

DESIGN AND ESTIMATION OF FLEXIBLE PAVEMENT ON 2/4 LANE CARRIAGEWAY WITH PAVED SHOULDER USING MX ROAD SOFTWARE

BADAKE SANJU KUMAR

M. Tech -Highway Engineering
Malla Reddy Institute of Technology &
Science

Email id: badakesanjukumar@gmail.com

MALOTHU NARASIMHA

Assistant Professor
Malla Reddy Institute of Technology &
Science

Emailid: nara100000@gmail.com

ABSTRACT

The project will apply to Design and Estimation of Flexible Pavement for R&B department Government of Telangana has been assigned the work of Phase -1 of project "Devarakonda - paddavuru - miryalaguda - kodad". Tentative length-115 KM corridor of NH/state roads (Approved in principle for declaration as National Highways) in the state of Telangana to two/four lane with paved shoulder configuration. The flexible pavement design as per IRC: 37-2015 or MOST standards and preparation of road projects IRC: SP: 19-2001. Road design using MX Road software is an advanced, string-based modeling tool that enables rapid designing of all road types with accurate. Using MX Road creation of Design alternatives for the construction of an ideal road system can be managed with ease. Once a design alternative has been authenticated, further details that are to be added to the design process can also be automated while using MX road modeling, saving both time as well as money. The project estimate should give a clear picture of the financial commitment involved and should be realistic. This is possible only if the items of work, the quantities determined to a reasonable degree of accuracy and the rates provided on a realistic basis. Using SSR as per T.S. revised standard data for the year 2016-17.

Keywords: Pavement, MX road modeling, 2/4 Lane Carriageway Introduction

INTRODUCTION

Development and application of systems approach to road and road transportation management is a major landmark in the

global advancement for the period of the last two years or so. It has had its due impact on INDIA, and the manner of introducing pavement management systems on the national highway and state roads in the country. The whole concept of road systems however, goes far beyond pavement managing and covers all aspects which have a bearing ensuring the optimal level of service to the road user. It is appropriate interlinking towards an end oriented approach and assurance of the requisite and (optimal level of service to the road user) which is the trademark of the systems approach.

Systems approach

Roads are intended for the safe, speedy and comfortable passage of traffic. The engineering vital is to achieve this objective optimally in the most economical way realistic. Optimal balancing of road construction and maintenance costs to achieve the negligible road costs and optimal balancing of road costs and road user costs to achieve the minimal total transportation costs is by nowadays common knowledge in the nation and this knowledge is motivating the nation towards the implementation of systems approach towards pavement management.

Surface evenness and skid resistance to confirm the requisite level of safety and comfort increases with the travel speed, and the structural strength requirements of the road rise with the rise in axle load magnitude and repetition. The initial condition, quality, design (structural strength) and the maintenance strategy adopted/anticipated, for the road, traffic information volumes, axle load magnitude and repetition, and environmental conditions, it is possible to model and predict the pavement performance, and such performance models can be a very useful tool to planning the optimally economical road repairs and up gradation strategies.

LITERATURE REVIEW

The pavement can be normally defined as to Performance of the change in their condition and purpose with respect to age. It can also be analytic of the ability of a pavement to carry the intended traffic and satisfy the environment during the design life, both functionally and structurally. With the increased economic and development activities in India, the traffic has increased multi fold during the last two years resulting in the overstressing of road network. The development of higher stresses leads to performance failure of the flexible pavements. If the pavements fail to carry the design loads acceptably, then the failure is of structural type. It's of functional type, when the pavement does not provided a smooth riding surface of road. The uneven surface not only causes discomfort, and also increases the Vehicle Operating Cost, thus influencing the overall transportation cost. This matter gives a broad outline of the importance of pavement performance evaluation, type of models, applications of

performance models in other countries for their Pavement Management System and the research studies carried out so far.

