

Study of Geometric Design, hydraulic and hydrology for Highways Using Civil 3D Software- A Case Study

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Abstract:

Indian road network consists of national highways, state highways, major district roads, other district roads, village roads and having road length of 35lakh km. from past 3 years all the roads are upgrading to, as per traffic requirement. The geometry of the highway is to provide optimum efficiency in traffic Operations with maximum safety at reasonable cost. It is possible to design and construct the pavement of a road in stages, but it is very expensive and rather difficult to improve the geometric elements of a road on late stages. Hence, highway development needs proper planning method. Case study was conducted for Mysore outer ring road of 32.3km .Data collected was then be analysed qualitatively and quantitatively. Analyzed data is presented in tables.The development of effective road transport system is the primary need of any developing country and the upgrading of existing road network system is essential for the developed countries as the capacity of roads in urban and nonurban highways will reach to saturation level with the passage of time, due to increase traffic, ribbon development etc. Hence highway development needs proper planning method. In the present case study, civil 3D software which is now commonly used, has been used for the geometric design and design of drainage systems of various road elements

Keywords —Road network geometry, Road drainage system, elevated Highway road surface.

I. INTRODUCTION

Indian road network consists of national highways, state highways, major district roads, other district roads, village roads and having road length of 35lakh km. from past 3 years all the roads are upgrading to, as per traffic requirement. The geometry of the highway is to provide optimum efficiency in traffic Operations with maximum safety at reasonable cost. It is possible to design and construct the pavement of a road in stages, but it is very expensive and rather difficult to improve the geometric elements of a road on late stages. The development of effective road transport system is the primary need of any developing country and the upgrading of existing road network system is essential for the developed countries, as the capacity of roads in urban and nonurban highways will reach to saturation level with the passage of time, due to increase traffic, ribbon development etc. Hence,

highway development needs proper planning method. Case study was conducted for Mysore outer ring road of 32.3km .Data collected was then be analysed qualitatively and quantitatively. Analyzed data is presented in tables. Hence highway development needs proper planning method. The design of route alignment and the pavement structure decide the cost of a highway project and for this job, the best available Highway Design Software tools must be deployed. In the present case study, civil 3D software which is now commonly used, has been used for the geometric design and design of drainage systems of various road elements

A. Problem statement

The development of effective road transport system is the primary need of any developing country and the upgrading of existing road network system is essential for the developed

countries as the capacity of roads in urban and nonurban highways will reach to saturation level with the passage of time, due to increase traffic, ribbon development etc. Hence highway development needs proper planning method. In the present case study, Civil 3D software which is now commonly used, has been used for the geometric design and design of drainage systems of various road elements

B. Objectives of the study

- i. Geometric design using Civil 3D
- ii. Flexible pavement design (By IRC 37-2012 method)
- iii. Earth work Quantity extraction using Civil 3D
- iv. Drainage system design Cross Drainage and Table Drain.

C. Significance of research study

- i. The collected runoff the road surface used for irrigation practice and ecology development by scientific methods or techniques to quantify the same.
- ii. The runoff collected from the road surface will be helpful to overcome the water crisis for irrigation

D. Scope of the study

This research study was carried to study of Geometric Design, hydraulic and hydrology for Highways Using Civil 3D Software A case study of mysore Outer Ring road. The study was done to Estimation of Road Surface Drainage water and use of same drainage water for the ecology development These study addressed Problems related to road surface drainage and integration between storm water drain networking.

The exact study is focused to study of Existing road drainage network, Existing Condition, maintenance of road and drainage infrastructures, impacts of integrated road drainage network. Collection of runoff water from the network and using same runoff water for ecology improvement.

E. The Study Area Description

Study area is located in Mysore, which is so called heritage cultural Valley of India. The study area which is mysore Outer ring ROAD length of 32.3km. Road network which connects to Bangalore, madakeri, ooty, and Kerala.

II. LITERATURE REVIEW

The following research materials published by different authors who had been engaged to reinforce the research work.

- i. Trees, people and the built environment Proceedings of the Urban Trees Research Conference 13–14 April 2011 Using
- ii. Highway Surface Drainage System & Problems of Water Logging In Road Section Management
- iii. Indian Road Congress, “Geometric Design Standards for Rural (Non Urban) Highways”, IRC: 73-1980.
- iv. Indian Road Congress, “Guidelines for the Design of Horizontal Curves for Highways and Design Tables”, IRC: 38-1988.
- v. Indian Road Congress, “Vertical Curves for Highways”, IRC: SP23-1983.
- vi. Indian Road Congress, “Guidelines for Capacity of Roads in Rural Areas”, IRC: 64-1990.
- vii. Indian Road Congress, “Guidelines for the Design of Flexible Pavements”, IRC: 37-2001.
- viii.

III. RESEARCH METHODOLOGY

F. Study setting\Area

Descriptive and exploratory types of research methods are adopted in which Descriptive method adopted to describe the existing condition of network and exploratory type adopted for physical measurements, same can be compared with standards. Study area is located in Bangalore city which is so called Silicon Valley and Information and technology hub of India. The study area which is NH44 Hebbal to International airport Devanahalli through flyover in Bangalore city length of 30km. Road network which connects to banglore international airport which

having 6-lane divided carriage (Elevated) and longitudinal pipe drain is established to drain off runoff water which is not properly maintained and it is not integrated.

