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Road Intersection Design for Improved Traffic Flow at CJITS College Road Junction Using Autocad Civil 3D

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Abstract: *This project presents the geometric design and technical evaluation of a T-intersection and the adjoining approach roads near CJITS College, Jangaon, with the primary aim of enhancing campus accessibility and road safety. The design includes a 257.98-meter-long main road connecting to NH-163 and a 586.69-meter-long secondary road intersecting the main road at chainage 130 meters, forming a T-junction.*

High-resolution topographic data was collected using drone-based aerial surveys, producing a Digital Elevation Model (DEM) and orthomosaic (Ortho) imagery. These datasets were georeferenced using Ground Control Points (GCPs) obtained through Differential GPS (DGPS), ensuring high spatial accuracy for terrain modeling and alignment design.

Traffic studies were conducted to assess existing and projected traffic flow. A classified volume count (CVC) and turning movement count (TMC) at the intersection provided insights into vehicle types, directional movements, and peak-hour conditions. The peak-hour volume reached 226 vehicles/hour, with an Average Annual Daily Traffic (AADT) of approximately 2,100 vehicles/day.

The road design adheres to IRC and MORTH standards, incorporating 3.0 m lanes with 1.5 m shoulders. Turning radii of 9–10 meters were applied to accommodate light vehicles. Subgrade strength was verified through California Bearing Ratio (CBR) tests, with soaked CBR values averaging 7%, suitable for flexible pavement. The pavement structure was designed using IRC:37-2018 guidelines for a design traffic of 2 million standard axles (msa).

Earthwork computations, based on chainage-wise level differences from the DEM, yielded precise cut-and-fill volumes. Material quantities for each pavement layer—bituminous surface, wet mix macadam (WMM) base, and granular sub-base (GSB)—were also computed. A comprehensive Bill of Quantities (BOQ) was prepared.

This project demonstrates an integrated approach combining drone technology, DGPS surveys, traffic analysis, and IRC-standard road design for efficient and sustainable road infrastructure planning in a rural institutional setting

Keywords: CJITS College

I. INTRODUCTION

The growing demand for improved infrastructure around educational institutions calls for strategic planning and the integration of modern technologies in road design. In particular, intersections such as T-junctions play a critical role in managing traffic flow, reducing delays, and improving accessibility and safety. This project focuses on the geometric design of a T-intersection and its adjoining roads located near Christu Jyothi Institute of Technology and Science (CJITS) in Jangaon, Telangana. The aim is to design a 257.98-meter main road connecting to NH-163 and a 586.69-meter secondary road intersecting it, forming a functional and safe T-junction. To support this design, a comprehensive drone-based aerial survey was conducted, producing high-resolution orthomosaic images and a Digital Elevation Model (DEM). These outputs were geo referenced using Ground Control Points (GCPs) obtained through Differential GPS

(DGPS), ensuring high spatial accuracy for alignment and earthwork calculations. Traffic volume studies, including classified volume counts and turning movement counts, were conducted to assess current traffic patterns and predict future demands. This data informed the intersection layout, turning radii, and lane configurations. The design process was carried out using Civil 3D software, adhering strictly to guidelines specified by the Indian Roads Congress (IRC) and the Ministry of Road Transport and Highways (MORTH). Further, subgrade strength was evaluated through California Bearing Ratio (CBR) testing, and a flexible pavement was designed for 2 million standard axles (MSA) based on a design CBR of 7%. The project integrates modern surveying technologies with civil engineering design principles to create a reliable and efficient road network that meets the functional requirements of the area and serves as a replicable model for rural and institutional infrastructure development.

II. OBJECTIVES

The main objectives of the project are as follows:

- To collect and analyze topographic and traffic data using drone-based surveys and field studies.
- To develop accurate Digital Elevation Models (DEMs) and orthomosaic images for alignment planning.
- To design a T-intersection and its connecting roads based on geometric design principles defined by the Indian Roads Congress (IRC) and Ministry of Road Transport and Highways (MORTH).
- To perform California Bearing Ratio (CBR) testing and interpret subgrade strength for pavement design.
- To conduct a detailed traffic volume study and project traffic growth for 10 years.
- To perform vertical and horizontal alignment design in Civil 3D.
- To generate road profiles, cross sections, and earthwork quantities. • To estimate material quantities required for each pavement layer.
- To demonstrate how modern survey tools like drones and Civil 3D software can be effectively integrated into road planning and design.

III. SCOPE OF WORK

The scope of this project encompasses the complete geometric and structural design of a rural T-intersection and its associated approach roads. The major components include:

- Survey and Data Collection: Aerial drone survey of the study area, DGPS survey for Ground Control Points (GCPs), and classified traffic volume surveys at the junction.
- Data Processing and Modeling: Generation of Digital Elevation Models (DEMs), orthomosaics, and contour maps using Agisoft Metashape software.
- Design of Roads and Intersection: Horizontal and vertical alignments, geometric elements such as lane width, shoulder width, and turning radius, designed using Civil 3D software.
- Traffic Analysis: Analysis of classified volume count, peak hour traffic, ADT, AADT, commercial vehicle percentage, and future growth projections to determine the required traffic capacity.
- Pavement Design: Flexible pavement design as per IRC:37-2012 for 2 MSA (Million Standard Axles) traffic based on CBR values derived from field testing.
- Quantity Estimation: Calculation of cut and fill volumes using the terrain model and chainage data; estimation of layer-wise material quantities for pavement construction.

