FEASIBILITY OF SIDEWALK ALONG THE AMBALA-SHIMLA NATIONAL HIGHWAY NO.-5 AT SHOGHI, SHIMLA, HIMACHAL PRADESH: DESIGN & ANALYSIS

A PROJECT

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

Mr. Ashish Kumar & Mr. Mani Mohan

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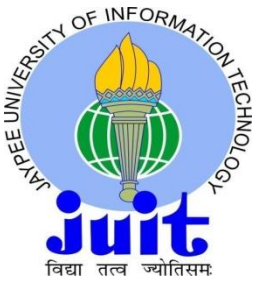
to



JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT SOLAN – 173 234

HIMACHAL PRADESH INDIA

May, 2015

CERTIFICATE

This certify that the work which is being presented in the project title **"FEASIBILITY OF SIDEWALK ALONG THE AMBALA-SHIMLA NATIONAL HIGHWAY NO. -5 AT SHOGHI, SHIMLA, HIMACHAL PRADESH: DESIGN AND ANALYSIS"** in partial fulfillment of the requirements for the award of the degree of Bachelor of technology and submitted in Civil Engineering Department, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by Mr.Akshay Sharma(111649), Mr.Pankaj Sharma(111673) and Mr.Jigme Wangdi (111692) during a period from August 2014 to May2015 under the supervision of **Mr. Ashish Kumar and Mr. Mani Mohan**, Assistant Professors, Civil Engineering Department, Jaypee University of information Technology, Waknaghat.

The above statement made is correct to the best of my knowledge.

Date:- ……

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ABSTRACT

From several years Shoghi is in great need of a parking facility and facility for pedestrians to walk upon. Our project 'Design of sidewalk at Shoghi' is a project that will not only addresses to these problems but also challenges us to apply our knowledge gained by us in the previous year's along with gaining of on-site work experience.

In the first chapter of this report we have given a brief introduction about Shoghi, its problems and possible solutions we have tried to find out. Also here we have discussed about the code IRC-103-1988 and which we have followed thus making the guidelines from the code as our base for the project. The second chapter gives us the details of the surveys which were performed by us. We have conducted both photographic and total station survey. Photographic survey has given us the fair idea of the problems faced by pedestrians and from the total station survey we collected data points that helped us to make a layout of the 1.1km long stretch.

In the third chapter the procedure for making the layout of the stretch by the use of software's likes AutoCAD and MS-Excel has been provided. The layouts laid the foundation of the designing part of the project where we plotted the sidewalk as well as came to know about the types of supports by allocation of concrete footings along the side walk. The fourth chapter of this report contains the designing and analysis of the sections chosen by us to serve as the sidewalk using STAAD.Pro and MACROS feature of MS-Excel. Initially, upto Cross-Section No.73 we designed steel sidewalk and for the rest of the stretch we used concrete sidewalk.

In the fifth chapter we have provided the estimate and cost analysis for carrying out the whole project and in final sixth chapter we have recommended some amendments that can be carried out for more safety of pedestrians.

Finally the results and discussions are drawn and the project is brought to its conclusion.

KEYWORDS:-AutoCAD, Concrete Sidewalk, MACROS, STAAD.Pro, Steel Sidewalk, Total Station Survey.

CONTENTS

Page No.

Page No.

LIST OF FIGURES

Page No.

LIST OF TABLES

CHAPTER-1

INTRODUCTION

1. 1 SHOGHI

Shoghi is a small suburb of Shimla, Himachal Pradesh, India. It is about 13 kilometers before Shimla on the Ambala Shimla national highway (NH-22). The road to the Taradevi temple (hilltop) goes from here which is about 5 km. Shoghi is also famous for bus halts for food as there are many dhabas (local name for food outlets) here. HIMUDA (Himachal Pradesh Urban Development Authority) has also constructed many flats here.

Nestled in the quaint, lush, green hills of Himachal Pradesh just 13 kilometers short of Shimla (The queen of hills), captivating building blocks of pinks and yellows with sloping tin roofs add a touch of natural grandeur to the picturesque surroundings. As you veer off the national highway towards the blocks, you realise you are entering the Housing Board Colony at Shoghi.

The colony was set up in the cozy hamlet of Shoghi in early 2001 by HIMUDA for meeting the housing needs of so many people. Not only accessible, the colony is far from the madding crowd situated on a knoll overlooking hills rising one after another to meet the insurmountable skies from a deep vale just across the road. You can go to Shoghi, and back to nature, without running into traffic jams, a characteristic of Shimla.

But over the years, the colony has lost most of its charm. The metalled road gives way to streets of cobbled stones, as your huffing and panting car wheezes its way up the hillock towards the rising blocks of flats.

Look down the slopes, along the colony streets, and you find the greenery suffocating under the thick layers of rubbish. Carelessly tossed wrappers of potato chips, aluminum foils and empty soda bottles not only narrate the tales of not-so-quiet evenings enjoyed with drinks, but also of sheer disrespect for the nature and inability of the authorities to

prevent the littering. The housing board society is now making attempts to clean up the mess, but the dirty picture's end is nowhere in sight.

It doesn't take you much time to realise that the colony has been left to fend for itself otherwise also. The concrete road signs, spelling out the location of the blocks, too seem to have crooked under their own weight. Security too is an issue. The colony precincts have not been demarcated; and in the absence of fencing, it's free for all. Water meters are stolen, and the open spaces in the campus have metamorphosised themselves into free public parking lots for the "outsiders".

Shoghi offers a beautiful option for a stay near Shimla with lots of nature activities.[8]

1.2 PROBLEMS AT SHOGHI

The main problem at Shoghi is from housing board colony gate-2 to Shimla bypass for heavy vehicles which is of 1.1 km stretch, within this stretch there is H.P.C.L (Hindustan Petroleum Corporation Limited) Shimla depot, police barrier, primary health center, a Government School, entrance gate towards Hosing Board colony, market place which contains taxi stand, Bus stand, DAV Public School and various kinds of shops and dhabas. For all these places to visit walking is a prime mode transport for the locals. In this stretch there are ample of space for the people to walk but there are always plenty of vehicles parked on the road and other available space making it difficult and forcing people to walk on the carriage way.

Fig.1.1 People walking on carriage way

Usually on this road, vehicles travel at an average speed of 50 km/h and people walking along the road risks their life increasing the probability of accidents. Shimla being the hot-spot for tourists and trekkers the vehicle density on NH-22 is increasing day by day leading to the congestion on NH-22 and the authorities at Shimla tried to relieve this congestion by making a bypass at shoghi via Mehli for the heavy vehicles, at that time Shoghi was not that populated and vehicle density was also not that high but now both have drastically increased.

As there is no proper facility to walk and cross the road, it makes unsafe for the people.

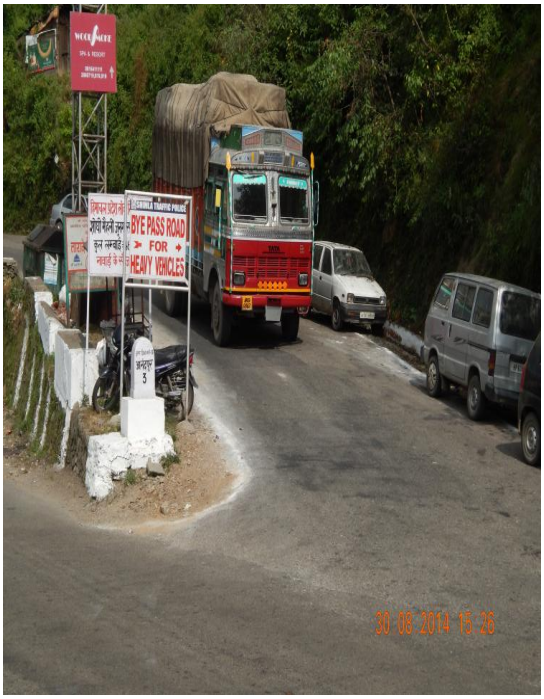


Fig.1.2 Bypass road for heavy vehicles at Shoghi

Fig.1.3 Traffic jams at Bypass road

1.3 ABOUT THE PROJECT

In this project we have designed the side walk. Since people walking towards their daily work and destination faces lots of problem and the safety of the people is the biggest concern we decided to take up our final year project on side walk design. The foot path we designed is a raised foot path of 30 cm from the carriage way level. Also we have

provided proper openings where ever necessary. For the people to cross from one road to another road we decided to provide zebra crossings and speed breaker to lower the speed of the moving vehicles. In this project we followed the IS 103-1988 for the guidelines.

1.3.1 OBJECTIVES

- To provide a safe walking area to the pedestrians of Shoghi.
- To design a feasible and economical sidewalk that can bear maximum load and can serve for at least 30years.
- To apply our knowledge of civil engineering gained by us in our B.Tech course.

1.3.2 ABOUT THE CODE (IRC-103-1988)

Walking is an important mode of transport. Significant trips up to 2 km are on foot and every journey start / end with a walk. Requirements are partly covered in IRC: 70-1977 "Guideline on regulation and control of mixed traffic in urban areas" and IRC: 86-1983 "Geometric design standards for urban roads in plains".

Width of side walk (meters)	Capacity (Number of persons per hour)	
	All in one direction	In both the directions
1.50	1200	800
2.00	2400	1600
2.50	3600	2400
3.00	4800	3200
4.00	6000	4000

Table 1.1 Capacity of side walks

- General Principles:
    1. Pedestrian facilities should be planned in an integrated manner to ensure continuous flow.
    2. Reduce conflict between pedestrian and vehicles.
    3. Convenience is paramount. [3]

- Footpath/Sidewalk:
    1. Should be on both sides.
    2. Minimum Width of 1.5 meters.
    3. There are criteria based on pedestrians per hour (as shown in Table1.1)
    4. In shopping areas, width should be increased by 1m (to be treated as dead width).
    5. When adjacent to buildings, fences –dead width has to be 0.5 meters. [3]
- Guard Rails:
    1. Two aspects which need special consideration are:-
        a. The height of hand-rail.
        b. The obstruction to visibility.
    2. The design should be neat, simple in appearance and as far as possible, vandal proof. [3]
- Zebra Crossing:
    1. Width: - 2 to 4meters.
    2. Nit within 150 meters from each other.
    3. Median strip should be of adequate width (this is only reference to pedestrian refugee).[3]
- What is missing?
    1. No mention of right of way for pedestrians at non-signal controlled zebra crossings (though Delhi Police website says so)
    2. No mention on height of footpaths.
    3. No mention on dipped kerbs and gradients
    4. No mention of slip free tilting (needed usually on dipped kerbs).
    5. No mention on pedestrian refugee and types
    6. Signal phases are mentioned but no guideline on timings.
    7. No mention with regards width around street furniture (bus stops, trees, benches, bins, electricity meter boxes, post boxes, signage poles, street lightning).

CHAPTER-2

SURVEYING

2.1 GENERAL

Surveying is the art of determining the relative position of points on, above or beneath the surface of the earth by means of direct or indirect measurement of distance direction and elevation. It includes the art of establishing points by predetermined angular and linear measurements.

The knowledge of surveying is advantageous in many phases of engineering. The earlier surveys were made in connection with land surveying. Practically every engineering project such as road, water supply and irrigation schemes, railroads and transmission lines, mines, bridges and buildings etc. require surveys. Before plans and estimates are prepared, boundaries should be determined and the topography of the site should be ascertained. After the plans are made, the structure must be staked out in the ground. As the work progresses, lines and grades must be given. [3][4]

In surveying all measurements of lengths are horizontal, or else are subsequently reduced horizontal distances. The object of a survey is to prepare plan or map so that it may represents the area on a horizontal plane. A plan or map is horizontal projection of an area and shows only horizontal distances of points.[1][7]

In this project, we have performed two types of survey:-

1. Photographic Survey
2. Total Station Survey

2.2 PHOTOGRAPHIC SURVEY

It is the basic kind of survey in which the surveyor visits the area to be surveyed, takes the photograph of the area under consideration to get idea of the topography, surroundings which helps the surveyor to plan his survey camp and helps him to choose

the method of surveying. Also, if necessary the surveyor can also talk to the local residents of the area.

In our photographic survey we tried to identify the major problems at Shoghi (as shown in figures). While doing the survey we talked to several residents of Shoghi who told us that there is no proper space for pedestrians to walk along the road neither there are any zebra crossing for the people. Also, there is no parking space for the parking of vehicles and thus the drivers park their vehicles along the side of the road causing the pedestrians to walk on the carriage way which may lead to any kind of accident at any point of time.

The photos of the photographic survey are shown in **APPENDIX-A**.

From the pictures we deduce that:-

1. There is encroachment by the locals.
2. Parking of vehicles is done along the road.
3. Loading and unloading of the goods and people is done by encroaching the areas which are meant for people to walk upon alongside the road.

According to a survey where no sidewalks are provided, or where sidewalks are in poor repair or have missing sections, the following conditions often result in :-

1. People being forced to walk in the carriage way, resulting in increased pedestrian/motor vehicle collisions. About 8 percent of all pedestrian crashes involve people walking along the road.
2. Without a safe and well-maintained place to walk, people are discouraged and, in extreme cases, prevented from walking. For example, children have a difficult time walking to school and seniors cannot access nearby shops.
3. The absence of sidewalks can eliminate access to all destinations for some people with disabilities. Even short gaps in sidewalk facilities make nearby destinations completely inaccessible to these individuals.
4. Not providing a safe place to walk does not accommodate the needs of people who rely on walking as a mode of travel.

Hence, there is a great need of sidewalk at Shoghi and until it is not provided over there a saying will always be there that " आगे की बजाए पीछे देख के चलना चाहिए | "

2.3 TOTAL STATION SURVEY

2.3.1 TOTAL STATION

A form of an electronic theodolite combined with an electronic distance measuring device (EDM), the primary function is to measure slope distance, vertical angle, and horizontal angle from a setup point to a foresight point most total stations use a modulated near-infrared light emitting diode which sends a beam from the instrument to a prism.

The prism reflects this beam back to the instrument. The portion of the wavelength that leaves the instrument and returns is assessed and calculated. Distance measurements can be related to this measurement.

The accuracy of a total station is dependent on instrument type. Angle Accuracy (Horizontal or Vertical) can range from 2" to 5". Distance Accuracy can range from: +/-(0.8 + 1 ppm x D) mm to +/- (3 + 3 ppm x D) mm Where, D = distance measured.
Accuracy is highly dependent on leveling the instrument. Thus two leveling bubbles are provided on the instrument and are referred to the circular level and the plate level. Circular level is located on the tribrack while plate level is on horizontal axis of instrument just below scope of the total station. Sensitivity of Circular Level = 10'/ 2mm. Sensitivity of Plate Level = 30" / 2mm.

Although taping and theodolites are used regularly on site – total stations are also used extensively in surveying, civil engineering and construction because they can measure both distances and angles. The appearance of the total station is similar to that of an electronic theodolite, but the difference is that it is combined with a distance measurement component which is fitted into the telescope. Because the instrument combines both angle and distance measurement in the same unit, it is known as an

integrated total station which can measure horizontal and vertical angles as well as slope distances.

2.3.2 ADVANTAGES OF TOTAL STATION

1. Relatively quick collection of information.
2. Multiple surveys can be performed at one set-up location.
3. Easy to perform distance and horizontal measurements with simultaneous calculation of project coordinates (Northing, Easting, and Elevations).
4. Layout of construction site quickly and efficiently.
5. Digital design data from CAD programs can be uploaded to data collector.
6. Daily Survey Information can also be quickly downloaded into CAD which eliminates data manipulation time required using conventional survey techniques.

2.3.3 DISADVANTAGES OF TOTAL STATION

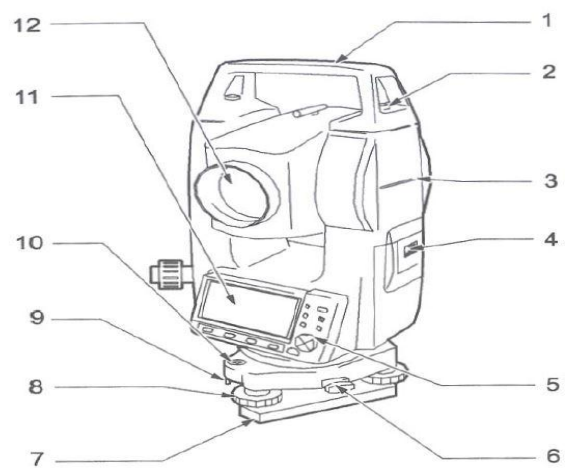
1. Vertical elevation accuracy is not as accurate as using conventional survey level and rod technique.
2. Horizontal coordinates are calculated on a rectangular grid system. However, the real world should be based on a spheroid and rectangular coordinates must be transformed to geographic coordinates if projects are large scale.
3. As with any computer-based application "Garbage in equals Garbage out". However, in the case of inaccurate construction surveys "Garbage in equals lawsuits and contractors claims for extras."

2.3.4 TYPES OF TOTAL STATION SURVEYING

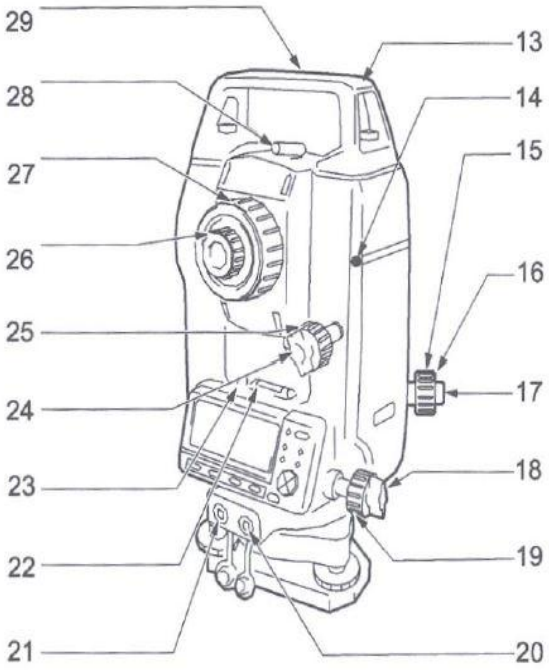
Slope Staking	Areas
Topographic Surveys	Intersections
Construction Project Layout	Point Projections
Leveling	Road (Highway) surveys
Resections	Taping from baseline
Traverse Surveys and adjustments	Building Face surveys

TABLE2.1 Types of total station surveying

2.3.5 COMPONENTS OF TOTAL STATION



1 Handle
2 Handle securing screw
3 Instrument height mark
4 Battery cover
5 Operation panel
6 Tribrach clamp (SET310S/510S/610S: Shifting clamp)
7 Base plate
8 Levelling foot screw
9 Circular level adjusting screws
10 Circular level
11 Display
12 Objective lens



13 Tubular compass slot
14 Beam detector for wireless keyboard (Not included on SET610/610S)
15 Optical plummet focussing ring
16 Optical plummet reticle cover
17 Optical plummet eyepiece
18 Horizontal clamp
19 Horizontal fine motion screw
20 Data input/output connector (Beside the operation panel on SET610/610S)
21 External power source connector (Not included on SET610/610S)
22 Plate level
23 Plate level adjusting screw
24 Vertical clamp
25 Vertical fine motion screw
26 Telescope eyepiece
27 Telescope focussing ring
28 Peep sight
29 Instrument center mark

Fig.2.1 Components of Total Station

☞ "5.1 Basic Key Operation"

