Republic of IRAQ
Ministry of higher education
and scientific research
Alkitab University
Surveying department

Title of project

Road and Site design

A graduation project is submitted to the surveying department-college of engineering- at Alkitab University as a part of the fulfillment of the requirements for the degree of bachelor in surveying.

By:

1. Beston ali khorshed

2. Diyar Safir Anwar

3. Elham Taha Mamand

Supervisor:

Lecturer: Aydin Adnan Rashid

2021-2022

Supervisor certification

I certify that the preparation of this project entitled by

Road and Site design

Prepared by: Beston ali khorshed

Diyar Safir Anwar

Elham Taha Mamand

Was made under my supervision at the surveying department-college of engineering – at Alkitab University as the part of the fulfillment of the requirements for the degree of bachelor in surveying.

Signature :

Aydin Adnan Rashid

Lecturer

Date:

Dedication

we dedicated this research to the Almighty ALLAH, praise you for your guidance, solidity, power of mind, preservation, dexterity, and for giving me a salutary life. All of these, we offer to you.

To our parents, wives, children, sisters, brothers, chancellor, friends, and classmates who shared their words of admonishing and motivation to complete this research.

Beston ali khorshed

Diyar Safir Anwar

Elham Taha Mamand

List of Contents

جدول المحتويات Table of Contents

جدول الأشكال Table of figures

يجب أن تدرج داخل المشروع

Acknowledgment

First of all, we thank **GOD** for the most mercy for enabling us to present this project in the best form that we wanted to be, we would like to thank our supervisor, assistant teacher (Aydin Adnan Rashid) for his valuable help and advice to come out with this project.

We thank our faculty and doctors that provided us with all the knowledge. Most of all we are all thankful for our families for their endless love, assistance, support, and encouragement. And for our friends for their understanding and support for us to complete this project.

List of figures

Abstract

Roads make a crucial contribution to development and economic growth, bringing considerable social benefits. Roads are paramount for growing and developing a country. Roads are opening up more areas and improving social and economic development. The location of the design for the highway's centerline on a surface is called alignment. Alignment's primary requirement is to be short, easy, safe, and economical. Horizontal alignment, vertical alignment, and cross-section are the three main parts of geometric design. This project demonstrates a typical design of roadway and site with the support of AutoCAD Civil 3D.AutoCAD Civil 3D design software helps in a comfortable and relaxed way to achieve the design. The civil 3D design is simple and easy to grasp to build alignment, AUTOCAD civil 3D uses the topography and survey data collected from the total station or similar technology.

In this project, we used a total station as a tool to take points from the ground and design it by helping Autodesk civil 3d to visualize the project.

Keywords: AutoCAD Civil 3D, Road, Site design, Total station

1. CHAPTER ONE

1.1 Introduction

Highways are required to make certain to assure users consolation and safety, to allow effective traffic movement. Highways are also predicted to reason the least harm to the environment and be aesthetically desirable in their finished form. The geometric layout of roads has three fundamental parts which are horizontal and vertical alignment, and cross-sections, that once combined give a 3-dimensional format for a road. The geometric design suggests that these demands are met. Horizontal alignment has three geometric components, including curves, tangents, and transition.

Vertical alignment is a longitudinal section, together with such geometric additives as crest curves, sag curves, and the gradients interfacing them. Highway geometry additives depend upon chosen, estimated, and in a manner that fulfills such design standards as sight distance, driver consolation, drainage, economy, vehicle stability, and aesthetics. from the developing world to use road design. This project shows a typical design of the roadway and site with the support of AutoCAD Civil 3D and Infraworks 360 software based on AASHTO geometric design.

1.2 Problem statement

The development of any country is directly connected to the road infrastructure. In Iraq, every year hundreds of kilometers of roads would be constructed due to the increase in population, and the increasingly huge amount of different types of vehicles leads to raise of crashing and resulting of growing dead due to car accidents. So it is our responsibility as surveyors to have a strong background in the fundamentals of road geometric design and constructing roads according to standard requirements.

2. Chapter two Litrature Review

الدراسات السابقة

2.1 Road and Site design

In geometric road design, there are some factors should be considered such as safety , comfortabilty, and economics. Also designing roads is not a complex task because it is a linear process. These linear steps are related each to other, the second step is dependent on the first step and so on to complete the design process. Nevertheless, the Site design is a very complicated task because it is a non-linear process there is no link between the steps of design.

2.2 History of road

The earliest records of such paths have been found around some springs near Jericho and date from about 6000 bc. The first indications of constructed roads date from about 4000 bc and consist of stone-paved streets at Ur in modern-day Iraq and timber roads preserved in a swamp in Glastonbury, England.

2.3 Roads based on speed

The road is a paved way or a route or a thoroughfare which drives you to reach your destination through vehicles. Roads are classified based on different criteria, each among them is further classified into different types of roads. In this project, I give a brief description of each type of road. Roads are primarily classified as follows:

2.3.1 Freeways:

Freeways are wide roads designed for fast-moving vehicles to travel long distances at higher speeds. These are generally designed in four lanes, two lanes in each direction. Traffic movement on freeways is continuous and unhindered because there are no railway or road intersections and no signals.

2.3.2 Expressways:

Expressways are one of the superior types of access-controlled roadways where the entry and exit of the expressway are fully controlled by ramps.

As the name itself "express" echoing that these are meant for a free flow of very speed traffic. Expressways are designed to travel quickly with great comfort and safety by avoiding sharp curves, busy traffic intersections, and railway junctions.

2.3.3 Highways

connect villages to cities or cities to cities or state to state or the roads connecting the state capital to the national capital are called highways. Highways are the roads that run through the length and breadth of the country. They are generally laid in two lanes. Highways are further classified into National Highways, State Highways, Urban Highways, and Rural Highways. We will discuss these types in location and function categories.

2.3.4 Arterials:

Arterials are the roads laid inside the city or town for the movement high volume of traffic. An arterial road joins the central business point to the outside residential areas. Arterials provide access to the highways

2.3.5 Local Streets:

Local streets don't carry a large volume of traffic like arterials. The speed limit is restricted to 30km/hr in a local street. Local streets allow you to have properties around it. In simple, the road which you to take to reach the nearest vegetable market is the local street.

2.3.6 Collector Roads:

Collector roads collect and deliver the traffic to and from local streets and arterials. The speed limit usually ranges between 35-55km/hr.

2.4 Roads based on geometric

Geometric design refers to the dimensions and arrangements of the visible features of a roadway. This includes pavement widths, horizontal and vertical alignment, slopes channelization, intersections, and other features that can significantly affect the operations, safety, and capacity of the roadway network.

2.5 Total Station:

Total station is a surveying instrument that is commonly used in Engineering, Construction and Industry. It is a combination of a microprocessor with the memory unit, an electronic theodolite, and an electronic distance measuring instrument. To set the stage for modern filed data collection and processing, the electronic digital theodolite used in 1960. The birth of the new concept in fully automated surveying started when the electronic theodolite used with a built-in EDM unit. The original name of this instrument was an electronic tachometer, But Hewlett-Packard introduced it to the name total station. This device is used to find out the angles and distances of the surveyed points from the instrument. We can use these angles and distance to determine the accurate position of the surveyed points with the help of trigonometry.

Figure 2.1 Total Station Topcon (GTS-250)

2.5.1 Total Stations applications:-

Surveyors and civil engineers can use total stations to assess topography, record existing natural features, or plan for buildings, roads and land boundaries. These impressive and accurate instruments are also useful in mining, meteorology, archaeological digs, forensic investigations and building information modeling (BIM). Total stations are particularly useful for performing functions like these:

- Topographic surveys
- Land and title surveys
- Roadway and corridor surveys
- Design surveys
- Infrastructure surveys
- Volumetric surveys to measure stockpile volumes
- Power line inspections
- Utility design surveys
- Crash scene investigations
- Crime scene investigations
- Mine and quarry surveys
- Tank calibration or inspection

2.5.2 Accessories used with the Instrument:

a) Tripod:

The quality of the Tripod has no effect on the accuracy of the measurement, but in the works that require high accuracy in

measurement, which can be obtained by using good quality of the tripod, accurate measurements can be obtained using wooden stands compared to aluminum stands because wooden stands are resistant to temperature changes. But aluminum stands are used most of the time because they are light in weight, which makes it easy to carry and work with the source.

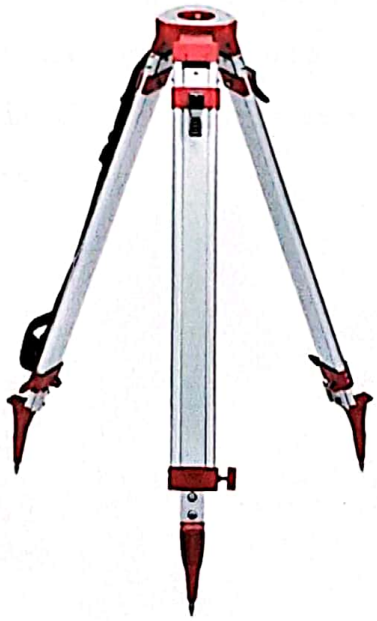


Figure 2.2 Tripod

b) Prism:

There are different types of prism, such as:

- Fixed reflector mounted on a tripod and used for fixing major scan points.
- A movable reflector used to raise and project area points.
- Paper reflector to be used when the previous two types are difficult to install over the respective point. And it is used a lot because it is quickly installed above the concerned point, unlike the previous two types.

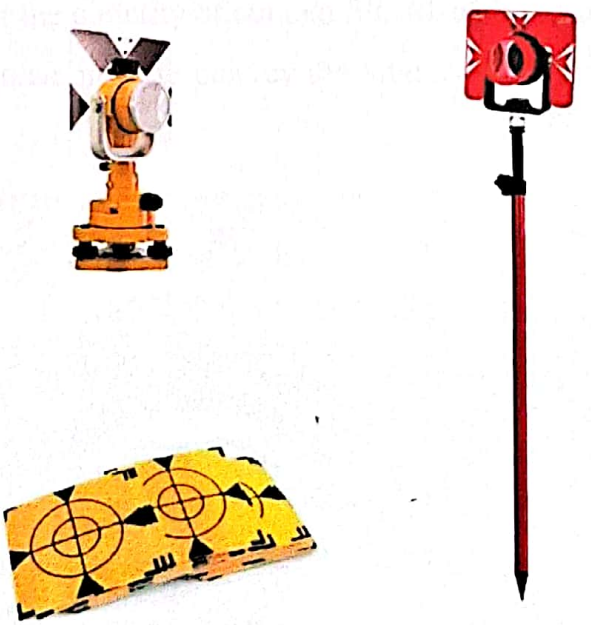


Figure 2.3 Prism

3. Chapter three

3.1 Study area and methodology

First of all, we determined a location from google earth which is located from the east of Erbil at the end of Kaznazan-road beside of Anfal monument such it as shown in Fig.2 below, and went to the site to take the total station. hence to be global our points used ordinary Garmin GPS for the first point of the total station as a reference coordinate. The place was a little bit far from Erbil and it had a steep topography working at that place needed experience to control taking the data because finally, we make a surface from that data and affect the quantity of cut and fill. Also, the location has a lot of trees, which means we need to convey the total station many times to take data precisely.