The study does not include cost estimation or economic analysis, as the primary focus remains on the technical aspects of road design using modern survey and modeling techniques.

IV. SITE LOCATION (CJITS COLLEGE,JANGAON)

The project site is located near Christu Jyothi Institute of Technology and Science (CJITS) in Jangaon, Telangana. The selected location experiences moderate traffic from local residents, students, and regional commuters. The main road under study originates near the college and connects to NH-163, a key national highway that links Warangal to

Hyderabad. A secondary road branches off from the main road and serves as a direct access route to the campus, forming a T-junction at chainage 130 meters of the main alignment.

The coordinates and terrain data for the site were collected via drone survey and DGPS-based GCPs to ensure high accuracy in mapping and alignment. The site features gently undulating terrain with minor elevation differences, making it suitable for rural flexible pavement design. The strategic location of this intersection makes it an ideal candidate for demonstrating modern road planning and intersection design methods.

V. METHODOLOGY

Drone Data Collection:

To begin the design and analysis process, high-precision data collection was carried out using the Mavic 3 Enterprise Drone, equipped with advanced imaging and surveying capabilities. The drone was selected for its ability to capture high-resolution imagery and generate accurate geospatial data, which were critical for the design of the T-intersection and the road alignments.

Flight Planning and Data Collection:

Before the flight, a comprehensive flight plan was created to cover the entire area of interest, including both the main and secondary roads as well as the intersection. The area was divided into smaller grids to ensure consistent coverage and sufficient overlap between individual images, a process known as overlap planning. The drone was flown at a controlled altitude to capture clear, georeferenced imagery.

Ground Control Points (GCPs):

To ensure the highest level of accuracy in the collected data, Ground Control Points (GCPs) were deployed across the site. These GCPs were carefully surveyed using Differential GPS (DGPS) equipment, which provides centimeter-level accuracy. The DGPS system was employed to measure the precise geographic coordinates of each GCP, which were then used as reference points during the photogrammetry process. The GCPs ensured the georeferencing of the aerial imagery, resulting in accurate spatial data for creating Digital Elevation Models (DEMs) and orthophoto mosaics.

Drone Imagery and Data Capture:

The Mavic 3 Enterprise captured overlapping aerial images in high-resolution RGB and infrared spectrums. This multi-spectral data provided rich information, enabling a comprehensive understanding of the terrain. The images were captured with an overlap of approximately 80% longitudinally and 60% laterally, which is essential for generating accurate 3D models and topographical data. Through this data collection method, we obtained imagery that served as the foundation for generating 3D models, DEMs, and ortho-images, essential for the road design and analysis in subsequent steps.

Data Processing Using Agisoft:

Once the drone survey was completed, the collected data was imported into Agisoft Metashape for processing. Agisoft Metashape is a photogrammetry software that is capable of converting raw images into highly accurate 3D models, DEMs, and orthophotos, which are crucial for road design.

Step 1: Image Alignment:

The first step in the data processing workflow was image alignment. In this phase, the software matched key features from the overlapping images, establishing common points to align the entire dataset. The GCPs collected using the DGPS system were incorporated into the alignment process to provide geospatial accuracy. This step generated an initial sparse point cloud, which serves as the backbone of the 3D model

.

Step 2: Dense Point Cloud Generation:

After the images were aligned, Agisoft used advanced algorithms to generate a dense point cloud from the sparse data. The dense point cloud represents the 3D surface of the surveyed area in great detail, including elevation and terrain features. The level of detail in the dense point cloud is vital for accurate topographical modeling, which is necessary for road alignment design and earthwork calculations.

Step 3: Mesh and Texture Generation:

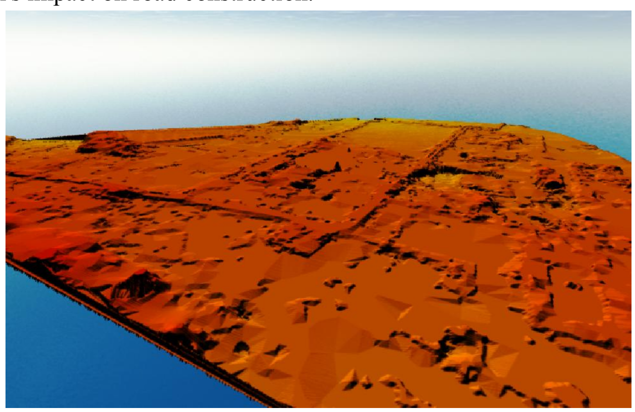
Once the dense point cloud was created, Agisoft converted the point cloud into a 3D mesh model. This mesh is essentially a polygonal representation of the surveyed area. To enhance the visual quality of the model, textures were applied to the mesh, creating a realistic, high resolution 3D representation of the terrain.