G. Study Design Data types

Data collection has been carried by adopting both Quantitative as well as qualitative data types. 80% of research data was collected from field surveying physical measurement and 20% of data was collected from secondary data sources in order to strengthen the data sources.

H. Data Collection Methods

Data collection has been carried out by two systems or methods for the present case study. Those are by field measurement of surveying operation was done by using survey equipment's like measuring tape, Dumpy level, Total station and hand GPS. Secondary data collection like Topographical sheets, Rain fall data, hydrographs etc.

I. Data Processing and analysis

The collected had been checked and analyzed by using software's like Auto cad, Civil3D and Microsoft office software

IV. RESULT AND DISCUSSION

J. Traffic analysis, Pavement Design, Geometry design, pavement structure and drainage network

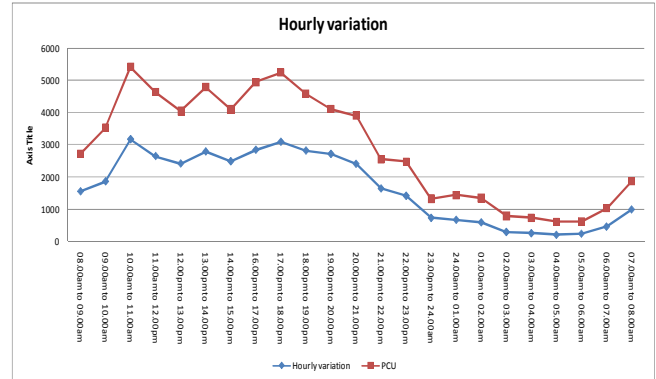
Traffic movements on the project road, as observed from Traffic surveys, show influence of local areas like Hebbal Industrial Area Belvadi Industrial Area within Mysore District, External places like Nanjanagudu, H D kote, Hunsur, Bangalore and Mangalore . Accordingly, traffic projections have taken into consideration the transport demand arising out of future economic development in the contributing areas. Table.1,2 and figure -1 shows the forecasted traffic data considered for pavement design.

Table 1: Forecasted traffic data considered for Pavement design

1. Package-1 was 30140 vehicles and 45735 PCU
2. Package-2 was 34486 vehicles and 44383 PCU

3. Package-3 was 7570 vehicles and 11728 PCU
4. Package-4 was 9635 vehicles and 15260 PCU

Figure -1-Hourly variation



Pavement design Details:

Flexible pavement design had been carried out using “IRC: 37-2001: Guidelines for the Design of Flexible Pavements”. design period for pavement design is considered as 15years

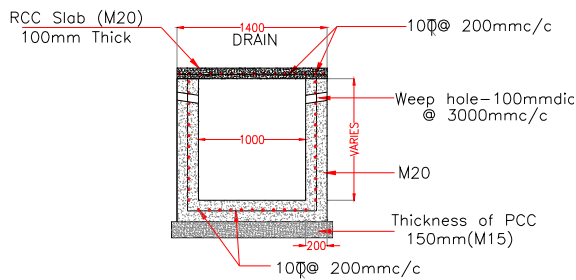
$$N = \frac{365[(1+r)^n - 1]A.D.F}{r}$$

The pavement has been designed for a minimum sub-grade CBR of 10%, the expected traffic loading at the end of 15 year design life is 99 MSA. The recommended pavement layers as per IRC 37 for the proposed road is as given below.

Bituminous Concrete 50 mm Dense Bituminous macadam, 130 mm (in two layer)-WMM as Base 250 mm Granular Sub base as Sub Base 200 mm Select Subgrade 500 mm.

K. Runoff calculation and hydraulic capacity.

Present case study, the runoff water generated from the road surface was determined by IRC SP 42-2014 Hydraulic capacities of the open channels were determined by using manning's Equation. Peak hour rate of runoff and hydraulic capacity of channels were calculated and presented in the below figure.1.



V. CONCLUSION AND RECOMMENDATIONS.

After research study and critical analysis, it was found that geometry of the road is good and also present road surface serviceability is good. Longitudinal road side drains are insufficient to carry runoff water if at all average of 600mm rainfall happens. Road side pipe drains are silted up everywhere because of improper maintenance. There is no integration between side drain and storm water drain.

- i. All improvements are planned within the proposed 45m RoW.
- ii. The obtained base traffic volume data has been projected to a period of 15 years (2010-2025)
- iii. A six lane divided carriageway of 3.0m median with service road of 5.5m consisting of 45m formation width is proposed for the project road.
- iv. A pavement crust thickness of 590mm to 630mm is adopted based on projected traffic – 38MSA to 99MSA and subgrade soil strength CBR – 10%.
- v. The proposed alignment encounters minimum horizontal curve radius, where the speeds are restricted to minimum.
- vi. All eight major junctions are proposed for improvement by recommending grade separator.

Inc.

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- vii. Median drains are proposed at curves, as the rain water enters into the median side due to superelevation.
- viii. High design precision and savings in time were achieved by using civil-3d software.
- ix. Rainwater harvesting from Road surface can be implemented as effective method for the improvement of ecology, irrigation engineering practice, and crop pattern & farmers economy.
- x. Road drainage /storm water drainage-integrated road drainage systems can be helped to come out from water scarcity issues.
- xi. Ground water table will be increased drastically.
- xii. No Flooding’s will happen if any zone is connected with integrated road drainage systems

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