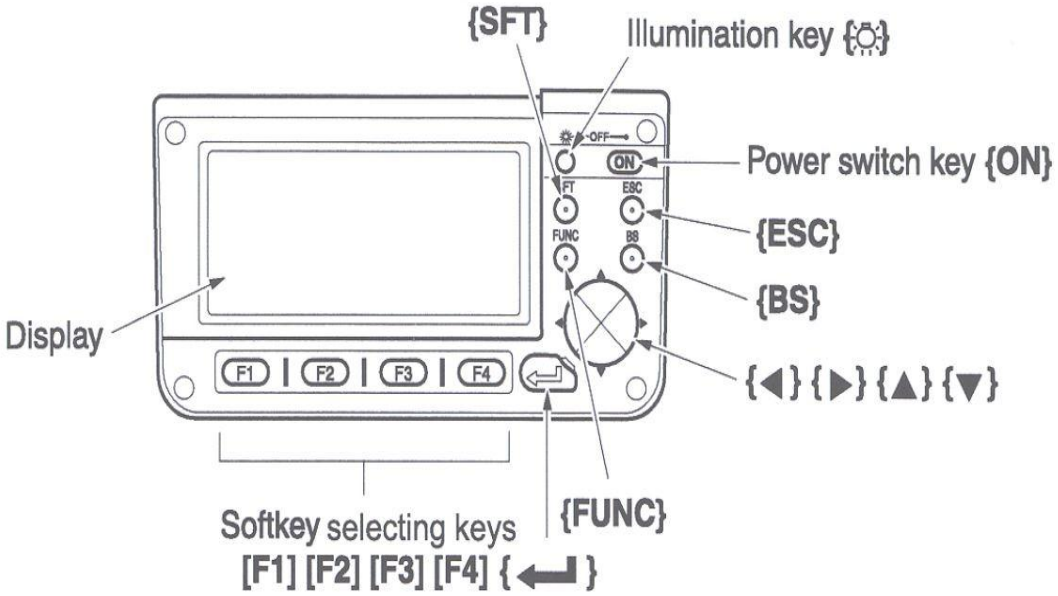


Fig.2.2 Basic Key Operations

Menu Pages:-

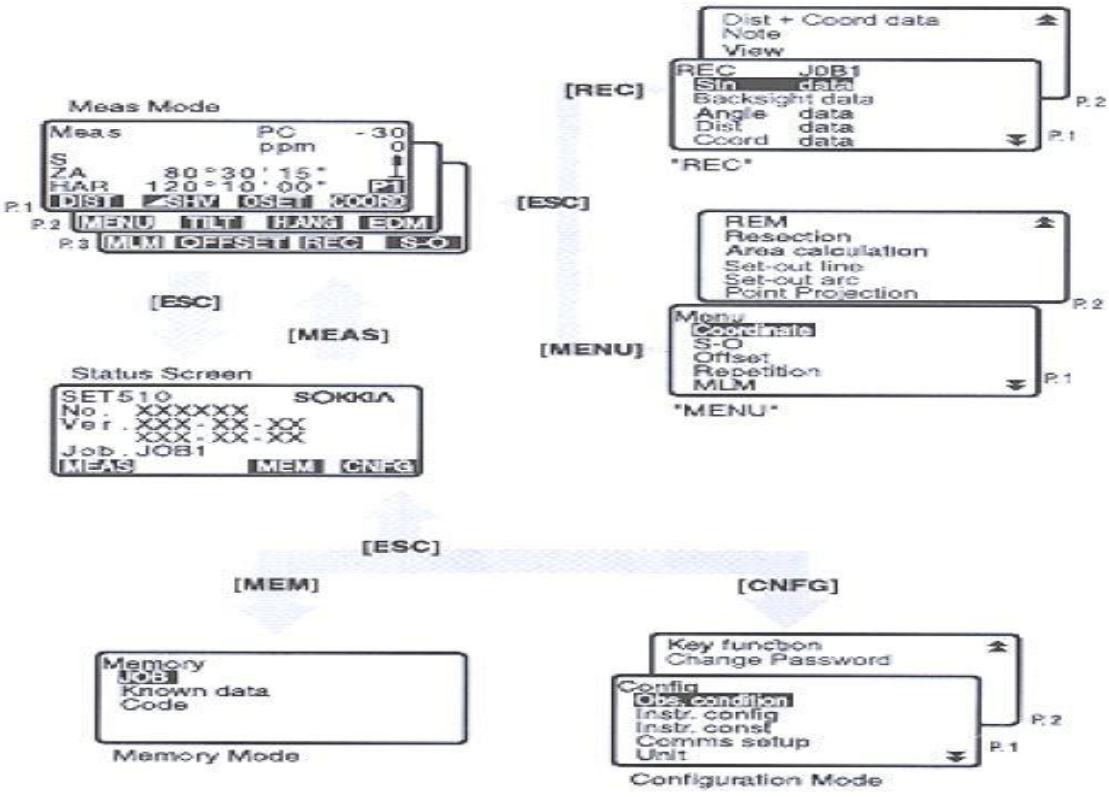


Fig.2.3 Menu Pages of Total Station

2.3.6 LEVELING OF TOTAL STATION

Leveling the Total station must be accomplished to sufficient accuracy otherwise the instrument will not report results. Before starting leveling the instrument it should be made sure that all the targets can be seen from the station point. After ensuring the leveling process should be started by following steps:-

1. Tripod Setup

Tripod legs should be equally spaced. The tripod head should be approximately leveled .also care should be taken that the head should be directly over survey point.

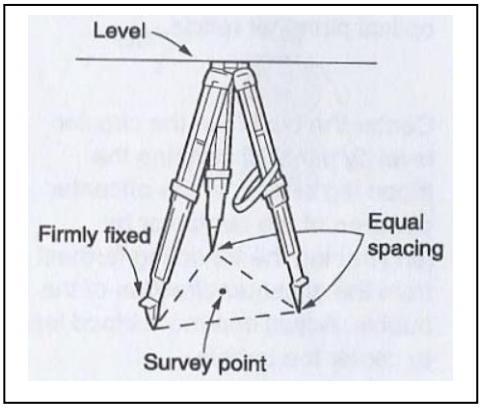


Fig.2.4 Tripod Setup

2. Mount Total station on tripod

Place instrument on Tripod .Secure with centering screw bracing the instrument with the other hand. Don't forget to insert the battery in Total station before leveling.

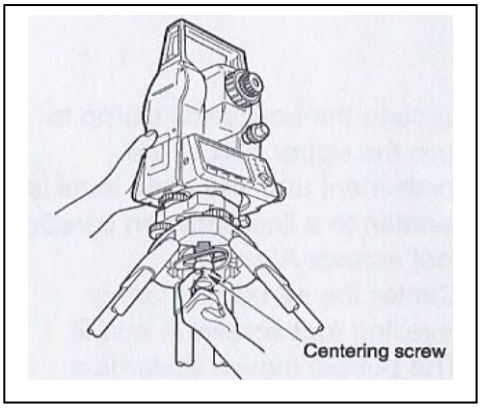


Fig.2.5 Mounting of Total Station

3. Focus on Survey Point

For this, use the optical plummet on the survey point.

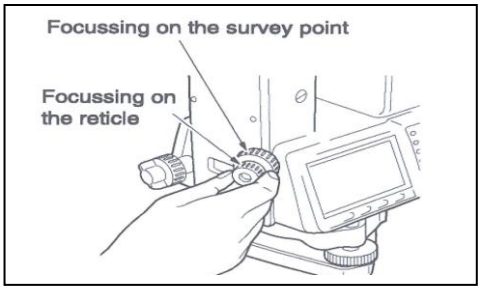


Fig.2.6 Focusing of Survey Point

4. Leveling

Adjust the leveling foot screws to center the survey point in the optical plummet reticle. Center the bubble in the circular level by adjusting the tripod legs.

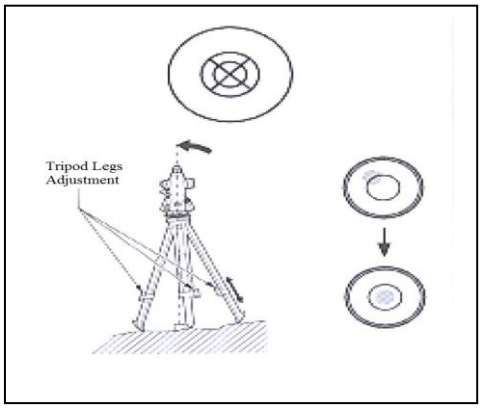


Fig.2.7 Leveling-A

Loosen the horizontal clamp and turn instrument until plate level is level to two of the leveling foot screws. Center the bubble using the leveling screws- the bubble moves towards the screw that is turned clockwise.

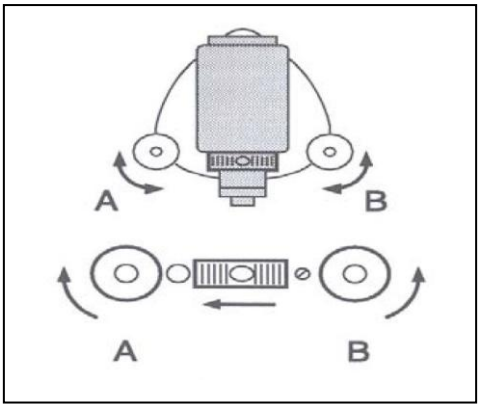


Fig.2.8 Leveling-B

Rotate the instrument 90 degrees and level using the third leveling screw.

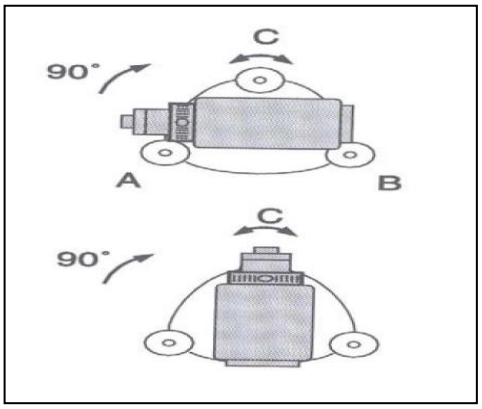


Fig.2.9 Leveling-C

Observe the survey point in the optical plummet and center the point by loosening the centering screw and sliding the entire instrument. After re-tightening the centering screw check to make sure that the plate level bubble is level in several directions.

5. Electronically Verify Leveling

Turn on the instrument by pressing and holding the "ON" button (you should hear an audible beep).The opening screen will be the "MEAS" screen. Select the [TILT] function. Adjust the foot level screws to exactly center the electronic "bubble". Rotate the instrument 90^{o} and repeat.

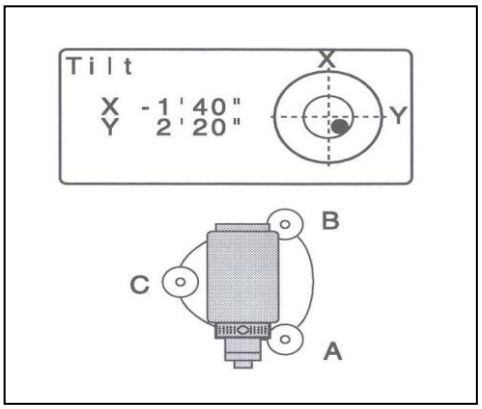


Fig.2.10 Verifying of Leveling

2.3.7 ACCESSORIES OF TOTAL STATION

Fig.2.11 Accessories of Total Station

2.3.8 HOW SURVEY WAS DONE AT SHOGHI?

The main aim of doing survey at Shoghi was to prepare a layout of the 1.1Km long stretch so that we could plan our design of sidewalk accordingly as well as to identify the areas where we have to give the zebra crossings and where we have to leave opening spaces.Through, total station we measured three Distances as shown in the figure namely D_{12}, D_{23} and D_{34}.

Fig.2.12 The various distances by total station survey

Where,

D_{12} - Distance between the left side's outer most point and the left side of the road (black top).

D_{23} - Width of the carriage way at several cross sections.

D_{23} - Distance between the right side's outer most point and the right side of the road (black top). ('NOTE- these distances are measured while moving from housing board colony GateNo.2, Shoghi TO 'The Starting of Bye Pass Road to Mehli from Shoghi.

The Data Sheets of the survey are shown in **APPENDIX-B**.

CHAPTER-3

MODELLING

3.1 GENERAL

In modeling, we have used the AUTO CAD software to prepare a layout of the 1.1Km long highway stretch by using the data points which were obtained from the Total Station Survey as discussed in the previous Chapter-2.

Though Auto Cad provides a large number of functions and tools to the users but here to prepare the layout we have used the basic commands such as

1. Drawing Commands: - To draw objects like Line, Poly line, Circle, Hatch etc.
2. Modifying Commands: - To edit the orientation of the objects commands like Copy, Paste, Rotate, Move, Mirror, Trim, Extend and Offset have been used.
3. Other Commands:-
    a. LAYERS – These allow the user to assign different line types and colours to named layers. For example, a layer may for red continuous lines, another may be for green hidden lines, and yet another for blue centre lines.
    b. UNITS – This command allows the user to set the insertion scale for the drawing and also helps to set the ‘Length’ and ‘Angle’ type and precision.
    c. DIMALIGNED
    d. DIMLINEAR
    e. DCLINEAR
    f. DCALIGNED
    g. MTEXT

3.2 PROCEDURE

Here, in Auto Cad we have to prepare the layout using the total survey data points. So here we imported these data points to get the layout by following steps:-

Step1:- Before importing the points and draw the layout we set the units and layers of the lines to be drawn. For this to be done we used 'UNITS' and the 'LAYER' commands. On entering the units command a pop window comes on the screen where we set the insertion units to 'Meters' and angle type to 'Surveyor's Units'.

Fig.3.1 Snapshot-1 from Auto-CAD

After then type the 'LAYER' command and then add new layers of different colors.

For Example:-

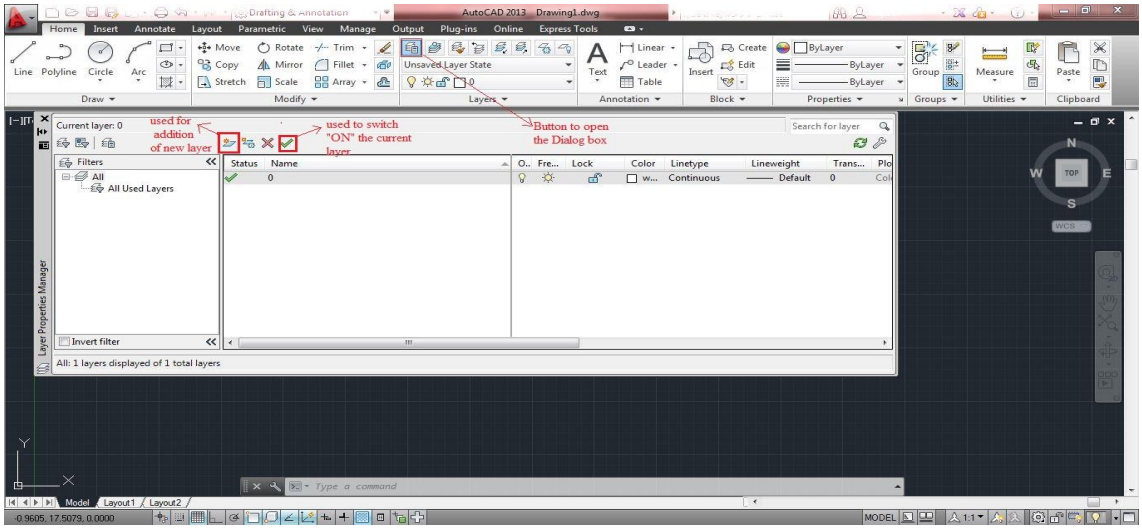


Fig.3.2 Snapshot-2 from Auto-CAD

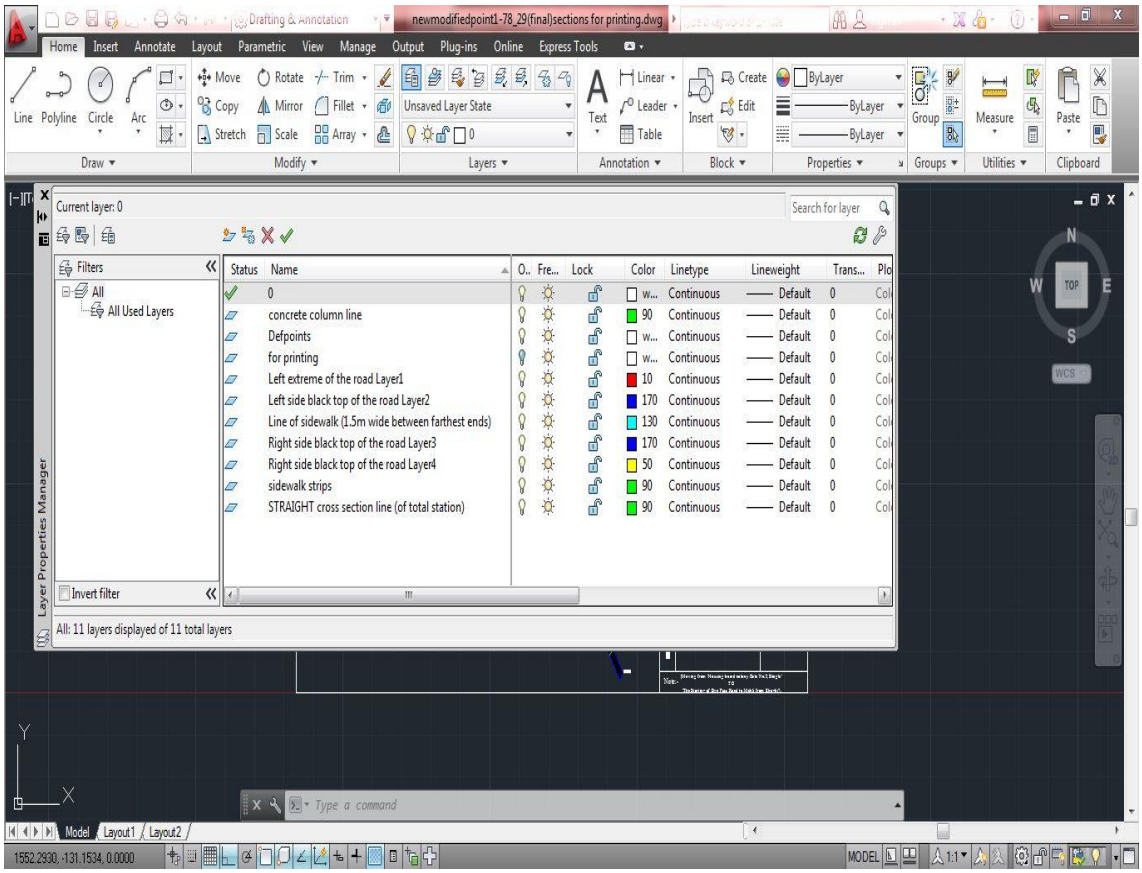


Fig.3.3 Snapshot-3 from Auto-CAD

Step2:- Since the drawing conditions are set and the adequate layer is 'on' in Auto CAD. It's time to import. Type the command 'LINE' and then move to the EXCEL SHEET where you have prepared the data points in the required (X, Y) format.

In the EXCEL Sheet select the points that are falling in one line, copy them and then paste them in the command line of Auto CAD. The Auto CAD will join all the points by making a line between two consecutive points.

Here, we achieved the whole layout by joining drawings made in the same fashion upto each change of station of Total Station. After then hatching was done with solid colour to show the carriage way.

Step3:- After the layout has been made select the different layer to show the cross section lines and then name them using the 'MTEXT' command. Here, to represent the Cross sections we have used the letters "C.S." followed by the corresponding numeral of the cross section. For example, the first cross section which was at the starting point of the survey is represented as C.S.1 and the last cross section which was at 1090m is represented as C.S.78.

Step4:- As the cross sections have been made and it has been decided that the sidewalk 1.5m wide will be provided at the left hand side of the carriage way (while moving from H.B. Colony Gate No.2 to Shoghi Bye Pass Road) and the length of each section of side walk will be 2.0m which is supported by 3 I-beam girders equidistant from each other. Then, to show the alignment of sidewalk along the stretch we have taken 'OFFSET' of the left hand side of the carriage way line first at 0.20m ; 0.575m; 0.950m; 1.325m; 1.700m. (Measuring from the left side carriage way line) using a different layer and 'POLYLINE'.

Step5:- After the sidewalk alignment is made, the cross-sections of sidewalk which are at 2.0m apart from each other are made using the 'CIRCLE', 'LINE', 'TRIM' and 'EXTEND' commands of Auto CAD. For this also a separate layer should be used.