Step 4: DEM and Orthophoto Creation:

From the 3D mesh, Digital Elevation Models (DEMs) were generated. The DEM provides a detailed representation of the ground surface and elevation changes, which was used to design the road geometry and calculate earthwork volumes. Similarly, orthophotos (georeferenced orthophotographs) were created by stitching together the images taken by the drone. These ortho images serve as the 2D visual map of the surveyed area, providing an accurate and detailed representation of the terrain.

Step 5: Output Generation for Road Design:

The processed data outputs, including the DEM, orthophotos, and 3D models, were imported into Civil 3D for road alignment and intersection design. These outputs provided the topographical and spatial data required for designing the road geometries, including horizontal and vertical alignments, as well as designing the T-junction. The DEM data was particularly useful for identifying level differences, which were crucial for calculating earthwork volumes (cut and fill) and understanding the terrain's impact on road construction.



Step 6: Quality Check and Accuracy Verification:

Throughout the processing steps, quality checks were performed to verify the accuracy of the models and ensure that the outputs met the required standards for the project. The accuracy of the GCPs was checked against the generated models, ensuring that the final data products were georeferenced correctly, thus supporting the precision of the subsequent road design and analysis.

By combining drone-based data collection with Agisoft's photogrammetry software, this methodology provided highly accurate spatial data, forming a solid foundation for the subsequent design phases. The high-resolution imagery and the detailed topographical data enabled precise road alignment, intersection design, and earthwork calculations, ultimately contributing to a more efficient and effective road design process for CJITS College.

VI. TRAFFIC SURVEY AND ANALYSIS

Conflict Point Analysis at T-Intersection In the proposed rural road design, a T-intersection is provided to connect a minor road to a two-lane major road. Based on the geometric layout and movement patterns, the intersection has a total of 9 conflict points, categorized as 3 merging, 3 diverging, and 3 crossing points. This reduction from the standard 15-point conflict layout is attributed to the provision of a 10-meter curb return, proper turning radii, and a simplified traffic movement scheme with no excessive opposing turns. As per IRC:SP:41-1994 and IRC:86-1983, such a layout improves safety by minimizing potential vehicle interaction zones, especially suitable for roads with low to moderate traffic volumes and a traffic load of 2 MSA with 7% CBR strength. The reduced conflict configuration aligns with best practices for rural road intersections, ensuring operational efficiency and improved safety.

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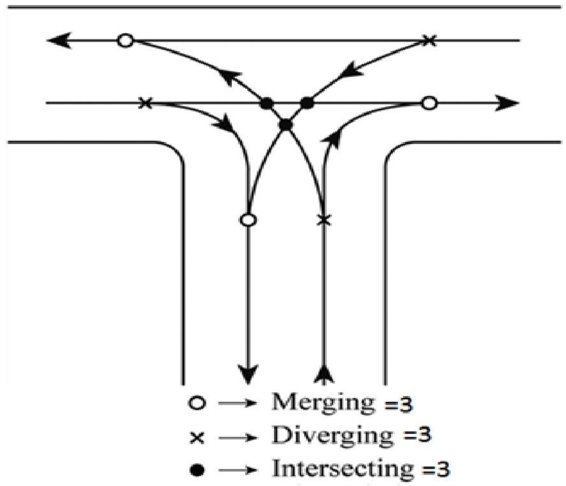

Total conflicts points =9
Merging Conflict Points
Definition: When two vehicle paths join into a single stream
Diverging Conflict Points
Definition: When one traffic stream splits into two paths.
Crossing Conflict Points
Definition: When two vehicle paths intersect at an angle (most dangerous).
T-Intersection Survey Data

1. Classified Volume Count (CVC) / Turning Movement Count (TMC)

Movement	Cars	Two-wheelers	Buses	Trucks	Total (veh/hr)
Major road → through	80	60	5	10	155
Major road → right turn	10	8	1	2	21
Major road → left turn	12	10	1	2	25
Minor road → right turn to major	8	5	0	1	14
Minor road → left turn to major	6	4	0	1	11

Peak Hour Volume ≈ 226 veh/hr

2. Traffic Volume Analysis: ADT & AADT

Vehicle Type	12-hr Count	Daily Factor (×1.2)	ADT	Seasonal Factor (×1.1)	AADT
Cars	800	960	960	1,056	1,056
Two-wheelers	600	720	720	792	792
Buses	50	60	60	66	66
Trucks	150	180	180	198	198
Total	—	—	1,920	—	2,112

Average Annual Daily Traffic (AADT) ≈ 2,100 veh/day

3. Design Parameters
Peak Hour Factor
(Note: This is a peak-to-average hourly ratio, not standard PHF)
PHF=2.58
Design Hourly Volume (DHV) : 315veh/hr
Commercial Vehicle Percentage: 12.5%

