Chapter : 10

Present approach for the Highway planning in India.

The scrutiny of existing roads reveals very important flaw in the present road system in India. It is evidenced in the case of road system in Marathwada. Even the state highways have been constructed, as it appears, with no due attention to intermodal vehicular linkage intensity. Only construction cost and not total cost have been taken into consideration while designing the layout for new roads. Operating cost appears to be completely ignored. This is explicit in the planning formula on which the road development has been formulated. This point can be substantiated by reviewing the criteria for road development in the new twenty years road plan in India for 1960 to 1980. The criteria in the plan are as follow:

Any road development prepared for this particular road development plan must take into consideration the following four points 1.

a) Need of semi developed and underdeveloped areas including forests.
b) Location of administrative head quarters, place of pilgrimage, tourist centres, Universities and cultural centres.

c) Commercial and industrial centres, railways junctions and ports.

d) Strategic need of the country.

The above four points indicate that centres that receive the priority for provision of road facilities but the question what would be the criteria for the connecting the different nodes has not received the analytical treatment.

The classification of roads into National highways and State highways has indirectly connected the important metropolitan cities with relatively lesser degree of detouring and circumlocutious routes. But as we are aware that the vehicular linkage intensity is generally the direct function of population of the towns and the inverse function of distance between them. The linking population between metropolitan cities is no doubt very significant but generally the distance between metropolitan cities is significantly more. Thus owing to the greater distance between metropolitan cities the vehicular traffic is not very much significant. It is revealed that the vehicular linkage intensity between a metropolitan city and other important commercial urban centres in the same state is significantly high. This maximum range of intermodal vehicular linkage intensity appears to influence the lay out planning of highways and roads.
Heading to the need of higher and excessive vehicular distance to be travelled between concerned nodes, as the routes would be circuitous and zigzag.

Further, explicit targets are expressed in terms of maximum distance of towns and villages from metal road as well as any road in twenty years plan as follows.

<table>
<thead>
<tr>
<th></th>
<th>From Metalled road</th>
<th>From any road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed and agricultural area</td>
<td>4</td>
<td>1.6</td>
</tr>
<tr>
<td>Semi-developed area</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Underdeveloped and uncultivable area</td>
<td>12</td>
<td>5</td>
</tr>
</tbody>
</table>

The above criteria provide criteria for future targets of road density in the region. This approach takes road facility as a function of specific elements in the region and not as a function of two nodes. Really speaking, road is function of two traffic generating nodes, though this particular contention would encounter many difficulties in applying for highway layout of planning owing to need of highways for innumerable centres.

In the discussion with the experienced engineers in India it has been revealed that for linking existing roads and village or town minimum construction cost is taken as a guideline for designing layout planning for the new road. This minimisation of construction cost
ignores its implications on operating cost to be incurred by all vehicles plying between given nodes.

As indicated in the context of optimising model, the possibility of increasing total cost including construction cost and operating cost is not at all taken into account.
10.1

ROAD DEVELOPMENT IN MARATHWADA AND THE OPTIMUM LAYOUT PLANNING MODEL

The optimum model does suggest that it is the total cost comprising operating cost as well as construction cost has to be taken into consideration while determining the layout planning for the roads between specific nodes. The total cost that is relevant is inter-model total cost as we have explained earlier.

The development of roads in Marathwada is not to be based exclusively on the targets of road density per square area in the region but also on the basis of rational and optimal linkage system. For the optimal highway linkage system, we have to choose the important focal points in Marathwada. The possibility of complementary accessibility between regions makes us aware that it is an intra-regional as well as inter-regional problem.

The analysis is to be restricted to limited extent as it is highly tentative because the data needed is inadequate.

The tentative and partial plan for the optimisation of highway system in Marathwada is to be proposed on the basis of following points.

1) The vehicle linkage intensity between Bombay and important selected focal points.
2) The implication of newly constructed Malsej Ghat.

3) Complementary accessibility between traffic on National Highways especially, passing through Vidarbha region and Hyderabad Bombay National Highway passing through Marathwada.