Figure 3.1 project site

3.2 Field Works

In this part of our work, we used Total Station for surveying work (collecting field data) precicely. After assuming Benchmark values, we gathered natural ground points inside the project boundary, The figure shows the total station and students in the field.

Figure 3.2 Surveying works in the field

3.3 Office Works

In this part of our work, different softwares have been used for organizing data and designing the project.

3.3.1 Autodesk Civil 3D

Autodesk Civil 3D software is a civil engineering design and documentation solution that supports Building Information Modeling (BIM) workflows on a variety of civil infrastructure project types, including roads and highways, land development, rail, airports, and water.

Autodesk's Civil 3D is used by civil engineers, civil designers, and other professionals to plan, design and manage land development, water, and transportation projects.

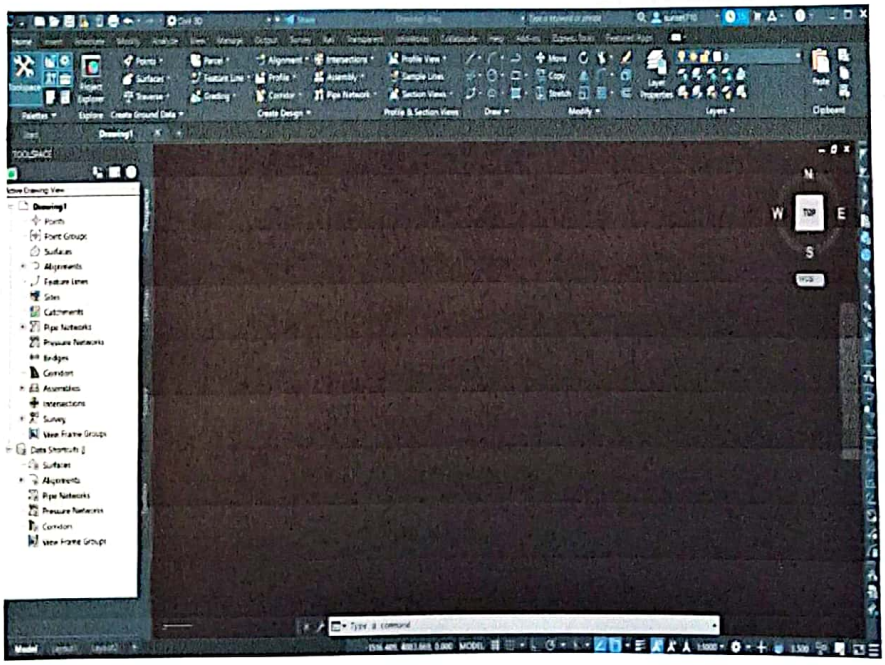


Figure 3.3 Autodesk Civil 3D interface

3.3.2 Alignment

Road alignment is the positioning of the centerline of the highway or road. It is also called highway alignment. Simply, it is the direction through which the road will pass. Road alignment provides proper guidance to pass the road through the path which is most economical, easy to construct, and free from conflicts.

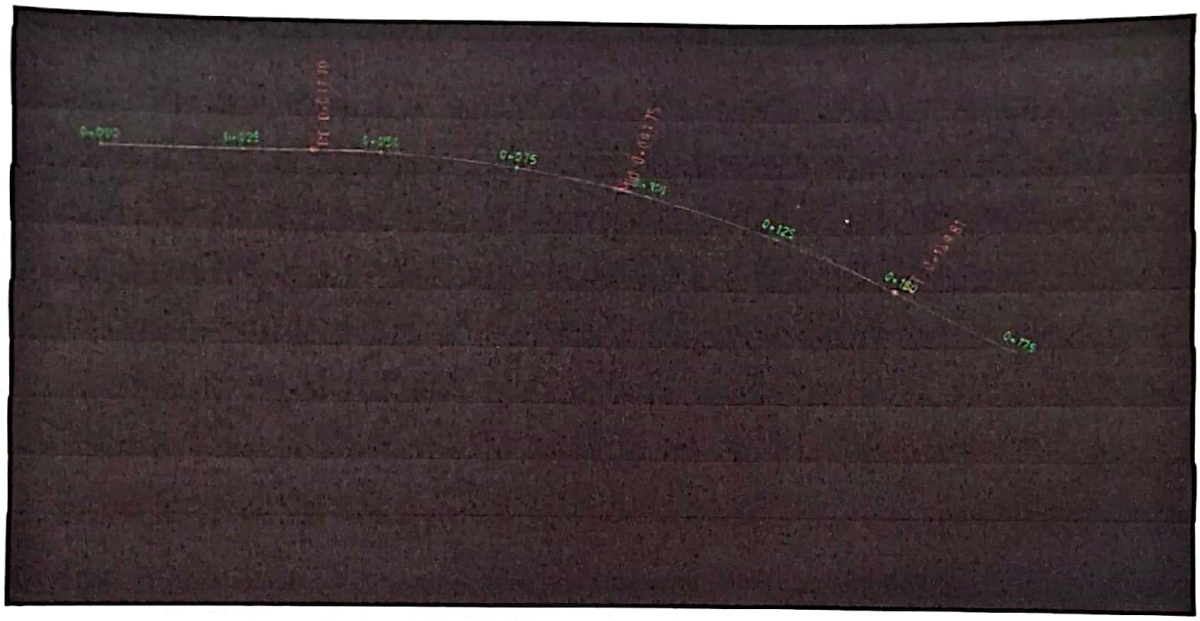


Figure 3.4 Geometric alignment

3.3.3 Profile

The profile is the vertical aspect of the road, including crest and sag curves, and the straight grade lines connecting them. The cross-section shows the position and number of vehicle and bicycle lanes and sidewalks, along with their cross slope or banking.

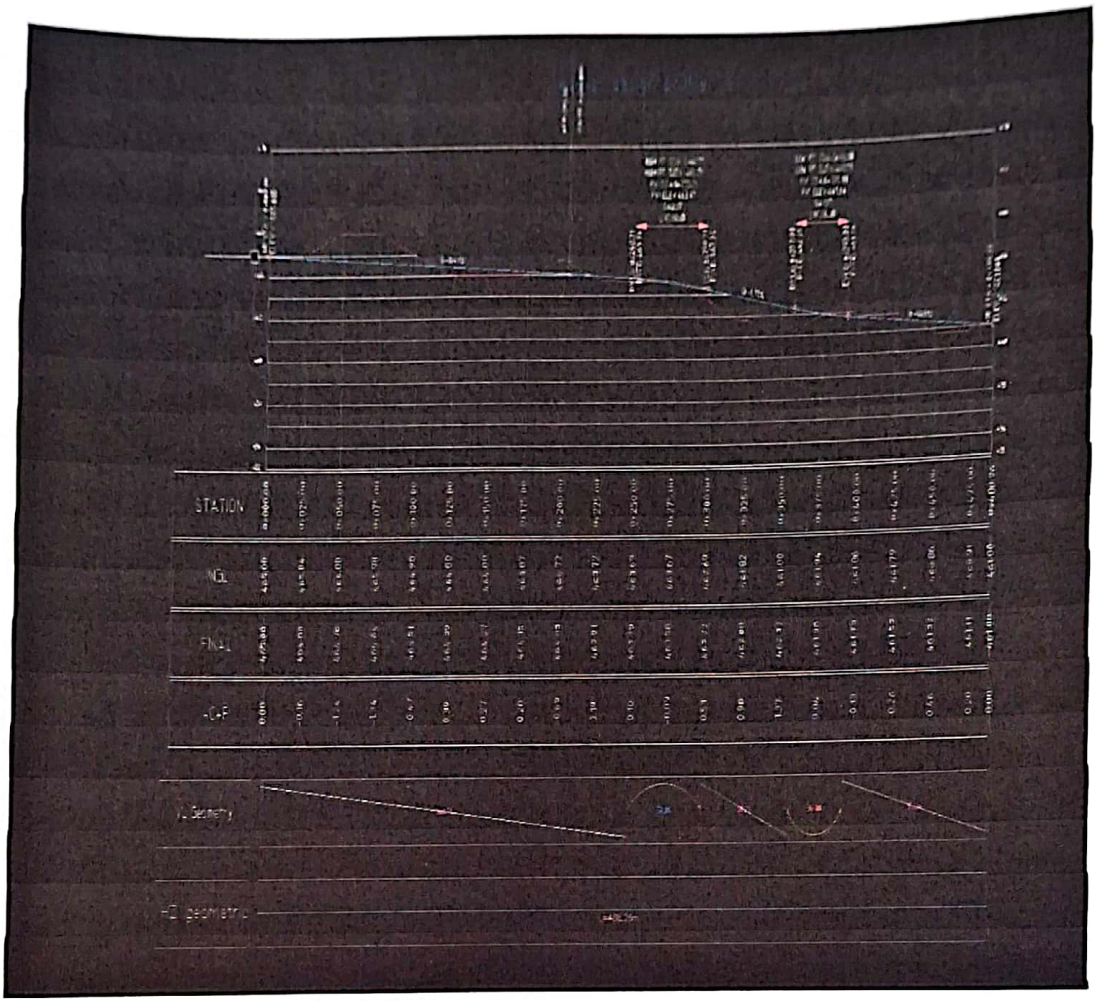


Figure 3.5 Geometric profile

3.3.4 Cross-section

roadway cross-section is a vertical section of the ground and roadway at right angles to the centerline of the roadway, including all elements of a highway or street from the right-of-way line (lanes, shoulders, retaining walls, curbs, medians, pavement structure, roadside slopes, ditches, bike lanes, and sidewalks).