4. Traffic Growth & MSA Calculation
Commercial Vehicles/day (CV/day) = 240
Growth Rate (r) = 7.5%
Design Life = 10 years
Growth Factor (F) ≈ 6.1
Total CVs over design life: 535,800 CVs
Vehicle Damage Factor (VDF) ≈ 3.0
MSA Calculation:1.6msa→Adopt 2msa

VII.ROAD GEOMETRY AND INTERSECTION DESIGN USING CIVIL 3D

1.Importing Drone DEM and Orthoimage DEM (Digital Elevation Model):

- Insert tab > Surface > Create Surface
- Type: TIN Surface
- Name your surface (e.g., ―Existing Ground‖)
- Right-click on Surface > Definition > DEM Files
- Click Add, browse and select your DEM (GeoTIFF or similar)

Orthophoto:

- Insert tab > Attach
- Choose your ortho image file (JPG, PNG, TIF)
- Ensure coordinate system matches your drawing
- Place it correctly using Geo-reference if needed

2. Create Alignments for Roads (Main Road and Side Road)

- Home tab > Create Design > Alignment > Create Alignment from Polyline
- If not drawn: Use Polyline to trace road centerlines
- Select polyline > Convert to Alignment
- Assign meaningful names (e.g., ―Main Road Alignment‖, ―Side Road Alignment‖)
- Choose design criteria (optional)

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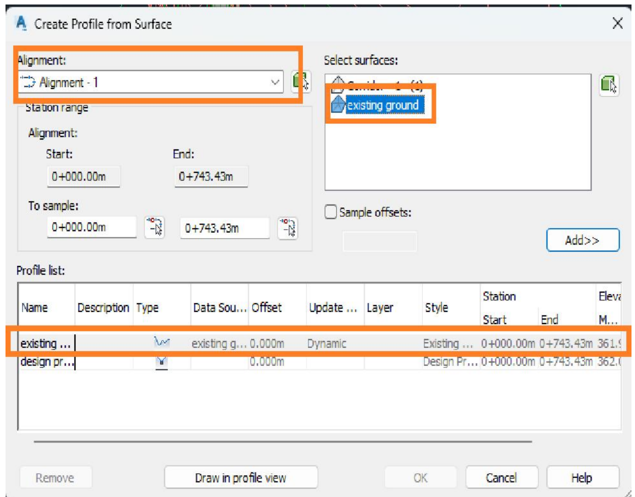
3. Create Existing Ground Surface Profile

- Home tab > Profile > Create Surface Profile
- Select your alignment
- Add the surface (Existing Ground)
- Click ―Draw in Profile View‖
- Name your profile and place it on screen

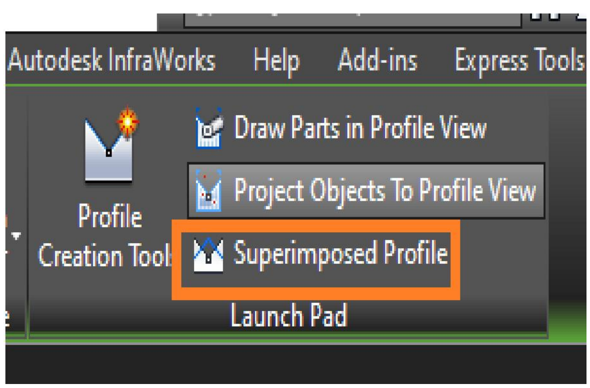


4. Create Design Profile

- Profile Layout Tools
- Use the toolbar to draw tangents, curves for the proposed design
- Save as ―Design Profile‖

5. Superimpose Side Road Profile onto Main Road

- Profile View > Right-click > Profile View Properties
- Go to Profile tab > Add
- Add the side road design profile to the main road profile view
- Choose style (dashed, color-coded) for clarity



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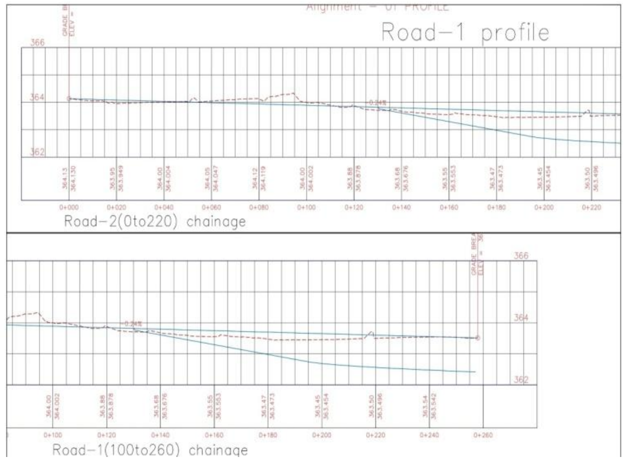

