TEST Engineering & Management

May – June 2020
ISSN: 0193-4120 Page No. 9396 - 9399

Topographic Survey, Geometric Design, Estimate of Maharashtra Samruddhi Mahamarg

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Article Info
Volume 83
Page Number: 9396 – 9399
Publication Issue:
May - June 2020

Article History
Article Received*: 19 November 2019*
Revised*: 27 January 2020*
Accepted*: 24 February 2020*
Publication*: 18 May 2020*

Abstract:
Development of highway infrastructure is the backbone of socio-economic development of a developing country like India. Maharashtra Samruddhi Mahamarg is a project of national importance connecting Mumbai and Nagpur. It's an expressway reducing the travelling time from 18 hours to about 8 hours with a design speed of 150 Kmph. It will be green field alignment and first of its kind in India with a high design speed, longest length and varied features. Field survey, selection of alignment, geometric design and preparation of estimate are important stages in preparing detailed project report for highway. This paper focuses on selection of feasible alignment for a 15 Km length from chainage 311/000 to 326/000 of Maharashtra Samruddhi Mahamarg, its geometric design keeping in view the efficiency of traffic operation and preparation of drawings like the longitudinal and cross profile to be used for earthwork calculations. Various software were used for survey data processing and generation of final drawings.

Keywords*: Survey, Road alignment, Geometric design, software, longitudinal profile, cross profile.*

Introduction:

With the advances of science and technology the traditional methods of surveying and geometric design are becoming obsolete and are being replaced by modern methods,reducing the tremendous field work involved, saving time and money. Before the advancement in the technology, the desktop studies for deciding the feasible alignment were done using maps and toposheets in the office. This is now done more conveniently and precisely on computers using freely available tools such as Google earth. The development in the surveying instruments like the Auto Levels, Total Stations and Differential Global Positioning Systems (DGPS) has reduced the labour involved in carrying out the field survey to a great extent and at the same time giving far better accuracy. This reduces the errors in surveying as well as saves time. The collected survey data is then used for the further analysis in the office. Software such as Prolink, Softdesk, etc. are used to convert the survey data in usable and readable format. The data is processed using various software such as AutoCAD, AutoPlotter, Civil 3D survey, etc. Geometric design is an important and critical task to be undertaken whiledesigning a highway. This influences the riding quality, vehicular performance and also the accident rate. The geometric design is precisely done using software which has pre-specified norms according prevalent IRC codes. Calculations and maintaining records is also a tedious task when done manually. This can be done conveniently in MS-Excel.

Fig. 1: Alignment of Samruddhi Mahamarg from Nagpur to Mumbai

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Method:

I. PROCEDURE

A. Selection of feasible alignment

As a part of initial preparation and desktop study for finalizing the alignment, google earth was the best tool available. Using Google Earth, various possible alternatives for the alignment were considered. The co-ordinates for the start and the end point of the proposed Samruddhi corridor were taken from the alignment finalized by the Government. A stretch of 15 kms out of 701 kms of this proposed alignment passes through Buldana district of Maharashtra. The coordinate of the start point is 20°6'35.24"N, 76°29'27.68"E whereas the co-ordinates of the end point are 19°56'6.03"N, 76°2'55.37"E. The alignment crosses major river Purna at CH 321/100. While finalizing the alignment, due considerations were given to

- Avoid different obstruction like River, Reservoir, Forest, Historical Places, High tension line etc.
- The alignment has been kept at right angle to the state highways and national highway wherever possible.
- Abrupt S-curves were avoided.
- The alignment was designed with minimum number of apexes.
- Sharp curves are avoided along the alignment.
- The rivers are crossed at right angles as far as possible.
- Intersections were kept flat.
- The alignment was selected in such a way that it was atleast 500 m away from the village boundary (Gaothan).

Fig 2: Alignment on Google Earth

B. Topographic Survey

Survey was carried out along the finalized alignment between pre-known coordinates using instruments like DGPS (Differential Global Positioning System) and Total Station. To start with, a detailed reconnaissance survey was taken up. This is a very important step while starting up the topographic survey for any big project like this. This activity gave a judgment of the quantum of the work to be done, the locations for establishing DGPS control station, the probable difficult stretches in the alignment and an estimate of the time required to complete the task. Once reconnaissance survey was over, DGPS control stations were established at every 5 kms along the alignment. For this, 8 hours continuous observation was done at the base station to get the accurate co ordinates. Once the base observation was over, it was time for DGPS observations at other control stations. Minimum 60 min observation was done at each rover station. The baselines data was post processed to get the accurate co ordinates of each station. ON completing this task, Total Stations were deployed at site to carry out detailed topographic survey. All manmade and natural surface features were surveyed and mapped. A code library was generated to assign a unique code to each surface feature. Cross section survey was also carried out at every 25 m c/c along the alignment for full width of ROW.

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C. Survey Data Processing

After the survey was done the further work was carried out in the office. For this the data is to be converted into usable format. The data was exported from total station using USB in.sdr format. Now in Prolink software the data in .sdr file format was converted into a .csv (comma separated value) format. This survey data in csv format was then imported into Softdesk where the survey points were displayed on the screen. Softdesk enabled to save the file in .dwg format which could be further used in any draftingsoftware for generating the survey drawings. Detailed surface plan was generated using the survey data. All the surface features were given unique symbol. The symbols used were the standard symbols as specified by the Survey of India.

D. Drafting

The drafting was carried out in AutoCAD 2014 software. In AutoCAD, the recorded survey data was displayed in points and each point carried point number, its reduced level and a special code. The codes for various features are given in the table given below.

