY

The ground surface data is required for designing the geometry of highways and flyover road. The survey information is in the form of DEM (Digital Elevation Model) having the file extension as **'.dem'**. It is a gridded raster representation of DTM (Digital Terrain Model). This surface file has been obtained by using the Google Earth and the Global Mapper software. First the area has been selected in Google Earth and the file is saved in.kmz format and then this file is imported in to Global Mapper to convert it into the format of .dem because .dem file format is supported by Civil 3D.

3.1 Study Area and Location

The study area is located in the ALLAHABAD (PRAYAGRAJ) district of Uttar Pradesh. The intersection point links two National Highways i.e. the **NH35** and the **NH30.** The proposing flyover road will be designed above the intersection.

Figure 3.1:- Google Map Image of the Study Area

3.2 Design Criteria For

3.2.1 Intersecting Roads

- Design Speed=60kmph
- Slope=-2%
- Number of Lanes=4
- Roadway width=26m
- Length of ALLAHABAD Road=1.160Km
- Length of NAINI Road=2Km
- Road widening on both sides= 3m
- Carriageway width=17m
- Curb width=0.150m
- Footpath width on both sides= 1.5m

3.2.2 Flyover Road

- Design speed=40kmph
- Slope=-2%
- Number of lanes=2
- Flyover road width=7m
- Superelevation=7%
- Curb height=1.5m
- Length of Road=880.90m

3.3 Design Procedure

- Import the surface file into the Civil 3D software
- Create 2 intersecting alignments on the surface
- Create a flyover alignment above the intersection
- Calculate the superelevation at the flyover curve
- Create surface profiles
- Create different assemblies for corridors
- Create corridors for intersecting road sand the flyover
- Perspective view of the project

3.9 Design Steps

3.9.1 Importing Surface File

a) Click Home tab
b) Create Ground Data
c) Surface drop-down
d) Create Surface from DEM

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e) Select the DEM surface from the saved location
f) Click on Open
g) The surface file will be imported in to the Civil 3D

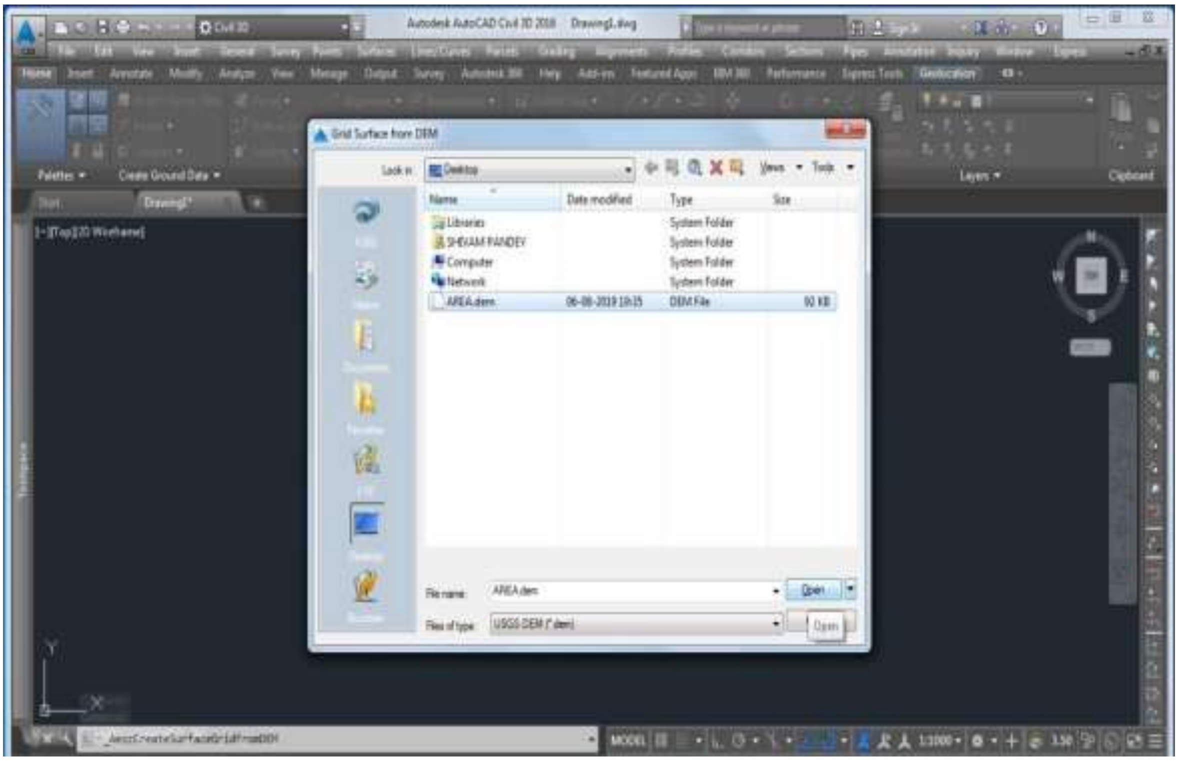

Figure 3.4:-Selecting the DEM Surface

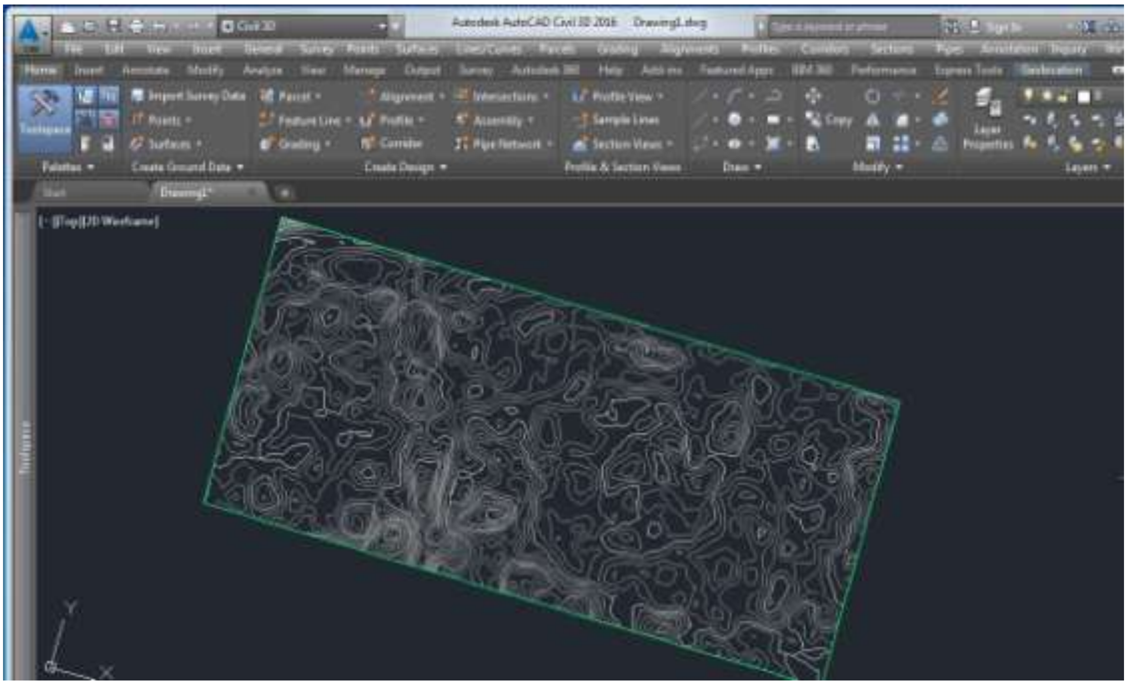

Figure 3.5:-Importing Surface File

3.9.2 Creating Alignments

A. Naini Alignment

a) Click the Home tab➤Create Design panel➤Alignment drop-down➤Alignment Creation Tools.
b) In the Create Alignment-Layout Dialog Box, enter a unique name for the alignment i.e. Naini Alignment.
c) Enter an optional description.
d) Enter a starting station value.
e) On the General tab, we specify the following settings:

➢ Site

Specify a site with which to associate the alignment or accept the default <None>.