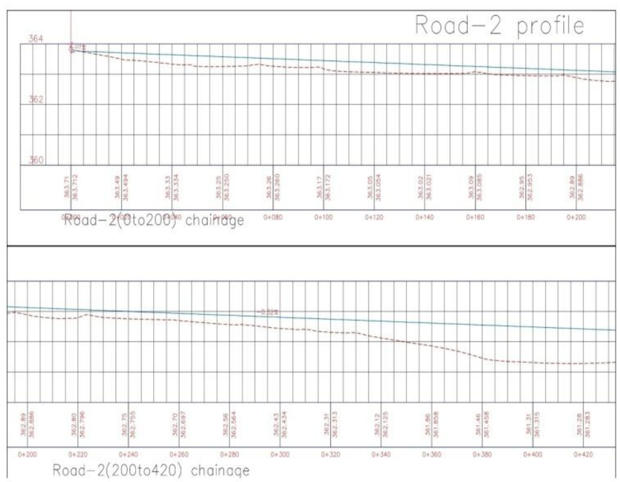

Station Range: Start: 0+000.00, End: 0+257.98

Design Profile report ROAD-1

PVI	Station	Easting	Northing	Elevation Existing	Elevation Design	Elevation Difference	Point Type
0	0+000.00	308968.3121	1960890.4001	364.130m	364.130m	0.000m	Start
1	0+010.00	308968.1322	1960880.4018	364.051m	364.107m	-0.055m	Regular
2	0+020.00	308967.9523	1960870.4034	363.949m	364.083m	-0.133m	Regular
3	0+030.00	308967.7724	1960860.405	363.987m	364.059m	-0.071m	Regular
4	0+040.00	308967.5925	1960850.4066	364.004m	364.035m	-0.030m	Regular
5	0+050.00	308967.4126	1960840.4082	364.022m	364.011m	0.011m	Regular
6	0+060.00	308967.2327	1960830.4098	364.047m	363.987m	0.060m	Regular

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7	0+070.00	308967.0528	1960820.4115	364.101m	363.963m	0.138m	Regular
8	0+080.00	308966.8729	1960810.4131	364.119m	363.939m	0.180m	Regular
9	0+090.00	308966.693	1960800.4147	364.283m	363.915m	0.368m	Regular
10	0+100.00	308966.5131	1960790.4163	364.002m	363.891m	0.110m	Regular
11	0+110.00	308966.3332	1960780.4179	363.894m	363.867m	0.027m	Regular
12	0+120.00	308966.1533	1960770.4196	363.878m	363.843m	0.035m	Regular
13	0+130.00	308965.9734	1960760.4212	363.712m	363.820m	-0.108m	Regular
14	0+140.00	308965.7935	1960750.4228	363.676m	363.796m	-0.120m	Regular
15	0+150.00	308965.6136	1960740.4244	363.594m	363.772m	-0.178m	Regular
16	0+160.00	308965.4337	1960730.426	363.553m	363.748m	-0.194m	Regular
17	0+170.00	308965.2538	1960720.4276	363.542m	363.724m	-0.182m	Regular
18	0+180.00	308965.0739	1960710.4293	363.473m	363.700m	-0.227m	Regular
19	0+190.00	308964.894	1960700.4309	363.449m	363.676m	-0.227m	Regular
20	0+200.00	308964.7141	1960690.4325	363.454m	363.652m	-0.198m	Regular
21	0+210.00	308964.5342	1960680.4341	363.476m	363.628m	-0.152m	Regular
22	0+220.00	308964.3543	1960670.4357	363.496m	363.604m	-0.109m	Regular
23	0+230.00	308964.1744	1960660.4374	363.526m	363.580m	-0.055m	Regular
24	0+240.00	308963.9945	1960650.439	363.542m	363.556m	-0.014m	Regular
25	0+250.00	308963.8146	1960640.4406	363.534m	363.532m	0.002m	Regular
26	0+257.98	308963.671	1960632.4609	363.513m	363.513m	-0.000m	End

Station Range: Start: 0+000.00, End: 0+586.69

Design Profile report ROAD-2

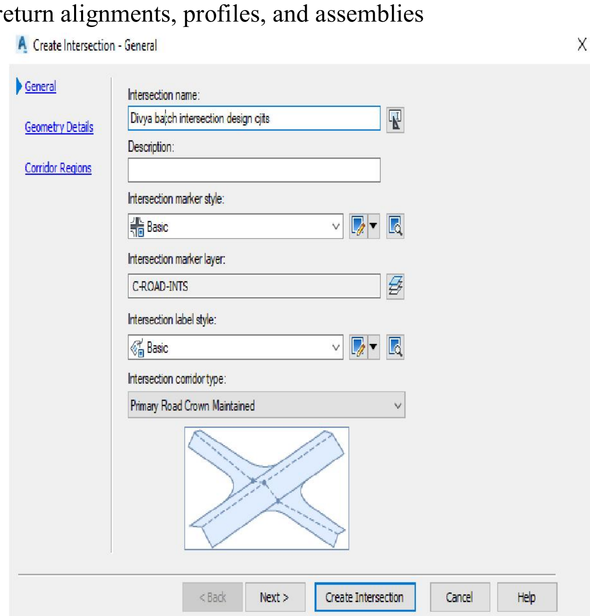
PVI	Station	Easting	Northing	Elevation Existing	Elevation Design	Elevation Difference	Point Type
0	0+000.00	308965.9734	1960760.4212	363.712m	363.820m	-0.108m	Start
1	0+010.00	308975.7274	1960758.2171	363.659m	363.736m	-0.077m	Regular
2	0+020.00	308985.4815	1960756.013	363.494m	363.704m	-0.210m	Regular
3	0+030.00	308995.2356	1960753.8089	363.421m	363.672m	-0.251m	Regular
4	0+040.00	309004.9897	1960751.6048	363.334m	363.640m	-0.306m	Regular
5	0+050.00	309014.7437	1960749.4007	363.258m	363.608m	-0.350m	Regular
6	0+060.00	309024.4978	1960747.1966	363.250m	363.576m	-0.326m	Regular
7	0+070.00	309034.2519	1960744.9925	363.281m	363.544m	-0.263m	Regular
8	0+080.00	309044.006	1960742.7884	363.260m	363.512m	-0.252m	Regular
9	0+090.00	309053.76	1960740.5843	363.221m	363.480m	-0.258m	Regular
10	0+100.00	309063.5141	1960738.3802	363.172m	363.448m	-0.276m	Regular

