Traffic Impact Study at the Existing Road Connecting between Botanical Garden of Gachibowli Miyapur Road and Ends at Prof C.R. Road, Hyderabad-Telangana

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Abstract: ***The existing road network system in Hyderabad is facing lot of problems associated with inadequate traffic management and lack of efficient transport system. This has resulted inconsiderable growth and use of personalized vehicles leading to traffic congestions due to inadequate road configurations. The primary and secondary road network of GHMC consisting of arterial, sub arterial, collector and local streets under GHMC undergoing frequent maintenance due to frequent digging of roads along and across for laying of new/shifting of existing utilities, inadequate carriageway width for the ever growing vehicular traffic. there is more probability of accidents due to unavailability of median, warning signs etc. Apart from the above improper/lack of footpath for the vulnerable pedestrians ,indiscriminate disposal of garbage and dumping of debris on the road side, unauthorized encroachments leading to reduction in road space thereby congestion, early failure of BT surface due to inadequate drainage facilities coupled with absence of proper camber, clogging of drains, quality of construction and maintenance etc., leading to the failure of these roads. Currently the existing road connecting between Botanical garden of Gachibowli Miyapur road and ends at prof C.R. Road .the Road is very narrow and frequent traffic jams occur on this road leading to inordinate delay for traffic. Most of the traffic passing through this road is two wheelers, cars, light commercial vehicles etc. there is a lot of open space In some areas along the road. and there is a little space for widening due to the establishments such as commercial shops, religious structures etc., very close to the road in some areas along the road***

Keywords: Design pavement composition, periodic repair costing, provision of dowel bar & tie bar, design of junctions, cost comparison

1. Introduction: Requirements for Good Pavement

Satisfactory pavement performance depends upon the proper design and functioning of all of the key components of the pavement system. These include:

- A wearing surface that provides sufficient smoothness, friction resistance, and sealing or drainage of surface water
- Bound structural layers (*i.e.*, asphalt or Portland cement concrete) that provide sufficient load-carrying capacity, as well as barriers to water intrusion into the underlying unbound materials.
- Sufficient thickness to distribute the wheel load stresses to a safe value on the sub grade soil
- Long design life with low maintenance cost
- A subgrade that provides a uniform and sufficiently stiff, strong, and stable foundation for the overlying layers.
- Drainage systems that quickly remove water from the pavement system before the water degrades the properties of the unbound layers and sub grade.
- Produce least noise from moving vehicles
- Dust proof surface so that traffic safety is not impaired by reducing visibility

Traditionally, these design issues are divided among many groups within an agency. The geotechnical group is typically responsible for characterizing the foundation characteristics of the subgrade. The materials group may be responsible for designing a suitable asphalt or Portland cement concrete mix and unbound aggregate blend for use as base course. The pavement group may be responsible for the structural ("thickness") design. The construction group may be responsible for ensuring that the pavement structure is constructed as designed.