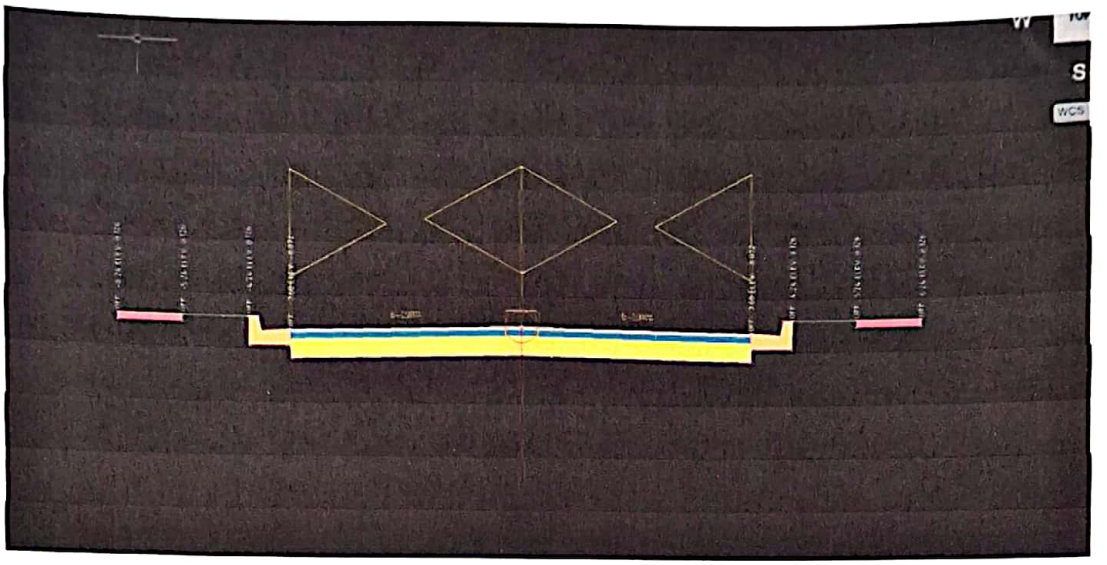


Figure 3.6 typical cross-section

3.3.5 Corridor

A corridor is defined as a long, narrow passageway. While we tend to think of corridors in association with buildings, the corridor concept applies to highways as well. The concept is useful because it prompts the designer to consider the linear nature of the roadway as a movement in space and time.

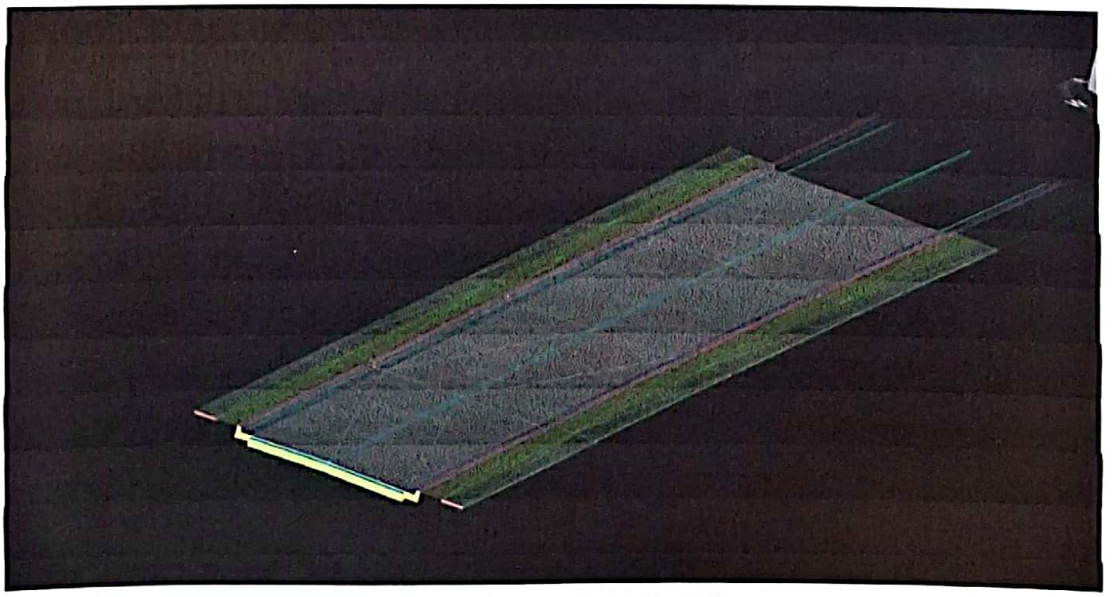


Figure 3.7 Geometric corridor

3.3.6 Autodesk Infraworks 360

Infraworks is one of the most used software in a BIM environment for the planning and design of infrastructure projects. This Autodesk tool is a great ally in BIM workflows, offering collaborative work options in the cloud, process automation, and collaboration with other platforms

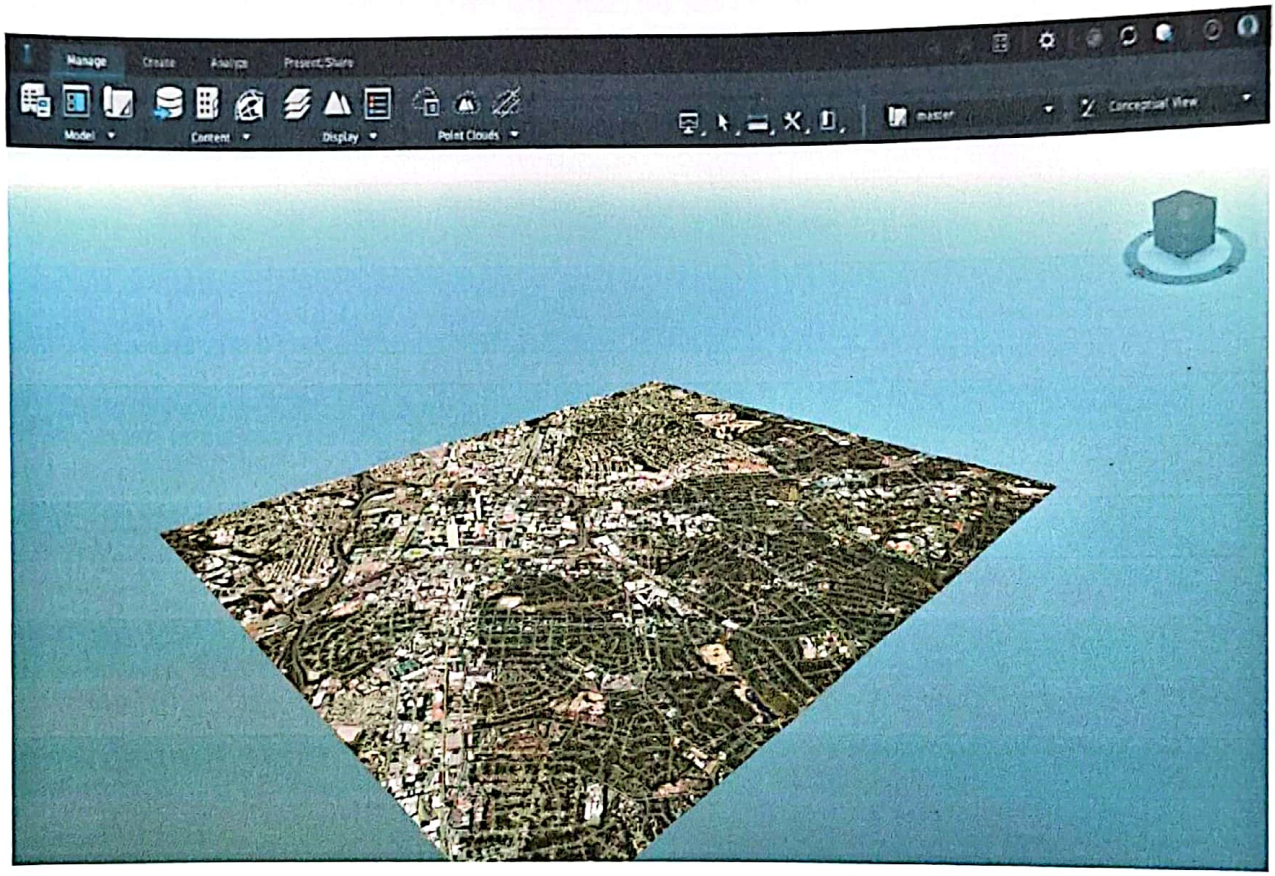


Figure 3.8 Autodesk Infraworks 360 interface

4. Chapter four

Results and discussion

In this chapter, we will try to explain the design step by step from the beginning by taking points from the ground and bringing it to the software and visualizing the final design.

4.1 Points

Points are AutoCAD Civil 3D objects that can be displayed in the drawing and manipulated graphically. Point appearance is controlled using point labels and point styles. Point Properties. Use the Prospector tree to access point properties. Points Collection (Prospector Tab). Also, there is some type of formatting of points such as text file, excel file, dxf file, etc. but the most common one is a text file and excel file. Each point consists of point number, easting, northing, elevation, and description

POINT ID	EASTING	NORTHING	ELEVATION	DISCRIPTION
1	424649.4944	4007687.853	672	NG
2	424656.424	4007674.369	673	NG
3	424662.8089	4007659.573	674	NG
4	424670.3872	4007647.651	675	NG
5	424678.2861	4007636.5	676	NG
6	424686.2716	4007625.558	677	NG
7	424693.3458	4007612.422	678	NG
8	424697.4186	4007602.116	678	NG
9	424688.0263	4007697.892	675	NG
10	424691.8639	4007681.766	676	NG
11	424695.8923	4007666.325	677	NG
12	424706.1797	4007652.74	678	NG
13	424720.5957	4007635.297	680	NG
14	424730.8982	4007623.459	681	NG
16	424700.1215	4007628.738	678	NG
17	424693.6119	4007643.234	677	NG
18	424683.9939	4007653.601	676	NG
19	424678.9025	4007668.155	675	NG
20	424672.331	4007682.502	674	NG
22	424706.629	4007704.749	677	NG
23	424717.8677	4007687.886	678	NG
24	424721.1628	4007676.637	679	NG