11	0+110.00	309073.2682	1960736.1761	363.082m	363.416m	-0.334m	Regular
12	0+120.00	309083.0223	1960733.972	363.054m	363.384m	-0.329m	Regular
13	0+130.00	309092.7763	1960731.7679	363.036m	363.352m	-0.316m	Regular
14	0+140.00	309102.5304	1960729.5638	363.021m	363.320m	-0.299m	Regular
15	0+150.00	309112.2845	1960727.3597	363.018m	363.288m	-0.269m	Regular
16	0+160.00	309122.0386	1960725.1556	363.085m	363.256m	-0.170m	Regular
17	0+170.00	309131.7926	1960722.9516	362.977m	363.224m	-0.247m	Regular
18	0+180.00	309141.5467	1960720.7475	362.953m	363.192m	-0.239m	Regular
19	0+190.00	309151.3008	1960718.5434	362.945m	363.160m	-0.214m	Regular
20	0+200.00	309161.0548	1960716.3393	362.886m	363.128m	-0.241m	Regular
21	0+210.00	309170.8089	1960714.1352	362.780m	363.096m	-0.316m	Regular
22	0+220.00	309180.563	1960711.9311	362.796m	363.063m	-0.267m	Regular
23	0+230.00	309190.3171	1960709.727	362.805m	363.031m	-0.226m	Regular
24	0+240.00	309200.0711	1960707.5229	362.755m	362.999m	-0.245m	Regular
25	0+250.00	309209.8252	1960705.3188	362.733m	362.967m	-0.234m	Regular
26	0+260.00	309219.5793	1960703.1147	362.697m	362.935m	-0.238m	Regular
27	0+270.00	309229.3334	1960700.9106	362.629m	362.903m	-0.275m	Regular
28	0+280.00	309239.0874	1960698.7065	362.564m	362.871m	-0.307m	Regular
29	0+290.00	309248.8415	1960696.5024	362.525m	362.839m	-0.315m	Regular
30	0+300.00	309258.5956	1960694.2983	362.434m	362.807m	-0.373m	Regular
31	0+310.00	309268.3497	1960692.0942	362.410m	362.775m	-0.365m	Regular
32	0+320.00	309278.1031	1960689.8871	362.313m	362.743m	-0.430m	Regular
33	0+330.00	309287.7268	1960687.1819	362.289m	362.711m	-0.423m	Regular
34	0+340.00	309297.0726	1960683.6337	362.125m	362.679m	-0.554m	Regular
35	0+350.00	309306.0669	1960679.2705	361.985m	362.647m	-0.662m	Regular
36	0+360.00	309314.6386	1960674.1266	361.858m	362.615m	-0.757m	Regular
37	0+370.00	309322.7203	1960668.2426	361.693m	362.583m	-0.890m	Regular
38	0+380.00	309330.2481	1960661.665	361.458m	362.551m	-1.093m	Regular
39	0+390.00	309337.1629	1960654.4455	361.354m	362.519m	-1.166m	Regular
40	0+400.00	309343.4099	1960646.6412	361.315m	362.487m	-1.173m	Regular
41	0+410.00	309348.9401	1960638.3134	361.286m	362.455m	-1.169m	Regular
42	0+420.00	309353.7097	1960629.5279	361.283m	362.423m	-1.141m	Regular
43	0+430.00	309357.6813	1960620.354	361.312m	362.391m	-1.079m	Regular
44	0+440.00	309360.8234	1960610.8639	361.392m	362.359m	-0.967m	Regular
45	0+450.00	309363.1113	1960601.1325	361.484m	362.327m	-0.843m	Regular