GREATER BOMBAY AS MAIN FOCAL POINT:

Greater Bombay is almost an island and it is the biggest city in the Maharashtra State and one of the important metropolitan cities in India. The population of this metropolitan centre according to 1971 census is nearly 59 lakhs.

It is the hub of business and industrial activities in Maharashtra State. It has highest density of population and also the highest number of registered factories in the State. Nearly 50 percent of the registered factories in the whole of the state are located in Greater Bombay, employing nearly 84 percent of total industrial workers'. Bombay is also an important port. All these factors have contributed in generating significant vehicular traffic. The origin destination survey conducted in 1964 reveals that the biggest centre in Maharashtra State generating goods traffic by road is Greater Bombay. According to this survey, average per day traffic of Greater Bombay was 14 thousands comprising 9 thousands originating and 3 thousand terminating. This excludes the intra city
traffic. This constitutes the 29 percent of the goods traffic by motor vehicles in the State in 1964.¹ The traffic from Bombay moves to various places, within the State as well as in other States of India. Goods are transported to nearly all towns in Maharashtra State. The main commodities of goods movement take place from Bombay are mineral oils, provisions, textiles, iron and steel products. Major commodities moved to Bombay are building materials, cotton textiles, sugar and gur.

Nearly all towns in Marathwada have trade relations with Greater Bombay. The towns in Marathwada import provisions textiles, mineral oils, iron and steel products from Greater Bombay. The Marathwada region exports mainly cotton bales, groundnut oil, oil seeds, pulses, Jowar and other food grains, vegetables and fruits too. Greater Bombay Aurangabad, Nanded, Latur, Jalna are the main traffic generating towns in Marathwada.

NEW MALSEJ Ghat AND OPTIMISING HIGHWAY SYSTEM.

The distance saving impact of newly constructed Malsej Ghat is underestimated. Before completion of Malsej Ghat all vehicular traffic between Bombay and Northern India, Central India, Vidarbha and certain part of Marathwada has

EXISTING ROUTES BETWEEN GREATER BOMBAY & IMPORTANT PHOCAL TOWNS IN MAHARASHTRA STATE.

NG = Nagpur
AM = Amaravati
AK = Akola
AU = Aurangabad
AH = Ahmadnagar
B = Bhir
FR = Parbhani
ND = Nanded
U = Umarga
PN = Poona

--- Route by National Highway.
--- Route by State Highway & M.D.I.
State Boundary &
to pass through Thal Chat. All the vehicular traffic between Bombay and Southern India, certain part of Western Maharashtra and Marathwada has to pass through Bor Chat. The roads orienting to Greater Bombay join the roads passing through either Thal Chat or Bor Chat. This caused circuitous routes, increasing the distance between the important towns especially in Marathwada and Vidarbha. The opening up of New Malsej Chat has provided the opportunity to construct new highways orienting to New Malsej Chat resulting into significant reduction in distance between many important towns in Marathwada, Vidarbha and Greater Bombay. Besides, the traffic on National Highways from Northern India, Eastern India and Southern India can be diverted via to Malsej Chat. This implies that there is opportunity of saving inter-modal vehicular distance resulting in significant saving of foreign exchange. Hence it would be justified to take Malsej Chat as focal point instead of Greater Bombay, while applying the optimum model for layout planning for new highways. It suggests that the deviation between Greater Bombay and towns are not relevant but deviation between actual road distance and linear distance to Malsej Chat plus existing distance between Malsej Chat and Greater Bombay is relevant and crucial. This deviation in kilometers is presented in the table 10.1.

The existing highways systems as said earlier cannot exploit the distance reducing impact of Malsej Chat to fuller extent owing to circuitous routes and absence of
road links between many roads leading to Malsej Chat. There are no signs from official quarters of modifying the existing road system in Marathwada and other parts of Maharashtra State so that the fullest advantage of Malsej Chat would be realised. Therefore, it is justified while rationalising the road system in the light of optimising model Malsej Chat would be taken as a focal point in the context of focal node: viz. Greater Bombay in our tentative study.