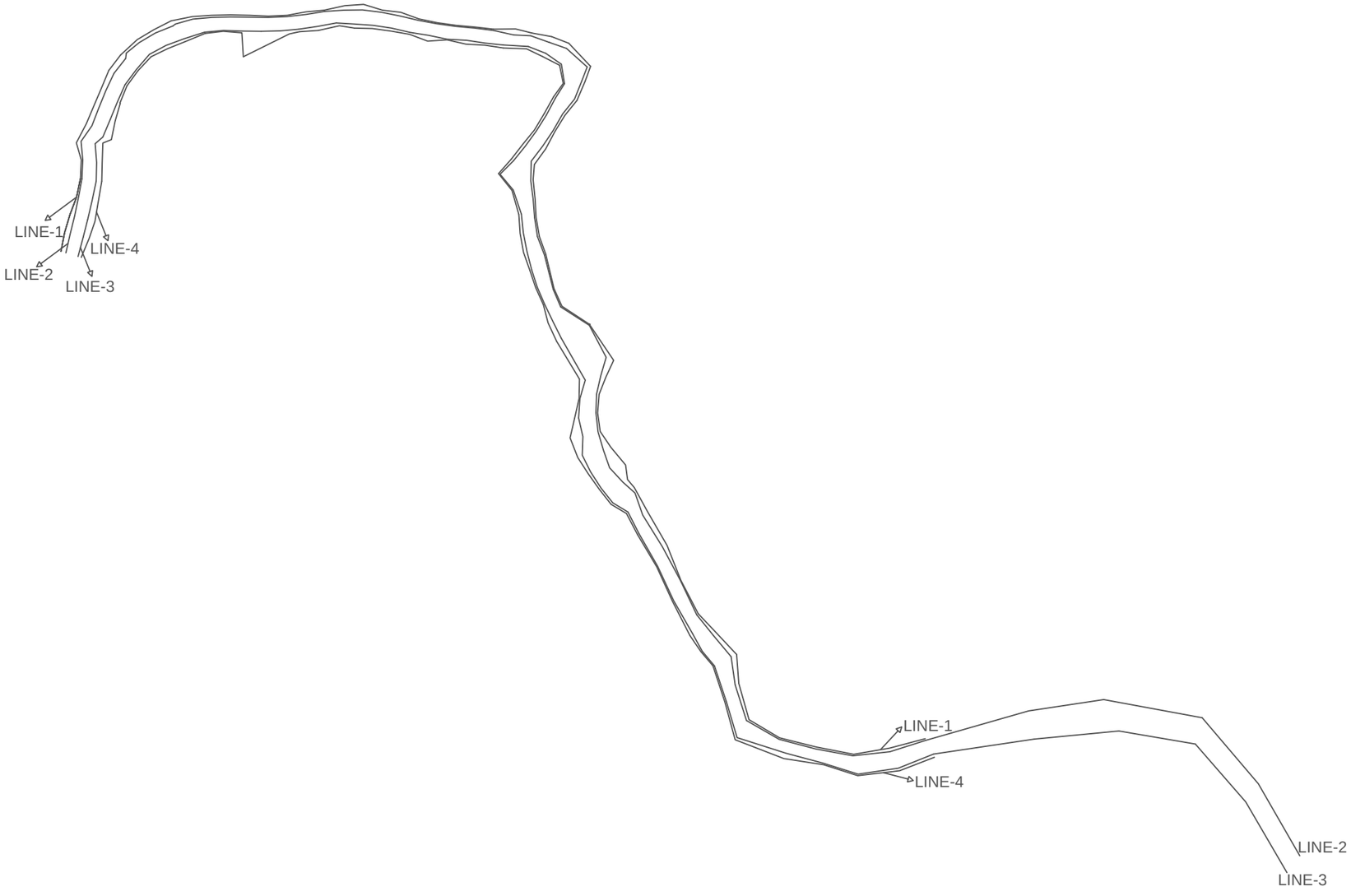
Step6:- In this step concrete column placement was find out in two steps:-

a) Drawing of concrete columns of size 0.3mx0.3m at each intersection of sidewalk lines and sidewalk cross section lines by again using the 'OFFSET', 'TRIM', 'EXTEND' commands.
b) Removal of those concrete columns which fall beyond the outermost left side of the carriage way (while moving from H.B. Colony Gate No.2 to Shoghi Bye Pass Road)using the erase command.

Note:- DIMALIGNED, DIMLINEAR, DCLINEAR, DCALIGNED commands were used to view the aligned and linear distances while drawing the layout.

So, by these six simple steps the modeling from total station data was completed and designing is started all along. (All these steps are shown below in layout diagrams).

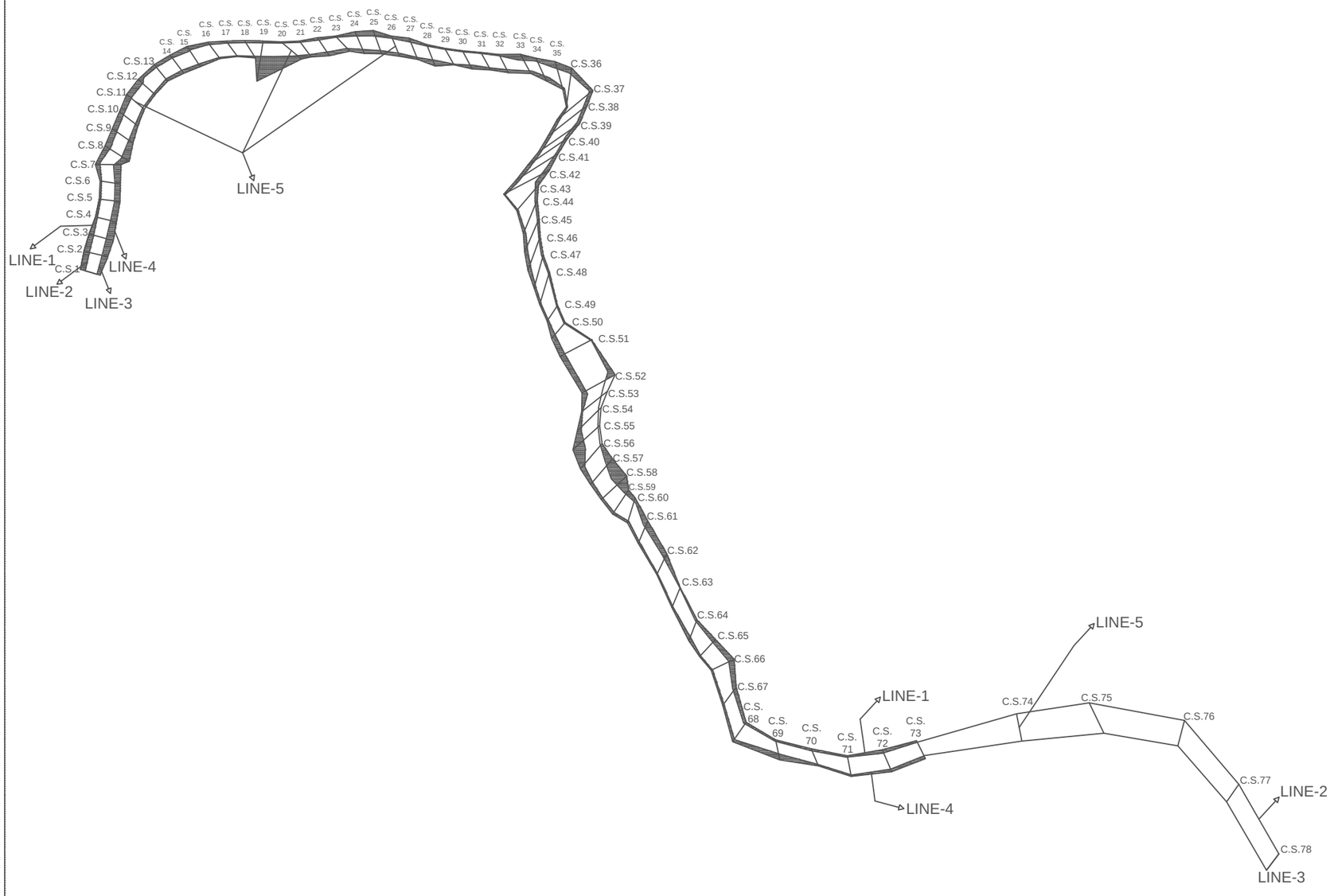
Fig.3.4 LINE DIAGRAM OF SHOGHI ROAD OBTAINED FROM TOTALSTATION SURVEY DATA



S.No.	Line Description	SYMBOL
1.	Outter most points at the Left side	LINE-1
2.	Left side of the road (black top)	LINE-2
3.	Right side of the road (black top)	LINE-3
4.	Outter most points at the Right side	LINE-4

Note:- (Moving from 'Housing board colony Gate No.2,Shoghi' TO 'The Starting of Bye Pass Road to Mehli from Shoghi').

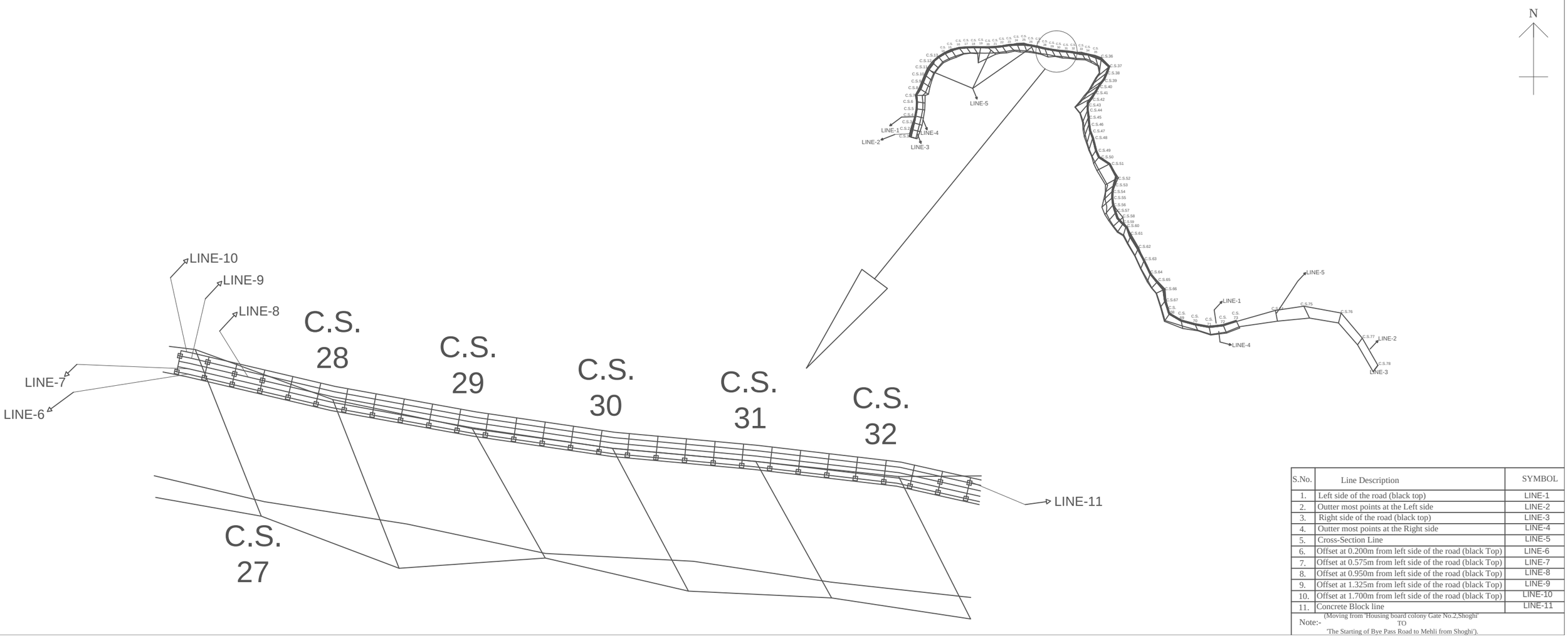
Fig.3.5 LINE DIAGRAM OF SHOGHI ROAD SHOWING CROSS-SECTIONS OF SURVEY DATA



S.No.	Line Description	SYMBOL
1.	Outter most points at the Left side	LINE-1
2.	Left side of the road (black top)	LINE-2
3.	Right side of the road (black top)	LINE-3
4.	Outter most points at the Right side	LINE-4
5.	Cross-Section Line	LINE-5

Note:- (Moving from 'Housing board colony Gate No.2,Shoghi' TO 'The Starting of Bye Pass Road to Mehli from Shoghi').

Fig.3.6 LINE DIAGRAM OF SHOGHI ROAD SHOWING STEEL SECTION OFFSETS AT A DISTANCE OF 0.20m,0.575m,0.950m,1.325m,1.7m FROM THE LEFT-SIDE BLACK TOP WITH REQUIRED CONCRETE BLOCKS



S.No.	Line Description	SYMBOL
1.	Left side of the road (black top)	LINE-1
2.	Outter most points at the Left side	LINE-2
3.	Right side of the road (black top)	LINE-3
4.	Outter most points at the Right side	LINE-4
5.	Cross-Section Line	LINE-5
6.	Offset at 0.200m from left side of the road (black Top)	LINE-6
7.	Offset at 0.575m from left side of the road (black Top)	LINE-7
8.	Offset at 0.950m from left side of the road (black Top)	LINE-8
9.	Offset at 1.325m from left side of the road (black Top)	LINE-9
10.	Offset at 1.700m from left side of the road (black Top)	LINE-10
11.	Concrete Block line	LINE-11

Note:- (Moving from 'Housing board colony Gate No.2,Shoghi' TO 'The Starting of Bye Pass Road to Mehli from Shoghi').

CHAPTER-4

DESIGNING & ANALYSIS

4.1 GENERAL

In the designing part we decided that we will be doing the designing of the sidewalk in two parts:-

PART I- Providing steel sections from Cross Section No. 1 (Housing Board Colony Gate No.-1) to the Cross section No.73 (At the junction of village road with the National Highway before the start of Shoghi market).

PART II- Providing concrete sidewalk from Cross Section No. 73 to Cross Section No.78

4.2 DESIGN OF STEEL SIDEWALK:-

Here we have decided to take a section of 2.0m x 1.5m for our sidewalk which will be raised from the earth/road surface at a height of 30cm fitted with the supports made of concrete columns of initial proposed height 0.5m and dimensions 0.3m x 0.3m. Our main goal is to make the structure light as far as possible without compromising the load carrying capacity of the structure so that the pedestrians can walk upon the sidewalk without any fear and worry of safety.

The section of 2.0m x 1.5m is a simple frame structure (which is differentiated on the basis of supports) consisting of ISA90x90x8 and steel strips of 2x5cm as horizontal members, ISJC150 of length 0.3m are used as columns for the transferring of loads to the concrete supports buried in the soil. Here, we are taking a load of 6KN/m^2 acting on the section along with the self-weight of the members present in the section and for the analysis of the section we are using '**STAAD.Pro V8i**' version 2007.

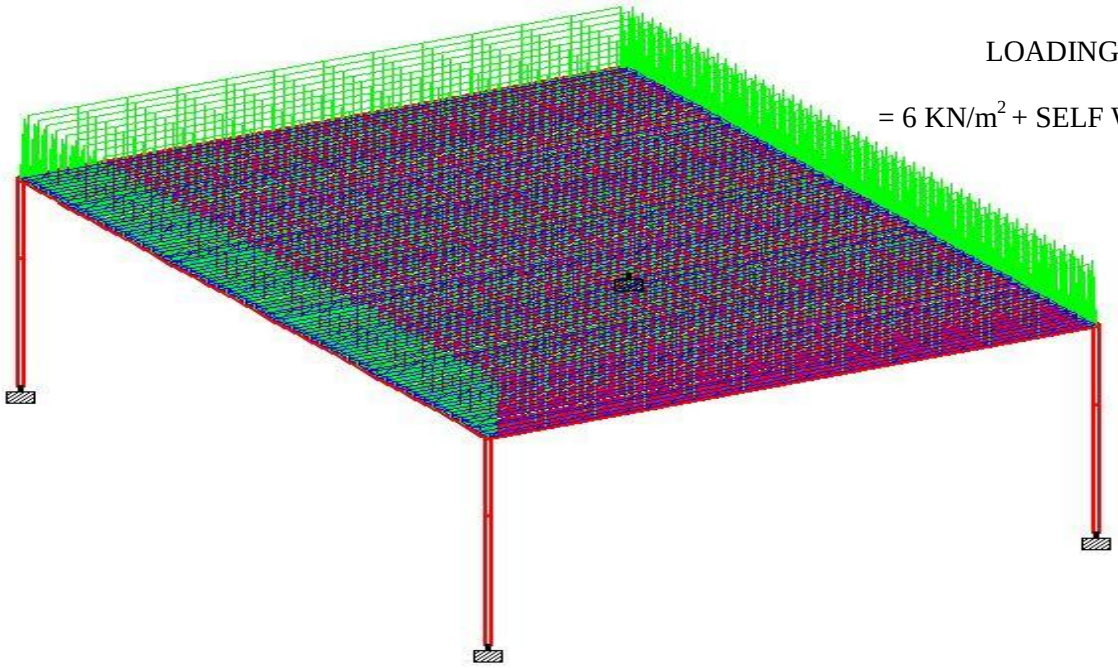


Fig.4.1Loading Conditions

4.2.1 TYPES OF STEEL SECTIONS

Based on the support conditions we have classified the section into 16 categories as follows:-

TYPE No.	STARTING SUPPORT OF CROSS-SECTION	ENDING SUPPORT OF CROSS-SECTION	NUMBER OF CROSS-SECTION ACCORDING TO **APPENDIX-C**
1.	FIXED	FIXED	124
2.	FIXED	P.C.1	11
3.	FIXED	P.C.2	2
4.	FIXED	CANTILEVER	0
5.	P.C.1	FIXED	10
6.	P.C.1	P.C.1	26
7.	P.C.1	P.C.2	10
8.	P.C.1	CANTILEVER	1

TYPE No.	STARTING SUPPORT OF CROSS-SECTION	ENDING SUPPORT OF CROSS-SECTION	NUMBER OF CROSS-SECTION ACCORDING TO **APPENDIX-C**
9.	P.C.2	FIXED	1
10.	P.C.2	P.C.1	12
11.	P.C.2	P.C.2	53
12.	P.C.2	CANTILEVER	10
13.	CANTILEVER	FIXED	0
14.	CANTILEVER	P.C.1	0
15.	CANTILEVER	P.C.2	10
16.	CANTILEVER	CANTILEVER	167

Table 4.1 Loading Condition Summary

Where,

1. P.C.1 i.e. Propped Cantilever 1:-
   Fixed Support is at 1.125m from the starting end moving transversely on sidewalk along 1.5m.
2. P.C.2 i.e. Propped Cantilever 2:-
   Fixed Support is at 0.75m from the starting end moving transversely on sidewalk along 1.5m.

Though the designing of these types of sections was easy but it would be very difficult for the manufacturer to create and fix these 16types of sections. So we decided to take only three of the sections and replace the others with them. The sections chosen as models were:-

1. **TYPE-1 (FIXED-FIXED) Support Section (124No.)**
2. **TYPE-11 (P.C.2-P.C.2) Support Section (146No.)**
3. **TYPE-16 (CANTILEVER-CANTILEVER) Support Section (167No.)**

Also we have to provide openings, for example near the Good Luck Restaurant at cross section 26-28, near the road to Primary Health Center at cross section 38-39 and at the road to primary school at cross section 52-53. All these openings are accounted in the following estimate part of report. The Staad-Editor code are given in **APPENDIX-D**.