2. An Index Map Showing the Road Alignment are Given Below

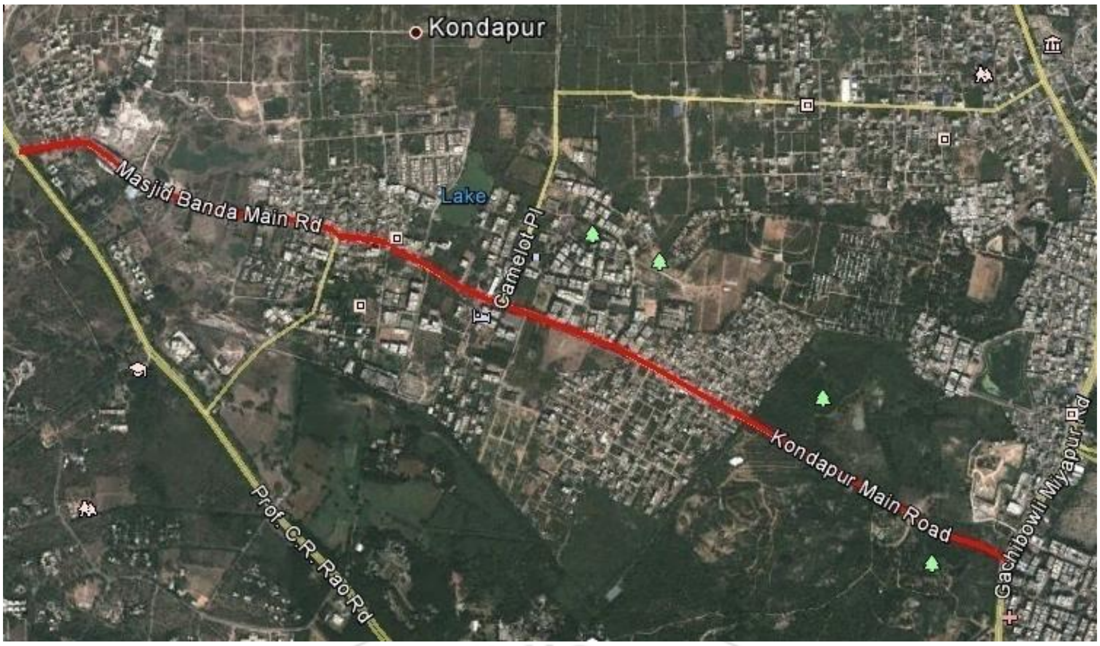

Figure: An Index Map Showing the Project Road Alignment

Design of Flexible Pavement (Widening/Reconstruction)

The traffic loading over design life period in terms of cumulative number of standard axles on the project road section would be calculated based on the following formula.
N = 365 x [(1+r)^n – 1)] x A x D x F / r
Where,
N = Cumulative number of standard axles to be catered in the design in terms of MSA
A = Initial traffic in the year of completion of construction in terms of number of Commercial Vehicles per Day.
D = Lane Distribution Factor, F = Vehicle Damage Factor.
n = Design Life in Years, r = Annual Growth Rate of Commercial Vehicles (For 7.5%, R = 0.075)

Design Pavement Composition
Mainline Pavement:
Traffic Loading - 22.9 msa
Design CBR - 10 %
Asphalt Concrete (AC) - 40 mm
Dense Bituminous Macadam (DBM) - 100 mm
Wet Mix Macadam (WMM) - 250 mm
Granular Sub-base - 200 mm

Cycle Track Paving
RMC M20 Concrete - 15mm
Wet Mix Macadam (WMM) - 250 mm

Strengthening Of Existing Carriageway
The design life considered for the overlays is 10 years. The design traffic loading is estimated for the design life works out to 7.6 msa. It is proposed to strengthen the existing carriageway by means of bituminous overlays.

Overlay Thickness
Asphalt Concrete -40 mm
Dense Bituminous Macadam -50 mm

Surface Treatment
Before application of profile correction and overlays, existing bituminous surface needs treatment. The proposed surface treatment to existing pavement depends upon extent of distress, which was observed during condition surveys. This includes pothole (deep) filling with coarse aggregate base and Bituminous Macadam, crack sealing using slurry seal etc. The highly distressed pavement with patches, shallow potholes, ravelling, rutting and extensive cracking is refilled with Bituminous Macadam. Bituminous material after reconditioning may be used for the purpose along with new material after checking the suitability.

3. Structural Overlay Costing of Flexible Pavement

Overlay Crust	Cost/km	No	Length (m)	Thickness (m)	Width (m)	Rate (Rs)
Bituminous Concrete (BC)	3,464,706	1	1000	0.040	10.5	8,249.30
Dense Bituminous Macadam (DBM)	3,994,883	1	1000	0.050	10.5	7,609.30
Profile Correction Course (BM)	2,927,400	1	1000	0.050	10.5	5,576.00
Tack Coat	396,270	3	1000	-	10.5	12.58
Initial Cost	**10,783,259**					