- Alignment Style
- Alignment Layer
- Alignment Label Set

f. On the Design Criteria tab, we specify a Starting Design Speed i.e. 60Kmph to apply to the alignment starting station. This design speed is applied to the entire alignment. Additional design speeds can be applied at other stations after the alignment has been created.
g. To associate design standards with the alignment, we select the Use Criteria- Based Design checkbox.

On the Design Criteria tab, specify the following settings:

Use Design Criteria File

Select this checkbox to associate a design criteria file with the alignment. The default design criteria file location and the Default Criteria properties become available when you select the checkbox

Use the Design Check Set

Select this checkbox to associate a design check set with the alignment. The design check set list becomes available when you select the checkbox. Select a design check set from the list.

f. Click OK to display the “Alignment Layout Tools” toolbar.
g. Use the commands on the “Alignment Layout Tools” toolbar to draw the alignment of length 2Km.

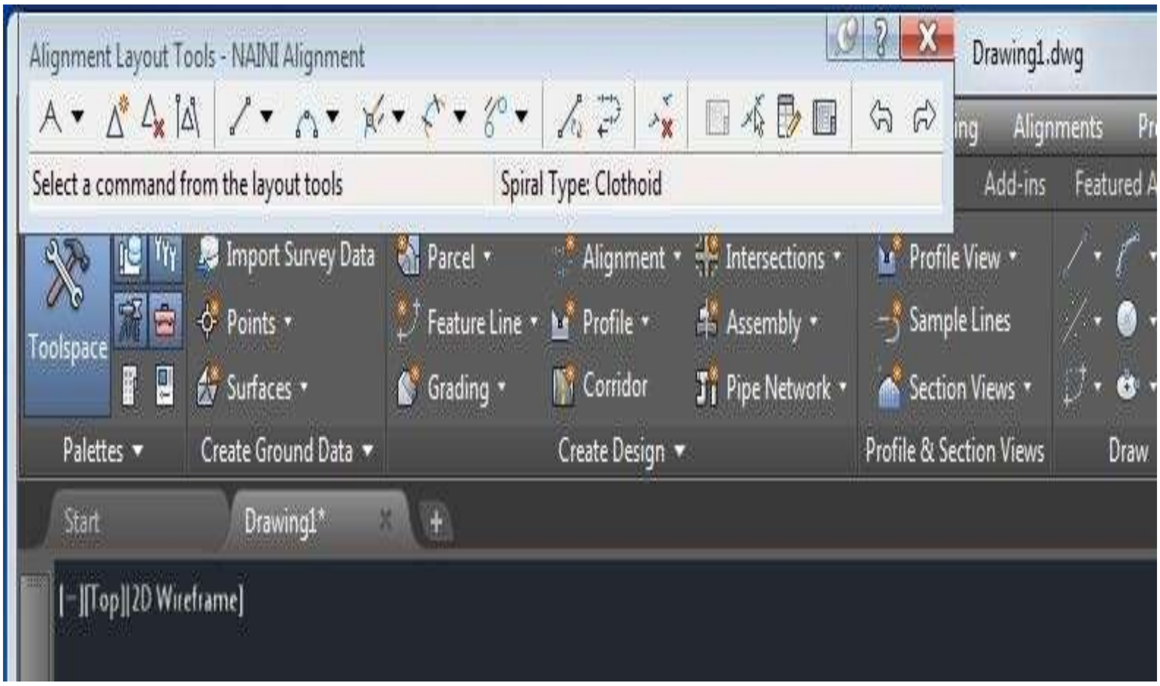

Figure 3.6 Alignment Layout Tools

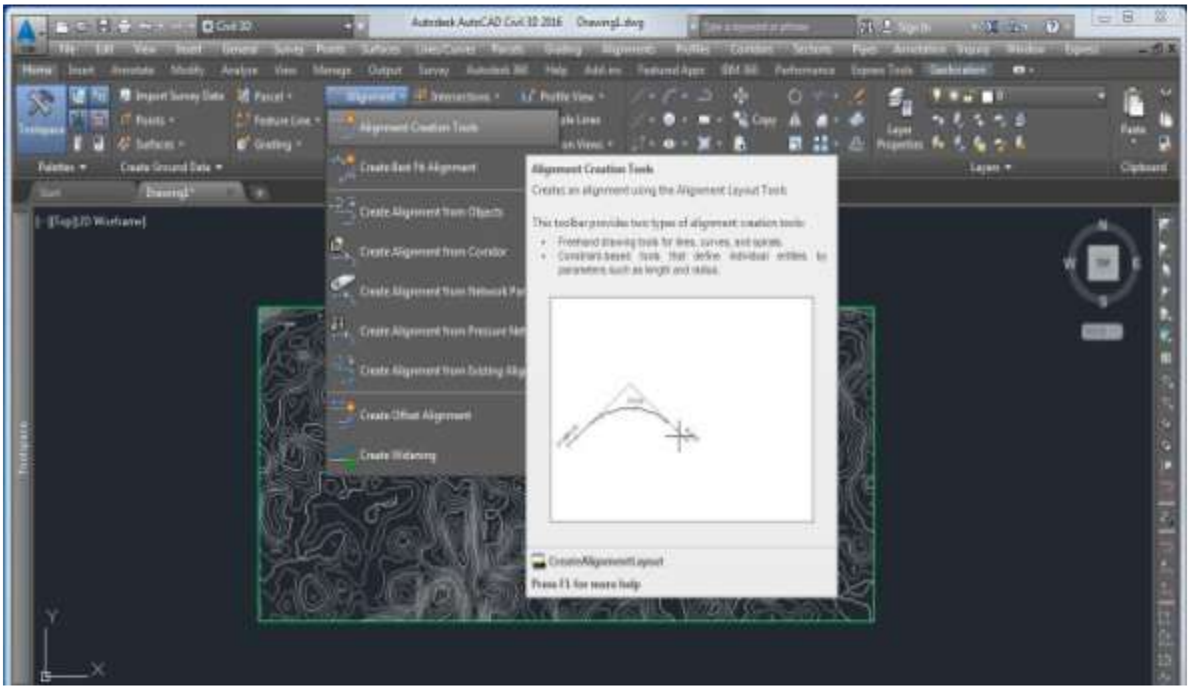

Figure 3.7:-Creating Naini Alignment

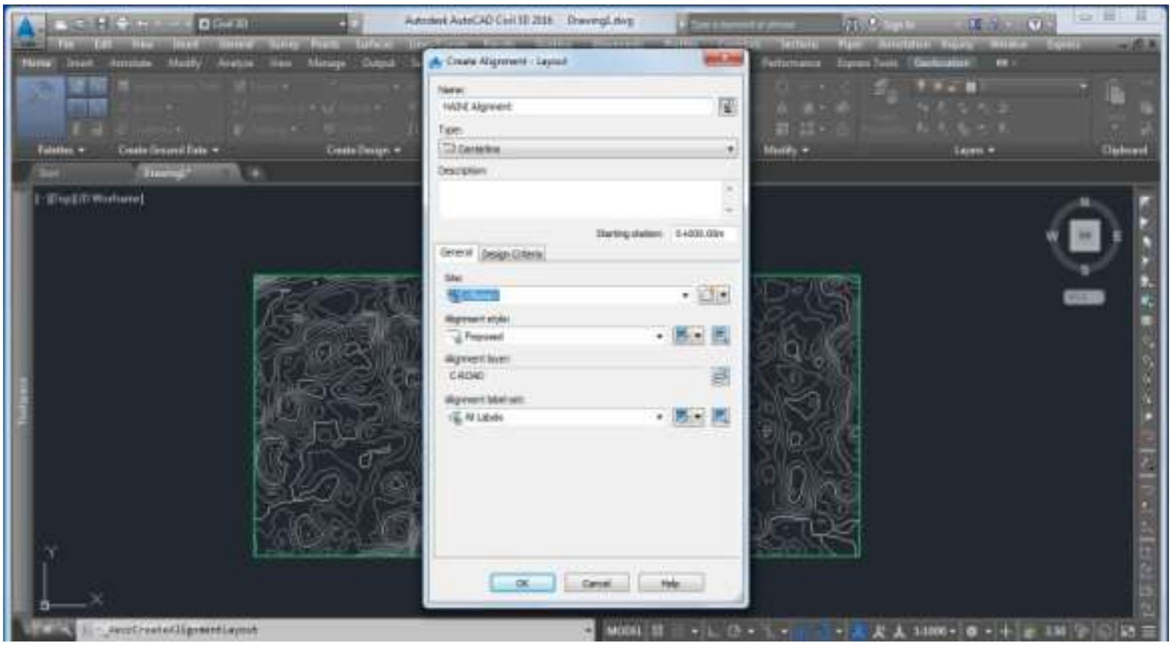

Figure 3.8:-Creating Alignment Layout

B. Allahabad Alignment and Flyover Alignment

By following the above procedures we will create the ALLAHABAD Alignment and the Flyover Alignment also. The length of the Allahabad Alignment will be1.160 Km where as the length of the Flyover Alignment will be 880.90m.