In all the models to maintain uniformity we have used the following specifications:-

S.No.	NAME OF ITEM	DIMENSIONS	LENGTH	MATERIAL	USED IN
01.	Concrete Column	0.3mx0.3m	0.5m	Concrete	All the sections accordingly
02.	Horizontal Strips	0.2mx0.5m	1.5m	Steel	All the Sections
03.	ISA 90x90x8[6]	90mmx90mmx8mm	1.5m	Steel	All the Sections
			0.81m		Model 2
			2.12m		Model 3
04.	ISJC150[6]	h=150mm b=55mm t_f= 6.9mm t_w=3.6mm	0.3m	Steel	All the Sections
05.	ISA 50x50x5[6]	50mmx50mmx5mm	2.0m	Steel	Guard Rail
			1.3m		
06.	Steel Bars	20mm-ϕ	1.0m	Steel	Guard Rail

Table 4.2 Specifications Table

4.2.1.1 MODEL-1 (FIXED-FIXED) Support Section (124 No.):-

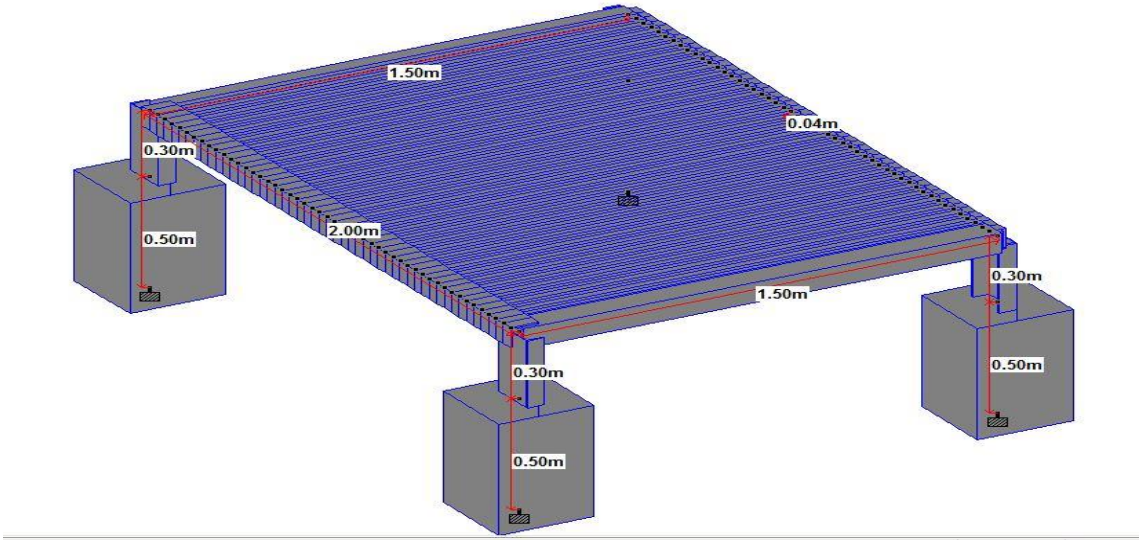


Fig.4.2Model-1 Showing Dimensions

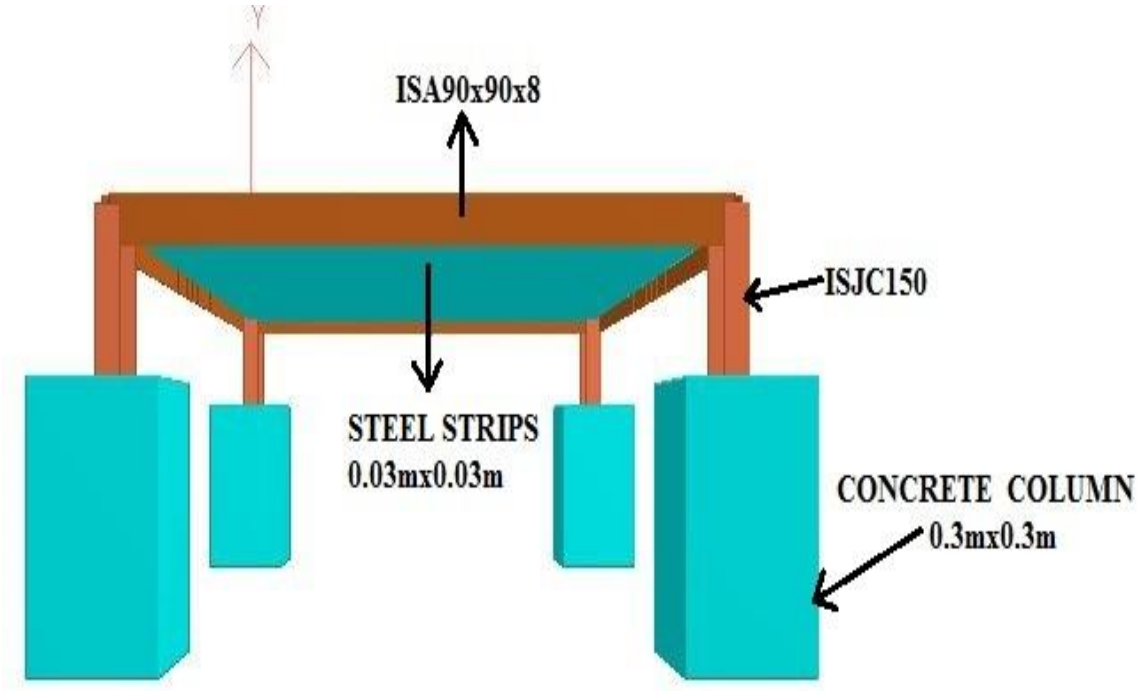


Fig.4.3 Model-1 showing member properties

4.2.1.2 MODEL-2 (P.C.2-P.C.2) Support Section (146No.):-

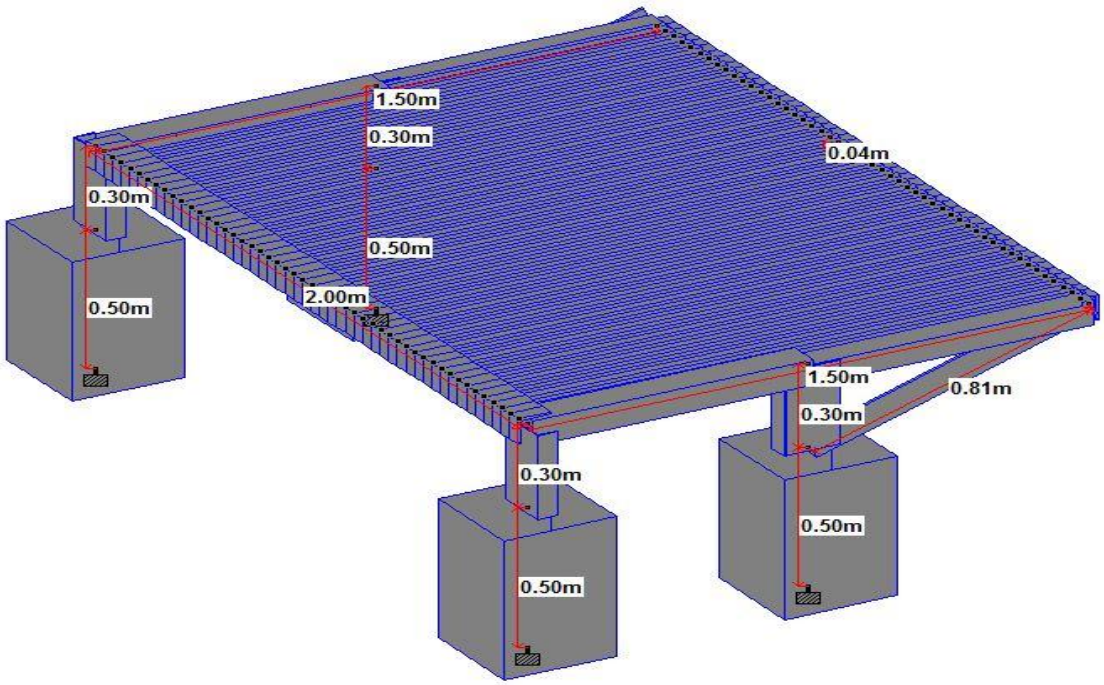


Fig.4.4 Model-2 Showing Dimensions

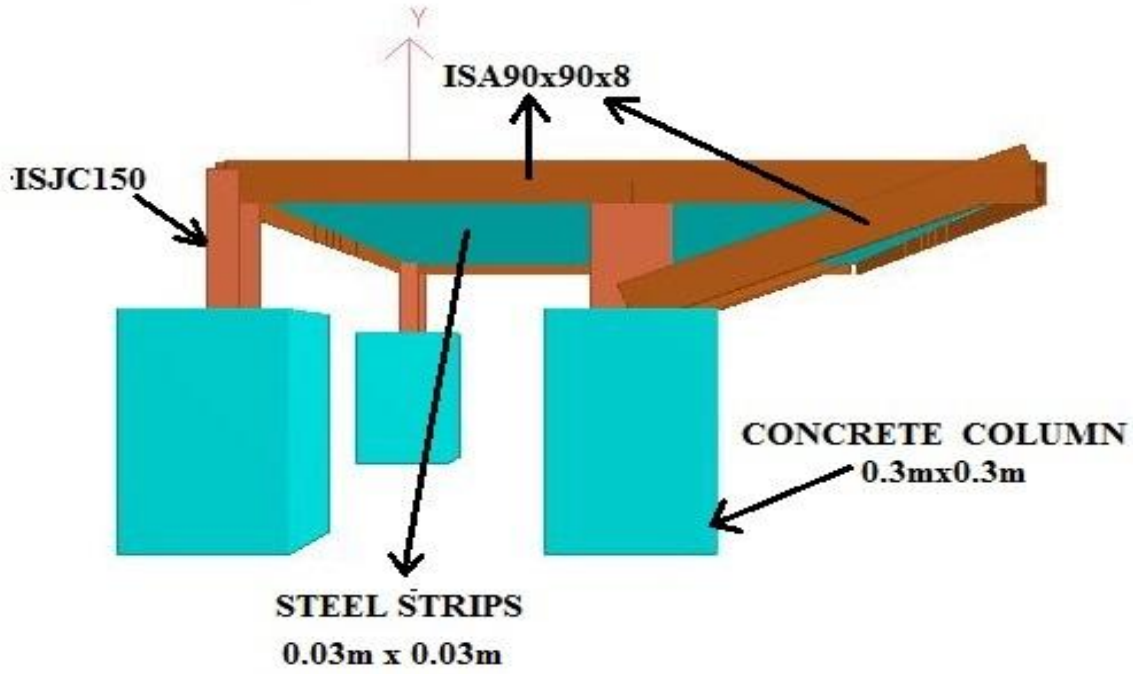


Fig.4.5 Model-2 showing member properties

4.2.1.3 MODEL-3 (CANTILEVER-CANTILEVER) Support Section (167No.):-

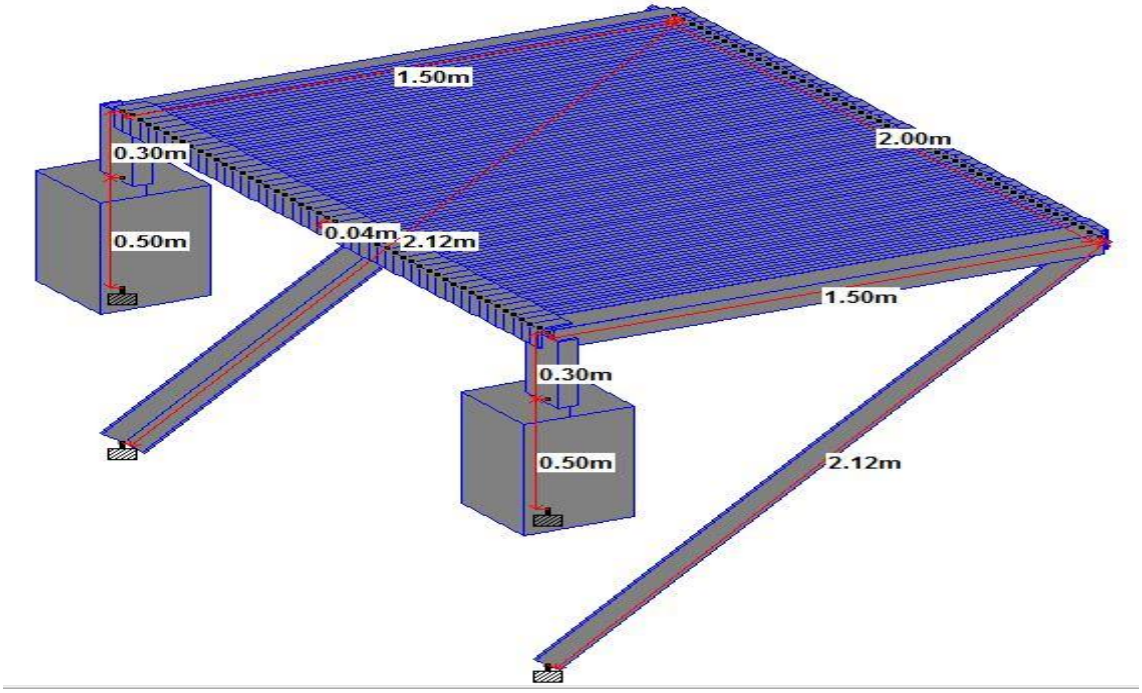


Fig.4.6 Model-3 Showing Dimensions

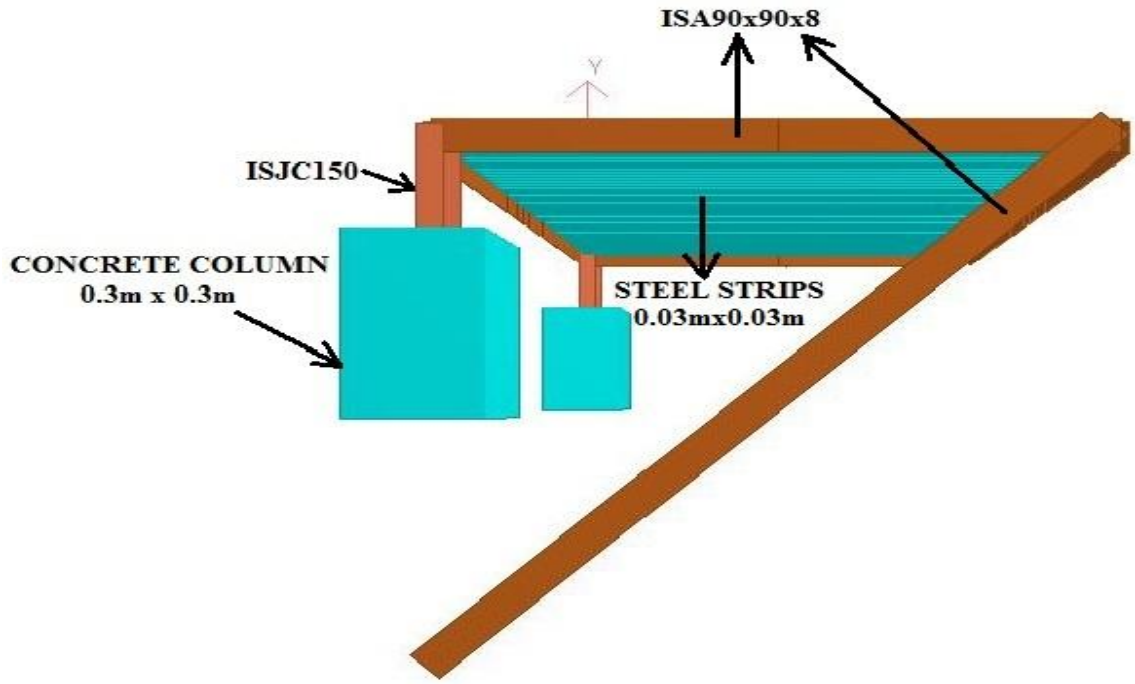


Fig.4.7 Model-3 showing member properties

4.2.1.4 GUARD RAIL:-

Pedestrian guard rails are an important design element

1. To prevent indiscriminate crossing and
2. To prevent spilling over of pedestrians on to the carriage way.

The design of guard rails should be neat; simple in appearance and as far as possible should be vandal proof. Two aspects which need special consideration are the height of hand rail and the obstruction to visibility. The visibility of the approaching vehicles by the pedestrians as well as the visibility of the pedestrians by the drivers of the approaching vehicles should be adequate. The guard rails should be sturdy but slender design.

Pedestrian guard rails could normally be considered under the following situations:-

(a) Hazardous locations on straight stretches
(b) At Junctions/Intersections
(c) Schools
(d) Bus Stops, Railway Stations, etc.
(e) Over pass, Subway, etc.
(f) Central reserves.

Provision of Guard-Rails:-

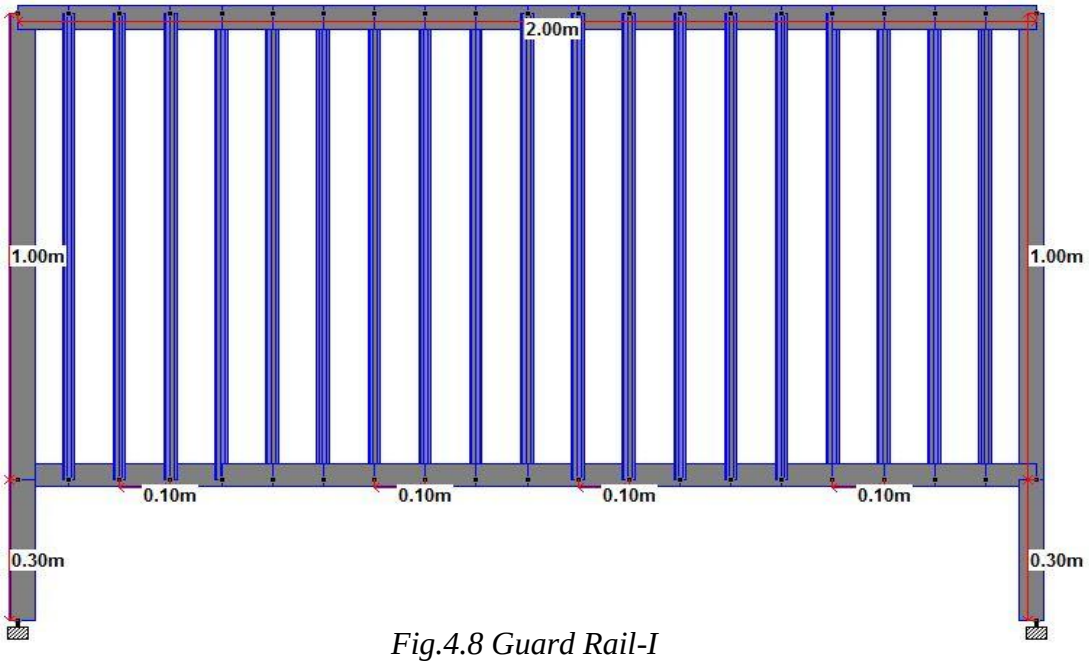


Fig.4.8 Guard Rail-I

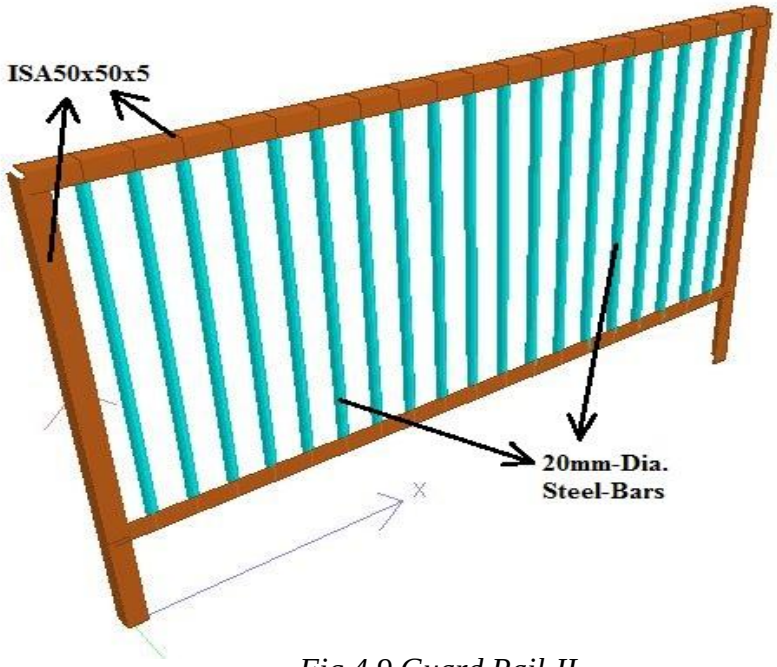


Fig.4.9 Guard Rail-II

Here we'll be providing a section of length 2.0m x 1.3m as shown in *Fig.4.8* and *Fig.4.9.* In the section all the joints are made by welding the members to each other. And the whole sections are joined to each other as shown in *Fig4.10*.

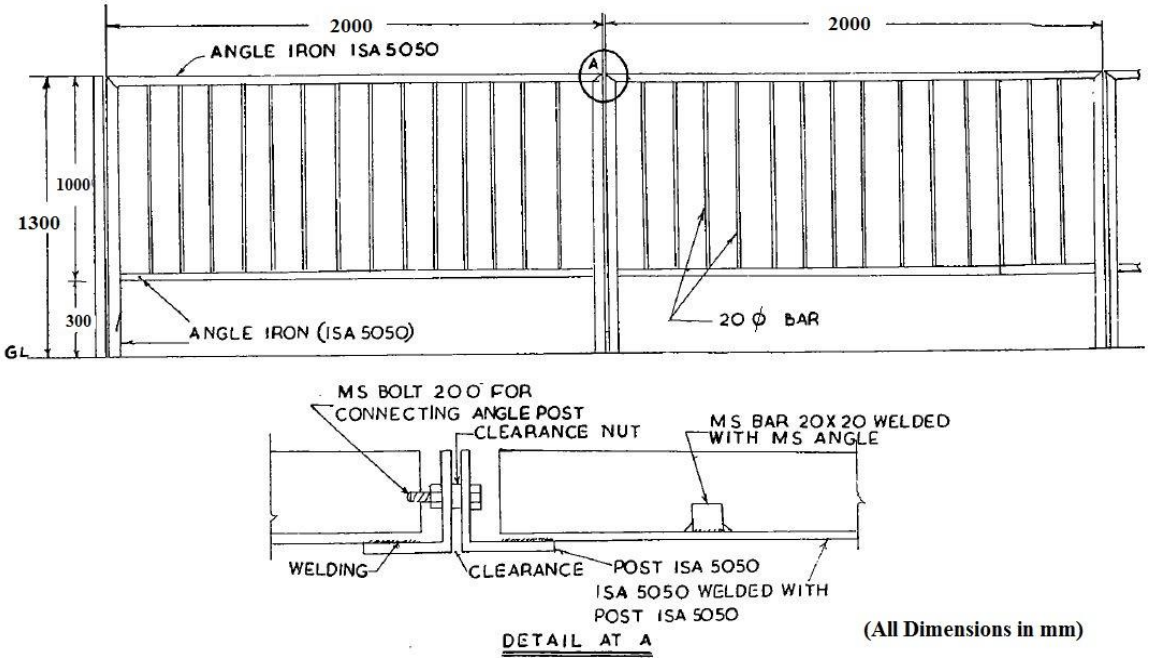


Fig.4.10 Guard Rail-Joint Section

Other Considerations:-

- There will be no gaps in between the guard rails.
- Also, guard rails will be providing on both the sides of the sidewalk.