Table 1: Codes Used at Site

FEATURES	CODES
Tree	T
Electric Pole	EP
Stone	STON
Well	W
Field Bund	FB
Forest Boundary	FOST_B
High Tension Tower	HTT
Electric Dp	EDP
Station Point	ST
Benchmark (Permanent)	ST_BM
House	H
Temple	TM
Bridge	BR
Fencing	FC
Road Edge	RE
Road Center	RC
Nalla Edge	NE
Nalla Center	NC

The complete data is then digitized by using AutoCAD. In AutoCAD different layers were created so as to represent different features. Each feature is represented by using a specific symbol. The ROW, drain edges, drain center, electric line etc. were plotted by joining their respective points. After the complete data was drafted, alignment was marked according to the ROW.

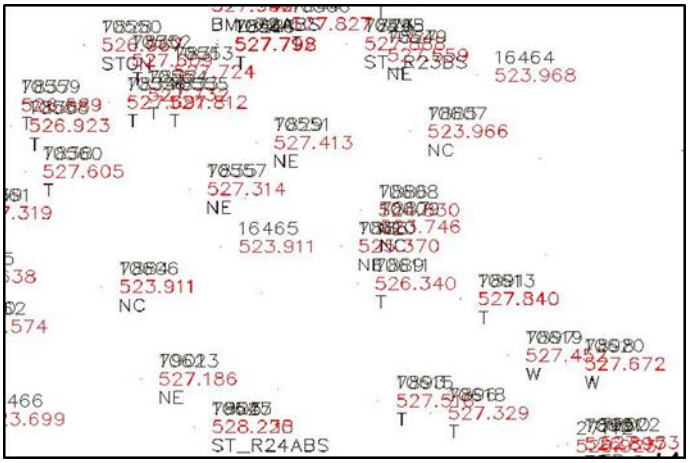

Fig. 3: Survey Data

E. Longitudinal Profile

The drafted file from AutoCAD was openedin AutoCAD Civil3D in order to get the reduce level of required points. A surface was built using all the survey data and a digital terrain model (DTM) was generated. For generating the data to be used for plotting the longitudinal profile, points were marked at an interval of 25m along the alignment. These points which were marked at an interval of 25 m were selected sequentially for calculating their reduced level. This data for longitudinal profile was then exported in .csv format in Point, Elevation, Northing, Zenith (elevation), Description (PENZD) format and the longitudinal profile along the alignment was generated.While generating the longitudinal profile the horizontal scale adopted was 1:1 and vertical scale adopted was1:1. The Finished Road Level (FRL) line was marked on longitudinal profile carefully considering the following parameters:

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- The Flatter grades were provided than 1 in 33.33
- No change in grade for the distance less than 150m.
- Over major crossings the FRL should be horizontal.

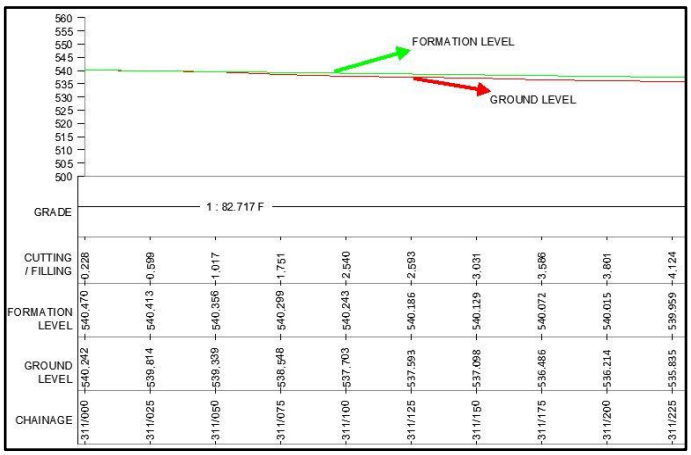

Fig. 4: Longitudinal Profile

F. Cross Section

The cross sections were marked at an interval of 25m at right angles to the center line of the proposed alignment in AutoCAD. Points were marked along the cross-section line at an offsets of 10 m.Using the previously generated DTM, the elevations at the offsets along the cross sections were calculated and the final cross section drawings were prepared. While generating the cross sections the horizontal scale adopted was 1:100 and vertical scale adopted was 1:100.

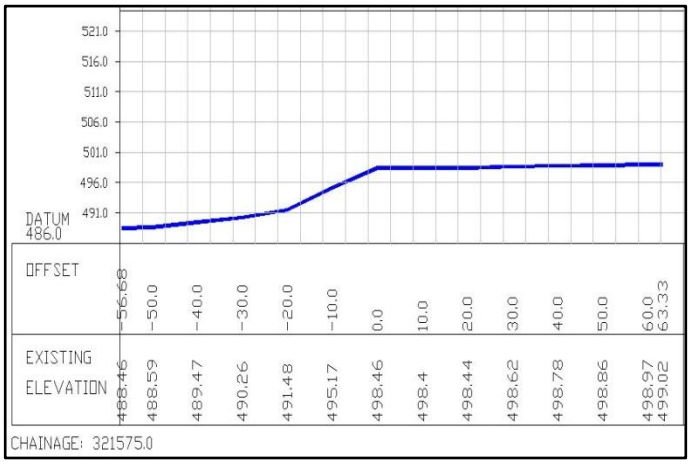

Fig. 5: Cross Section

CONCLUSION

With the advancements in the surveying instruments, far better accuracy can be achieved using the modern surveying instruments like Total Stations and Differential Global Positioning System (DGPS). Similarly using the latest drafting software, generation of various drawings from the survey data has become quite easy and fast. The main advantage of this drafting software is the variation in the drafting scale which otherwise is a very difficult and laborious task when done manually. Civil 3D software enabled to get reduced level of required points using DTM tool. The project work can be used as a reference for carrying out a highway project of similar kind.

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