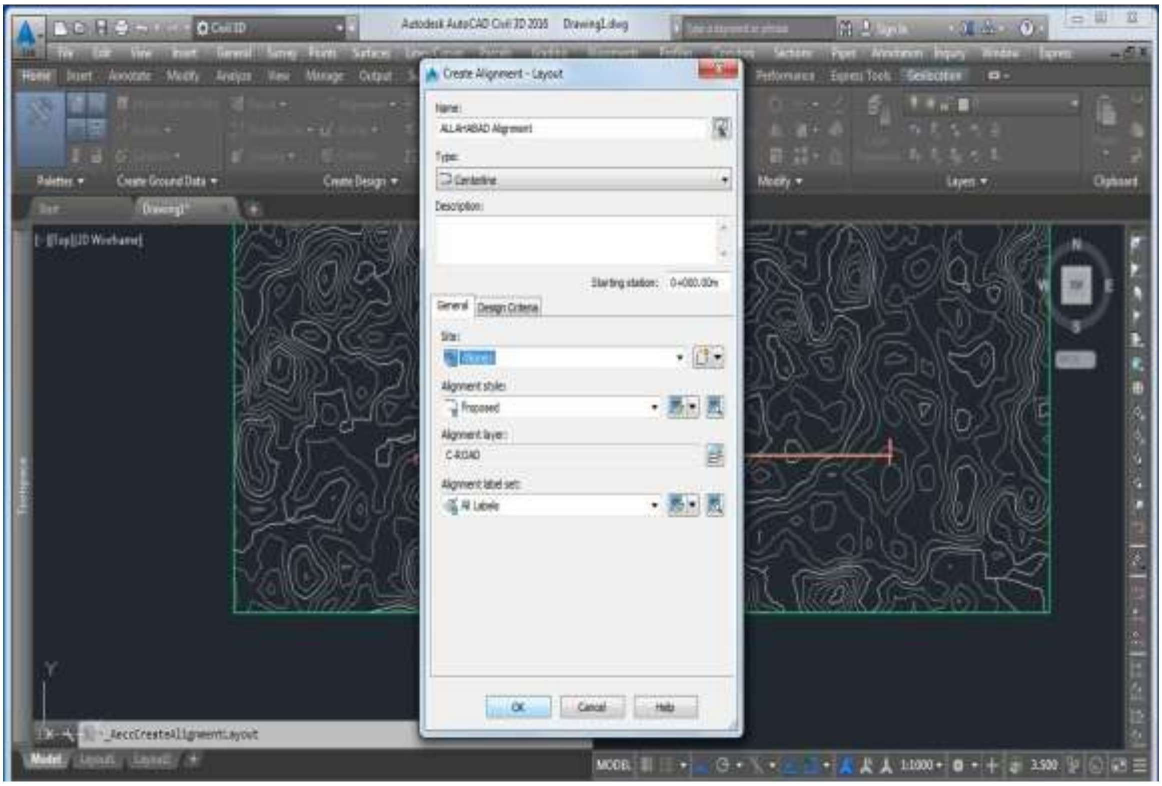

Figure 3.9:- Creating Allahabad Alignment

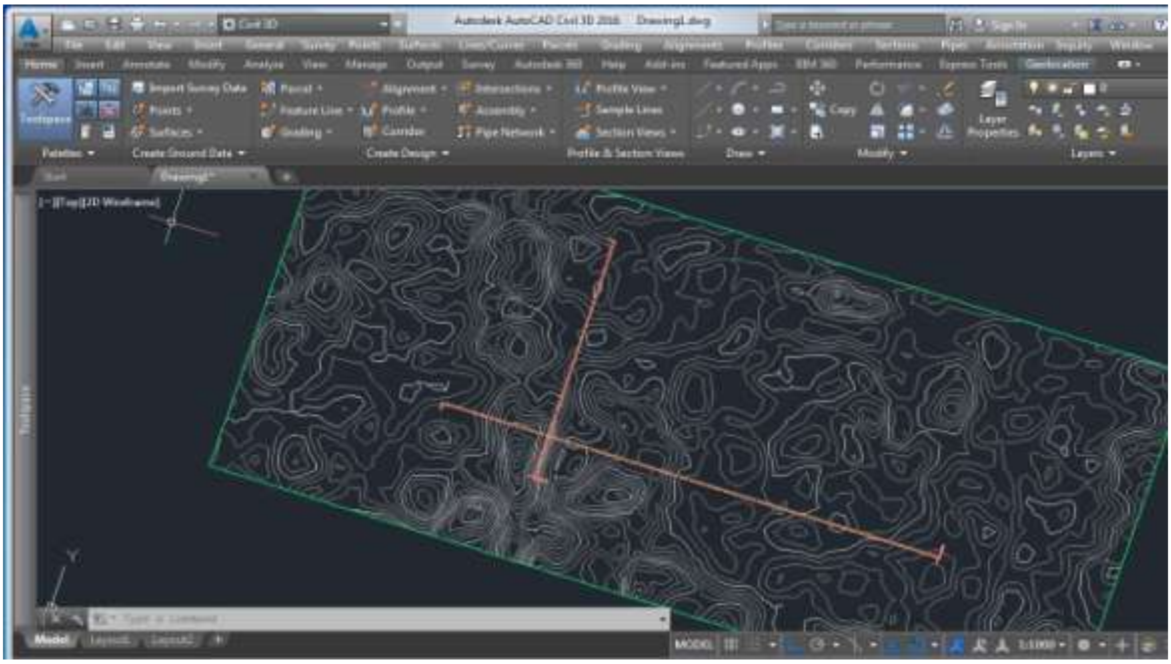

Figure 3.10:-Intersection of Naini and Allahabad Alignments

3.9.9 Creating Intersection

a. Do one of the following:

- Click the Home tab
- Create Design panel
- Intersection
- At the command line, enter Create Intersection. We are prompted to pick an intersection point in the drawing.

b. In the drawing, click the location in the drawing where two alignments intersect.

c. If we are creating a 4-way intersection, we will be prompted to select the alignment that will be identified as the primary road. If so, select the alignment by clicking the alignment in the drawing, or by pressing ENTER and selecting from the list of alignments in the drawing.

d. On the General page of the Create Intersection wizard, enter a name for the intersection object, or accept the default. We can also enter an optional description, and change defaults for marker styles, layers, and labels.

e. For the Intersection Corridor Type, select one of the following to specify the corridor grade options through the intersection area.

f. Click Next to proceed to the next page of the wizard.

g. On the Geometry Details page, we may accept or change the defaults.

h. By default, new offset alignment objects will be created. However, if we want to specify an existing offset alignment from the drawing, click the Offset Parameters button, set Use an Existing Alignment to Yes, and select the alignment by clicking next to the Alignment Name property.

i. When we are finished configuring the Geometry Details page, click next to proceed to the next page of the wizard.

j. On the Corridor Regions page, we may accept or change the defaults.

k. Click the items listed under Corridor Region Section Type, and notice that the conceptual graphics update with each selection. Click Create Intersection. The intersection will be created.