4.3 DESIGN OF CONCRETE SIDEWALK [6]:-

The concrete sidewalk will be provided from the Cross-Section No.73 to Cross-Section No.78 i.e. for the whole market area. Following are the few considerations:-

- Width of the Sidewalk = 2.0m
- Height of the Sidewalk = 30 cm
- Transverse Slope of the Side Walk =1:15
- Grade of Concrete Used = M20 (1:1.5:3)
- Water/Cement Ratio= 0.5
- Calculation of dry materials:-
    - Ratio=1:1.5:3
    - Sum= 1+1.5+3 = 5.5
    - Total dry mortar for $1m^3$ of cement concrete = $1.20m^3$
      (Considering a wastage of 20%)
    - Therefore the materials required for $1m^3$ of cement concrete are:-
        - Cement = $\frac{\mathbf{1*1.20*28.8}}{\mathbf{5.5}}$ = 6.284 bags
        - Sand = $\frac{\mathbf{2.65*1.20}}{\mathbf{5.5}}$ = 0.578 m^3
        - Aggregates = $\frac{\mathbf{2.8*1.20}}{\mathbf{5.5}}$ = $0.611m^3$
        - Volume of Water for $1m^3$ of Concrete = $\frac{6.284x0.5x50}{1000}$ = $0.1571m^3$

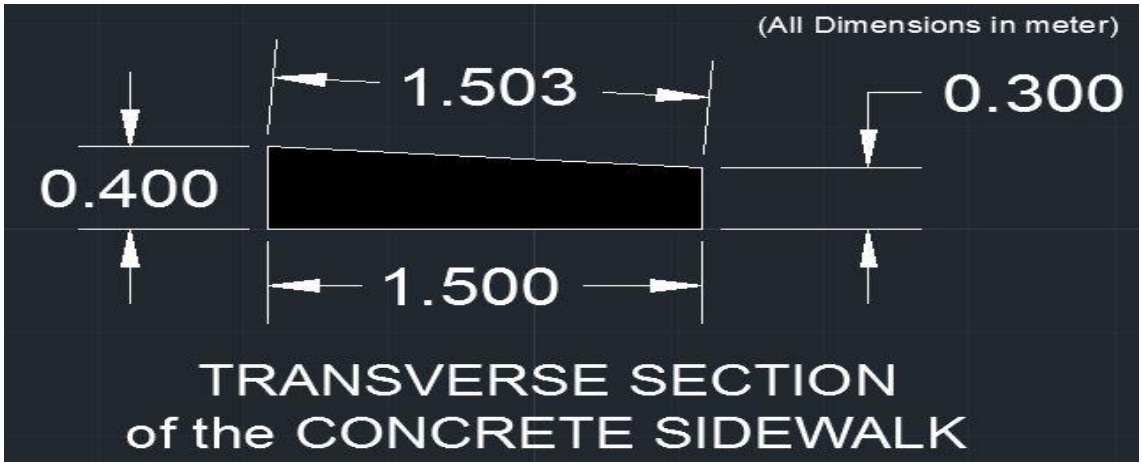


Fig.4.11 Transverse Section of the concrete sidewalk

- Determination of Length of Sidewalk covered with $1m^3$ of concrete:-
  - Area of Cross-Section as shown in *Fig.4.11* = $\frac{1}{2}$x(0.3+0.4) x 1.5 **=0.525m^2**
  - $0.525m^2$ x (Length of Sidewalk) = $1m^3$

    $\Longrightarrow$ Length of Sidewalk = $\frac{1}{0.525}$ = 1.905m
- Total volume of concrete required for sidewalk of width 1.5m and length 150m

  = $\frac{150}{1.905}$ m^3 = **78.74 m^3**
- Also concrete required to make the supports columns (656 No.) of length 0.5m and dimensions 0.3mx0.3m = 656 x 0.3 x 0.3x 0.5 =**29.52 m^3**
- So net volume of concrete required = 29.52+78.74 = **108.26 m^3**

4.4 CALCULATION OF LENGTH OF WELD[5]

We calculated the length of Weld using the MACROS feature of MS-Excel in which we used as follows:-

```
Sub WELDED()

'Enter data
fu = Cells(3, 5)
fy = Cells(4, 5)
Gmw = Cells(5, 5)
'thickness of plate t'
t = Cells(6, 5)
'Angle of Weld A'
A = Cells(7, 5)
'Force to be handled F'
F = Cells(8, 5)

Smin = 0
'Size of Weld,S'
If 0 < t And t <= 10 Then
   Smin = 3
ElseIf 11 < t And t <= 20 Then
   Smin = 5
ElseIf 21 < t And t <= 32 Then
   Smin = 6
ElseIf 33 < t And t <= 50 Then
   Smin = 8
GoTo Skip1
End If

Skip1:
Cells(10, 5) = Smin
```

```
TT = 0
'Throat thickness TT'
If 60 <= A And A <= 90 Then
   TT = 0.7 * Smin
ElseIf 91 <= A And A <= 100 Then
   TT = 0.65 * Smin
ElseIf 101 <= A And A <= 106 Then
   TT = 0.6 * Smin
ElseIf 107 <= A And A <= 113 Then
   TT = 0.55 * Smin
ElseIf 114 <= A And A <= 120 Then
   TT = 0.5 * Smin
Else
   GoTo Skip2
End If


Skip2:
Cells(11, 5) = TT

'Length of Weld L'
L = (F * ((3) ^ 0.5) * Gmw) / (fu * TT)
Cells(13, 5) = L

'Total Length of Weld'
TL = L + (2 * Smin)
Cells(14, 5) = TL
```

End SubExample data is shown in *Table 4.3*

S.No.	ENTITY	SYMBOL	VALUES	SYMBOLS
1	f_u		= 410	N/mm^2
2	f_y		= 250	N/mm^2
3	γ_{mw}		= 1.5	
4	Thickness of Plate	t	= 8	mm
5	Angle of Weld	A	= 90	degree
6	Force to be handled	F	= 6120	N
7	Minimum Size of Weld	S	= 3	mm
8	Throat Thickness	T	= 2.1	mm
9	Length of Weld	L	= 18.5	mm
10	Total Length of Weld	L+2S	= 24.5	mm

Table 4.3 Length of Weld for Model-1

4.5 CALCULATION OF DEVELOPMENT LENGTH[4][5]

We calculated the length of Weld using the MACROS feature of MS-Excel in which we used as follows:-

```
Sub DevelopmentLength()

'Enter Data

'Area of Cross Section,A

A = Cells(3, 5)

'perimeter of Cross Section,p

P = Cells(4, 5)

fvd = Cells(5, 5)
```

```
 If Cells(6, 5) = "YES" And Cells(7, 5) = "M10" Then
        Tbd = 1.2
    Else
        GoTo Skip0
    End If
Skip0:
    If Cells(6, 5) = "YES" And Cells(7, 5) = "M20" Then
        Tbd = 1.2 + (0.2 * 1.2)
    Else
        GoTo Skip1
    End If
Skip1:
    If Cells(6, 5) = "YES" And Cells(7, 5) = "M25" Then
        Tbd = 1.4 + (0.2 * 1.4)
    Else
        GoTo Skip2
    End If
Skip2:
    If Cells(6, 5) = "YES" And Cells(7, 5) = "M30" Then
        Tbd = 1.5 + (0.2 * 1.5)
    Else
```

```
        GoTo Skip3
    End If
Skip3:
    If Cells(6, 5) = "YES" And Cells(7, 5) = "M35" Then
        Tbd = 1.7 + (0.2 * 1.7)
    Else
        GoTo Skip4
    End If
Skip4:
    If Cells(6, 5) = "YES" And Cells(7, 5) = "M40" Then
        Tbd = 1.9 + (0.2 * 1.9)
    Else
        GoTo Skip5
    End If
Skip5:
    If Cells(6, 5) = "NO" And Cells(7, 5) = "M20" Then
        Tbd = 1.2
    Else
        GoTo Skip6
    End If
Skip6:
```

```
    If Cells(6, 5) = "NO" And Cells(7, 5) = "M25" Then
        Tbd = 1.4
    Else
        GoTo Skip7
    End If
Skip7:
    If Cells(6, 5) = "NO" And Cells(7, 5) = "M30" Then
        Tbd = 1.5
    Else
        GoTo Skip8
    End If
Skip8:
    If Cells(6, 5) = "NO" And Cells(7, 5) = "M35" Then
        Tbd = 1.7
    Else
        GoTo Skip9
    End If
Skip9:
    If Cells(6, 5) = "NO" And Cells(7, 5) = "M40" Then
        Tbd = 1.9
    End If
```

Cells(8, 5) = Tbd

'Development Length,Ld

Ld = (A * fvd) / (Tbd * P)

Cells(10, 5) = Ld

'Force in the Member,F

F = Cells(12, 5)

'Required Development Length,RLd

RLd = (A * F) / (Tbd * P)

Cells(13, 5) = RLd

End Sub

Example data is shown in *Table 4.4*

S.No.	ENTITY	SYMBOLS	VALUES	UNITS
1	Area of Cross Section	A	= 1265	mm^2
2	Perimeter of Cross Section	P	= 512.8	mm
3	f_{vd}		= 250	N/mm^2
4	Whether it is a compression member?		= YES	
5	Grade of concrete		= M20	
6	τ_{bd} [4]		= 1.44	N/mm^2
7	Maximum Development Length	L_d	= 428.27	mm
8	Stress in the member	F	= 45.404	N/mm^2
9	Required Development Length	L_d required	= 77.8	mm

Table 4.4 Development Length for Model-1

CHAPTER-5

ESTIMATION & COSTING

5.1 GENERAL

In this chapter we have done quantity estimation and based on that we have calculated the cost for the whole project using the 'Standard Schedule of Rates 2009 – HIMACHAL PRADESH PUBLIC WORKS DEPARTMENT (Building Civil Works)'.

5.2 ESTIMATE OF QUANTITIES

Detail of Measurements									
Name of Work- Proposed Sidewalk along the Ambala-Shimla National Highway-5 at Shoghi , Himachal Pradesh of Length 1.1 Km.									
S.No.	**Description of Items**	**Nos.**		**L (m)**	**B (m)**	**H/D (m)**	**QTY. (m)**		**REMARKS**
		SEC.	**SIDE**						
1	**AMOUNT OF STEEL IN WELDED BUILT-UP SECTIONS FOR STEEL SIDE WALK**								
(a)	**MODEL 1**								
(i)	ST ISJC150	122		1.2			146.4	**Rmt.**	122*1.2
(ii)	ST ISA90*90*8	122		7			854	"	122*7
(iii)	PRISMATIC STEEL (39strips per section) (0.03x0.03m)	122		58.5			7137	"	122*58.5
(b)	**MODEL 2**								
(i)	ST ISJC150	128		1.2			153.6	"	128*1.2
(ii)	ST ISA90*90*8	128		8.62			1103.36	"	128*8.62
(iii)	PRISMATIC STEEL (39strips per section) (0.03x0.03m)	128		58.5			7488	"	128*58.5

S.No.	Description of Items	Nos.		L (m)	B (m)	H/D (m)	QTY. (m)		REMARKS
		SEC.	SIDE						
(c)	**MODEL 3**								
(i)	ST ISJC150	155		0.6			93	"	155*0.6
(ii)	ST ISA90*90*8	155		11.24			1742.2	"	155*11.24
(iii)	PRISMATIC STEEL (39strips per section) (0.03x0.03m)	155		58.5			9067.5	"	155*58.5
(d)	**GUARD RAIL**								
(i)	ST ISA50*50*5	810		6.6			5346	"	810*6.6
(ii)	Steel bar of 20mm dia	810		19			15390	"	810*19
(e)	**DEVELOPMENT LENGTH**								
(i)	**Model 1**								
	ST ISJC150	488		0.0778			37.966	"	488*0.078
(ii)	**Model 2**								
	ST ISJC150	512		0.1205			61.696	"	512*0.121
	SLANT ST ISA90*90*8	256		0.2471			63.258	"	256*0.247
(iii)	**Model 3**								
	ST ISJC150	310		0.277			85.87	"	310*0.277
	SLANT ST ISA90*90*8	310		0.2378			73.718	"	310*0.238
(f)	**LENGTH of WELD**								
(i)	**Model 1**								
	At the junction of 3 members	488	3	0.0245			35.868	"	488*3*0.025
	Between the strips & the standard angle	4758	2	0.0245			233.142	"	39*122*2* 0.0245
(ii)	**Model 2**								
	At the junction of 3 members	512	3	0.0245			37.632	"	4*128*3* 0.0245
	Between the strips & the atandard angle	4992	2	0.0245			244.608	"	39*128*2* 0.0245
	Between the slant angle & horizontal angle	128	2	0.0426			10.906	"	128*2*0.042 6*10.9056
(iii)	**Model 3**								
	At the junction of 3 members	620	3	0.0269			50.034	"	155*4*3* 0.0269

S.No.	Description of Items	Nos.		L (m)	B (m)	H/D (m)	QTY. (m)		REMARKS
		SEC.	SIDE						
	Between the strips & the angle	6045	2	0.0269			325.221	"	39*155*2* 0.0269
	Between the slant angle & horizontal angle	155	2	0.0269			8.339	"	155*2* 0.0269
(iv)	**Guard rail**								
	20mm dia bars connected to ISA50*50*8	19	2	0.1256			4.773	"	19*2*0.1256

(g)	**NUMBER OF BOLTS (MS20mm DIA) USED IN GUARD RAIL CONNECTIONS**	810	1				810	**No.**	

NET QUANTITY ESTIMATE FOR STEEL SIDEWALK									
S.No.	Description of Items	Nos.		QTY.		WT./ MTR. (Kg/ Rmt.)	NET QTY.		REMARKS
		SECT.	SIDE						
1	ST ISJC150	405		393	Rmt.	9.9	3891	**Kg**	393*9.9
2	ST ISA90*90*8	405		3699.56	Rmt.	10.8	39955	**Kg**	3699.568* 10.8
3	PRISMATIC STEEL (39strips per section) (0.03x0.03m)	405		23692.5	Rmt.	7.065	167388	**Kg**	23692.4* 7.065
4	ST ISA50*50*5	810		5346	Rmt.	3.8	20314.8	**Kg**	5346* 3.8
5	Steel bar of 20mm dia	810		15390	Rmt.	2.47	38013.3	**Kg**	15390* 2.47
6	Welding Rods (No.) 45cm long & 4mm thick			950.5224	Rmt.		2112	**RODS**	1156.41/ 0.45
7	MS 20mm-dia Bolts	810		810	No.		810	**No.**	

Table 5.1 Quantity estimate for steel section sidewalk

Earlier in Chapter-4 we calculated that $1m^3$ of concrete can be used for 1.905m length of sidewalk and whole length will require a total volume of $78.74m^3$ and steel section requires $29.52m^3$ of concrete of Grade M20.So, the required weight of concrete's constituents are shown in Table5.2

NET QUANTITY ESTIMATE FOR CONCRETE SIDEWALK						
S.No.	**Description of Items**	**QTY. USED PER m^3 OF CONCRETE**		**NET QTY. For $108.26m^3$ of concrete**		**REMARKS**
1	Cement Bags	6.284	bags	**680**	**bags**	6.284*108.26
2	Coarse Aggregates	0.578	m^3	**63**	**m^3**	0.578*108.26
3	Fine Aggregates	0.611	m^3	**66**	**m^3**	0.611*108.26
4	Water	0.1571	m^3	**17**	**m^3**	0.1571*108.26

Table 5.2 Quantity estimate for concrete section sidewalk

5.3 ESTIMATE OF COST

ABSTRACT OF COST[10]					
Name of Work- Proposed Sidewalk along the Ambala-Shimla National Highway-5 at Shoghi , Himachal Pradesh of Length 1.1 Km.					
S.No.	PARTICULARS	Quantity	Unit	Rate	Amount (Rs.)
1	ST IS JC150	3891	Kg	Rs.43/Kg	167313
2	ST ISA90*90*8	39955	Kg	Rs.43/Kg	1718065
3	Prismatic Steel (0.03mx0.03m)	167388	Kg	Rs.43/Kg	7197684
4	ST ISA50*50*5	20314.8	Kg	Rs.43/Kg	873536.4
5	Steel Bar of 20mm dia.	38013.3	Kg	Rs.43/Kg	1634572
6	Welding Rod(45 cm long and 4 mm thick)	2112	Rods	Rs5/rod	10560
7	MS 20mm-dia Bolts	810	Bolts	Rs45/10Bolts	3645
8	Cement Bags	680	Bags	Rs.310/Bag	210800
9	Coarse Aggregates	63	m^3	Rs.581/m^3	30793
10	Fine Aggregates	66	m^3	Rs.300/m^3	19800
11	Water	17	m^3	1.5 % to 2% of total cost of concrete	5227.86

S.No.	PARTICULARS	Quantity	Unit	Rate	Amount (Rs.)
				TOTAL	11871996
12	Contractor's Profit	10% Total Cost			1187200
				GRAND TOTAL	**1,30,59,196**
Cost of the project =One Crore Thirty Lacs Fifty Nine Thousand One Hundred Ninety Six Rupees only.					

Table 5.3 Abstract of Cost

CHAPTER-6

PROPOSED AMMENDEMENTS

6.1 PROVISION FOR ZEBRA CROSSINGS AT SHOGHI[3]

We are proposing two zebra crossings at the Shoghi highway. It will be provided at the major points where there is an immense need for the pedestrian to cross the road.

- **LOCATION OF ZEBRA CROSSINGS**
  - Near the housing board colony gate no 2 (between cross section 50-51)
  - Main market along the bus stand.(between cross section 74-75)
- **WIDTH OF ZEBRA CROSSINGS**
  - Near the housing board colony gate no 2 (between cross section 50-51) – 2m
  - Main market along the bus stand.(between cross section 74-75) – 3.5m
- **WIDTH OF BLACK AND WHITE STRIPS IN ZEBRA CROSSINGS**
  - 30-50cm

Fig.6.1 Zebra-Crossing near the housing board colony at Gate No.2 (between cross section 50-51)

Fig.6.2 Zebra-Crossing at the main market (between cross section 74-75)

6.2 PROVISION FOR SPEED-BREAKERS AT SHOGHI[2]

- **LOCATION OF SPEED-BREAKERS:-**
  - The curve where visibility is less (Between cross section 30-31).
  - 50m before the zebra crossing i.e. near the housing board colony gate no.2 (Between cross-sections 45-46).
  - 50m after zebra crossing (At cross-section 56).
  - 100m away from bus stand (Between cross-sections 76-77).