**COMPLEMENTARITY BETWEEN INTRA AND INTER STATE TRAFFIC.**

As revealed in the map the distance reducing impact of Malsej Chat is not confined only to Aurangabad District in Marathwada, Nagur and Poona districts in West Maharashtra as generally argued. By modifying road system with additional roads it can be extended to many more towns in Marathwada and Vidarbha. Towns like Nagpur, Amravati, Akola from Vidarbha and towns like Nanded, Latur, Udgir from Marathwada can be mentioned. Many of these towns are on the National Highways that links Greater Bombay and Northern India and Eastern India. The National Highway No. 6 carries interstate vehicular traffic between Greater Bombay and Calcutta, Jabalpur, Bilaspur in addition to intra state traffic from Vidarbha. Due consideration is to be given to this fact while rationalising road system. Further,
National Highway linking Greater Bombay and Southern India mainly including Hyderabad also passes through Marathwada region. Omerga is a town in Marathwada on this National Highway. The traffic on this national Highway and the traffic between Bombay and Latur, Udgir, Osmanabad can be taken as complementary traffic for the new proposed roads leading to Malsej Ghat. Thus the complementarities of Intra State and Inter State traffic are to be explored while suggesting new roads leading to Greater Bombay via Malsej Ghat. The potential distance saving impact is presented in Table No. 10.1.
Table 10.1

Potential distance saving impact of Malsej Ghat with reference to Greater Bombay.

(Selected focal towns)  (Kms)

<table>
<thead>
<tr>
<th>Focal Towns</th>
<th>Linear distance to Malsej Ghat</th>
<th>Total distance including linear distance to Malsej Ghat and existing road distance from Malsej Ghat to Bombay</th>
<th>Distance with existing short route</th>
<th>Potential saving in distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aurangabad</td>
<td>162</td>
<td>290</td>
<td>344*</td>
<td>53</td>
</tr>
<tr>
<td>Jalna</td>
<td>219</td>
<td>347</td>
<td>411*</td>
<td>64</td>
</tr>
<tr>
<td>Nanded</td>
<td>350</td>
<td>478</td>
<td>646*</td>
<td>168</td>
</tr>
<tr>
<td>Latur</td>
<td>291</td>
<td>419</td>
<td>511*</td>
<td>92</td>
</tr>
<tr>
<td>Bhir</td>
<td>183</td>
<td>326</td>
<td>336*</td>
<td>60</td>
</tr>
<tr>
<td>Omerga</td>
<td>314</td>
<td>442</td>
<td>521*</td>
<td>79</td>
</tr>
</tbody>
</table>

MAHARASHTRA REGION (AURANGABAD DIVISION)

<table>
<thead>
<tr>
<th>Focal Towns</th>
<th>Linear distance to Malsej Ghat</th>
<th>Total distance including linear distance to Malsej Ghat and existing road distance from Malsej Ghat to Bombay</th>
<th>Distance with existing short route</th>
<th>Potential saving in distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nagpur</td>
<td>548</td>
<td>676</td>
<td>822*</td>
<td>146</td>
</tr>
<tr>
<td>Amravati</td>
<td>430</td>
<td>558</td>
<td>631*</td>
<td>133</td>
</tr>
<tr>
<td>Akola</td>
<td>348</td>
<td>476</td>
<td>605*</td>
<td>129</td>
</tr>
</tbody>
</table>

* This refers to distance via Ahmadnagar Malsej-Ghat with existing road links.

For optimising lay-out planning the importance of
towns generating significant vehicular traffic is crucial.
So the brief description of traffic generating factors
of these towns would be appropriate.

The important relevant factors are population,
market arrivals in regulated markets, and number of
industrial factories.

Aurangabad: Aurangabad is divisional centre of
Aurangabad division popularly known as Marathwada. According
to 1971 census the population of this city is 1,65,253 ranking
first in the region on the basis of population. Marathwada
University is situated at Aurangabad. Aurangabad is one of
important tourist centres as Elora and Ajantha caves are
situated near this city.

Recent industrial Development of this particular city is
commendable. Maharashtra Industrial Development corporation
has fostered the industrial development of the city,
especially, by establishing Industrial Estates providing in
infrastructural facilities such as developed lands, roads,
electricity etc. in 1970 there were 43 factories. This city
is served by meter gauge railway.
Jalna: The population of the city, according to 1971 census, is 31,089. On the basis of population this city ranks third. The market arrivals in the regulated markets for agricultural produce are maximum. In 1968-69, the market arrivals were to the tune of 60,211 tonnes. Number of factories in 1970 were 49. This city is served by meter gauge railway.