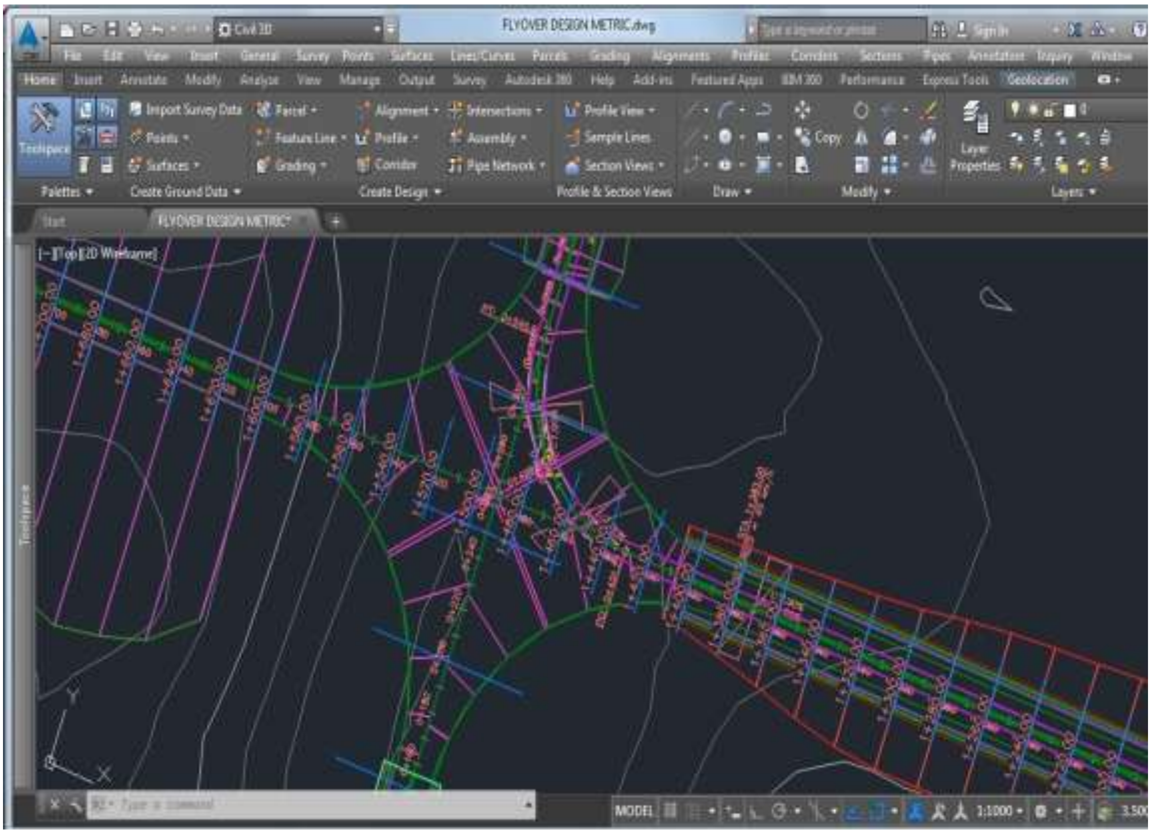

Figure 3.30:- 2D Intersection View

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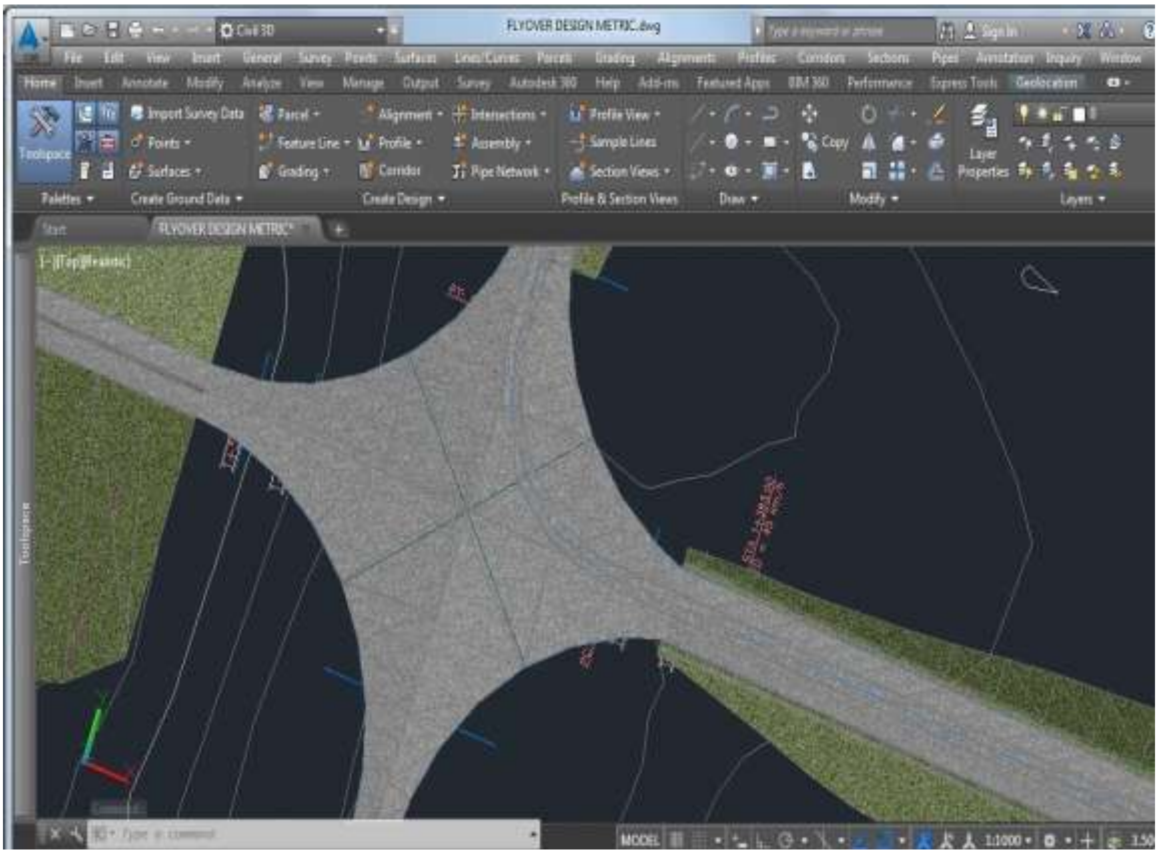

Figure 3.31:- Realistic Intersection View

3.9.10 Creating Corridors

a) Click Home tab ➤Create Design panel ➤Corridor drop-down ➤Create a Simple Corridor
b) In the Create Simple Corridor Dialog Box, in the Name field, enter a name for the corridor. To name the corridor, select its default name and enter a new name, or use the name template.
c) In the Description field, enter a description for the corridor.
d) To change the style used by the corridor, click the Corridor Style list or use the standard style creation tools to edit or create a style. The corridor style controls the appearance of corridor region boundaries and assembly insertion stations.
e) Click to select a layer.
f) Click OK.
g) Select an alignment in the drawing or press Enter to select an alignment in the Select An Alignment dialog box
h) Select a profile in the drawing or press Enter to select a profile in the Select A Profile dialog box
i) Select an assembly in the drawing or press Enter to select an assembly in the Select An Object dialog box
j) The corridor name is displayed in the Corridors collection on the Prospector tab. For information about editing and managing the corridor, see Managing and Editing Corridors
k) Click OK to create the corridor. The corridor name is displayed in the Corridors collection on the Prospector tab.