Periodic Repair Costing
The following Pot Hole Progression model developed by Central Road Research Institute (CRRI) was been made use of:

$$\% \text{ Pot Hole} = \frac{1.23 \times \% CP \times MSA \times (1+CQ) + (2.5 \times \% PI \times MSA \times (1+CQ))}{170 \times MSN}$$

Where,

$$\% CP = \text{Percentage Cracking} = 4.26 \times (CMSA/MSN) \times 0.56 \times (SCRi)^{0.32}$$

% PI = Percentage Pot Holes Initiated = $0.13 \times (170^{0.47}) \times e^{-0.12 \times MSA}$

MSA = Standard Axles in Million, CMSA= Cumulative Standard Axles in Million

MSN = Modified Structural Number = 3.28 x (Initial Deflection)$^{-0.23}$

CQ = Construction Quality= 0 for Major Roadways

= 1 for Minor Roadways

SCRi = Percent Surfacing Cracking Initiated = $4^{-1.09*(CMSA/MSN^2)}$

Design of Rigid Pavement

From Geotechnical investigations, it was observed that the existing sub grade / natural ground soaked CBRs is varies from 6% to 15%. However, the design of concrete pavement is based on 10% sub grade CBR.

Design Input

Tire wheel pressure	=	8 kg/cm2
Design life Elasticity of Concrete, E	= =	30 Years 300000 kg/cm^2
Poisson's ratio of concrete, µ	=	0.15
Temperature differentials, t	=	21 ^{o}C
Co-efficient of linear expansion of concrete, ∝	=	0.00001/^{o}C
Load safety factor (LSF)	=	1.2
Flexural strength of concrete, fck	=	45 kg/cm^2
Coefficient of friction, f	=	1.5
Density of concrete, w	=	2400 kg/m^3

Permissible Tensile stresses in Plain bars, fls	=	1250 kg/cm^2
Permissible Tensile stresses in deformed bars, shs	=	2000 kg/cm^2
Permissible bearing stress in concrete, bes	=	100 kg/cm^2
Permissible bond stress in plain tie bars, bop	=	17.5 kg/cm^2
Permissible bond stress in deformed tie bars, bod	=	24.6 kg/cm^2

k value comes out to be 4.5 kg/cm2/cm. IRC 15:2002 suggests that cement concrete pavement cannot be laid directly over the sub grade of k value less than 6 kg/cm2/cm. Therefore, It has been proposed to provide dry lean concrete (DLC) of 100 mm thick as a base course for rigid pavement to increase „k" value by 18.7 kg/cm2/cm. It has been observed that rigid pavement with permeable sub base course like drainage layer gave very good performance with no faulting, cracking or joint spalling. In view of this observation, it has been proposed to introduce drainage layer of granular sub base (GSB-II) below DLC.

Provision of Dowel Bar & Tie Bar

It will have doweled contraction joints at 4.0m spacing. The longitudinal joints will have a spacing of 3.75 m and 3.50 m in order to accommodate 0.25 m wide edge strips. Expansion joints will be provided only at the junctions of structures like culverts, bridges etc. Based on volume of commercial vehicles following layer composition is proposed for concrete pavement. The concrete pavement composition is as follows:

Table: use of dowel and tie bars

Traffic MSA	Panel Size (m)	Layer Composition			Dowel Bar		Tie Bar	
		PQC (mm)	DLC (mm)	GSB (mm)	Dia. (mm)	Spacing (mm)	Dia. (mm)	Spacing (mm)
53.8	3.5 X 4.0	300	100	150	32	300	12	500

Initial Construction Costing of Concrete Pavement

Table: Initial Cost Details

Layers	Cost/km	No	Length (m)	Thickness (m)	Width (m)	Rate (Rs)
Excavation	762,300	1	1000	0.55	10.5	132.00
GSB-II	1,889,339	1	1000	0.15	10.5	1,199.58
DLC	3,597,773	1	1000	0.1	10.5	3,426.45
PQC	16,893,450	1	1000	0.3	10.5	5,363.00
Initial Cost	23,142,861					

Design f Junctions

In project road there are a number of minor junction and 6 major junctions. All minor junctions connect the collector roads to main carriageway and are designed according to IRC standards. Improved facilities/parameters are proposed at major junctions and are tabulated below. The details of junction layouts are shown in the design plan.