HIGHWAY DEVELOPMENT AND MANAGEMENT MODELS:

Singh et al. (2005) did the program analysis using HDM-4 and carried out the life cycle analysis for a period of 15 years. The budget requirement for unconstrained program was obtained. The optimized program was developed for three scenarios namely 75, 50 and 35 percent of the required budget, respectively. HDM-4 contains PPM's for major pavement distresses like cracking, potholes, rutting and roughness. The initiation phase is separated from the progression phase, and developed the cracking initiation and progression models. The pavement condition and change in condition were predicted every year for each mode of distress in the order given below (Attoh-Okine and Paris, 2005):

- a) The age for initiation of all cracking and increment in area of all cracking.
- b) Initiation and increase in the area of all potholes,
- c) Increment in rut depth (mean and standard deviation), and
- d) Increment in roughness, These PPMs were developed from the results of extensive field experiments conducted in different conditions. [1]

1.1 PAVEMENT PERFORMANCE MODELS IN THE INDIAN PERSPECTIVE

Sood and Sharma (1996) reported a pavement Performance Study conducted with a view to develop data for total

transportation cost model for Indian conditions, to be achieved through development of pavement performance data and attempted development of layer equivalence and strength coefficients. Data was collected on the construction and maintenance inputs of different pavements based on studies carried out on nine pavement sections for a period of about 10 years. [1]

Sharma and Pandey (1997) made a study on the existing pavements completed in recent years and developed total transportation cost model for Indian conditions. Indian research results were used to develop this model and its predictions and results were considered truly reflective of Indian conditions. The model helps to apply a rational approach in road maintenance decisions for obtaining best results from available funds including benefits of periodic maintenance, cost effectiveness of maintenance strategies etc. [2]

Kumar Ashok gave geometric design of existing road using MXROAD Software. Existing road used was SH 131 in Maharashtra to improve its geometric features and upgrading it from two lanes to four lanes. The Software uses 3D string modeling technology and offers the desired values of different components of geometric design such as Horizontal, Vertical Curves, and Super elevation, Shoulder, etc.[3]

HarshilS. Shah and P.A. Shinkar (2016)reported a planning and design of proposed bypass road connecting kalawad road to Gondal road, Rajkot using auto desk civil 3D software. The software uses 3D design to give the values of different components of geometric design such as

Horizontal and Vertical Curves, Super elevation etc. [4]

OBJECTIVE'S

1. Design and Estimation of Flexible Pavement on 2/4 Lane Carriageway.
2. A road design on 2/4 lane with Paved Shoulder Using Mx Road Software.
3. A Study on Economic Analysis, Financial Analysis.
4. A Study on Flexible pavement design.

METHODOLOGY

Pavement design forms an integral part of detailed engineering study. Performance of pavement is critical as the economical revenues are directly dependent on its performance. The design methodology adopted for the strengthening and rehabilitation of the existing carriageway and the also suggests the design approach for flexible pavement for the new carriageway.

Pavement Design Methodology

Pavement design methodology includes two basic functions namely; design of strengthening overlay for exiting pavement and design of new crust for additional lanes. Types of pavement to be adopted for additional lanes shall also be decided based on life cycle cost analysis as a part of pavement design methodology. Accordingly, the following methodology has been adopted in pavement design to achieve requirements of TOR.

Step 1: Various Pavement investigations have been carried out on the project corridor to assess the adequacy of the existing

pavement crust. These investigations include:

1. Visual Pavement Condition
2. Pavement Roughness Surveys
3. BD measurements
4. Subgrade investigations
5. Investigations on existing granular layers
6. Investigations for quarry and Barrow areas

Step 2: Axle load surveys have been conducted on the corridor and VDF for different categories of vehicle established.

Step 3: Detailed material investigations have been conducted in the projected influence area and strength characteristics and availability of construction material has been determined.

Step 4: For the purpose of designing the overlay, the project corridor has been divided into homogeneous sections based on deflection measurements using Cumulative standards approach. Design thickness of overlay has been estimated from IRC-81-1997 using estimated traffic level and characteristic deflection of particular homogeneous section. Estimated BM thickness is then adjusted to equivalent thickness of AC & DBM using conversion factors given in IRC 81-1997.