Figure 4.1 shows the excel coordinate format

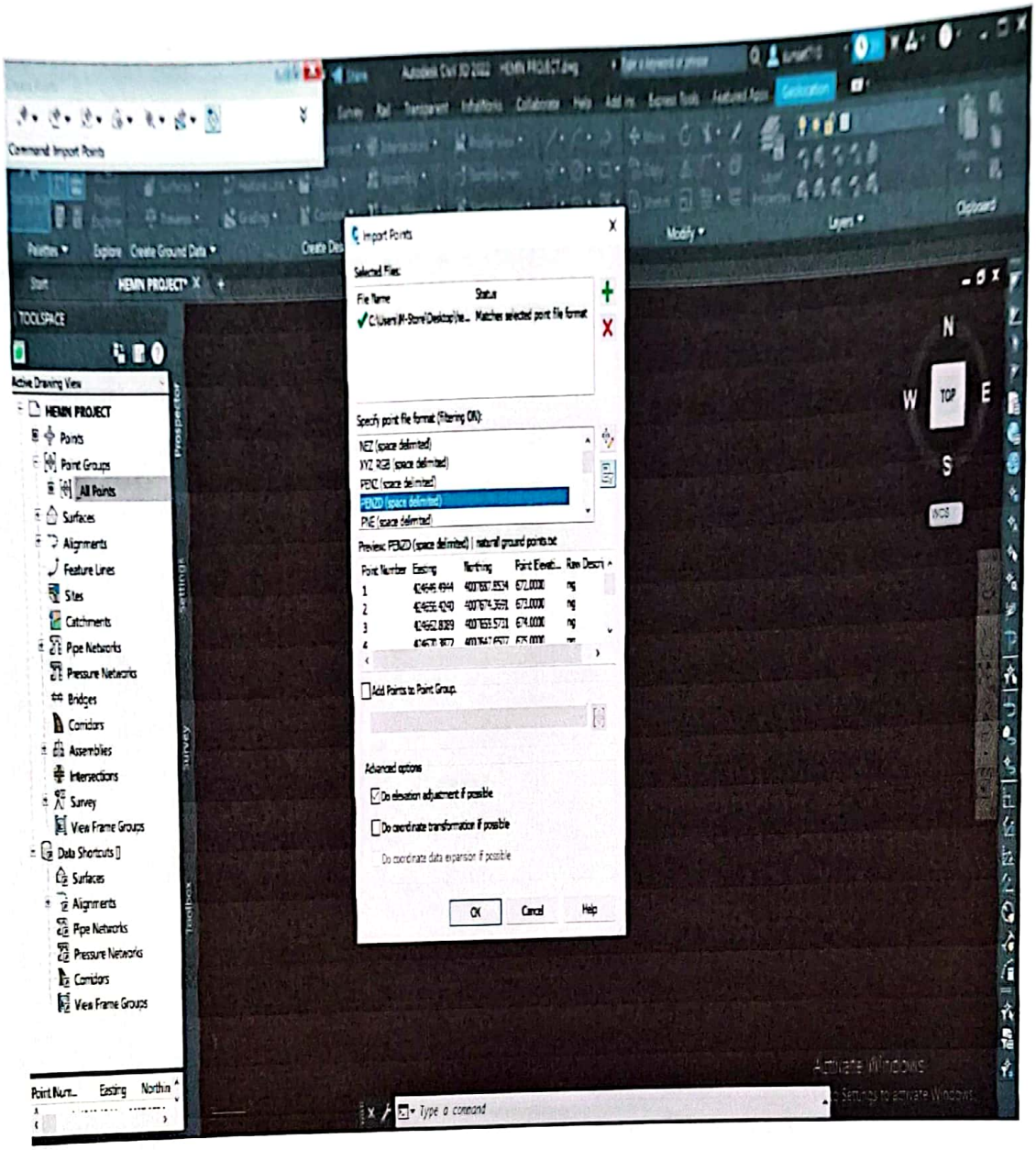


Figure 4.2 shows bringing text files to Civil 3D software

4.2 Surface

A surface is a 3D view of the land that can represent existing conditions, proposed conditions, or any other scenario involving the group's surface. Understanding what they are and how to work with them is fundamentally important for Civil 3D users. The basic understanding of the surface is to make a triangular between every three points and shows the shape of the ground.