46	0+460.00	309364.5269	1960591.2365	361.593m	362.295m	-0.702m	Regular
47	0+470.00	309365.0592	1960581.254	361.704m	362.263m	-0.560m	Regular
48	0+480.00	309364.7038	1960571.2636	361.784m	362.231m	-0.447m	Regular
49	0+490.00	309363.4637	1960561.3441	361.807m	362.199m	-0.393m	Regular
50	0+500.00	309361.3726	1960551.5677	361.793m	362.167m	-0.374m	Regular
51	0+510.00	309359.0287	1960541.8463	361.833m	362.135m	-0.302m	Regular
52	0+520.00	309356.6847	1960532.1249	361.872m	362.103m	-0.231m	Regular
53	0+530.00	309354.3408	1960522.4035	361.873m	362.071m	-0.198m	Regular
54	0+540.00	309351.9968	1960512.6821	362.290m	362.039m	0.251m	Regular
55	0+550.00	309349.6529	1960502.9607	362.203m	362.007m	0.196m	Regular
56	0+560.00	309347.309	1960493.2392	362.081m	361.975m	0.106m	Regular
57	0+570.00	309344.965	1960483.5178	362.123m	361.943m	0.180m	Regular
58	0+580.00	309342.6211	1960473.7964	362.069m	361.911m	0.158m	Regular
59	0+586.69	309341.054	1960467.2969	361.890m	361.890m	0.000m	End

6. Create Intersection Using Civil 3D Intersection Tool

- Home tab > Create Design > Intersection
- Click at the T-intersection point of alignments
- Follow wizard:
    - o Select main road and side road alignments
    - o Select appropriate profiles
    - o Set curb return radii
    - o Choose offset parameters
- Civil 3D will generate curb return alignments, profiles, and assemblies



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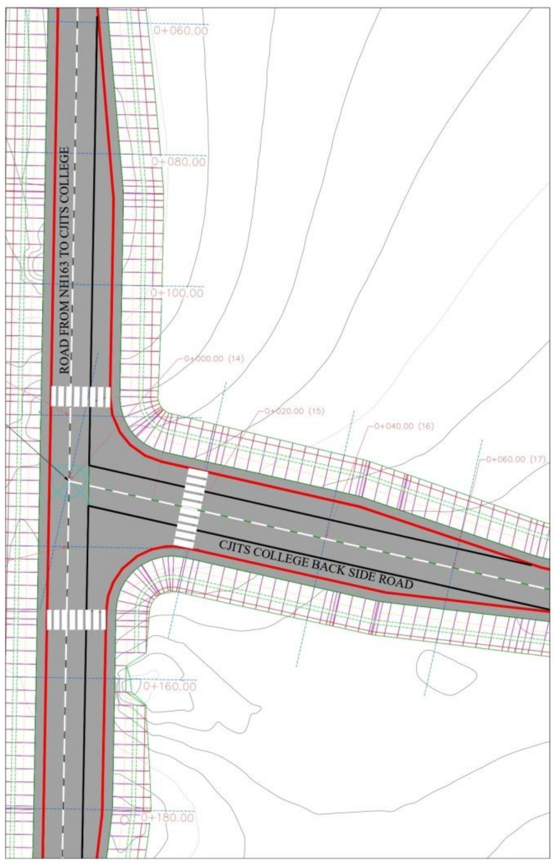
7. Create Corridor for Road Design
- Home tab > Create Design > Corridor
- Select main alignment, design profile, and assembly
- Add region(s)
- Add surface targets if necessary (e.g., EG surface for daylighting)
- Repeat for side road using same steps

8. Build Corridor Surface
- Toolspace > Corridors > Your Corridor
- Right-click > Surface > Create Corridor Surface
- Add links (usually ―Top‖ or ―Datum‖)
- Set boundaries to clip corridor surface
- Rebuild corridor surface



9. Create Sample Lines along Corridor
- Home tab > Profile & Section Views > Sample Lines
- Select the corridor alignment
- Choose stations manually or use range (e.g., every 10m)
- Sample the corridor and EG surfaces

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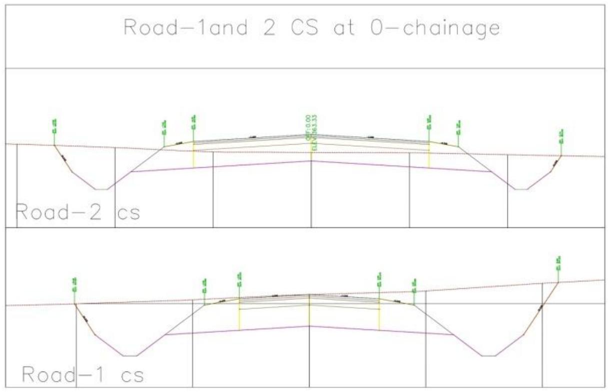
10. Generate Cross Sections
- Home tab > Profile & Section Views > Create Multiple Views
- Choose sample line group
- Select desired surfaces (EG + Corridor)
- Place views on layout



VIII. RESULTS

The design and analysis of the T-intersection and adjoining roads near Christu Jyothi Institute of Technology and Science (CJITS) in Jangaon yielded several important findings. These results demonstrate the effectiveness of integrating modern surveying technologies and design principles.