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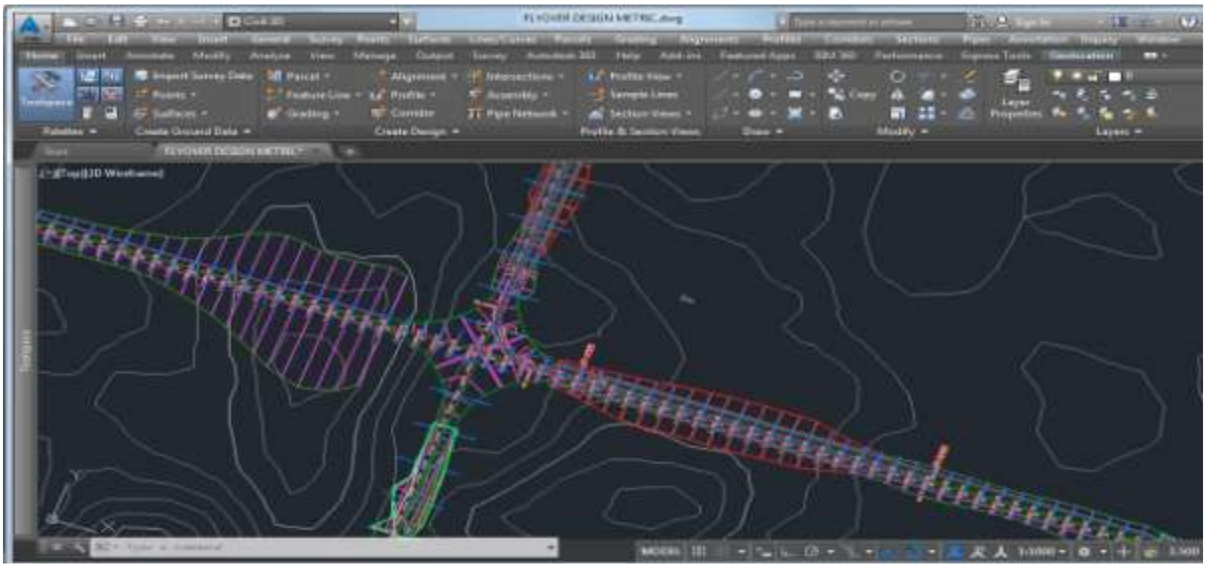

Figure 3.32:-2D View of Corridors

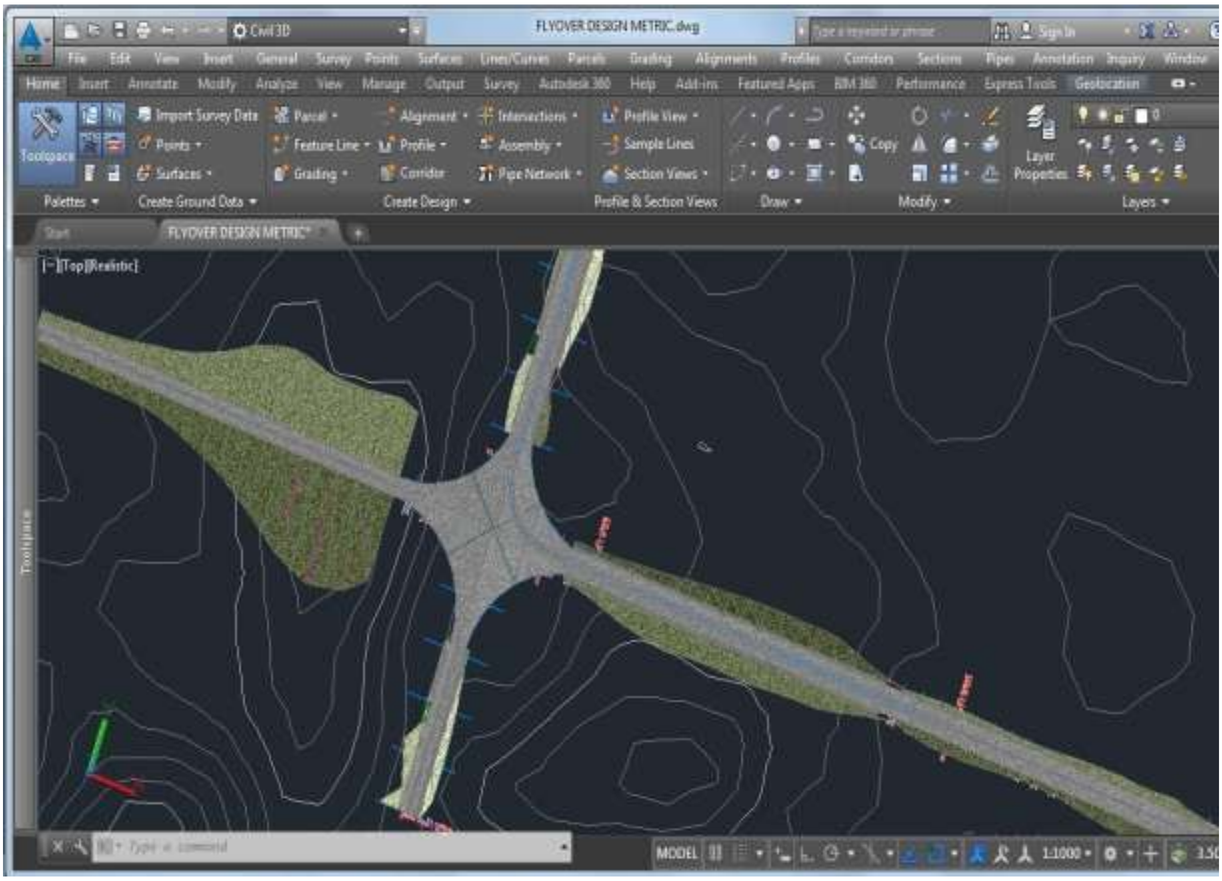

Figure 3.33:-3D View of Corridors

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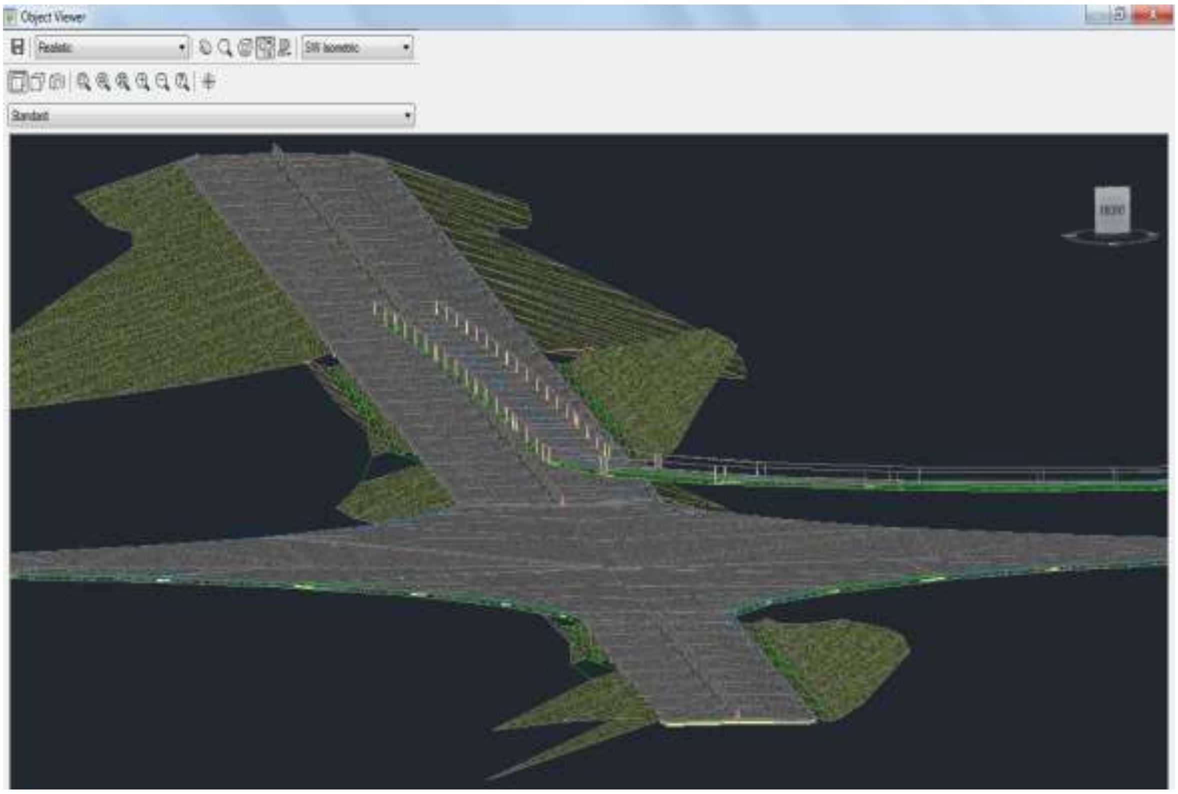

Figure 3.34:- View of Flyover

IV. RESULTS

4.1 Surface Report

Gives the details of the surfaces created during the designing process.