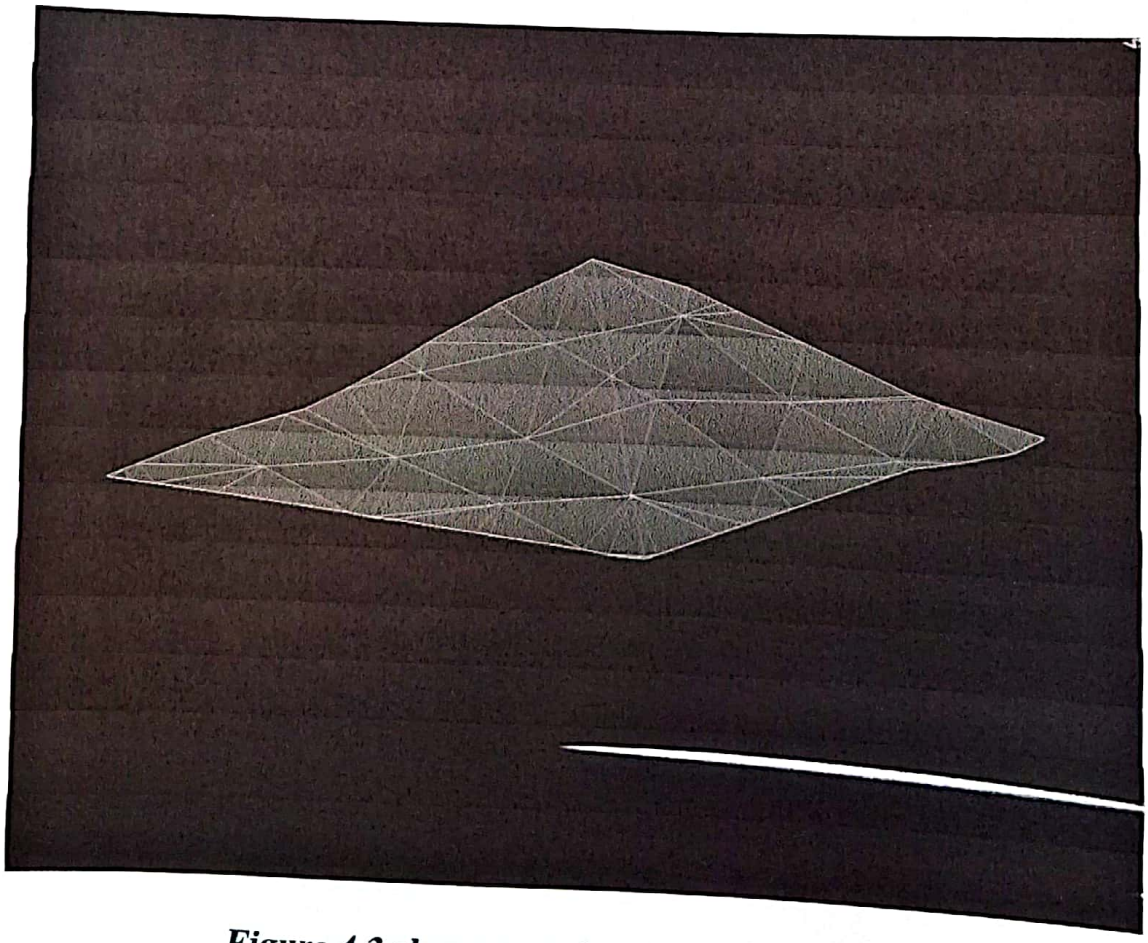


Figure 4.3 shows a surface made from points

4.3 Process of design

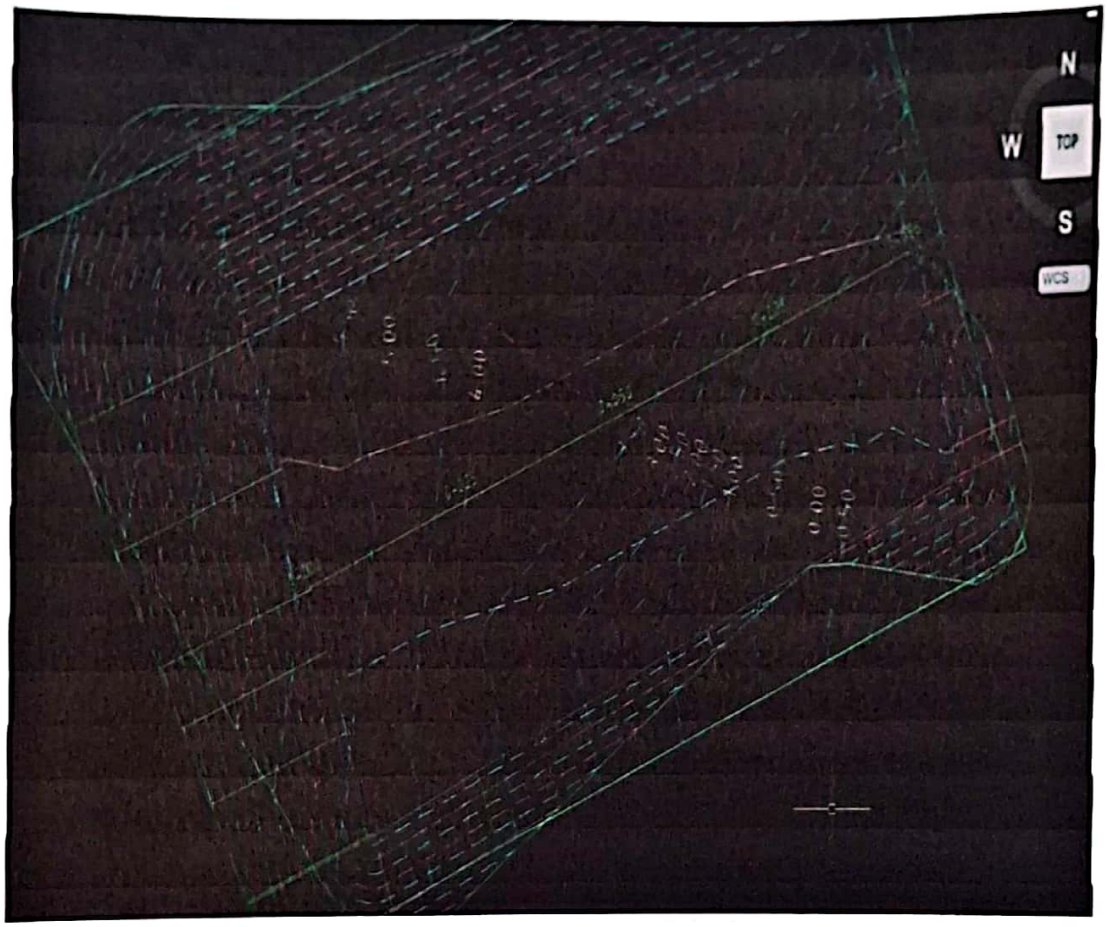


Figure 4.4 shows contour line(0.5:1) meter

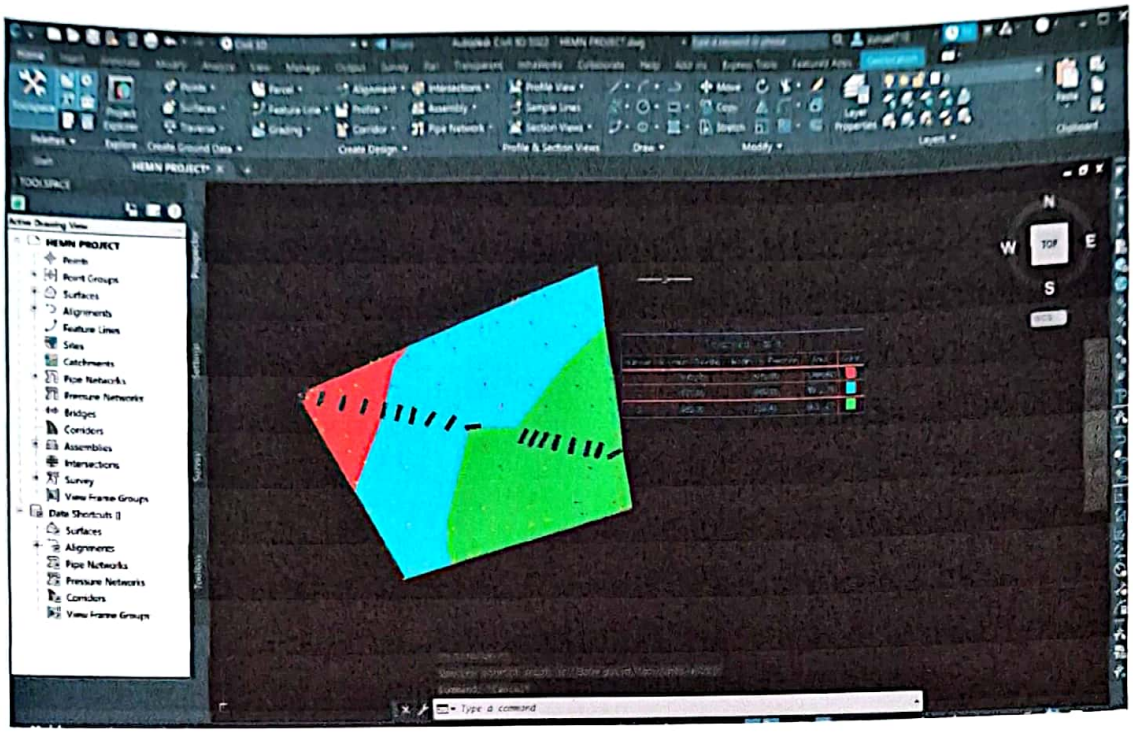


Figure 4.5 shows the colourized rate of elevation

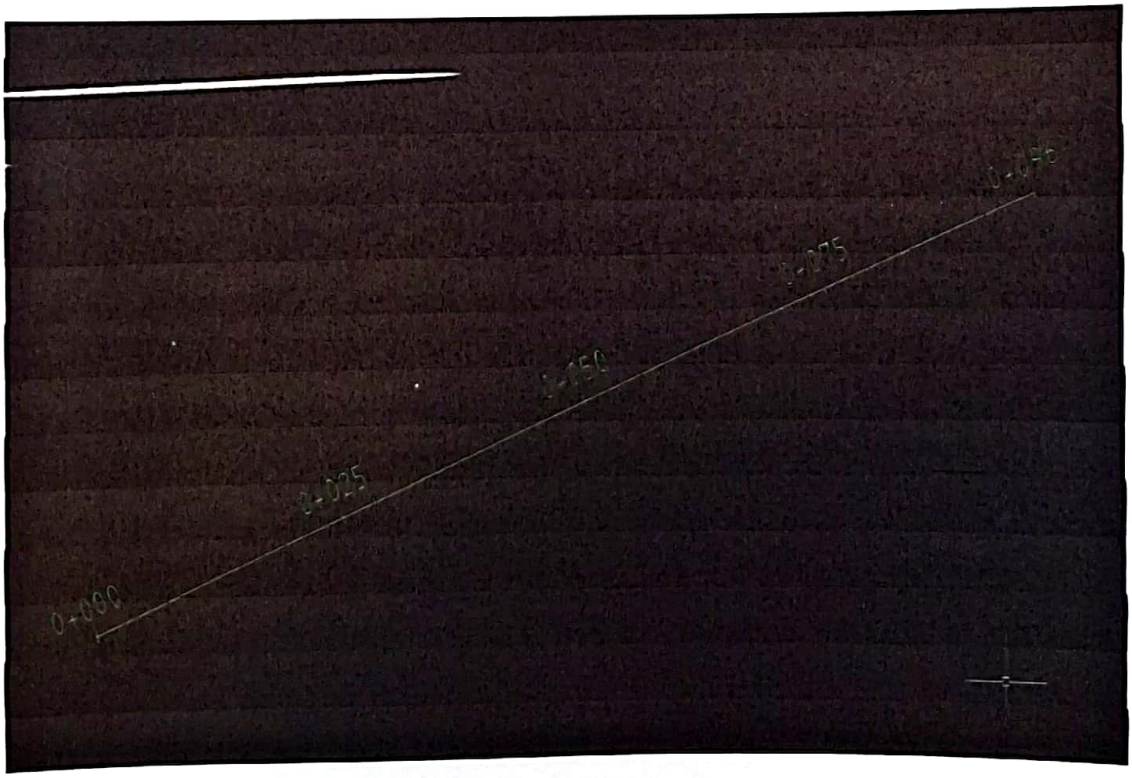


Figure 4.6 Alignment

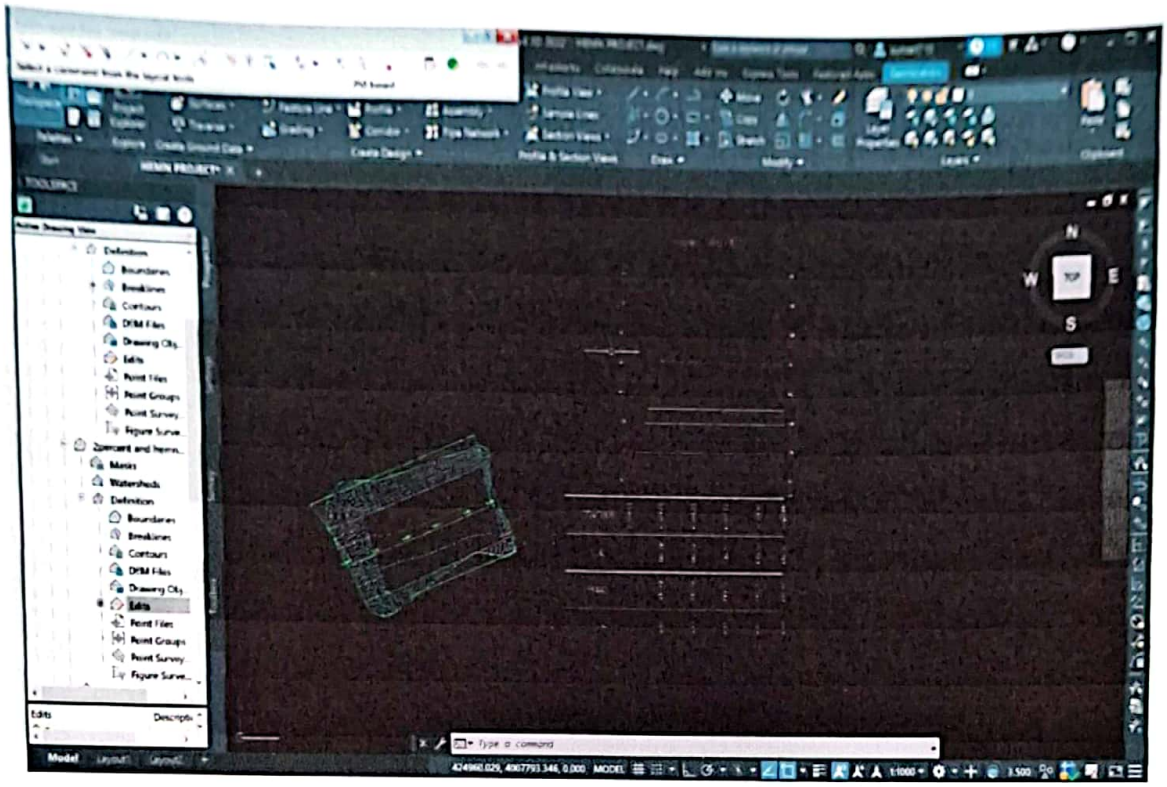


Figure 4.7 natural ground profile

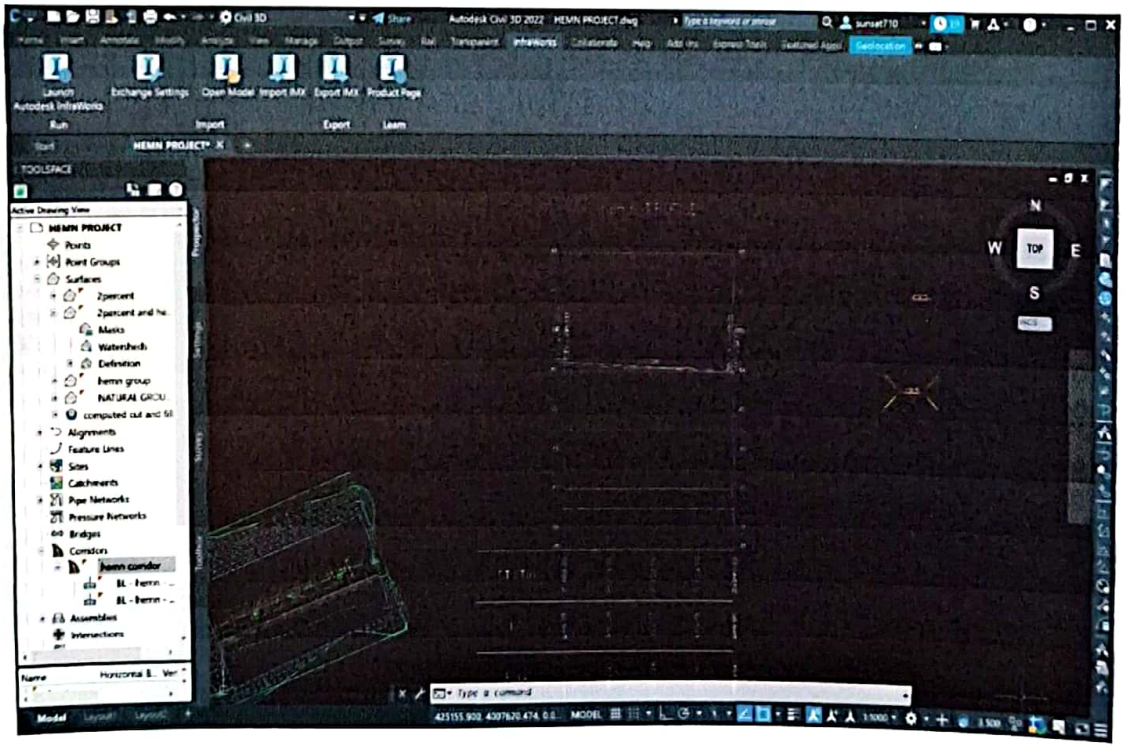


Figure 4.8 design profile

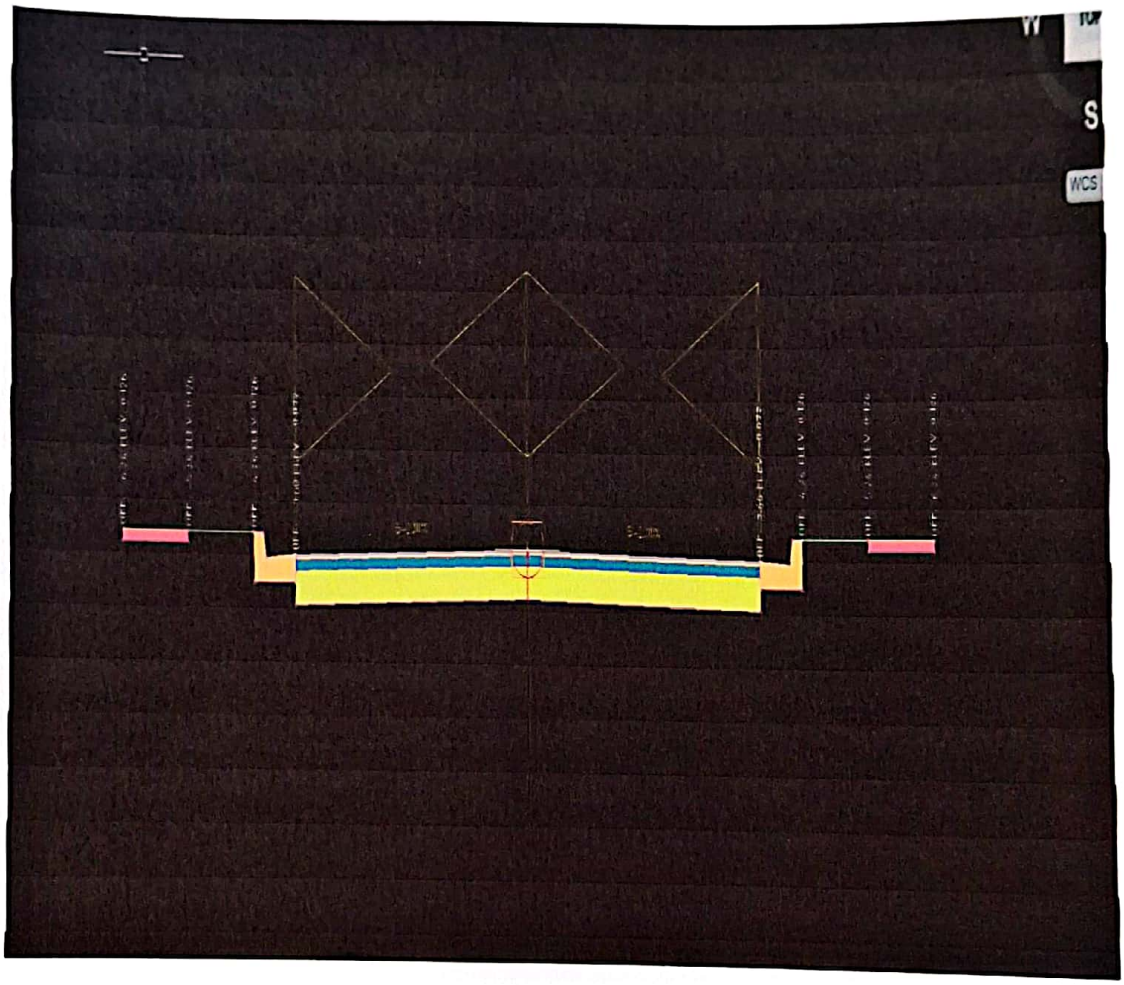


Figure 4.9 typical cross-section

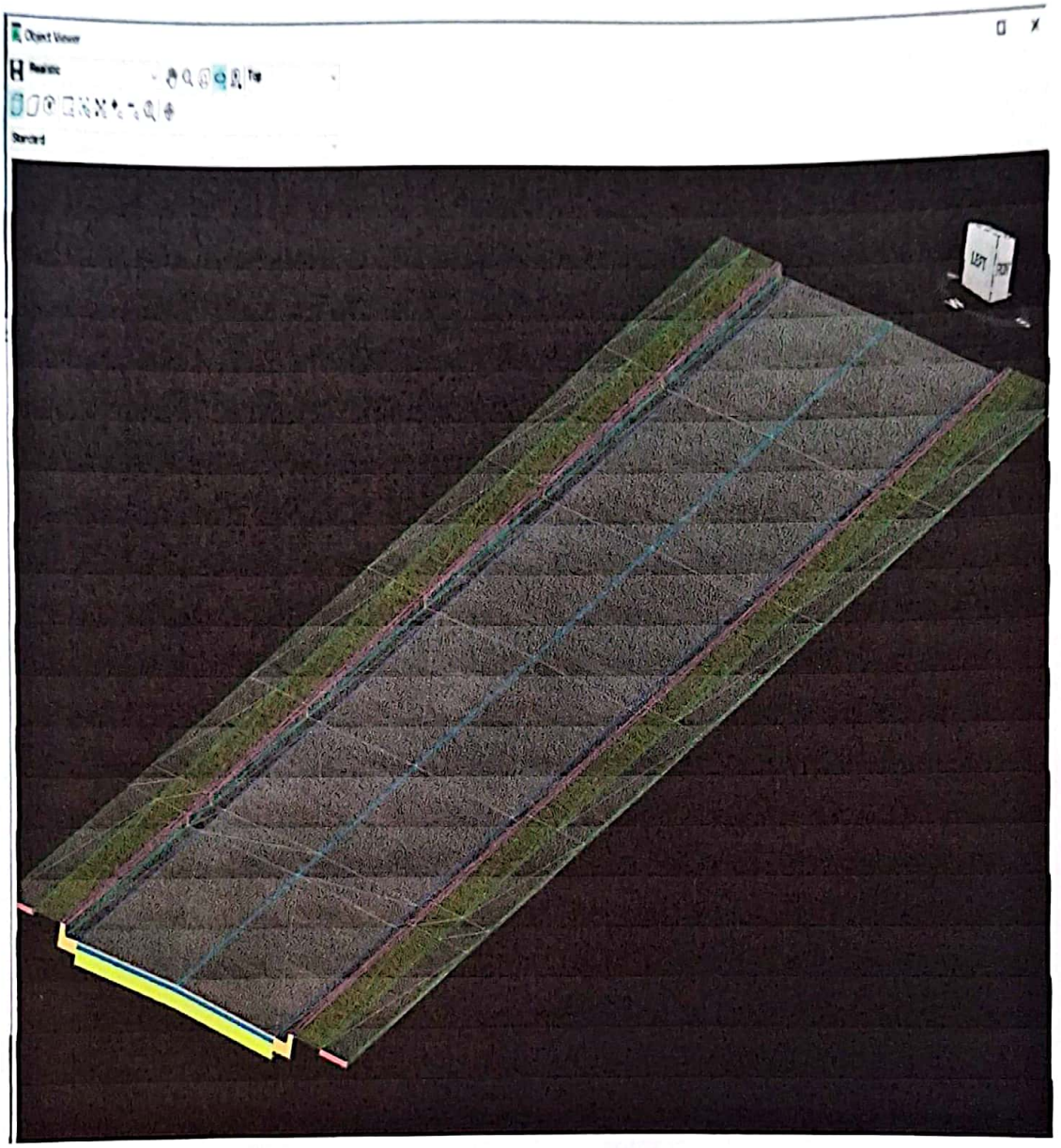


Figure 4.10 corridor

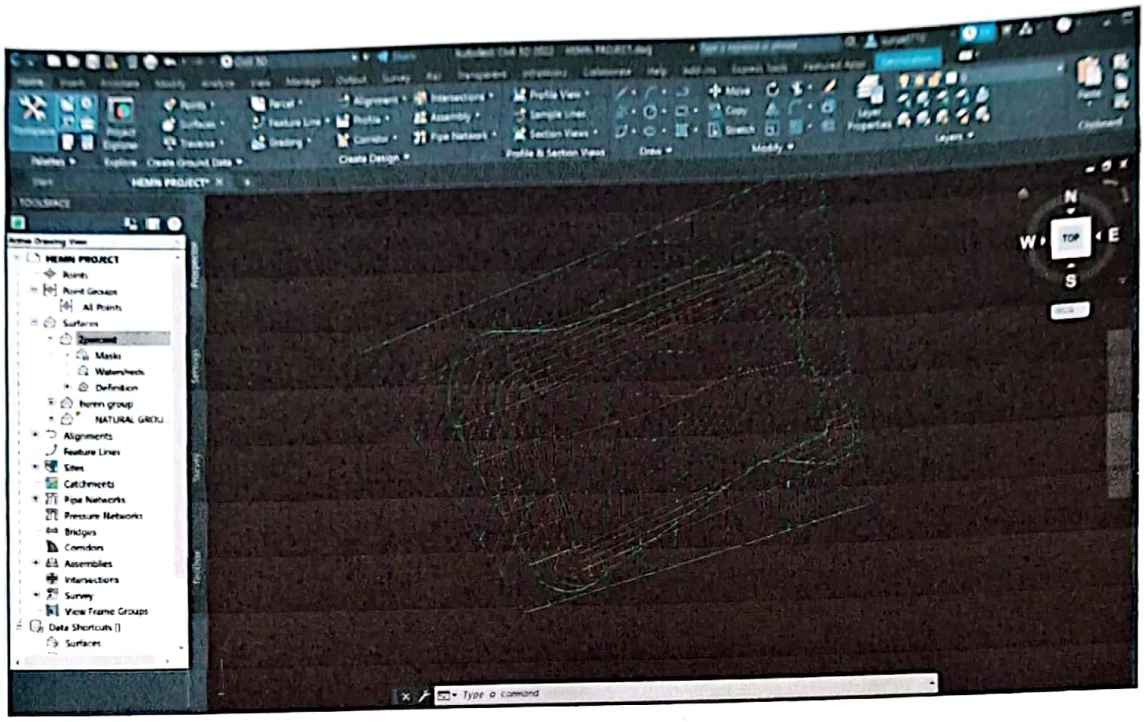


Figure 4.11 site design