Estimation of Quantities and Project Costs

i). The project prepare detailed estimates for quantities and project cost for the whole project, including the cost of environmental and social safe guards proposed based on MORT&H's Standard Data Book and market rate for the inputs.

ii. Detailed analysis for computing the unit rates for the different items of works. The

unit rate analysis shall duly take into account the various inputs and their basic rates, suggested location of plants and respective lead distances for mechanized construction.

FLEXIBLE PAVEMENT DESIGN AND ANALYSIS

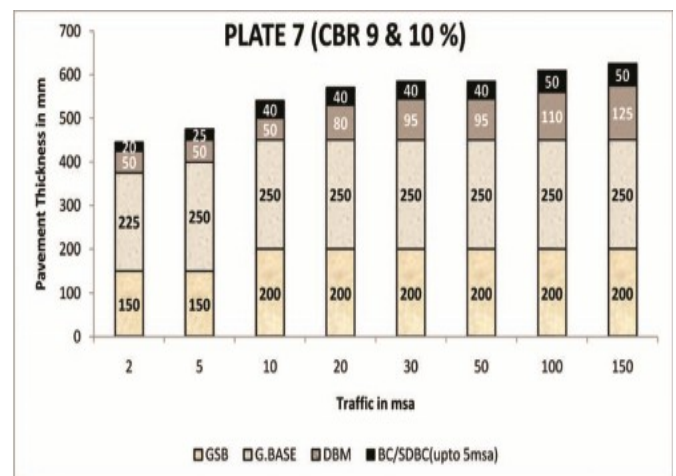
Pavement Structure Design by IRC: 37-2015 After adjustment by interpolation on traffic, pavement structures according to the sectioning, given by IRC: 37.

Design Traffic = 39Msa.

Design of CBR: 10%

The CBR of borrow material is varying from 10% to 20%. Considering the fact that the contractor executing the works may opt for alternative sources than studied here-in, a lower value of 10% is adopted in the pavement design.

Design of pavement structure



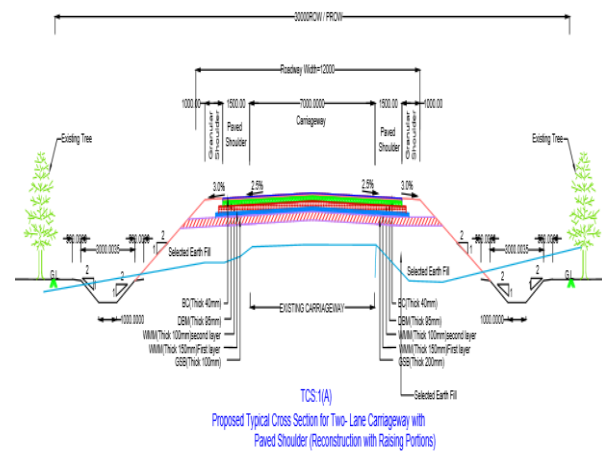
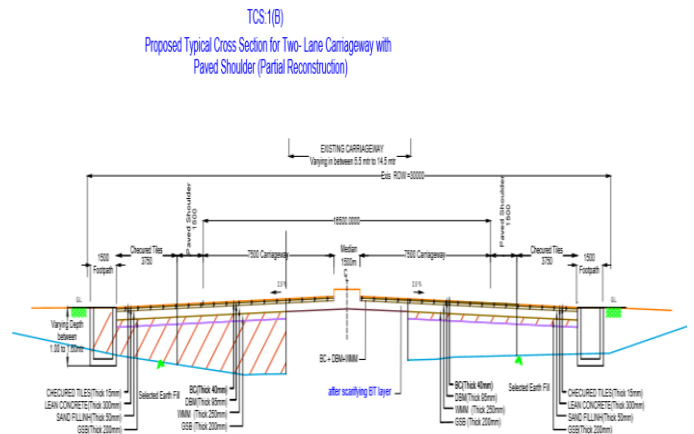
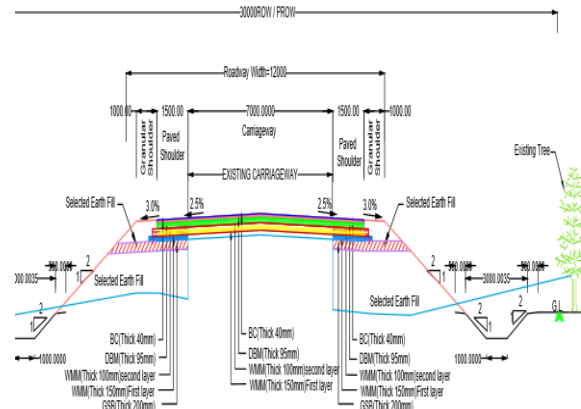
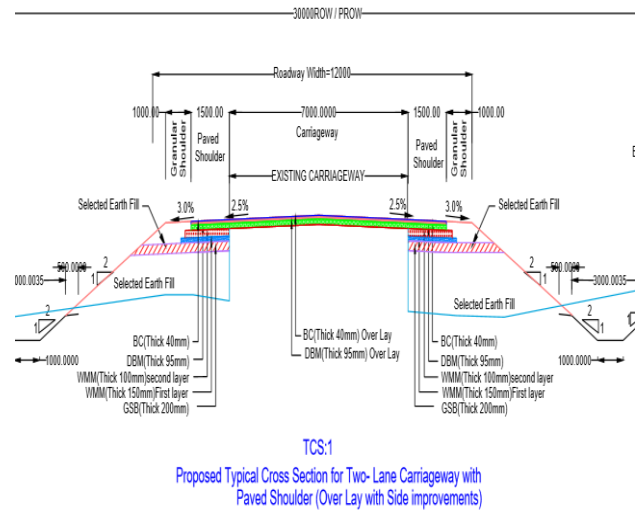
The computed strain from IITPAVE software are