1. Road Alignment:

The road alignment design, a key aspect of this project, was developed using Civil 3D software, incorporating the data obtained from the drone survey (DEM and ortho). The alignment for both the main road (257.98 meters) and the secondary road (586.69 meters) was designed to meet the necessary geometric design standards as per IRC (Indian Roads Congress) and MORTH (Ministry of Road Transport and Highways) guidelines. The road layout ensures smooth transitions and the necessary horizontal and vertical curves to provide a comfortable and safe driving experience. Specific attention was given to the turning radii, lane widths, and shoulder design to accommodate traffic flow at the T-junction.

2. Intersection Design:

The T-junction design was heavily influenced by the traffic survey data, including classified volume counts and turning movement counts (TMC). The peak-hour traffic volume was found to be approximately 226 vehicles per hour, and the Average Annual Daily Traffic (AADT) was around 2,100 vehicles per day. These figures helped optimize the intersection geometry, with turning radii designed to accommodate both light and heavy vehicles. For instance, the right turn radius was designed to facilitate smooth vehicle movement, while the lane widths were set according to IRC standards (3 meters per lane). The T-junction design also included provisions for future traffic growth, ensuring that the intersection will function efficiently over time.

3. Traffic Data Analysis:

Comprehensive traffic data were gathered through detailed traffic surveys, which included classified vehicle counts for cars, two-wheelers, buses, and trucks. This data helped assess not just the existing traffic conditions but also projected future traffic volumes. Key observations included a peak-hour volume of 226 vehicles per hour, which served as a critical factor for optimizing the design of the intersection. Additionally, the Commercial Vehicle Percentage (CVP) was found to be 12.5%, and the Design Hourly Volume (DHV) was determined to be 315 vehicles per hour. This data, combined with the growth rate of 7.5% over 10 years, allowed for the calculation of the design traffic (MSA) value, which was set at 2 million standard axles (MSA) based on the traffic loading category.

4. Pavement Design:

The California Bearing Ratio (CBR) tests, which measure the subgrade strength of the soil, yielded a design CBR value of 7% for the main and secondary roads. This value was adequate for the design of a flexible pavement, following the guidelines in IRC 37:2012. The pavement structure designed for the road includes:

- Surface Course: 50 mm of bituminous material (BC + DBM),
- Base Course: 100 mm of Wet Mix Macadam (WMM),
- Sub-base: 300 mm of Granular Sub-Base (GSB).

The overall thickness of the pavement structure is 450 mm, which provides sufficient strength and durability for the expected traffic load.

5. Earthwork Calculations:

Earthwork analysis was an essential part of this design process. Using the DEM and chainage-wise level differences, the total cut and fill volumes were calculated for both the main and secondary roads. The main road (0+000 to 0+257.981) had a total cut volume of 3,067.18 m³, while the secondary road (0+000 to 0+586.686) had a total cut volume of 3,230.41 m³. The net earthwork volume for both roads amounted to 5,509.47 m³, indicating an excess cut which can be reused for fill operations. This minimized the need for external material sources, reducing both cost and environmental impact.

6. Material Quantities:

Material quantities required for the construction of the roads were carefully calculated, ensuring the design is both efficient and cost-effective. For the main road, the required volumes of pavement layers include:

- Pave1: 52.66 m³
- Pave2: 52.66 m³
- Base: 210.63 m³
- Sub-base: 1,154.72 m³

For the secondary road, the quantities were:

- Pave1: 102.81 m³
- Pave2: 102.81 m³
- Base: 411.26 m³
- Sub-base: 2,364.10 m³

These quantities were derived based on the pavement design, taking into account the soil properties, traffic loads, and road geometry. The total quantities of materials for both roads were added up to estimate the required resources for construction.

IX. CONCLUSION

This project successfully integrated modern surveying techniques, design software, and traffic data analysis to deliver a comprehensive design for a T-intersection and adjoining roads near Christu Jyothi Institute of Technology and Science (CJITS). By utilizing drone technology for high-resolution mapping and the use of Civil 3D for alignment design, the project ensured both accuracy and efficiency in the design process. The resulting road geometry, intersection layout, and pavement structure were optimized to handle current and future traffic volumes effectively.

The use of traffic survey data was pivotal in informing the design of the T-junction, particularly in optimizing turning radii, lane widths, and the overall intersection layout. The CBR test results supported the design of a flexible pavement, ensuring that the pavement layers will provide sufficient strength to accommodate the forecasted traffic loads.

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The earthwork calculations demonstrated that the excess cut volumes from the road construction could be reused, minimizing the need for external fill materials, thus reducing the overall cost and environmental impact of the project. Additionally, the material quantities for both roads were calculated to ensure that all resources were accurately planned for construction.

In conclusion, this road design project not only meets the immediate needs of CJITS College for better access and road safety but also serves as a replicable model for rural and institutional road projects in areas with similar terrain and traffic conditions. By adhering to the guidelines set forth by IRC and MORTH, and utilizing advanced data collection and design techniques, the project ensures the creation of a sustainable, cost-effective, and safe road network for both present and future users.

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