Surface: Allahabad Corridor
Area 2D: 5437.243m^2 Area 3D: 5741.474m^2
Elevation Max: 93.900m Elevation Min:- 83.895m

Surface: Allahabad Widening Corridor
Area 2D: 31130.157m^2 Area 3D: 32350.479m^2
Elevation Max: 95.682m Elevation Min:- 78.907m

Surface: Allahabad_1_Corridor
Area 2D: 13572.376m^2 Area 3D: 14084.066m^2
Elevation Max: 89.028m Elevation Min:- 83.763m

Surface: Earthwork Allahabad
Area 2D: 5437.243m^2 Area 3D: 5696.326m^2
Elevation Max: 1.338m Elevation Min:- 3.523m

Surface: Earthwork Allahabad 1
Area 2D: 13572.376m^2 Area 3D: 14103.319m^2
Elevation Max: 4.971m Elevation Min:- 0.335m

Surface: Naini_1_Corridor
Area 2D: 42506.424m^2 Area 3D: 43948.777m^2
Elevation Max: 89.028m Elevation Min:- 63.285m

Surface: Naini 1 Earthwork
Area 2D: 42506.424m^2 Area 3D: 44316.666m^2
Elevation Max: 21.269m Elevation Min:-0.389m

Surface: Naini Corridor
Area 2D: 25841.526m^2 Area 3D: 27096.128m^2
Elevation Max: 92.910m Elevation Min:- 81.262m

Surface: Naini Earthwork
Area 2D: 25841.526m^2 Area 3D: 27088.518m^2
Elevation Max: 6.751m Elevation Min:-3.672m

Surface: Naini Widening Corridor
Area 2D: 34393.854m^2 Area 3D: 36420.373
Elevation Max: 99.867m Elevation Min:- 85.221m

Surface: Naini Widening Earthwork
Area 2D:34393.854m^2 Area 3D: 36315.235m^2
Elevation Max: 3.190m Elevation Min:-10.382m

Volume Surface: Allahabad Widening Earthwork

Volume Cut-16610.717m^3 Volume Fill: 86804.625m^3 VolumeTotal-70193.908m^3
Base Surface: Grid from DEM file Area

Volume Surface: Allahabad Earthwork
Volume Cut-6396.564m^3
Volume Fill-278.783m^3
Volume Total-6117.781m^3
Base Surface: Grid from DEM file Area
Volume Surface: Allahabad 1 Earthwork
Volume Cut-3.847m^3
Volume Fill-34052.645m^3
Volume Total-34048.798m^3
Base Surface: Grid from DEM file Area

Volume Surface: Naini 1 Earthwork
Volume Cut-7.387m^3 VolumeFill-383732.961m^3 Volume Total-383725.574m^3
Base Surface: Grid from DEM file Area

Volume Surface: Naini Earthwork
Volume Cut-21734.802m^{3}Volume Fill-30778.717m^3 Volume Total-9043.915m^3 Base Surface: Grid from DEM file Area

Volume Surface: Naini Widening Earthwork
Volume Cut-111359.059m^{3}Volume Fill-18444.313m^3
Volume Total-92914.746m^3 Base Surface: Grid from DEM file Area

4.2 Alignment Design Criteria Verification Report

This report compares alignment parameters with its specified design criteria. The report displays each entity's parameters and whether the entity clears or violates the specified design checks.

Alignment Name: Allahabad Alignment
Station Range: Start: 0+000.00m, End: 1+200.21m
Start Station: 0+000.00m
End Station: 1+200.21m
Length: 1,200.207m
Design Speed: 60kmph

Alignment Name: A Curve Alignment
Station Range: Start: 0+000.00m, End: 0+157.08m
Start Station: 0+000.00m
End Station: 0+157.08m
Radius: 100.000m
Design Speed: 60kmph

Alignment Name: B Curve Alignment
Station Range: Start: 0+000.00m, End: 0+157.08m
Start Station:
0+000.00m
End Station:
0+157.08m
Radius: 100m
Design Speed: 60kmph

Alignment Name Curve Alignment
Station Range: Start: 0+000.00m, End: 0+157.08m
Start Station: 0+000.00m
End Station: 0+157.08m
Radius: 100.000m
Design Speed: 60kmph

Alignment Name: D Curve Alignment
Station Range: Start: 0+000.00m, End: 0+157.08m
Start Station: 0+000.00m
End Station: 0+157.08m
Radius: 100.000m

Design Speed: 60kmph

Alignment Name: Flyover Alignment
Station Range: Start: 0+000.00m, End: 0+880.91m
Start Station: 0+000.00m
End Station: 0+451.22m
Length: 451.223m
Design Speed: 40kmph

Start Station: 0+451.22m
End Station: 0+545.91m
Length: 60.282m
Design Speed: 40kmph

Start Station: 0+545.91m
End Station: 0+880.91m
Length: 335.001m
Design Speed: 40kmph

Alignment Name: Naini Alignment
Station Range: Start: 0+000.00m, End: 2+000.00m
Start Station: 0+000.00m
End Station: 2+000.00m
Length: 2,000.000m
Design Speed: 60kmph

4.3 Flyover Alignment Design Criteria Report
Alignment Name: Flyover Alignment
Station Range: Start: 0+000.00m, End: 0+880.91m

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1. Tangent
Start Station: 0+000.00m
End Station: 0+451.22m
Length: 451.22m
Design Speed: 40kmph

2. Circular Curve
Start Station: 0+451.22m
End Station: 0+545.91m
Length: 60.282m
Design Speed: 40kmph

3. Tangent
Start Station: 0+545.91m
End Station: 0+880.91m
Length: 335.001m
Design Speed: 40kmph

4.4 Lane Slope Report

The lane slope report displays the station values for the sample lines associated with the selected corridor object, the X, Y coordinates of the sample line at the intersection of the alignment, the elevation values of the existing ground and layout profiles at that X, Y point and the left and right slopes of the lanes defined between the alignment and the edge of the pavement.