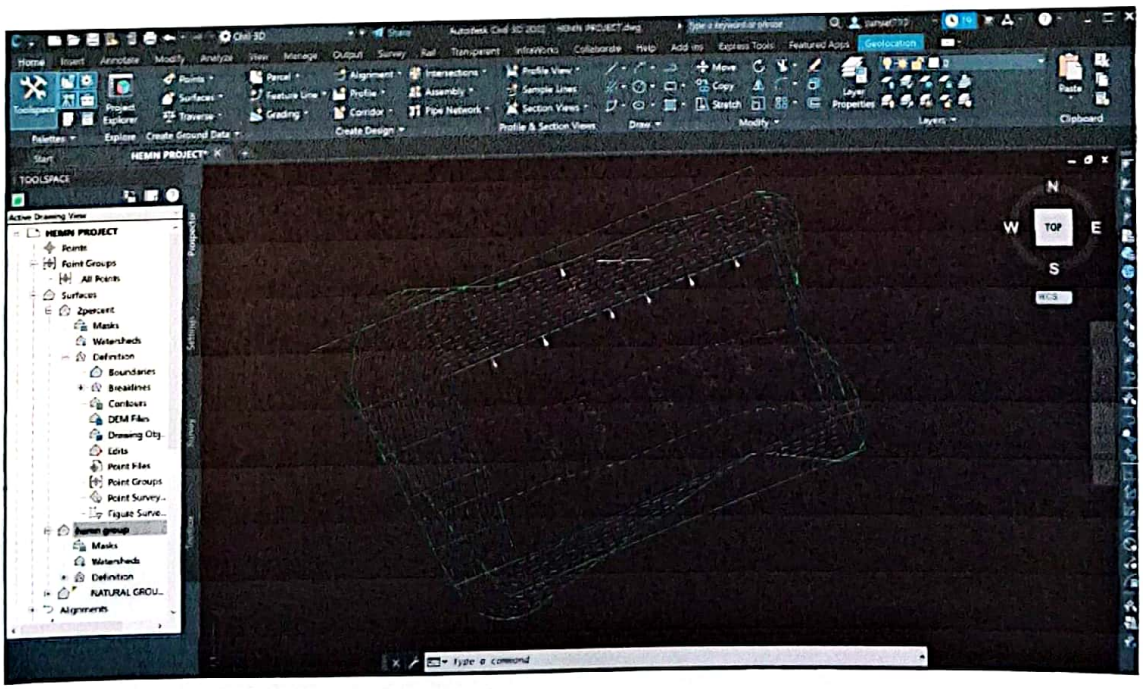


Figure 4.12 two percent slope site design

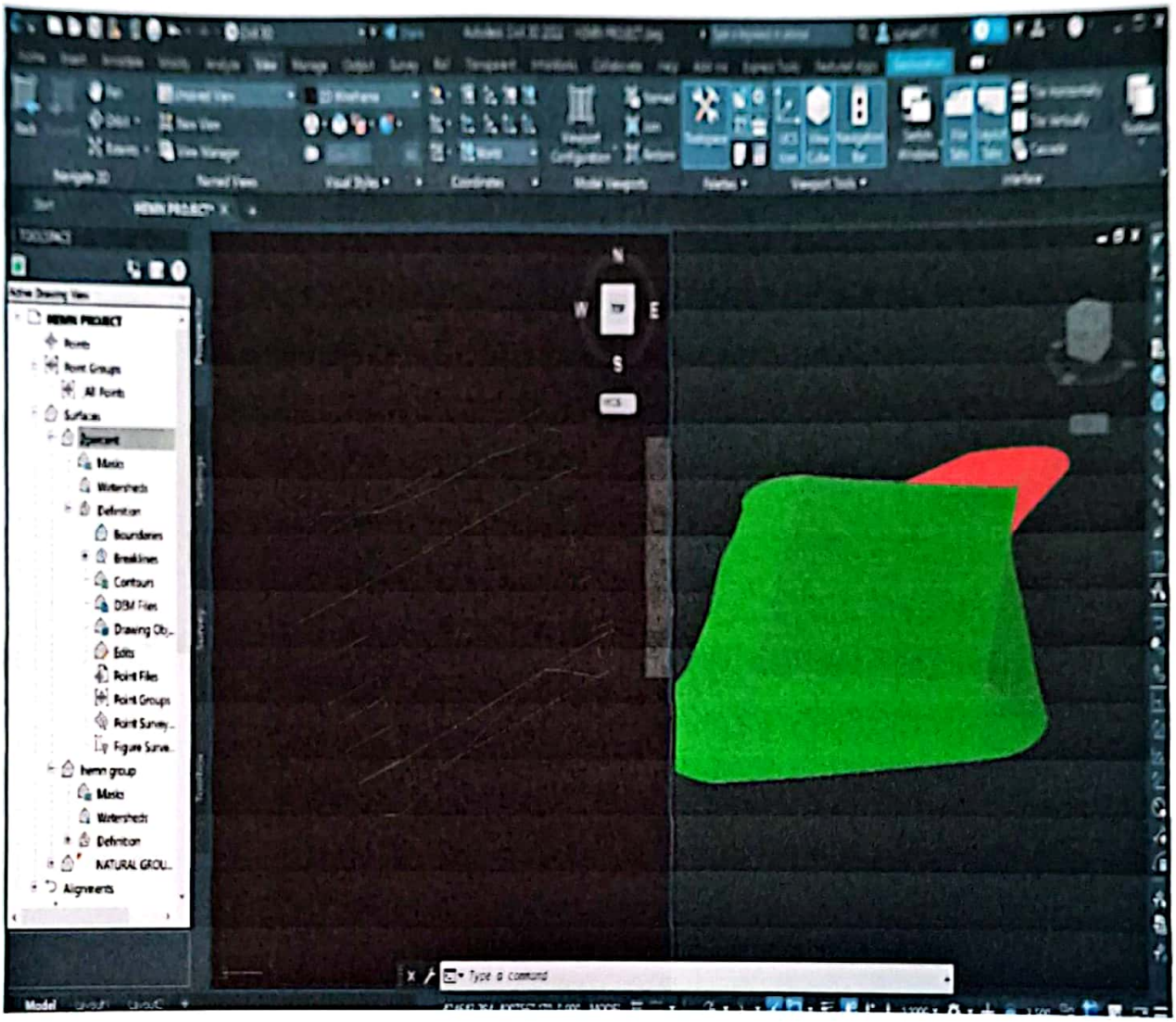


Figure 4.13 visualized side design

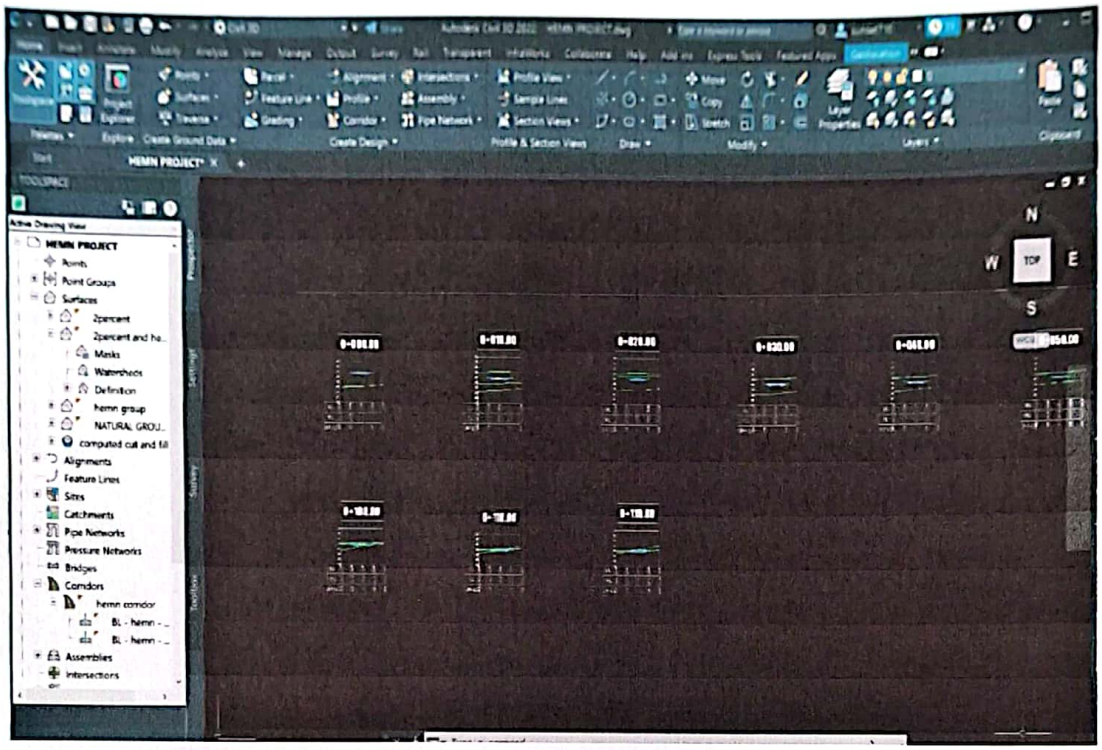


Figure 4.14 cross-section of each 10 meters a long alignment

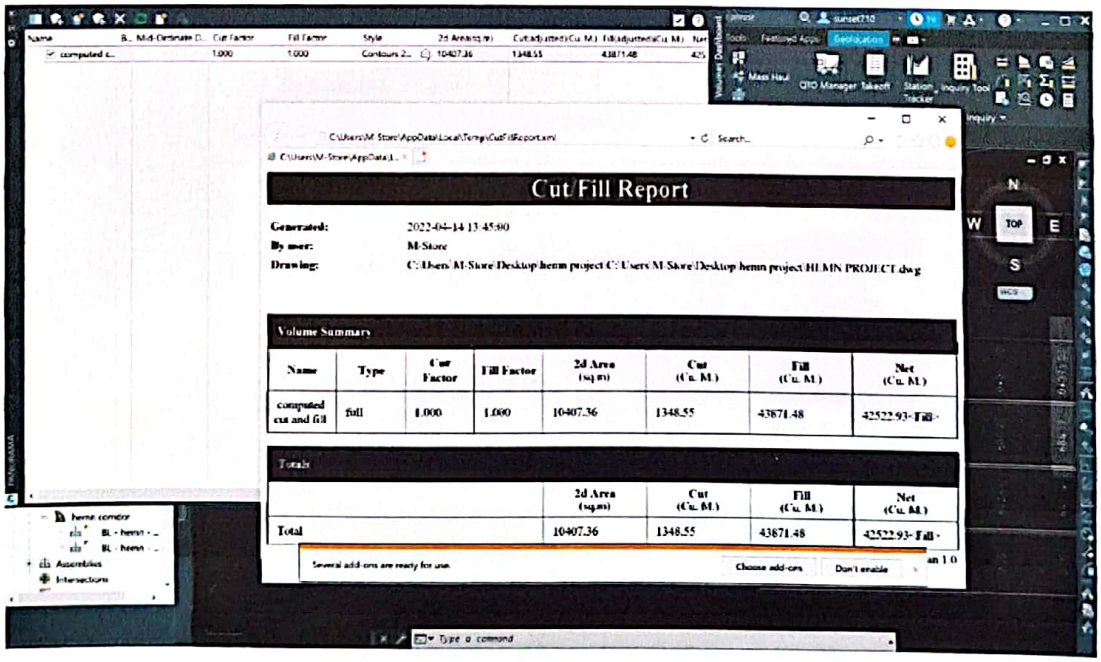


Figure 4.15 earthwork quantity

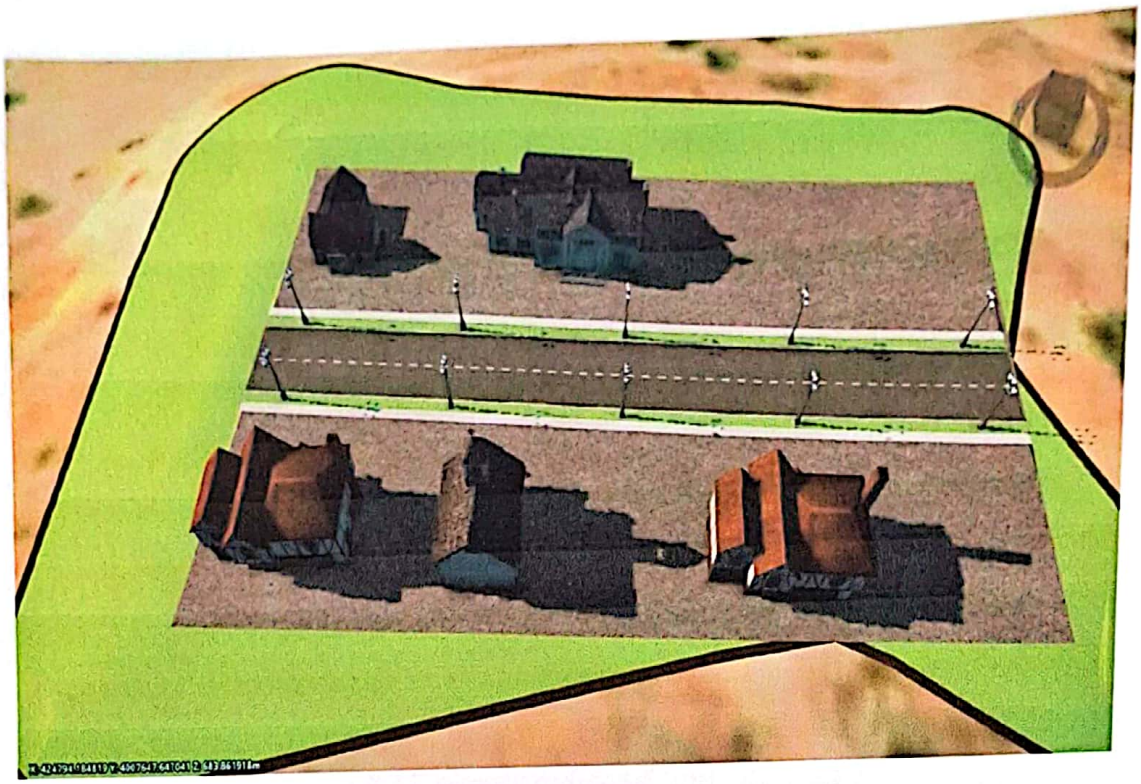


Figure 4.16 visualized road and site step 1

Figure 0.17 visualized road and site step 2

Figure 4.18 visualized road and site step 3

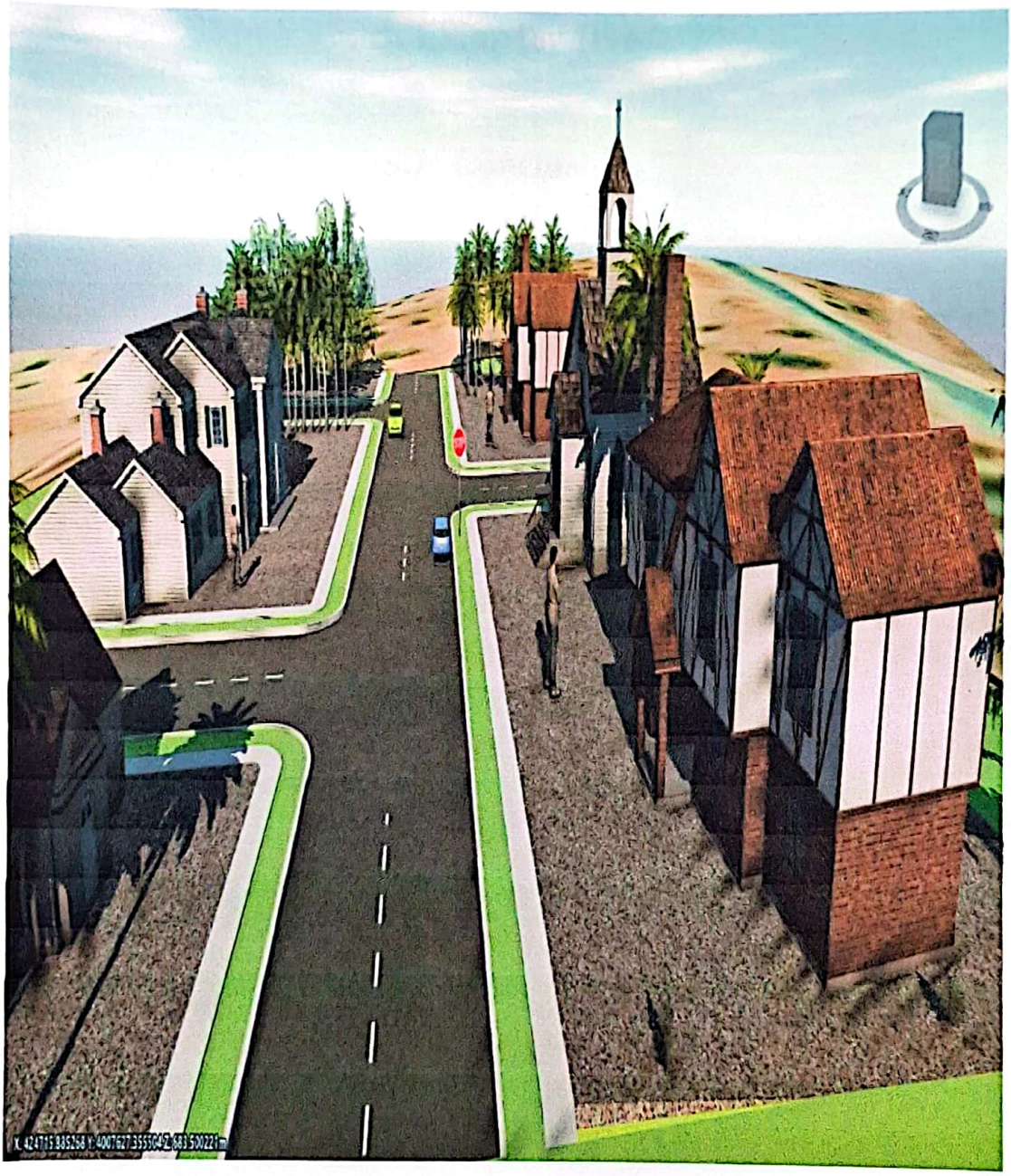


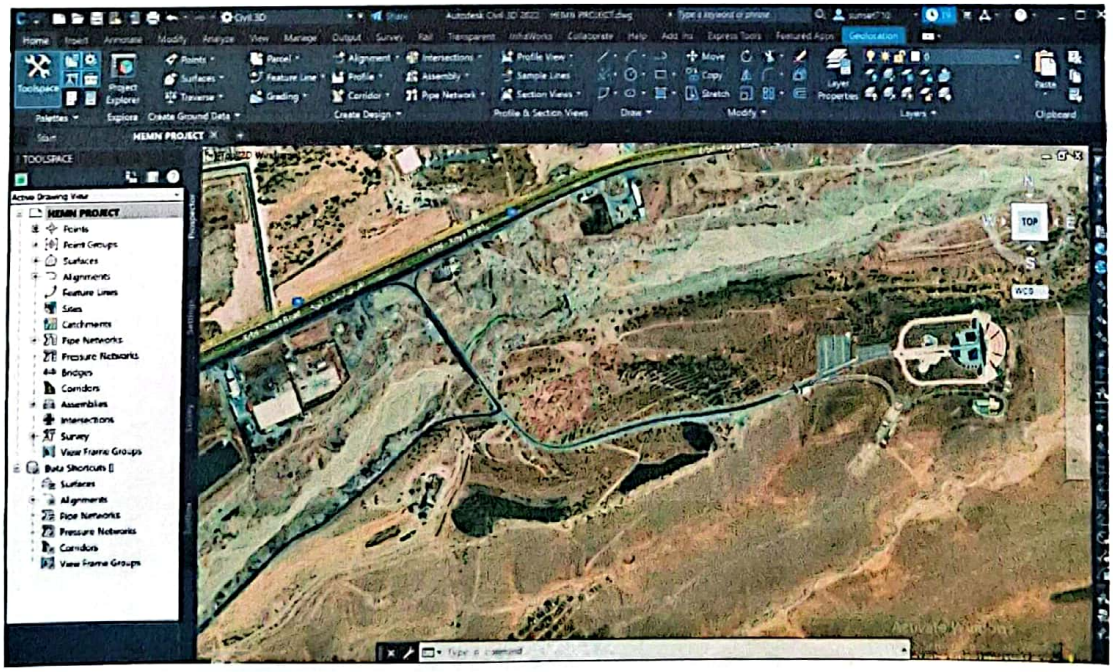
Figure 4.19 final visualization of the project

5. Chapter five

5.1 Conclusion