Fig.6.3 Speed-Breaker near the curve where sight distance is not visible

(Between cross-section30-31)

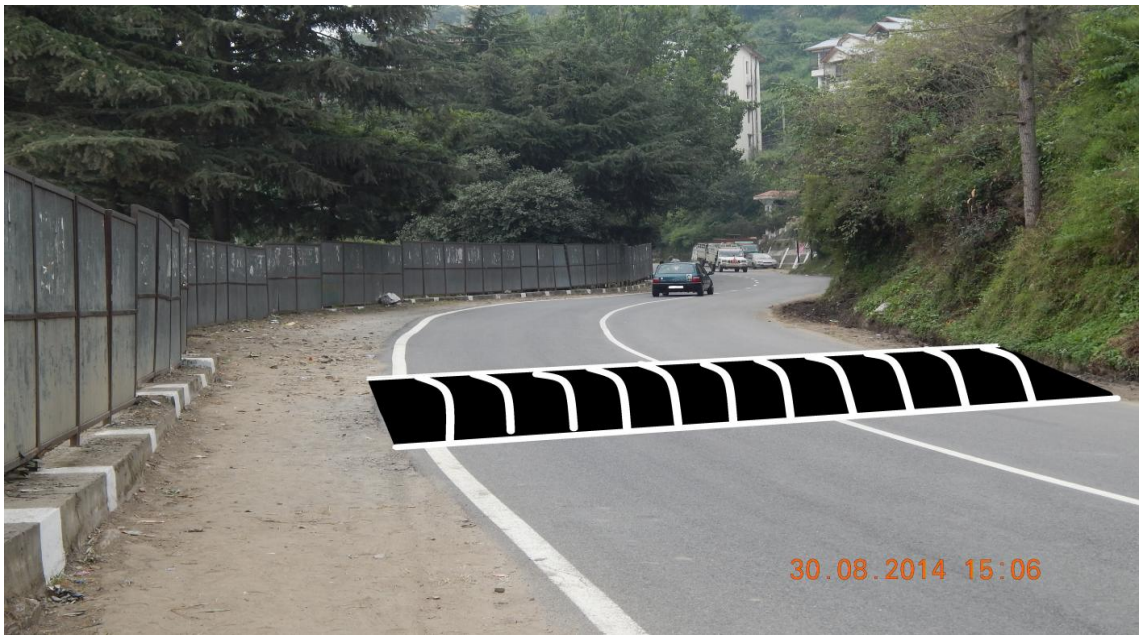


Fig.6.4 Speed-Breaker at 50m before the zebra crossing, near the housing board colony gate no.2 (Between cross-section45-46)

Fig.6.5 Speed Breaker at 50m after zebra crossing (At cross-section 56)

Fig.6.6 Speed-Breaker at 100m away from bus stand

(Between Cross-Section 76-77)

- **DESIGN OF SPEED BREAKERS:-**
  - Speed breakers are formed basically by providing around it (of 17m radius) hump of 3.7m width and 10cm height for the preferred crossing speed of 25 km/h for general traffic.
  - To facilitate appreciable and comfortable passage for larger and heavier vehicle humps may be modified with 1.5m long ramps (1:20) at each edge.
  - The distance between one hump to another can vary from (100-120) m centre to centre.

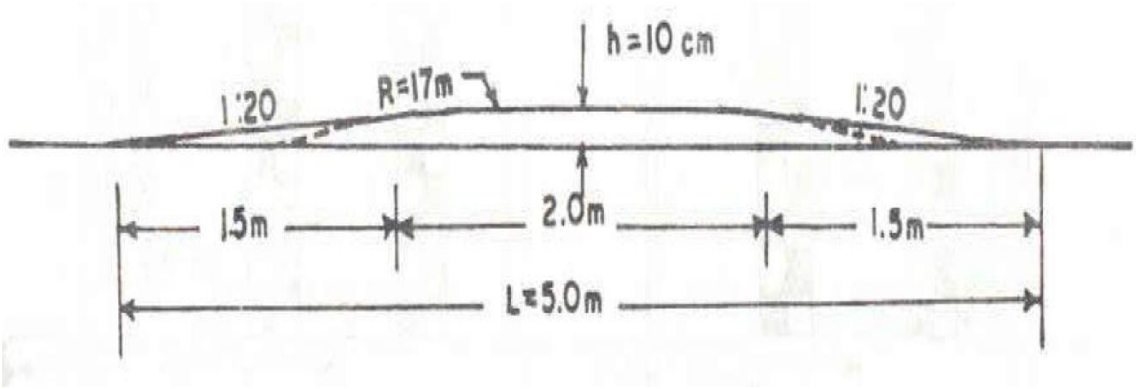


Fig.6.7 Longitudinal Cross-Section of Speed-Breaker

6.3 PROVISION FOR SIGN POST AND MARKINGS[2]

- DRIVERS SHOULD BE WARNED OF THE presence of speed breakers by posting suitable advanced warning signs. The sign should have definition plate with the words 'SPEED BREAKER' and should be located 40m in advance of the first speed breaker.
- Speed breakers should be painted with alternate black and white bands. Embedded cat-eyes can also be used to enhance night visibility**.**
- **SIGN DETAILS:-**
    - Lateral Placement Left :-
        - 0.60m on kerbed roads.
        - 2.3m on unkerbed roads.
    - Mounting Height :-
        - 2.0m on kerbed roads.
        - 1.5m on unkerbed roads.
    - Use reflective paint or strip.
    - Side of triangle- 60cm or 90cm (standard).
    - Red Strip width- 4.5cm or 7.0cm.
    - Post Height- 8cm x 8cm x 0.8cm.
    - T-Iron to be painted white and black in alternate 25cm bands.

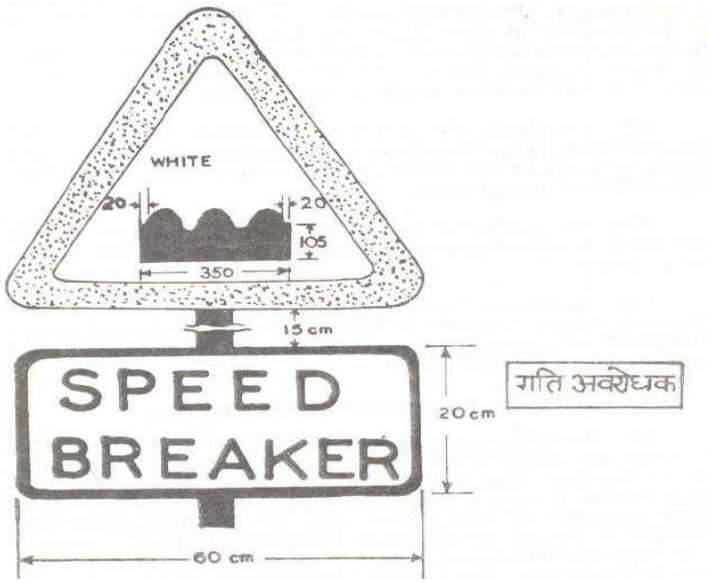


Fig.6.8 Sign Post

CHAPTER-7

RESULTS AND DISCUSSIONS

7.1 RESULTS

- From the Total-Station survey the whole stretch of 1.1Km was divided into a total number of 78 cross-sections of length 10m, 20m and 50m respectively. Also, the data points were obtained in (x, y) format for the layout formation from the total-station survey.
- After preparing the layout in AUTO-CAD, 16 support based models were identified and total number of 437 sections of dimensions 2.0m x 1.5m were classified under these support based models.(up to Cross-Section No.-73).
- A maximum load intensity of 6KN/m^2 was chosen and to make the design as simple as possible, the 16 support based models were incorporated into 3 support based model namely,
    - MODEL-1 (FIXED-FIXED) Support Section (124 No.)
    - MODEL-2 (P.C.2-P.C.2) Support Section (146 No.)
    - MODEL-3 (CANTILEVER-CANTILEVER) Support Section (167 No.)

  which were analyzed for feasibility on Staad.Pro and MS-Excel (Macros).
- The total estimated quantity cost after considering the openings in the side walk for the project came out to be Rs. One Crore Thirty Lacs Fifty Nine Thousand One Hundred Ninety Six Rupees only. Of which 55.11% of the total cost is due to the prismatic steel sections of dimensions (0.03cm x 0.03cm) which are 39 in number per section.
- To provide additional safety features for pedestrian recommendations were provided for zebra-crossing and speed breakers. A total of 2 zebra-crossings and 4 speed-breakers are proposed in the report.

7.2 DISCUSSIONS

The layout obtained from the data points is similar to the 'Google-Earth' maps. So we can say that our obtained layout is correct.

For designing and analysis of the sidewalk a load of 6KN/m^2 was taken which was more than the specified maximum load in IS 875:1987 (Part-2) i.e. 5KN/m^2. It was taken 6KN/m^2 in order to accumulate the load from the pedestrians and for the static load coming from guard rail along with the dynamic load (minor) caused due to the movement of vehicles near the guard rails.

Also the high cost of the project is due to prime condition for maintaining a simple, uniform design. For fulfillment of this condition we have to use heavy sections like ISA90x90x8 and ISJC150 along with prismatic steels members of dimensions 1.5mx0.03mx0.03m and if observed carefully about 55.11% of the cost of the project is due to the prismatic steel member.

But had we used a smaller section as prismatic steel member, all sections were failing under the condition of 'Slenderness Ratio' when the design was checked in reference to IS 800:2007 (for Limit State Design). A steel section rather than 0.03mx0.03m which was not failing under this criteria was 0.02mx0.05m which was adding an additional cost of Rs.28,50,335/- (Rupees Twenty eight lac fifty thousand three hundred thirty five only). So we can say that our designed sidewalk can safely bear a load of 6KN/m^2 and is safe according to the checks of IS 800:2007.

CONCLUSIONS

At the end of this project report we would like to conclude that our designed steel and concrete sidewalk will be able to bear a live load of 6(KN/m^2) safely and efficiently without needing any maintenance atleast for the next 20-25 years. We have designed the sidewalk keeping the future perspective in our mind i.e. population increase, increasing locality, schools, hospitals etc as Shoghi is expanding by leaps and bounds.

Also, after surveying the total stretch of 1.1Km we found that there was not enough space for lying of concrete throughout the stretch. It was only the market place where the concrete sidewalk can be used as by using steel sidewalk we not only increased the cost for the project but also the noise pollution for the area. So we switched for our use of steel sections for the remaining 810m. Though this increased the cost of the project but to have a safe, efficient, uniform and according to code design it was the price we had to pay.

Thus, we would like to conclude that we were able to fulfill our objectives except for giving an economical design but this project taught us a lot. We not only used our knowledge of subjects like surveying, design of steel structures and concrete technology but also helped us to explore more about these subjects and softwares being used in civil engineering like AutoCAD, Staad.Pro , Tekla Structures etc.

FUTURE SCOPE OF WORK

Though much work cannot be done in the surveying and modeling part of the project but there is a scope for doing future work in the design optimization of this project.

Rather than using grating of prismatic steel, the girder and thin chequered plate can be used so as to optimize the cost of the project as our design had 55.11% of total cost of the project because of the use of prismatic steel members. Also one could work on the possibility for making a sidewalk wholly of concrete and reduce the cost to its minimal level.

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APPENDIX-A

PHOTOGRAPHIC SURVEY

FigA.1 Pedestrian walking along the road

Fig.A.2 Children walking towards school

Fig.A.3 Bus moving closely to the unpaved shoulder

Fig.A.4 Motorcycles parked on the road

Fig.A.5 Encroachment by the shopkeepers on the carriage way

Fig.A.6 Loading and unloading on the carriage way

Fig.A.7 Repair work of vehicles on the along the road

Fig.A.8 Open drainage along the road

Fig.A.9 Snapshot of bus station

Fig.A.10 No space to walk for the pedestrian

FigA.11 Snapshot of open drainage

Fig.A.12 traffic jam at Shoghi bypass

Fig.A.13 Vehicles parked along the road

APPENDIX-B

TOTAL STATION SURVEY DATA AND CALCULATED DISTANCES

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.1	0	A1	-0.672	-1.588	0.132	278.0	6.725	174.0	
		A2	0.459	0.952	0.003				
		A3	3.039	7.162	0.035				
		A4	3.755	8.748	0.092				
C.S.2	10	B1	8.171	-6.46	0.255	310.7	7.045	319.3	
		B2	9.426	-3.618	0.072				
		B3	12.55	2.696	0.019				
		B4	14.123	5.475	0.041				
C.S.3	20	C1	17.241	-10.263	0.298	248.8	7.149	393.3	
		C2	18.254	-7.991	0.202				
		C3	21.183	-1.47	0.123				
		C4	22.908	2.065	0.088				
C.S.4	30	D1	26.562	-13.565	0.22	100.5	7.405	332.1	
		D2	27.063	-12.694	0.251				
		D3	29.974	-5.885	0.21				
		D4	31.683	-3.038	0.222				
C.S.5	40	E1	35.299	-18.214	0.281	80.8	7.617	292.3	
		E2	35.732	-17.532	0.283				
		E3	38.798	-10.559	0.353				
		E4	40.182	-7.984	0.356				
C.S.6	50	F1	43.726	-23.298	0.554	85.3	7.405	295.1	
		F2	44.217	-22.6	0.383				
		F3	47.164	-15.807	0.604				
		F4	48.618	-13.239	0.365				
C.S.7	60	G1	49.921	-30.441	0.636	251.5	7.604	406.7	
		G2	51.864	-28.844	0.532				
		G3	55.01	-21.921	0.832				
		G4	57.529	-18.728	0.718				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.8	70	H1	61.225	-31.542	0.695	308.9	8.284	471.8	
		H2	61.951	-28.54	0.745				
		H3	60.159	-20.452	0.942				
		H4	61.5	-15.929	0.804				
C.S.9	80	I1	71.166	-33.453	0.914	276.6	8.524	270.2	
		I2	71.711	-30.741	1.028				
		I3	70.047	-22.381	0.928				
		I4	70.835	-19.796	0.895				
C.S.10	90	J1	81.092	-35.358	1.292	270.7	8.570	164.5	
		J2	81.362	-32.664	1.5				
		J3	79.774	-24.242	1.09				
		J4	80.105	-22.631	0.891				
C.S.11	100	K1	91.145	-37.24	1.678	315.2	8.309	114.7	
		K2	91.312	-34.092	1.872				
		K3	89.62	-25.957	1.36				
		K4	89.66	-24.811	1.305				
C.S.12	110	L1	101.317	-36.598	2.086	322.4	8.133	103.9	
		L2	101.288	-33.374	2.157				
		L3	99.572	-25.424	1.568				
		L4	99.538	-24.386	1.47				
C.S.13	120	M1	106.23	-25.705	2.499	187.6	8.174	151.5	
		M2	104.404	-25.276	2.331				
		M3	96.904	-22.026	1.727				
		M4	95.453	-21.591	1.617				
C.S.14	130	N1	108.522	-15.853	2.515	197.0	8.631	188.7	
		N2	106.567	-15.607	2.45				
		N3	98.634	-12.208	1.919				
		N4	96.776	-11.877	1.741				
C.S.15	140	O1	110.099	-5.561	2.697	283.2	8.928	171.6	
		O2	107.267	-5.564	2.593				
		O3	99.025	-2.133	2.03				
		O4	97.311	-2.209	1.923				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.16	150	P1	102.731	3.156	2.754	140.4	9.305	66.3	
		P2	101.751	2.15	2.692				
		P3	92.561	0.693	2.147				
		P4	92.024	0.304	2.251				
C.S.17	160	Q1	95.223	9.924	2.696	117.4	9.208	53.5	
		Q2	94.445	9.045	2.564				
		Q3	85.353	7.588	2.296				
		Q4	85.121	7.106	2.404				
C.S.18	170	R1	87.56	16.334	2.476	119.1	9.627	97.3	
		R2	86.8	15.417	2.472				
		R3	77.363	13.512	2.385				
		R4	77.006	12.607	2.408				
C.S.19	180	S1	79.534	22.438	2.376	109.7	9.599	1640	
		S2	78.941	21.515	2.404				
		S3	69.553	19.514	2.484				
		S4	68.56	3.143	2.194				
C.S.20	190	T1	71.514	28.232	2.414	76.1	9.390	525.5	
		T2	71.088	27.601	2.331				
		T3	61.852	25.905	2.623				
		T4	56.948	27.792	2.684				
C.S.21	200	U1	63.974	34.764	2.396	70.6	9.064	134.6	
		U2	63.565	34.189	2.259				
		U3	54.606	32.813	2.57				
		U4	53.583	31.938	2.43				
C.S.22	210	V1	57.424	42.193	2.425	137.8	8.726	215.3	
		V2	56.419	41.25	2.253				
		V3	47.774	40.061	2.417				
		V4	46.151	38.646	2.168				
C.S.23	220	W1	50.309	49.04	2.335	73.2	8.555	220.5	
		W2	49.726	48.598	2.349				
		W3	41.229	47.605	2.272				
		W4	39.661	49.155	2.304				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARK
C.S.24	230	Y1	43.232	57.439	2.516	249.6	9.046	221.6	
		Y2	42.161	55.185	2.749				
		Y3	33.465	52.692	2.269				
		Y4	32.037	50.998	2.224				
C.S.25	240	Z1	35.749	63.884	2.669	294.9	9.766	169.5	
		Z2	34.416	61.254	2.623				
		Z3	25.152	58.162	2.257				
		Z4	24.399	56.643	1.976				
C.S.26	250	AA1	26.005	67.528	2.484	121.1	9.839	159.2	
		AA2	25.681	66.361	2.552				
		AA3	16.465	62.916	2.367				
		AA4	15.738	61.5	2.05				
C.S.27	260	BB1	17.617	72.49	2.488	198.5	10.201	102.7	
		BB2	16.886	70.645	2.422				
		BB3	7.366	66.979	2.526				
		BB4	6.925	66.051	2.275				
C.S.28	270	CC1	7.884	75.53	2.442	77.5	9.527	312.6	
		CC2	7.544	74.834	2.377				
		CC3	-1.472	71.756	2.633				
		CC4	-2.921	68.986	2.525				
C.S.29	280	DD1	-1.091	79.804	2.331	50.8	9.647	32.4	
		DD2	-1.383	79.388	2.339				
		DD3	-10.412	75.991	2.724				
		DD4	-10.587	75.718	2.721				
C.S.30	290	EE1	-9.687	84.639	2.235	57.5	9.242	210.7	
		EE2	-9.999	84.156	2.32				
		EE3	-18.936	81.801	2.651				
		EE4	-19.921	79.938	2.436				
C.S.31	300	FF1	-18.189	89.963	2.475	57.5	9.472	109.3	
		FF2	-18.472	89.463	2.453				
		FF3	-27.452	86.45	2.599				
		FF4	-28.142	85.602	2.392				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.32	310	GG1	-26.741	95.156	2.55	68.1	9.313	149.0	
		GG2	-27.039	94.544	2.53				
		GG3	-35.842	91.504	2.591				
		GG4	-36.736	90.312	2.472				
C.S.33	320	HH1	-29.708	84.384	2.99	330.3	9.782	154.4	
		HH2	-26.41	84.566	2.641				
		HH3	-18.875	78.328	2.565				
		HH4	-17.348	78.556	2.561				
C.S.34	330	II1	-27.869	74.585	2.91	154.2	11.640	134.8	
		II2	-26.33	74.683	2.828				
		II3	-16.33	68.725	2.539				
		II4	-15.074	69.215	2.606				
C.S.35	340	JJ1	-27.061	63.931	3.126	325.6	13.396	101.2	
		JJ2	-23.973	64.963	2.995				
		JJ3	-11.508	60.057	2.668				
		JJ4	-10.699	60.665	2.75				
C.S.36	350	KK1	-25.357	54.46	3.411	298.8	18.638	74.1	D23 is increased because of the sharp curvature at the police barrier
		KK2	-22.433	55.076	3.257				
		KK3	-3.899	53.11	2.91				
		KK4	-3.659	53.811	3.026				
C.S.37	360	LL1	-18.901	45.319	3.696	177.5	23.539	117.7	D23 is increased because of the sharp curvature at the police barrier
		LL2	-17.695	46.621	3.575				
		LL3	5.593	50.05	3.273				
		LL4	5.794	51.21	3.77				
C.S.38	370	MM1	-10.455	43.95	3.534	167.1	25.991	133.1	D23 is increased because of the sharp curvature at the police barrier
		MM2	-11.242	45.424	3.651				
		MM3	0.244	68.739	3.598				
		MM4	-0.816	69.544	3.746				
C.S.39	380	NN1	-2.168	51.059	3.821	149.9	26.395	106.4	D23 is increased because of the sharp curvature at the police barrier
		NN2	-3.327	52.009	3.806				
		NN3	6.765	76.399	3.767				
		NN4	5.911	77.033	3.611				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.40	390	OO1	3.313	59.409	3.738	137.0	26.000	177.7	D23 is increased because of the sharp curvature at the police barrier
		OO2	2.325	60.358	3.741				
		OO3	12.593	84.245	3.956				
		OO4	10.985	85.002	4.007				
C.S.41	400	PP1	9.863	67.061	3.958	107.2	26.340	136.4	D23 is increased because of the sharp curvature at the police barrier
		PP2	9.031	67.737	3.894				
		PP3	17.934	92.527	4.077				
		PP4	16.831	93.329	4.179				
C.S.42	410	QQ1	17.069	74.394	4.295	209.7	17.246	116.3	D23 is increased because of the sharp curvature at the police barrier
		QQ2	15.263	75.459	4.165				
		QQ3	17.887	92.504	4.099				
		QQ4	16.915	93.142	4.18				
C.S.43	420	RR1	23.182	82.585	4.428	241.3	17.837	79.0	D23 is increased because of the sharp curvature at the police barrier
		RR2	21.027	83.671	4.36				
		RR3	22.597	101.439	4.223				
		RR4	21.864	101.734	4.065				
C.S.44	430	SS1	30.56	85.626	4.59	144.3	18.184	137.4	D23 is increased because of the sharp curvature at the police barrier
		SS2	30.838	87.042	4.509				
		SS3	46.042	97.017	4.549				
		SS4	45.732	98.356	4.663				
C.S.45	440	TT1	40.481	87.686	4.608	98.9	18.562	166.5	D23 is increased because of the sharp curvature at the police barrier
		TT2	40.323	88.662	4.574				
		TT3	55.728	99.017	4.852				
		TT4	55.558	100.673	4.935				
C.S.46	450	UU1	50.158	90.129	4.679	83.5	18.132	181.3	D23 is increased because of the sharp curvature at the police barrier
		UU2	49.985	90.946	4.623				
		UU3	65.59	100.18	5.014				
		UU4	65.6	101.993	5.137				
C.S.47	460	VV1	60.074	91.55	4.756	101.5	17.777	98.2	D23 is increased because of the sharp curvature at the police barrier
		VV2	59.844	92.539	4.726				
		VV3	75.618	100.737	5.159				
		VV4	75.789	101.704	5.291				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.48	470	WW1	23.964	88.603	4.434	77.9	17.301	79.5	D23 is increased because of the sharp curvature at the police barrier
		WW2	23.188	88.673	4.43				
		WW3	18.659	105.371	4.792				
		WW4	17.887	105.559	4.95				
C.S.49	480	XX1	25.458	98.363	4.626	53.2	17.248	72.4	D23 is increased because of the sharp curvature at the police barrier
		XX2	24.937	98.469	4.628				
		XX3	20.555	115.151	4.93				
		XX4	19.837	115.245	4.895				
C.S.50	490	YY1	27.239	108.085	4.826	66.2	16.989	257.8	D23 is increased because of the sharp curvature at the police barrier
		YY2	26.644	108.376	4.838				
		YY3	22.878	124.942	5.05				
		YY4	20.302	125.041	5.143				
C.S.51	500	ZZ1	29.081	118.069	5.094	53.0	16.640	288.5	D23 is increased because of the sharp curvature at the police barrier
		ZZ2	28.568	118.202	5.086				
		ZZ3	25.355	134.529	5.413				
		ZZ4	22.644	135.516	5.533				
C.S.52	510	AAA1	14.594	135.708	5.312	424.2	16.676	305.4	D23 is increased because of the sharp curvature at the police barrier
		AAA2	14.963	131.482	5.411				
		AAA3	-0.061	124.246	5.804				
		AAA4	-0.082	121.192	5.976				
C.S.53	520	BBB1	4.801	134.36	5.658	273.5	16.385	50.2	At point BBB4, width of truck is to be added to D12 
		BBB2	4.966	131.63	5.548				
		BBB3	-10.044	125.06	6.101				
		BBB4	-10.054	124.558	6.127				
C.S.54	530	CCC1	-4.779	133.615	5.739	139.3	15.806	210.2	At point CCC1,width of truck is to be added to D12 
		CCC2	-5.057	132.25	5.735				
		CCC3	-19.906	126.833	6.365				
		CCC4	-20.673	124.876	6.458				
C.S.55	540	DDD1	-14.343	135.71	5.977	95.8	14.199	677.3	At point DDD1,width of truck is to be added to D12 
		DDD2	-14.667	134.808	5.941				
		DDD3	-28.543	131.796	6.507				
		DDD4	-31.208	125.569	6.844				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.56	550	EEE1	-23.365	139.771	6.185	114.1	14.874	269.0	
		EEE2	-23.893	138.76	6.277				
		EEE3	-38.094	134.335	6.814				
		EEE4	-39.957	132.394	6.937				
C.S.57	560	FFF1	-29.723	147.538	6.289	410.7	13.387	160.8	
		FFF2	-32.216	144.274	6.341				
		FFF3	-45.223	141.106	6.934				
		FFF4	-46.493	140.12	6.76				
C.S.58	570	GGG1	-36.4	157.723	6.739	854.9	11.700	108.1	
		GGG2	-40.2	150.065	6.596				
		GGG3	-51.835	148.829	6.954				
		GGG4	-52.684	148.16	7.639				
C.S.59	580	HHH1	-43.428	160.871	6.735	281.1	12.185	116.9	
		HHH2	-45.463	158.932	6.778				
		HHH3	-57.49	156.978	6.989				
		HHH4	-58.464	156.332	6.946				
C.S.60	590	III1	-46.561	165.547	7.22	277.7	10.743	114.7	
		III2	-49.096	166.681	7.243				
		III3	-51.838	177.068	7.1				
		III4	-52.776	177.728	6.975				
C.S.61	600	JJJ1	-56.465	175.737	7.263	309.7	9.905	101.4	
		JJJ2	-59.012	173.975	7.505				
		JJJ3	-68.882	174.802	7.182				
		JJJ4	-69.796	174.364	7.1				
C.S.62	620	KKK1	-70.644	190.847	8.452	251.1	10.536	50.6	
		KKK2	-72.166	188.85	7.747				
		KKK3	-82.692	189.317	7.591				
		KKK4	-83.083	188.996	7.528				
C.S.63	640	LLL1	-86.209	203.132	7.95	25.9	11.256	69.3	
		LLL2	-86.374	202.933	7.949				
		LLL3	-97.625	202.599	8.113				
		LLL4	-98.026	202.034	7.963				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.64	660	MMM1	-100.38	216.997	8.305	96.9	10.337	170.8	
		MMM2	-101.13	216.389	8.415				
		MMM3	-111.44	217.182	8.537				
		MMM4	-112.71	216.042	9.23				
C.S.65	680	NNN1	-111.87	232.813	8.607	220.3	10.173	71.0	
		NNN2	-113.76	231.672	8.66				
		NNN3	-123.87	232.735	8.775				
		NNN4	-124.49	232.382	8.813				
C.S.66	700	OOO1	-125.09	245.341	9.111	314.5	10.010	78.9	
		OOO2	-122.07	246.24	9.001				
		OOO3	-113.89	240.475	9.238				
		OOO4	-113.13	240.692	9.319				
C.S.67	720	PPP1	-120.58	226.071	9.557	212.7	9.959	89.1	
		PPP2	-118.46	226.265	9.474				
		PPP3	-110.17	220.75	9.602				
		PPP4	-109.29	220.922	9.627				
C.S.68	740	QQQ1	-116.04	206.724	9.696	139.5	10.386	141.3	
		QQQ2	-114.67	206.944	9.67				
		QQQ3	-105.86	201.434	9.885				
		QQQ4	-104.52	200.991	9.895				
C.S.69	760	RRR1	-125.45	190.571	9.854	87.8	8.113	303.0	At point RRR3, [illegible] TRUCK [illegible] be added to D23
		RRR2	-124.86	189.916	9.861				
		RRR3	-124.5	181.811	10.268				
		RRR4	-122.13	179.927	10.326				
C.S.70	780	SSS1	-140.01	176.89	10.079	101.4	8.266	113.8	
		SSS2	-139.3	176.162	10.12				
		SSS3	-138.94	167.904	10.58				
		SSS4	-138.98	166.767	10.641				
C.S.71	800	TTT1	-155.46	164.057	10.324	96.5	10.029	86.8	
		TTT2	-154.68	163.478	10.317				
		TTT3	-152.49	153.691	11.078				
		TTT4	-151.86	153.097	11.149				