Corridor Name: Naini Corridor
Base Alignment Name: NAINI Alignment
Station Range: Start: 0+000.00m, End: 2+000.00m

Table 4.1 Lane Slope Report Naini Corridor

Station	Existing Ground Elevation	Layout Profile Elevation	X	Y	Slope Left	Slope Right
0+000.00	82.650	89.000	5,87,621.894	28,10,751.387	2.0%	2.0%
0.050.00	83.582	89.000	5,87,571.894	28,10,751.387	2.0%	2.0%
0+100.00	84.928	89.000	5,87,521.894	28,10,751.387	2.0%	2.0%
0+150.00	86.438	89.000	5,87,471.894	28,10,751.387	2.0%	2.0%
0+200.00	88.409	89.000	5,87,421.894	28,10,751.387	2.0%	2.0%
0+250.00	89.378	89.000	5,87,371.894	28,10,751.387	2.0%	2.0%
0+300.00	90.894	89.000	5,87,321.894	28,10,751.387	2.0%	2.0%
0+350.00	91.427	89.000	5,87,271.894	28,10,751.387	2.0%	2.0%
0+400.00	89.557	89.000	5,87,221.894	28,10,751.387	2.0%	2.0%
0+450.00	90.624	89.000	5,87,171.894	28,10,751.387	2.0%	2.0%
0+500.00	91.759	89.000	5,87,121.894	28,10,751.387	2.0%	2.0%
0+550.00	91.506	89.000	5,87,071.894	28,10,751.387	2.0%	2.0%
0+600.00	89.300	89.000	5,87,021.894	28,10,751.387	2.0%	2.0%
0+650.00	87.965	89.000	5,86,971.894	28,10,751.387	2.0%	2.0%
0+700.00	87.123	89.000	5,86,921.894	28,10,751.387	2.0%	2.0%
0+750.00	86.209	89.000	5,86,871.894	28,10,751.387	2.0%	2.0%
0+800.00	86.400	89.000	5,86,821.894	28,10,751.387	2.0%	2.0%
0+850.00	87.292	89.000	5,86,771.894	28,10,751.387	2.0%	2.0%
0+900.00	87.731	89.000	5,86,721.894	28,10,751.387	2.0%	2.0%
0+950.00	87.048	89.000	5,86,671.894	28,10,751.387	2.0%	2.0%
1+000.00	86.705	89.000	5,86,621.894	28,10,751.387	2.0%	2.0%
1+050.00	88.879	89.000	5,86,571.894	28,10,751.387	2.0%	2.0%
1+100.00	95.665	89.000	5,86,521.894	28,10,751.387	2.0%	2.0%
1+150.00	97.979	89.000	5,86,471.894	28,10,751.387	2.0%	2.0%
1+200.00	97.362	89.000	5,86,421.894	28,10,751.387	2.0%	2.0%
1+250.00	96.869	89.000	5,86,371.894	28,10,751.387	2.0%	2.0%
1+300.00	95.930	89.000	5,86,321.894	28,10,751.387	2.0%	2.0%
1+350.00	93.335	89.000	5,86,271.894	28,10,751.387	2.0%	2.0%
1+400.00	90.603	89.000	5,86,221.894	28,10,751.387	2.0%	2.0%
1+450.00	89.911	89.000	5,86,171.894	28,10,751.387	2.0%	2.0%
1+500.00	89.954	89.000	5,86,121.894	28,10,751.387	2.0%	2.0%
1+550.00	82.196	89.000	5,86,071.894	28,10,751.387	2.0%	2.0%
1+600.00	71.053	89.000	5,86,021.894	28,10,751.387	2.0%	2.0%

1+650.00	68.738	89.000	5,85,971.894	28,10,751.387	2.0%	2.0%
1+700.00	68.531	89.000	5,85,921.894	28,10,751.387	2.0%	2.0%
1+750.00	72.209	89.000	5,85,871.894	28,10,751.387	2.0%	2.0%
1+800.00	78.296	89.000	5,85,821.894	28,10,751.387	2.0%	2.0%
1+850.00	83.526	89.000	5,85,771.894	28,10,751.387	2.0%	2.0%
1+900.00	85.096	89.000	5,85,721.894	28,10,751.387	2.0%	2.0%
1+950.00	85.340	89.000	5,85,671.894	28,10,751.387	2.0%	2.0%
2+000.00	85.939	89.000	5,85,621.894	28,10,751.387	2.0%	2.0%

Corridor Name: Allahabad Corridor
Base Alignment Name: Allahabad Alignment
Station Range: Start: 0+000.00m, End: 1+200.21m

Table 4.2 Lane Slope Report Allahabad Corridor

SL Name	Station	Existing Ground Elevation	Layout Profile Elevation	X	Y	Slope Left	Slope Right
0+000.00 (89)	0+000.00	88.862	89.000	5,86,130.389	28,10,486.669	2.0%	2.0%
0.050.00	0.050.00	89.991	89.000	5,86,130.389	28,10,536.669	2.0%	2.0%
0+100.00	0+100.00	90.158	89.000	5,86,130.389	28,10,586.669	2.0%	2.0%
0+150.00	0+150.00	89.605	89.000	5,86,130.389	28,10,636.669	2.0%	2.0%
0+200.00	0+200.00	89.721	89.000	5,86,130.389	28,10,686.669	2.0%	2.0%
0+250.00	0+250.00	89.875	89.000	5,86,130.389	28,10,736.669	2.0%	2.0%
0+300.00	0+300.00	89.677	89.000	5,86,130.389	28,10,786.669	2.0%	2.0%
0+350.00	0+350.00	87.325	89.000	5,86,130.389	28,10,836.669	2.0%	2.0%
0+400.00	0+400.00	87.647	89.000	5,86,130.389	28,10,886.669	2.0%	2.0%
0+450.00	0+450.00	90.721	89.000	5,86,130.389	28,10,936.669	2.0%	2.0%
0+500.00	0+500.00	90.402	89.000	5,86,130.389	28,10,986.669	2.0%	2.0%
0+550.00	0+550.00	91.218	89.000	5,86,130.389	28,11,036.669	2.0%	2.0%
0+600.00	0+600.00	88.453	89.000	5,86,130.389	28,11,086.669	2.0%	2.0%
0+650.00	0+650.00	82.779	89.000	5,86,130.389	28,11,136.669	2.0%	2.0%
0+700.00	0+700.00	80.045	89.000	5,86,130.389	28,11,186.669	2.0%	2.0%
0+750.00	0+750.00	80.399	89.000	5,86,130.389	28,11,236.669	2.0%	2.0%
0+800.00	0+800.00	84.577	89.000	5,86,130.389	28,11,286.669	2.0%	2.0%
0+850.00	0+850.00	85.816	89.000	5,86,130.389	28,11,336.669	2.0%	2.0%
0+900.0	0+900.0	84.823	89.000	5,86,130.38	28,11,386.66	2.0%	2.0%

0	0			9	9		
0+950.0 0	0+950.0 0	85.000	89.000	5,86,130.38 9	28,11,436.66 9	2.0%	2.0%
1+000.0 0	1+000.0 0	84.710	89.000	5,86,130.38 9	28,11,486.66 9	2.0%	2.0%
1+050.0 0	1+050.0 0	84.546	89.000	5,86,130.38 9	28,11,536.66 9	2.0%	2.0%
1+100.0 0	1+100.0 0	86.344	89.000	5,86,130.38 9	28,11,586.66 9	2.0%	2.0%
1+150.0 0	1+150.0 0	85.608	89.000	5,86,130.38 9	28,11,636.66 9	2.0%	2.0%
1+200.0 0	1+200.0 0	84.355	89.000	5,86,130.38 9	28,11,686.66 9	2.0%	2.0%
1+200.2 1	1+250.0 0	84.348	89.000	5,86,130.38 9	28,11,686.87 6	2.0%	2.0%

4.5 Volume Report
Naini Alignment Volume Report
Alignment: Naini Alignment
Start Sta: 0+000.00m End Sta: 2+000.00m

Table 4.3 Naini Alignment Volume Report

Station	**Cut Area (m^2)**	**Cut Volume (m^3)**	**Reusable Volume (m^3)**	**Fill Area (m^2)**	**Fill Volume (m^3)**	**Cum. Cut Vol. (m^3)**	**Cum. Reusable Vol. (m^3)**	**Cum. Fill Vol. (m^3)**	**Cum. Net Vol. (m^3)**
0+000.00	0.00	0.00	0.00	791.60	0.00	0.00	0.00	0.00	0.00
0.050.00	0.00	0.00	0.00	659.41	36,275.31	0.00	36,275.31	36,275.31	-36,275.31
0+100.00	0.00	0.00	0.00	489.02	28,710.80	0.00	64,986.10	64,986.10	-64,986.10
0+150.00	0.00	0.00	0.00	442.32	23,283.61	0.00	88,269.71	88,269.71	-88,269.71
0+200.00	0.00	0.00	0.00	455.45	22,444.30	0.00	110,714.01	110,714.01	-110,714.01
0+250.00	0.00	0.00	0.00	498.31	23,844.01	0.00	134,558.02	134,558.02	-134,558.02
0+300.00	0.00	0.00	0.00	613.14	27,786.35	0.00	162,344.37	162,344.37	-162,344.37
0+350.00	0.00	0.00	0.00	614.52	30,691.51	0.00	193,035.88	193,035.88	-193,035.88
0+400.00	0.00	0.00	0.00	481.92	27,410.69	0.00	220,446.57	220,446.57	-220,446.57
0+450.00	0.00	0.00	0.00	425.01	22,672.94	0.00	243,119.51	243,119.51	-243,119.51