1. Horizontal tensile strain in Bituminous layer is $173 \times 10^{-6} < 178 \times 10^{-6}$

2. Vertical compressive strain on sub grade is $330 \times 10^{-6} < 370 \times 10^{-6}$

Hence the pavement composition safe.

Typical Cross-Sections of the Project



Note:-
1. All the dimensions are in mm unless otherwise mentioned.
2. For less than 100mm thickness DBM will be laid in single layer otherwise in two layers. For less than 200mm thickness WMM will be laid in single layer otherwise in two layers.

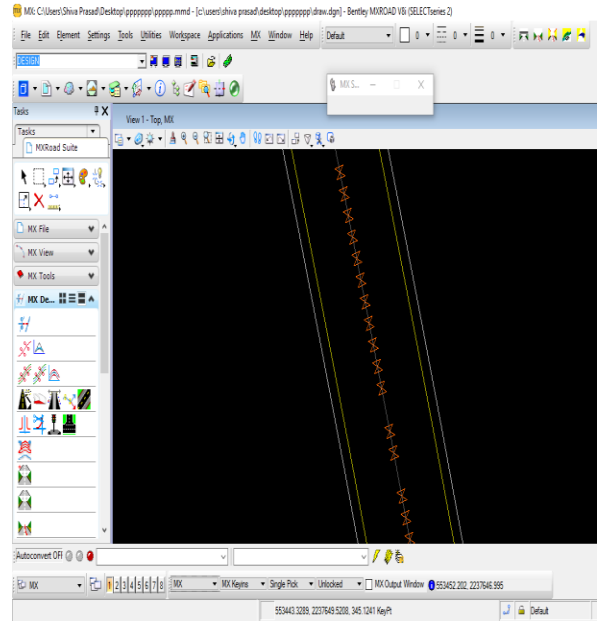
Note:-
1. All the dimensions are in mm unless otherwise mentioned.
2. For less than 100mm thickness DBM will be laid in single layer otherwise in two layers. For less than 200mm thickness WMM will be laid in single layer otherwise in two layers.