Table: junctions observed along the road

Sl. No.	Chainage	Type of Junction	Connecting Road	Treatment	Turning Radii Provided (m)
1	0+000	T	GachibowliMiyapur	Unsignalized	10-30
2	2+420	+	SaiPruthvi Enclave Colony	Unsignalized	10-30
3	2+640	+	SaiPruthvi Enclave Colony	Unsignalized	10-30
4	3+810	T	Prof. C. R. Rao Road	Unsignalized	10-30

Cost comparison between Flexible Pavement and Rigid Pavement

A cost comparison between the options of repairing/rehabilitating the existing flexible pavement against the option of providing a new cement concrete pavement was made. When upkeep of two pavement options over a life time of 30 years are compared, maintenance costs of cement concrete pavement are negligible compared to that of the flexible pavement. Nonetheless, in this case the initial construction cost of the cement concrete pavement far offsets the benefits of providing a rigid pavement.

Considering the initial cost of construction, the time of opening to traffic and the client‟s requirement flexible pavement is proposed for the project road

Storm Water Drainage

Storm water drains are available for very short length abutting Sarada Nagar and of closed type of width 0.40 - 0.75 m. Remaining length there is no proper surface drainage and majority of the length is in water logging condition during monsoon for lack of storm water drain.

Rational Method for Flood Estimation

The rational method is a universally accepted, empirical formula relating rainfall to runoff and is applicable to small catchment areas not exceeding 50 Km2. The entire precipitation over drainage district does not reach the drain. The characteristics of drainage district such as imperviousness, topography including depressions and duration of precipitation etc, from which fraction of the precipitation which will reach to the drain has to be determined. This fraction is known as co-efficient of runoff which will be determined for each drainage district depending on its characteristic. The runoff reaching the drain is given by fhe expression

$Q = 0.028\ PAIC$

Where:

Q =discharge (peak runoff) in cumec

P =coefficient of run-off for the catchment characteristics

A =area of catchment in hectares

Ic =critical intensity of rainfall in cm/hr for the selected frequency and for duration equal to the time of concentration

COST SUMMARY : BOTANICAL GARDEN ROAD		
Section	Short Description	Total Amount (Rs.)
1)	Site Clearance	56690
2)	Earthwork	18711757
3)	Drainage and Protective Works, Shabad stone in FP, cross pipes for utilities etc	56518479
4)	Pavement	166694373
5)	Road Markings	2507528
6)	**Total**	24,44,88,827
7)	Add vat @ 5%	1,22,24,441
8)	Labour Charges @ 1%	24,44,888
9)	QC Charges	5,00,000
10)	1% for shifting utilities	24,44,888
11)	Tender premium & Price escalation & Shifting & electric lines	1,28,96,956
	TOTAL (6-11)	**27,50,00,000**

4. Conclusion

The stretch of Botanical Garden Road, Kothaguda in the scope of work starts from the Kothguda Junction of GachibowliMiyapur Road and ends at Prof. C.R. Rao Road Junction via Sri Ram Nagar, CMC and SaiPruthviEnclave.the design road for the project is 6 lane flexible pavement after estimating the different alternatives present. The project road is a major link in west Zone. The length of the project road is 3.85 km. with a team of members we have successfully completed the widening and improvement of road project .by analysing and observing the road (i.ecracks,fissures, shoulders, foot paths, gutters, median etc. besides measuring available leeway for future expansion to accommodate future traffic.) through naked eye .traffic analysis is done at the site and results are plotted accuratelyand neatly by minimising the errors .and by collecting the undisturbed sample from site different test are performed in the lab to analyse the soil characteristics. and cost for different items of the work are calculated.

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