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
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.

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

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

Density 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

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

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

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

Where,
- \( \% \text{CP} \) = Percentage Cracking = 4.26 x (CMSA/MSN) X 0.56 x (SCRi) \( 0.32 \)
% PI = Percentage Pot Holes Initiated = 0.13 x (170.0.47) x ε - 
0.12 x 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
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.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tire wheel pressure</td>
<td>8 kg/cm²</td>
</tr>
<tr>
<td>Design life</td>
<td>30 Years</td>
</tr>
<tr>
<td>Elasticity of Concrete, E</td>
<td>30,000 kg/cm²</td>
</tr>
<tr>
<td>Poisson's ratio of concrete, μ</td>
<td>0.15</td>
</tr>
<tr>
<td>Temperature differentials, t</td>
<td>21 °C</td>
</tr>
<tr>
<td>Co-efficient of linear expansion of concrete, α</td>
<td>0.00001°C⁻¹</td>
</tr>
<tr>
<td>Load safety factor (LSF)</td>
<td>1.2</td>
</tr>
<tr>
<td>Flexural strength of concrete, fck</td>
<td>45 kg/cm²</td>
</tr>
<tr>
<td>Coefficient of friction, f</td>
<td>1.5</td>
</tr>
<tr>
<td>Density of concrete, w</td>
<td>2400 kg/m³</td>
</tr>
</tbody>
</table>

### Table: use of dowel and tie bars

<table>
<thead>
<tr>
<th>Traffic MSA</th>
<th>Panel Size (m)</th>
<th>Layer Composition</th>
<th>Dowel Bar</th>
<th>Tie Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PQC (mm)</td>
<td>DLC (mm)</td>
<td>GSB (mm)</td>
</tr>
<tr>
<td>53.8</td>
<td>3.5 X 4.0</td>
<td>300</td>
<td>100</td>
<td>150</td>
</tr>
</tbody>
</table>

Initial Construction Costing of Concrete Pavement

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

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>
<thead>
<tr>
<th>Sl. No.</th>
<th>Chainage</th>
<th>Type of Junction</th>
<th>Connecting Road</th>
<th>Treatment</th>
<th>Turning Radii Provided (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0+000</td>
<td>T</td>
<td>Gachibowli/Myapur</td>
<td>Unsignalized</td>
<td>10-30</td>
</tr>
<tr>
<td>2</td>
<td>2+420</td>
<td>+</td>
<td>SaiPruthvi Enclave Colony</td>
<td>Unsignalized</td>
<td>10-30</td>
</tr>
<tr>
<td>3</td>
<td>2+640</td>
<td>+</td>
<td>SaiPruthvi Enclave Colony</td>
<td>Unsignalized</td>
<td>10-30</td>
</tr>
<tr>
<td>4</td>
<td>3+810</td>
<td>T</td>
<td>Prof. C. R. Rao Road</td>
<td>Unsignalized</td>
<td>10-30</td>
</tr>
</tbody>
</table>

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 coefficient of runoff which will be determined for each drainage district depending on its characteristic. The runoff reaching the drain is given by the 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
- \( I_c \) = critical intensity of rainfall in cm/hr for the selected frequency and for duration equal to the time of concentration

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.e.cracks, 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 accurately and 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.

References
[5] Soil mechanics by ARORA.
[7] environmental effects on flexible pavements wiki.com