GEOMETRIC DESIGN OF ROAD USING MX SOFTWARE

The existing pavement in the project road from km 23.000 (Miryalaguda) to km 34.200 (Kodad) of Highway is flexible in nature. Geometric design of a highway deals with the dimension and layout of visible features of the highway such as alignment, sight distances and inter section.



Detail of Project Length.



Vertical alignment

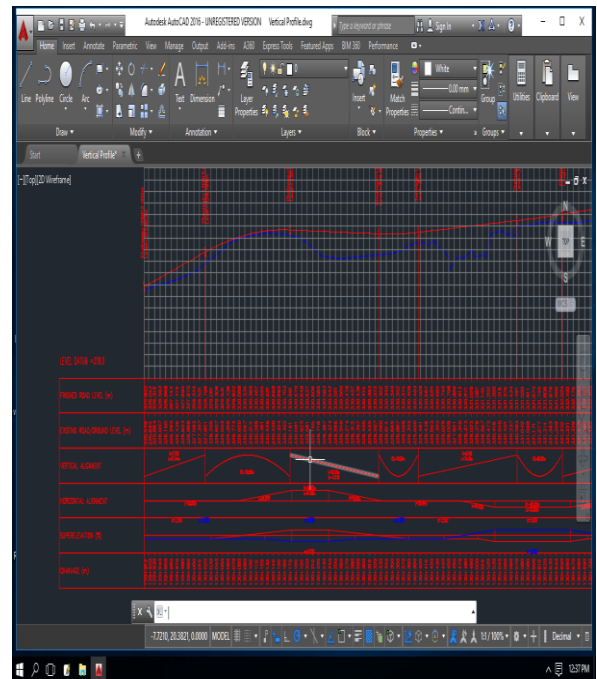
S r. N o.	Section		Exi stin g Len gth (km)	Section		Proposed Length (Design) (km)				
	Fr om (k m)	To (K m)		Fr om (k m)	To (K m)	Reali gnme nt Len gth (km)	Geom etric Impro veme nt (km)	Wid enin g (km)	Tot al Len gth (k m)	
1	23. 00 0	34. 10 0	11. 100	0. 00	34. 02 8	11. 02 8	4.958	0.940	10.8 00	11. 02 8

Alignment design to using mx road software

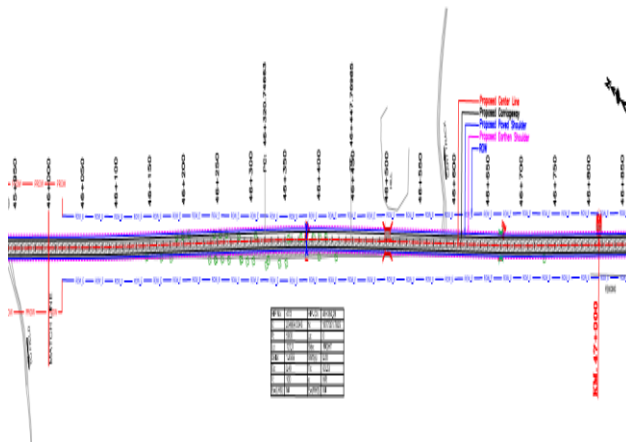
1 Survey data in text file

This survey data includes X, Y, Z coordinates (i.e. Northing, Easting and Reduced Level). This data can be collected now days by using total station instrument.

2 Horizontal alignment: Creating Horizontal Alignment using survey data



Longitudinal profile



ROUTEMAP

ESTIMATION

Before undertaking the construction of a project it is essential to know its probable cost which is worked out by estimating.1. An estimate is defined, as computation or calculation of the required quantities of completed items of work and its expenses (cost) likely to be suffered for its construction.2. The main object of estimate is to know the required quantity of material, labor and cost before actual execution.3. It helps an engineer to plan the construction work, for quick and proper construction with required quantity.

1. Standard Schedule of Rates (SSR): In schedule of rates the rates of various materials, machinery hiring charges and wages of laborers are available and is prepared by “Board of chief Engineers” in Telangana and approved in year 2016-2017.