CROSS SECTION	Distance from previous C.S.	POINT	N	E	Z	D12 (cm)	D23 (m)	D34 (cm)	REMARKS
C.S.72	820	UUU1	-173.69	157.608	10.586	192.8	9.740	146.2	
		UUU2	-172.85	155.875	10.621				
		UUU3	-172.52	146.141	11.205				
		UUU4	-172.36	144.687	11.362				
C.S.73	840	VVV1	-192.41	152.983	10.738	94.9	8.328	170.0	C.S.73 is marked at 1.5m ahead of the junction where the road is bifercated to Shoghi's industrial area(road in downward direction)
		VVV2	-192.22	152.052	11.041				
		VVV3	-192.33	143.725	11.248				
		VVV4	-191.91	142.08	10.979				
C.S.74	890						15.210		
		WWW2	-147.24	186.131	11.711				
		WWW3	-157.41	197.446	12.121				
C.S.75	940						18.373		C.S.75 Start of Taxi Stand
		XXX2	-118.72	214.317	12.719				
		XXX3	-127.21	230.612	12.301				
C.S.76	990						14.279		
		YYY2	-95.231	261.493	12.783				
		YYY3	-108.43	266.936	12.425				
C.S.77	1040						9.394		
		ZZZ2	-107.53	305.534	13.329				
		ZZZ3	-116.87	306.549	13.476				
C.S.78	1090						11.074		
		AAAA2	-122.56	346.295	14.334				
		AAAA3	-133.63	346.279	14.124				

APPENDIX-C
DETAILED OBSERVATION TABLE FROM THE LAYOUT

STARTING CROSS SECTION	ENDING CROSS SECTION	Type-1 FIXED FIXED	Type-2 FIXED P.C.1	Type-3 FIXED P.C.2	Type-4 FIXED CANTILEVER	Type-5 P.C.1 FIXED	Type-6 P.C.1 P.C.1	Type-7 P.C.1 P.C.2	Type-8 P.C.1 CANTILEVER	Type-9 P.C.2 FIXED	Type-10 P.C.2 P.C.1	Type-11 P.C.2 P.C.2	Type-12 P.C.2 CANTILEVER	Type-13 CANTILEVER FIXED	Type-14 CANTILEVER P.C.1	Type-15 CANTILEVER P.C.2	Type-16 CANTILEVER CANTILEVER	TOTAL
C.S.1	C.S.2	5																5
C.S.2	C.S.3	5																5
C.S.3	C.S.4	1	1					1				1	1					5
C.S.4	C.S.5																5	5
C.S.5	C.S.6																5	5
C.S.6	C.S.7		1			1					1	1				1		5
C.S.7	C.S.8	3	1			1	1											6
C.S.8	C.S.9	5																5
C.S.9	C.S.10	5																5
C.S.10	C.S.11	5																5
C.S.11	C.S.12	6																6
C.S.12	C.S.13	1		1			1				1	3						7
C.S.13	C.S.14						5											5
C.S.14	C.S.15	5				1												6
C.S.15	C.S.16		1				2	1				2						6
C.S.16	C.S.17											3	1				1	5
C.S.17	C.S.18																5	5
C.S.18	C.S.19																5	5
C.S.19	C.S.20																5	5
C.S.20	C.S.21																5	5
C.S.21	C.S.22											1				1	3	5
C.S.22	C.S.23												1				4	5
C.S.23	C.S.24	1				1					1	1				1		5
C.S.24	C.S.25	5																5
C.S.25	C.S.26	2		1								2						5
C.S.26	C.S.27						2				1	2						5
C.S.27	C.S.28							1				1	1				2	5
C.S.28	C.S.29																5	5
C.S.29	C.S.30																5	5
C.S.30	C.S.31																5	5
C.S.31	C.S.32																5	5
C.S.32	C.S.33	3								1	1					1		6
C.S.33	C.S.34	2	1					1										4
C.S.34	C.S.35	4				1					1							6
C.S.35	C.S.36	5																5
C.S.36	C.S.37	3	1				2	1				1						8
C.S.37	C.S.38											4						4
C.S.38	C.S.39											6						6
C.S.39	C.S.40											5						5
C.S.40	C.S.41											1	1				3	5
C.S.41	C.S.42					1	1				1	1				1		5
C.S.42	C.S.43	4	1					1										6
C.S.43	C.S.44											4						4

contd.....

STARTING CROSS SECTION	ENDING CROSS SECTION	Type-1 FIXED FIXED	Type-2 FIXED P.C.1	Type-3 FIXED P.C.2	Type-4 FIXED CANTILEVER	Type-5 P.C.1 FIXED	Type-6 P.C.1 P.C.1	Type-7 P.C.1 P.C.2	Type-8 P.C.1 CANTILEVER	Type-9 P.C.2 FIXED	Type-10 P.C.2 P.C.1	Type-11 P.C.2 P.C.2	Type-12 P.C.2 CANTILEVER	Type-13 CANTILEVER FIXED	Type-14 CANTILEVER P.C.1	Type-15 CANTILEVER P.C.2	Type-16 CANTILEVER CANTILEVER	TOTAL
C.S.44	C.S.45											1	1				3	5
C.S.45	C.S.46																5	5
C.S.46	C.S.47																5	5
C.S.47	C.S.48																5	5
C.S.48	C.S.49																9	9
C.S.49	C.S.50																5	5
C.S.50	C.S.51																9	9
C.S.51	C.S.52	4				1	1				1	1				1	4	13
C.S.52	C.S.53	4																4
C.S.53	C.S.54	1	1					1				1						4
C.S.54	C.S.55											1	1				3	5
C.S.55	C.S.56															1	4	5
C.S.56	C.S.57	4				1					1							6
C.S.57	C.S.58	6																6
C.S.58	C.S.59	4																4
C.S.59	C.S.60	1	1															2
C.S.60	C.S.61	3				1			1		1					1	1	8
C.S.61	C.S.62	10																10
C.S.62	C.S.63	1	1				1	1				1	1				4	10
C.S.63	C.S.64																10	10
C.S.64	C.S.65					1	2				1	1				1	1	7
C.S.65	C.S.66	8																8
C.S.66	C.S.67	7																7
C.S.67	C.S.68	1	1				4	1				3	1					11
C.S.68	C.S.69																10	10
C.S.69	C.S.70																10	10
C.S.70	C.S.71																10	10
C.S.71	C.S.72						3				1	2				1	3	10
C.S.72	C.S.73						1	1				3	1				3	9

TOTAL	124	11	2	0	10	26	10	1	1	12	53	10	0	0	10	167	437

APPENDIX-D

STAAD-EDITOR CODES

1. MODEL-1

STAAD SPACE

START JOB INFORMATION

ENGINEER DATE 02-Apr-15

END JOB INFORMATION

INPUT WIDTH 79

UNIT METER KN

JOINT COORDINATES

1 0 0 0; 2 0 0 2; 3 1.5 0 0; 4 1.5 0 2; 5 0 -0.3 0; 6 0 -0.3 2; 7 1.5 -0.3 0;

8 1.5 -0.3 2; 9 0 -0.8 0; 10 0 -0.8 2; 11 1.5 -0.8 0; 12 1.5 -0.8 2;

13 0 0 0.05; 14 1.5 0 0.05; 15 0 0 0.1; 16 1.5 0 0.1; 17 0 0 0.15;

18 1.5 0 0.15; 19 0 0 0.2; 20 1.5 0 0.2; 21 0 0 0.25; 22 1.5 0 0.25;

23 0 0 0.3; 24 1.5 0 0.3; 25 0 0 0.35; 26 1.5 0 0.35; 27 0 0 0.4; 28 1.5 0 0.4;

29 0 0 0.45; 30 1.5 0 0.45; 31 0 0 0.5; 32 1.5 0 0.5; 33 0 0 0.55;

34 1.5 0 0.55; 35 0 0 0.6; 36 1.5 0 0.6; 37 0 0 0.65; 38 1.5 0 0.65;

39 0 0 0.7; 40 1.5 0 0.7; 41 0 0 0.75; 42 1.5 0 0.75; 43 0 0 0.8; 44 1.5 0 0.8;

45 0 0 0.85; 46 1.5 0 0.85; 47 0 0 0.9; 48 1.5 0 0.9; 49 0 0 0.95;

50 1.5 0 0.95; 51 0 0 1; 52 1.5 0 1; 53 0 0 1.05; 54 1.5 0 1.05; 55 0 0 1.1;

56 1.5 0 1.1; 57 0 0 1.15; 58 1.5 0 1.15; 59 0 0 1.2; 60 1.5 0 1.2;

61 0 0 1.25; 62 1.5 0 1.25; 63 0 0 1.3; 64 1.5 0 1.3; 65 0 0 1.35;

66 1.5 0 1.35; 67 0 0 1.4; 68 1.5 0 1.4; 69 0 0 1.45; 70 1.5 0 1.45;

71 0 0 1.5; 72 1.5 0 1.5; 73 0 0 1.55; 74 1.5 0 1.55; 75 0 0 1.6; 76 1.5 0 1.6;

77 0 0 1.65; 78 1.5 0 1.65; 79 0 0 1.7; 80 1.5 0 1.7; 81 0 0 1.75;

82 1.5 0 1.75; 83 0 0 1.8; 84 1.5 0 1.8; 85 0 0 1.85; 86 1.5 0 1.85;

87 0 0 1.9; 88 1.5 0 1.9; 89 0 0 1.95; 90 1.5 0 1.95;

MEMBER INCIDENCES

5 1 5; 6 2 6; 7 3 7; 8 4 8; 9 5 9; 10 6 10; 11 7 11; 12 8 12; 13 1 3; 15 2 4;

16 1 13; 17 3 14; 18 13 15; 19 14 16; 20 13 14; 21 15 17; 22 16 18; 23 15 16;
24 17 19; 25 18 20; 26 17 18; 27 19 21; 28 20 22; 29 19 20; 30 21 23; 31 22 24;
32 21 22; 33 23 25; 34 24 26; 35 23 24; 36 25 27; 37 26 28; 38 25 26; 39 27 29;
40 28 30; 41 27 28; 42 29 31; 43 30 32; 44 29 30; 45 31 33; 46 32 34; 47 31 32;
48 33 35; 49 34 36; 50 33 34; 51 35 37; 52 36 38; 53 35 36; 54 37 39; 55 38 40;
56 37 38; 57 39 41; 58 40 42; 59 39 40; 60 41 43; 61 42 44; 62 41 42; 63 43 45;
64 44 46; 65 43 44; 66 45 47; 67 46 48; 68 45 46; 69 47 49; 70 48 50; 71 47 48;
72 49 51; 73 50 52; 74 49 50; 75 51 53; 76 52 54; 77 51 52; 78 53 55; 79 54 56;
80 53 54; 81 55 57; 82 56 58; 83 55 56; 84 57 59; 85 58 60; 86 57 58; 87 59 61;
88 60 62; 89 59 60; 90 61 63; 91 62 64; 92 61 62; 93 63 65; 94 64 66; 95 63 64;
96 65 67; 97 66 68; 98 65 66; 99 67 69; 100 68 70; 101 67 68; 102 69 71;
103 70 72; 104 69 70; 105 71 73; 106 72 74; 107 71 72; 108 73 75; 109 74 76;
110 73 74; 111 75 77; 112 76 78; 113 75 76; 114 77 79; 115 78 80; 116 77 78;
117 79 81; 118 80 82; 119 79 80; 120 81 83; 121 82 84; 122 81 82; 123 83 85;
124 84 86; 125 83 84; 126 85 87; 127 86 88; 128 85 86; 129 87 89; 130 88 90;
131 87 88; 132 89 2; 133 90 4; 134 89 90;
DEFINE MATERIAL START
ISOTROPIC STEEL
E 2.05e+008
POISSON 0.3
DENSITY 76.8195
ALPHA 1.2e-005
DAMP 0.03
ISOTROPIC CONCRETE
E 2.17185e+007
POISSON 0.17
DENSITY 23.5616
ALPHA 1e-005
DAMP 0.05
END DEFINE MATERIAL
MEMBER PROPERTY INDIAN

9 TO 12 PRIS YD 0.3 ZD 0.3
MEMBER PROPERTY INDIAN
20 23 26 29 32 35 38 41 44 47 50 53 56 59 62 65 68 71 74 77 80 83 86 89 92 -
95 98 101 104 107 110 113 116 119 122 125 128 131 134 PRIS YD 0.03 ZD 0.03
5 TO 8 TABLE ST ISJC150
13 15 TO 19 21 22 24 25 27 28 30 31 33 34 36 37 39 40 42 43 45 46 48 49 51 -
52 54 55 57 58 60 61 63 64 66 67 69 70 72 73 75 76 78 79 81 82 84 85 87 88 -
90 91 93 94 96 97 99 100 102 103 105 106 108 109 111 112 114 115 117 118 -
120 121 123 124 126 127 129 130 132 133 TABLE ST ISA90X90X8
CONSTANTS
BETA 315 MEMB 13 17 19 20 22 23 25 26 28 29 31 32 34 35 37 38 40 41 43 44
-
46 47 49 50 52 53 55 56 58 59 61 62 64 65 67 68 70 71 73 74 76 77 79 80 82 -
83 85 86 88 89 91 92 94 95 97 98 100 101 103 104 106 107 109 110 112 113 -
115 116 118 119 121 122 124 125 127 128 130 131 133 134
BETA 90 MEMB 7 8
BETA 270 MEMB 5 6
MATERIAL STEEL ALL
MATERIAL CONCRETE MEMB 9 TO 12
SUPPORTS
9 TO 12 FIXED
LOAD 1 LOADTYPE None TITLE LOAD CASE 1
SELFWEIGHT Y -1 LIST 5 TO 13 16 TO 134
FLOOR LOAD
YRANGE 0 0.3 FLOAD -6 XRANGE 0 1.5 ZRANGE 0 2 GY
PERFORM ANALYSIS
PARAMETER 1
CODE IS800 LSD
CHECK CODE MEMB 5 TO 8 13 15 TO 134
PARAMETER 2
CODE IS800 LSD