0+500.00	0.00	0.00	0.00	490.33	22,883.47	0.00	266,002.98	266,002.98	-266,002.98
0+550.00	0.00	0.00	0.00	494.03	24,609.07	0.00	290,612.05	290,612.05	-290,612.05
0+600.00	0.00	0.00	0.00	491.14	24,629.30	0.00	315,241.35	315,241.35	-315,241.35
0+650.00	0.00	0.00	0.00	488.93	24,501.68	0.00	339,743.04	339,743.04	-339,743.04
0+700.00	0.00	0.00	0.00	432.61	23,038.34	0.00	362,781.38	362,781.38	-362,781.38
0+750.00	0.00	0.00	0.00	348.91	19,537.97	0.00	382,319.35	382,319.35	-382,319.35
0+800.00	0.00	0.00	0.00	329.68	16,964.78	0.00	399,284.13	399,284.13	-399,284.13
0+850.00	0.00	0.00	0.00	317.60	16,182.06	0.00	415,466.19	415,466.19	-415,466.19
0+900.00	0.00	0.00	0.00	299.45	15,426.43	0.00	430,892.62	430,892.62	-430,892.62
0+950.00	0.00	0.00	0.00	334.42	15,846.91	0.00	446,739.53	446,739.53	-446,739.53
1+000.00	0.00	0.00	0.00	376.51	17,773.36	0.00	464,512.89	464,512.89	-464,512.89
1+050.00	0.00	0.00	0.00	376.63	18,828.67	0.00	483,341.56	483,341.56	-483,341.56
1+100.00	0.00	0.00	0.00	463.69	21,008.02	0.00	504,349.58	504,349.58	-504,349.58
1+150.00	0.00	0.00	0.00	545.66	25,233.59	0.00	529,583.17	529,583.17	-529,583.17
1+200.00	0.00	0.00	0.00	553.77	27,485.63	0.00	557,068.81	557,068.81	-557,068.81
1+250.00	0.00	0.00	0.00	484.90	25,966.68	0.00	583,035.49	583,035.49	-583,035.49
1+300.00	0.00	0.00	0.00	428.76	22,841.56	0.00	605,877.06	605,877.06	-605,877.06
1+350.00	0.00	0.00	0.00	355.61	19,609.33	0.00	625,486.38	625,486.38	-625,486.38
1+400.00	0.00	0.00	0.00	0.00	8,894.24	0.00	634,376	634,376.	-

							.62	62	634,376.62
1+450.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+500.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+550.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+600.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+650.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+700.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+750.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+800.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+850.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+900.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
1+950.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62
2+000.00	0.00	0.00	0.00	0.00	0.00	0.00	634,376.62	634,376.62	-634,376.62

Allahabad Alignment Volume Report
Alignment: Allahabad Alignment
Start Sta: 0+000.00m End Sta: 1+200.00m

Table4.4 Allahabad Alignment Volume Report

Station	**Cut Area (m^2)**	**Cut Volume (m^3)**	**Reusable Volume (m^3)**	**Fill Area (m^2)**	**Fill Volume (m^3)**	**Cum. Cut Vol. (m^3)**	**Cum. Reusable Vol. (m^3)**	**Cum. Fill Vol. (m^3)**	**Cum. Net Vol. (m^3)**
0+000.00	0.62	0.00	0.00	2.92	0.00	0.00	0.00	0.00	0.00
0.050.00	0.00	15.70	15.70	56.80	1493.00	15.70	1493.00	1493.00	-1477.31
0+100.00	0.00	0.07	0.07	135.55	4808.80	15.77	6,301.81	6,301.81	-6,286.81

0+150.00	0.00	0.00	0.00	56.16	4792.92	15.77	11,094.53	11,094.53	-11,078.76
0+200.00	0.00	0.00	0.00	5.54	1542.46	15.77	12,636.99	12,636.99	-12,621.22
0+250.00	1.13	28.13	28.13	0.74	157.07	43.90	12,794.06	12,794.06	-12,750.16
0+300.00	40.74	0.00	0.00	0.00	18.60	1090.44	12,812.66	12,812.66	-11,722.22
0+350.00	33.22	1848.84	1848.84	0.00	0.00	2939.28	12,812.66	12,812.66	-9,873.38
0+400.00	0.00	830.43	830.43	5.27	131.78	3769.71	12,944.44	12,944.44	-9,174.72
0+450.00	0.00	0.02	0.02	11.69	424.11	3769.74	13,368.54	13,368.54	-9,598.81
0+500.00	6.17	154.37	154.37	0.23	298.09	3924.11	13,666.64	13,666.64	-9,742.53
0+550.00	0.00	154.37	154.37	97.03	2431.63	4078.45	16,098.26	16,098.26	-12,019.81
0+600.00	0.00	0.00	0.00	251.17	8705.12	4078.45	24,803.38	24,803.38	-20,724.93
0+650.00	0.00	0.00	0.00	364.99	15403.89	4078.45	40,207.27	40,207.27	-36,128.81
0+700.00	0.00	0.00	0.00	489.65	21365.88	4078.45	61,573.15	61,573.15	-57,494.70
0+750.00	0.00	0.00	0.00	556.66	26157.72	4078.45	87,730.87	87,730.87	-83,652.41
0+800.00	0.00	0.00	0.00	576.66	28335.58	4078.45	116,066.45	116,066.45	-111,987.99
0+850.00	0.00	0.00	0.00	561.55	28457.95	4078.45	144,524.40	144,524.40	-140,445.95
0+900.00	0.00	0.00	0.00	428.23	24744.57	4078.45	169,268.97	169,268.97	-165,190.52
0+950.00	0.00	0.00	0.00	394.97	20579.98	4078.45	189,848.95	189,848.95	-185,770.50
1+000.00	0.00	0.00	0.00	538.52	23337.24	4078.45	213,186.19	213,186.19	-209,107.74
1+050.00	0.00	0.00	0.00	542.63	27028.64	4078.45	240,214.83	240,214.83	-236,136.38
1+100.00	0.00	0.00	0.00	533.99	26915.35	4078.45	267,130.18	267,130.18	-263,051.73
1+150.00	0.00	0.00	0.00	573.27	27681.51	4078.45	294,811.70	294,811.70	-290,733.24
1+200.00	0.00	0.00	0.00	484.84	26452.81	4078.45	321,264.51	321,264.51	-317,186.05

V. CONCLUSIONS

1. Upon completing the design work using AutoCAD Civil 3D, we have thoroughly familiarized ourselves with its various design functionalities. A flyover structure was successfully designed over an intersection by leveraging the advanced features of the software.
2. Key tools such as horizontal and vertical alignment profiles, super-elevation, assemblies, subassemblies, and corridor modeling played a crucial role throughout the design process. AutoCAD Civil 3D significantly streamlines highway geometric design, enabling rapid execution with high precision and ease of use.
3. Post-design, the software facilitated the automatic generation of detailed reports, effectively overcoming the challenges of traditional manual design methods, which are often tedious, time-consuming, and susceptible to human errors. The proposed flyover will not only enhance traffic movement and reduce accident rates but also contribute to the city's visual appeal and elevate the property value around the intersection.
4. Additionally, AutoCAD Civil 3D enhances project collaboration. If a new design engineer joins midway, they can easily understand the project workflow thanks to the real-time report generation. The software installation is also straightforward, with the AutoCAD engine and required extensions being installed simultaneously. A hardware lock (key) allows flexible usage across different systems, making it highly accessible and efficient.

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