2. Rate analysis: The determination of cost per unit of work, from the cost of materials, cost of labors charges, cost of machinery hire charges, VAT, pretty supervision charges, contingencies, contractor profit etc. The rates of materials and labour charges vary from place to place.

3. Detailed Estimation

1. Based on approximate estimate of the project “Administrative approval” is accorded.

2. For getting “Technical sanction” the detailed estimate is prepared.

3. Detailed estimation is required for arranging the contract and entering into agreement between contractor and engineer.

RESULTS AND DISCUSSION

1. Flexible pavement design

Structural Design of pavement and failure criteria checked with iit pave software and also checked IRC 37-2015 guidelines.

2. 2/4 lane carriageway with paved shoulder using mx road software

i). Road Designed checked with IRC: SP: 73-2007 and IRC: SP: 84-2014 guidelines.

ii). Mx road software used designed given bellow elements:

1. Alignment 2. Horizontal alignment 3. Vertical alignment 4. Sight distances 5. Over lay design 6. Volumetric analysis of road

3. Estimation

1). 1 km partial Reconstruction of two lane with paved shoulder in flexible pavement layers are taken (Chainage at km 29.000 to km 30.000).

2). Total cost of 1 km partial Reconstruction of two lane with paved shoulder in flexible pavement **INR 2, 25, 15698/-**

CONCLUSION

1. The project design from chainage at Km 23.000 to Km 34.200 (Devarakonda to Koadad Route) in Nalgonda District, Telangana state.

2. Design speed of highway is 100 Kmph.

3. The design of flexible pavement is mostly empirical in nature, initial cost of flexible pavement is less. In flexible pavement, traffic is allowed to move, once the pavement is rolled.

4. Flexible pavement design is mainly concerned with determining appropriate layer thickness and composition. The main design factors are stresses due to temperature variations and traffic load.

5. MX Road software be present an advanced, string based modeling tool that enables rapid designing of all road types with precise. Using MX Road creation of Design alternatives for the construction of an ideal road system can be able to with ease. Once a design alternative has been authenticated, further details that are to be added to the design process can also be automated while using MX road modeling, saving both time as well as money.

6. The project estimate should give a clear picture of the financial commitment

involved and should be realistic. This is possible only if the items of work, the quantities determined to a reasonable degree of accuracy and the rates provided on a realistic basis.

7. Highways are very important to a country's economic development. The construction of a high quality road network directly increases a nation's economic output by reducing journey times and costs, making a region more attractive economically.

REFERENCES

[1] IRC: 37-2015 "Guidelines for the Design of Flexible Pavements".

[2] Dr. L.R. Kadyali. "Traffic Engineering and Transportation Planning". Khanna Publishers, Seventh Edition 2007.

[3] IRC-73-1980, "Geometric design standards for Rural road in Plain areas."

[4] Transportation Research Board, Highway Capacity Manual, 2000

[5] Kumar A et al, "Up Gradation of Geometric Design of State highway-131(Ch. 9.00km-15.00 km) Using MX road Software-A Case Study" International Journal of Civil Engineering and Technology (IJCIET) 2016.

[6] IRC: SP: 73 -2015 "Manual of specifications & standards for 2 lanning of Highways with paved shoulders".

[7] IRC: SP: 19-2001 "Manual for survey, investigation and preparation of road projects".

[8] IRC: SP: 23-1983 "Guidelines for design of Vertical curves for highways".

[9] IRC: 38-1988 "Guidelines for design of Horizontal curves for highways".

[10] IRC: 64-1976 "Tentative guidelines on capacity of roads in rural area".



[11] IRC: 66-1976 "Recommended practice for sight distance on rural highways".

[12] HarshilS. Shah and P. A. Shinkar et al, "planning and design of proposed bypass road connecting Kalawad road to Gondal road, Rajekote using Autodesk Civil 3D software-A Case Study"

International Journal of scientific development and research (IJS DR)2016.

[13] Dutta, B.N. "Estimation and Costing in civil Engineering", UBS Publishers and distributors Pvt. Ltd., 2009