Conducting this project consisting of Road and Site with advanced survey instrument tools such as (Topcon total station) and using extremely sophisticated and highly common software to analyze and visualize the project is very useful and should be given a priority to that to develop the infrastructure of the country. It should be considered in every road and site design to minimize the error of human beings and reduce the amount of time and see or visualize the project before going to break the ground.

Appendix



1	424776.6196	4007722.346	680	"BM1"
2	424793.1871	4007652.154	685.5	"BM2"
3	424683.6582	4007678.437	679	"BM3"
4	424700.9532	4007629.778	681	"BM4"

References:

1-https://www.google.iq/search?q=what+is+civil+3d%

2-https://www.google.iq/search?q=total+station&sxsrf=

3-https://www.google.iq/search?q=what+is+the+differntial+gps&sxsrf

4-https://www.google.iq/search?q=what+is+geometirc+of+road&sxsrf

5-https://www.google.iq/search?q=what+is+alignment+of+road&sxsrf

6-https://www.google.iq/search?q=what+is+profile+of+road&sxsrf

7- https://www.google.iq/search?q=what+is+cross+section+of+road&

8- https://www.google.iq/search?q=what+is+surface+in+civil+3d&sxsrf

9- https://www.google.iq/search?q=what+is+points+in+civil+3d&sxsrf

10-
https://www.academia.edu/43201227/A_Review_Geometric_Design_of_Highway_with_the_Help_of_Autocad_Civil_3D

11-https://civilread.com/road-types/

12-https://www.google.iq/search?q=INFRAWORKS+360+DEFINITION&