STEEL TAKE OFF LIST 5 TO 8 13 15 TO 134

PERFORM ANALYSIS

FINISH

2. MODEL-2

STAAD SPACE

START JOB INFORMATION

ENGINEER DATE 02-Apr-15

END JOB INFORMATION

INPUT WIDTH 79

UNIT METER KN

JOINT COORDINATES

1 0 0 0; 2 0 0 2; 3 1.5 0 0; 4 1.5 0 2; 5 0 -0.3 0; 6 0 -0.3 2; 7 0.75 -0.3 0;
8 0.75 -0.3 2; 9 0 -0.8 0; 10 0 -0.8 2; 11 0.75 -0.8 0; 12 0.75 -0.8 2;
111 0.75 0 0; 112 0.75 0 2; 113 0 0 1.95; 114 1.5 0 1.95; 115 0 0 1.9;
116 1.5 0 1.9; 117 0 0 1.85; 118 1.5 0 1.85; 119 0 0 1.8; 120 1.5 0 1.8;
121 0 0 1.75; 122 1.5 0 1.75; 123 0 0 1.7; 124 1.5 0 1.7; 125 0 0 1.65;
126 1.5 0 1.65; 127 0 0 1.6; 128 1.5 0 1.6; 129 0 0 1.55; 130 1.5 0 1.55;
131 0 0 1.5; 132 1.5 0 1.5; 133 0 0 1.45; 134 1.5 0 1.45; 135 0 0 1.4;
136 1.5 0 1.4; 137 0 0 1.35; 138 1.5 0 1.35; 139 0 0 1.3; 140 1.5 0 1.3;
141 0 0 1.25; 142 1.5 0 1.25; 143 0 0 1.2; 144 1.5 0 1.2; 145 0 0 1.15;
146 1.5 0 1.15; 147 0 0 1.1; 148 1.5 0 1.1; 149 0 0 1.05; 150 1.5 0 1.05;
151 0 0 1; 152 1.5 0 1; 153 0 0 0.95; 154 1.5 0 0.95; 155 0 0 0.9;
156 1.5 0 0.9; 157 0 0 0.85; 158 1.5 0 0.85; 159 0 0 0.8; 160 1.5 0 0.8;
161 0 0 0.75; 162 1.5 0 0.75; 163 0 0 0.7; 164 1.5 0 0.7; 165 0 0 0.65;
166 1.5 0 0.65; 167 0 0 0.6; 168 1.5 0 0.6; 169 0 0 0.55; 170 1.5 0 0.55;
171 0 0 0.5; 172 1.5 0 0.5; 173 0 0 0.45; 174 1.5 0 0.45; 175 0 0 0.4;
176 1.5 0 0.4; 177 0 0 0.350001; 178 1.5 0 0.350001; 179 0 0 0.300001;
180 1.5 0 0.300001; 181 0 0 0.250001; 182 1.5 0 0.250001; 183 0 0 0.200001;
184 1.5 0 0.200001; 185 0 0 0.150001; 186 1.5 0 0.150001; 187 0 0 0.100001;
188 1.5 0 0.100001; 189 0 0 0.0500008; 190 1.5 0 0.0500008;

MEMBER INCIDENCES

5 1 5; 6 2 6; 7 111 7; 8 112 8; 9 5 9; 10 6 10; 11 7 11; 12 8 12; 164 111 3;

166 8 4; 167 3 7; 168 1 189; 169 3 190; 171 113 2; 172 114 4; 173 113 114;

174 115 113; 175 116 114; 176 115 116; 177 117 115; 178 118 116; 179 117 118;

180 119 117; 181 120 118; 182 119 120; 183 121 119; 184 122 120; 185 121 122;

186 123 121; 187 124 122; 188 123 124; 189 125 123; 190 126 124; 191 125 126;

192 127 125; 193 128 126; 194 127 128; 195 129 127; 196 130 128; 197 129 130;

198 131 129; 199 132 130; 200 131 132; 201 133 131; 202 134 132; 203 133 134;

204 135 133; 205 136 134; 206 135 136; 207 137 135; 208 138 136; 209 137 138;

210 139 137; 211 140 138; 212 139 140; 213 141 139; 214 142 140; 215 141 142;

216 143 141; 217 144 142; 218 143 144; 219 145 143; 220 146 144; 221 145 146;

222 147 145; 223 148 146; 224 147 148; 225 149 147; 226 150 148; 227 149 150;

228 151 149; 229 152 150; 230 151 152; 231 153 151; 232 154 152; 233 153 154;

234 155 153; 235 156 154; 236 155 156; 237 157 155; 238 158 156; 239 157 158;

240 159 157; 241 160 158; 242 159 160; 243 161 159; 244 162 160; 245 161 162;

246 163 161; 247 164 162; 248 163 164; 249 165 163; 250 166 164; 251 165 166;

252 167 165; 253 168 166; 254 167 168; 255 169 167; 256 170 168; 257 169 170;

258 171 169; 259 172 170; 260 171 172; 261 173 171; 262 174 172; 263 173 174;

264 175 173; 265 176 174; 266 175 176; 267 177 175; 268 178 176; 269 177 178;

270 179 177; 271 180 178; 272 179 180; 273 181 179; 274 182 180; 275 181 182;

276 183 181; 277 184 182; 278 183 184; 279 185 183; 280 186 184; 281 185 186;

282 187 185; 283 188 186; 284 187 188; 285 189 187; 286 190 188; 287 189 190;

288 1 111; 289 4 112; 290 112 2;

DEFINE MATERIAL START

ISOTROPIC STEEL

E 2.05e+008

POISSON 0.3

DENSITY 76.8195

ALPHA 1.2e-005

DAMP 0.03

ISOTROPIC CONCRETE

E 2.17185e+007
POISSON 0.17
DENSITY 23.5616
ALPHA 1e-005
DAMP 0.05
END DEFINE MATERIAL
MEMBER PROPERTY INDIAN
9 TO 12 PRIS YD 0.3 ZD 0.3
MEMBER PROPERTY INDIAN
5 TO 8 TABLE ST ISJC150
MEMBER PROPERTY INDIAN
173 176 179 182 185 188 191 194 197 200 203 206 209 212 215 218 221 224 227
-
230 233 236 239 242 245 248 251 254 257 260 263 266 269 272 275 278 281 284
-
287 PRIS YD 0.03 ZD 0.03
164 166 TO 169 171 172 174 175 177 178 180 181 183 184 186 187 189 190 192
-
193 195 196 198 199 201 202 204 205 207 208 210 211 213 214 216 217 219 220
-
222 223 225 226 228 229 231 232 234 235 237 238 240 241 243 244 246 247 249
-
250 252 253 255 256 258 259 261 262 264 265 267 268 270 271 273 274 276 277
-
279 280 282 283 285 286 288 TO 290 TABLE ST ISA90X90X8
CONSTANTS
BETA 135 MEMB 166 167
BETA 180 MEMB 8
BETA 0 MEMB 7
BETA 270 MEMB 5 6

BETA 315 MEMB 164 169 172 175 178 181 184 187 190 193 196 199 202 205 208 -
211 214 217 220 223 226 229 232 235 238 241 244 247 250 253 256 259 262 265 -
268 271 274 277 280 283 286 288 TO 290
MATERIAL STEEL MEMB 5 TO 8 164 166 TO 169 171 TO 290
MATERIAL CONCRETE MEMB 9 TO 12
SUPPORTS
9 TO 12 FIXED
LOAD 1 LOADTYPE None TITLE LOAD CASE 1
SELFWEIGHT Y -1 LIST 5 TO 12 164 166 TO 169 171 TO 290
FLOOR LOAD
YRANGE 0 0.3 FLOAD -6 XRANGE 0 1.5 ZRANGE 0 2 GY
PERFORM ANALYSIS
PARAMETER 1
CODE IS800 LSD
CHECK CODE MEMB 5 TO 8 164 166 TO 169 171 TO 290
PARAMETER 2
CODE IS800 LSD
GROUP MEMB 5 TO 8
PARAMETER 3
CODE IS800 LSD
GROUP MEMB 164
PARAMETER 4
CODE IS800 LSD
GROUP MEMB 166 167
PARAMETER 7
CODE IS800 LSD
STEEL TAKE OFF LIST 5 TO 8 164 166 TO 169 171 TO 290
PERFORM ANALYSIS
FINISH

3. MODEL-3

STAAD SPACE

START JOB INFORMATION

ENGINEER DATE 02-Apr-15

END JOB INFORMATION

INPUT WIDTH 79

UNIT METER KN

JOINT COORDINATES

1 0 0 0; 2 0 0 2; 3 1.5 0 0; 4 1.5 0 2; 5 0 -0.3 0; 6 0 -0.3 2; 9 0 -0.8 0;

10 0 -0.8 2; 113 0 -1.5 0; 114 0 -1.5 2; 115 0 0 0.05; 116 1.5 0 0.05;

117 0 0 0.1; 118 1.5 0 0.1; 119 0 0 0.15; 120 1.5 0 0.15; 121 0 0 0.2;

122 1.5 0 0.2; 123 0 0 0.25; 124 1.5 0 0.25; 125 0 0 0.3; 126 1.5 0 0.3;

127 0 0 0.35; 128 1.5 0 0.35; 129 0 0 0.4; 130 1.5 0 0.4; 131 0 0 0.45;

132 1.5 0 0.45; 133 0 0 0.5; 134 1.5 0 0.5; 135 0 0 0.55; 136 1.5 0 0.55;

137 0 0 0.6; 138 1.5 0 0.6; 139 0 0 0.65; 140 1.5 0 0.65; 141 0 0 0.7;

142 1.5 0 0.7; 143 0 0 0.75; 144 1.5 0 0.75; 145 0 0 0.8; 146 1.5 0 0.8;

147 0 0 0.85; 148 1.5 0 0.85; 149 0 0 0.9; 150 1.5 0 0.9; 151 0 0 0.95;

152 1.5 0 0.95; 153 0 0 1; 154 1.5 0 1; 155 0 0 1.05; 156 1.5 0 1.05;

157 0 0 1.1; 158 1.5 0 1.1; 159 0 0 1.15; 160 1.5 0 1.15; 161 0 0 1.2;

162 1.5 0 1.2; 163 0 0 1.25; 164 1.5 0 1.25; 165 0 0 1.3; 166 1.5 0 1.3;

167 0 0 1.35; 168 1.5 0 1.35; 169 0 0 1.4; 170 1.5 0 1.4; 171 0 0 1.45;

172 1.5 0 1.45; 173 0 0 1.5; 174 1.5 0 1.5; 175 0 0 1.55; 176 1.5 0 1.55;

177 0 0 1.6; 178 1.5 0 1.6; 179 0 0 1.65; 180 1.5 0 1.65; 181 0 0 1.7;

182 1.5 0 1.7; 183 0 0 1.75; 184 1.5 0 1.75; 185 0 0 1.8; 186 1.5 0 1.8;

187 0 0 1.85; 188 1.5 0 1.85; 189 0 0 1.9; 190 1.5 0 1.9; 191 0 0 1.95;

192 1.5 0 1.95;

MEMBER INCIDENCES

5 1 5; 6 2 6; 9 5 9; 10 6 10; 168 114 4; 170 113 3; 171 1 3; 172 2 4;

173 1 115; 174 3 116; 175 115 117; 176 116 118; 177 115 116; 178 117 119;

179 118 120; 180 117 118; 181 119 121; 182 120 122; 183 119 120; 184 121 123;

185 122 124; 186 121 122; 187 123 125; 188 124 126; 189 123 124; 190 125 127;

191 126 128; 192 125 126; 193 127 129; 194 128 130; 195 127 128; 196 129 131;

197 130 132; 198 129 130; 199 131 133; 200 132 134; 201 131 132; 202 133 135;

203 134 136; 204 133 134; 205 135 137; 206 136 138; 207 135 136; 208 137 139;

209 138 140; 210 137 138; 211 139 141; 212 140 142; 213 139 140; 214 141 143;

215 142 144; 216 141 142; 217 143 145; 218 144 146; 219 143 144; 220 145 147;

221 146 148; 222 145 146; 223 147 149; 224 148 150; 225 147 148; 226 149 151;

227 150 152; 228 149 150; 229 151 153; 230 152 154; 231 151 152; 232 153 155;

233 154 156; 234 153 154; 235 155 157; 236 156 158; 237 155 156; 238 157 159;

239 158 160; 240 157 158; 241 159 161; 242 160 162; 243 159 160; 244 161 163;

245 162 164; 246 161 162; 247 163 165; 248 164 166; 249 163 164; 250 165 167;

251 166 168; 252 165 166; 253 167 169; 254 168 170; 255 167 168; 256 169 171;

257 170 172; 258 169 170; 259 171 173; 260 172 174; 261 171 172; 262 173 175;

263 174 176; 264 173 174; 265 175 177; 266 176 178; 267 175 176; 268 177 179;

269 178 180; 270 177 178; 271 179 181; 272 180 182; 273 179 180; 274 181 183;

275 182 184; 276 181 182; 277 183 185; 278 184 186; 279 183 184; 280 185 187;

281 186 188; 282 185 186; 283 187 189; 284 188 190; 285 187 188; 286 189 191;

287 190 192; 288 189 190; 289 191 2; 290 192 4; 291 191 192;

DEFINE MATERIAL START

ISOTROPIC STEEL

E 2.05e+008

POISSON 0.3

DENSITY 76.8195

ALPHA 1.2e-005

DAMP 0.03

ISOTROPIC CONCRETE

E 2.17185e+007

POISSON 0.17

DENSITY 23.5616

ALPHA 1e-005

DAMP 0.05

END DEFINE MATERIAL

MEMBER PROPERTY INDIAN

9 10 PRIS YD 0.3 ZD 0.3

MEMBER PROPERTY INDIAN

177 180 183 186 189 192 195 198 201 204 207 210 213 216 219 222 225 228 231
-

234 237 240 243 246 249 252 255 258 261 264 267 270 273 276 279 282 285 288
-

291 PRIS YD 0.03 ZD 0.03

168 170 TO 176 178 179 181 182 184 185 187 188 190 191 193 194 196 197 199
-

200 202 203 205 206 208 209 211 212 214 215 217 218 220 221 223 224 226 227
-

229 230 232 233 235 236 238 239 241 242 244 245 247 248 250 251 253 254 256
-

257 259 260 262 263 265 266 268 269 271 272 274 275 277 278 280 281 283 284
-

286 287 289 290 TABLE ST ISA90X90X8

5 6 TABLE ST ISJC150

CONSTANTS

BETA 225 MEMB 170

BETA 135 MEMB 168

BETA 270 MEMB 5 6

BETA 45 MEMB 172 173 175 178 181 184 187 190 193 196 199 202 205 208
211 214 -

217 220 223 226 229 232 235 238 241 244 247 250 253 256 259 262 265 268 271 -

274 277 280 283 286 289

BETA 315 MEMB 171 174 176 177 179 180 182 183 185 186 188 189 191 192 194 -

195 197 198 200 201 203 204 206 207 209 210 212 213 215 216 218 219 221 222 -

224 225 227 228 230 231 233 234 236 237 239 240 242 243 245 246 248 249 251 -

252 254 255 257 258 260 261 263 264 266 267 269 270 272 273 275 276 278 279 -

281 282 284 285 287 288 290 291

MATERIAL STEEL MEMB 5 6 168 170 TO 291

MATERIAL CONCRETE MEMB 9 10

SUPPORTS

9 10 113 114 FIXED

LOAD 1 LOADTYPE None TITLE LOAD CASE 1

SELFWEIGHT Y -1 LIST 5 6 9 10 168 170 TO 291

FLOOR LOAD

YRANGE 0 0.3 FLOAD -6 XRANGE 0 1.5 ZRANGE 0 2 GY

PERFORM ANALYSIS

PARAMETER 1

CODE IS800 LSD

CHECK CODE MEMB 5 6 168 170 TO 291

PARAMETER 2

CODE IS800 LSD

GROUP MEMB 5 6

PARAMETER 3

CODE IS800 LSD

GROUP MEMB 168 170

STEEL TAKE OFF LIST 5 6 168 170 TO 291

PERFORM ANALYSIS

FINISH

4. GUARD RAIL

STAAD SPACE
START JOB INFORMATION
ENGINEER DATE 13-May-15
END JOB INFORMATION
INPUT WIDTH 79
UNIT METER KN
JOINT COORDINATES
1 0 0 0; 2 0 0.3 0; 3 0 1.3 0; 4 0.1 0.3 0; 5 0.1 1.3 0; 6 0.2 0.3 0;
7 0.2 1.3 0; 8 0.3 0.3 0; 9 0.3 1.3 0; 10 0.4 0.3 0; 11 0.4 1.3 0;
12 0.5 0.3 0; 13 0.5 1.3 0; 14 0.6 0.3 0; 15 0.6 1.3 0; 16 0.7 0.3 0;
17 0.7 1.3 0; 18 0.8 0.3 0; 19 0.8 1.3 0; 20 0.9 0.3 0; 21 0.9 1.3 0;
22 1 0.3 0; 23 1 1.3 0; 24 1.1 0.3 0; 25 1.1 1.3 0; 26 1.2 0.3 0; 27 1.2 1.3 0;
28 1.3 0.3 0; 29 1.3 1.3 0; 30 1.4 0.3 0; 31 1.4 1.3 0; 32 1.5 0.3 0;
33 1.5 1.3 0; 34 1.6 0.3 0; 35 1.6 1.3 0; 36 1.7 0.3 0; 37 1.7 1.3 0;
38 1.8 0.3 0; 39 1.8 1.3 0; 40 1.9 0.3 0; 41 1.9 1.3 0; 42 2 0 0; 43 2 0.3 0;

44 2 1.3 0;
MEMBER INCIDENCES
1 1 2; 2 2 3; 3 2 4; 4 3 5; 5 4 5; 6 4 6; 7 5 7; 8 6 7; 9 6 8; 10 7 9; 11 8 9;
12 8 10; 13 9 11; 14 10 11; 15 10 12; 16 11 13; 17 12 13; 18 12 14; 19 13 15;
20 14 15; 21 14 16; 22 15 17; 23 16 17; 24 16 18; 25 17 19; 26 18 19; 27 18 20;
28 19 21; 29 20 21; 30 20 22; 31 21 23; 32 22 23; 33 22 24; 34 23 25; 35 24 25;
36 24 26; 37 25 27; 38 26 27; 39 26 28; 40 27 29; 41 28 29; 42 28 30; 43 29 31;
44 30 31; 45 30 32; 46 31 33; 47 32 33; 48 32 34; 49 33 35; 50 34 35; 51 34 36;
52 35 37; 53 36 37; 54 36 38; 55 37 39; 56 38 39; 57 38 40; 58 39 41; 59 40 41;
60 42 43; 61 40 43; 62 41 44; 63 43 44;
DEFINE MATERIAL START
ISOTROPIC STEEL
E 2.05e+008
POISSON 0.3
DENSITY 76.8195
ALPHA 1.2e-005
DAMP 0.03
END DEFINE MATERIAL
MEMBER PROPERTY INDIAN
1 TO 4 6 7 9 10 12 13 15 16 18 19 21 22 24 25 27 28 30 31 33 34 36 37 39 40 -
42 43 45 46 48 49 51 52 54 55 57 58 60 TO 63 TABLE ST ISA50X50X5
MEMBER PROPERTY INDIAN
5 8 11 14 17 20 23 26 29 32 35 38 41 44 47 50 53 56 59 PRIS YD 0.025
CONSTANTS
BETA 45 MEMB 1 2 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 62
BETA 135 MEMB 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 61
63
MATERIAL STEEL ALL
SUPPORTS
1 42 FIXED
LOAD 1 LOADTYPE None TITLE LOAD CASE 1

SELFWEIGHT Y -1 LIST 1 TO 63

PERFORM ANALYSIS

PARAMETER 1

CODE IS800 LSD

CHECK CODE ALL

PARAMETER 2

CODE IS800 LSD

STEEL TAKE OFF LIST 1 TO 63

PERFORM ANALYSIS

FINISH