Nanded: Nanded is also an important town in the region. The population according to 1971 census is 1,36,533. This city ranks second on the basis of population. Number of factories in 1970 were 29. The Osmanshahi Textile Mill, biggest textile mill in the region is located at Nanded. Market arrivals of agricultural produce were estimated 45,509 tonnes in 1968-69. This city is served by meter gauge railway. Holy Gurudwara is located at Nanded. Industrial Estate in Nanded is one of the important Industrial Estates in Marathwada Region. Marathwada development Corporation has established its textile unit.

Latur: Latur is also a very important commercial centre in the region. The population according to 1971 census is 70,166. Market arrivals of agricultural produce in regulated market were 60,471 tonnes in 1968-69. Number of factories located at this place were 16 in 1970. It is served by narrow gauge railway.

The relative level of truck traffic is demonstrated in the table 10.2.
### Table 10.2

**Important towns in Marathwada and its various aspects.**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Aspects</th>
<th>Aurangabad</th>
<th>Jalna</th>
<th>Nanded</th>
<th>Latur</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Population (Census 1971)</td>
<td>1,65,253</td>
<td>91,099</td>
<td>1,26,533</td>
<td>70,156</td>
</tr>
<tr>
<td>2.</td>
<td>Number of factories (1970)</td>
<td>43</td>
<td>49</td>
<td>29</td>
<td>16</td>
</tr>
<tr>
<td>3.</td>
<td>Market arrivals of Agricultural produce in regulated market annually in (tonnes) in 1968-69</td>
<td>32,949</td>
<td>65,211</td>
<td>45,509</td>
<td>60,471</td>
</tr>
<tr>
<td>4.</td>
<td>Average total originating and terminating traffic by truck, per day in 1964. (In tonnes)</td>
<td>809</td>
<td>593</td>
<td>614</td>
<td>581</td>
</tr>
</tbody>
</table>


THE ISSUE OF ESTIMATING INTER-NODAL VEHICULAR LINKAGE INTENSITY.

No ready data of inter-nodal linkage intensity in terms of vehicles is available. So the real difficulty in applying the optimum model is how to estimate the inter-nodal vehicle intensity between important nodes which are crucial for our purpose. It necessitates the indirect measurement of inter-nodal vehicle intensity.

The inter-nodal vehicle intensity is to be derived from origin destination survey conducted in 1964 by Govt. of Maharashtra for important and selected towns in Maharashtra State. The data that could be obtained is in the form of tonnes of goods originated and terminated by trucks with reference to towns covered by the Survey. Further, transit tonnes traffic at focal point is also available. On the basis of originating terminating and transitory traffic the vehicle linkage intensity especially with reference to Greater Bombay can be estimated for 1964. This particular estimated vehicle linkage intensity becomes obsolete as the growth in vehicle traffic after 1964 is significant. The growth rate of vehicular traffic after 1964 is necessary. Owing to lack of data this growth rate of traffic is to be estimated on the basis of point vehicle density on the road as focal points. This point vehicle density is available each year as annual survey of point vehicle density is conducted by State Government near the important
focal points. Assuming same inter-nodal composition, with the help of estimated average growth rate, we can forecast the vehicle linkage intensity for future specific years applying following formula:

\[
\text{Forecasted vehicle linkage intensity in 1974} = \text{Vehicle linkage intensity in 1974} \times \frac{\text{Average growth rate after point of density of all heavy vehicles in 1974}}{\text{Number of years after 1964}}
\]

The above formula will give us, no doubt highly approximate and tentative estimate of inter-nodal vehicle intensity.

REFERENCE YEAR 1985.

The one more crucial issue is to determine the reference year of which inter nodal vehicle linkage intensity is to be taken as a basis for optimising road system. The growth of the traffic cannot be imagined indefinitely. From theoretical point of view, after a certain stage vehicular traffic on the given sections of roads is expected to be stabilized, this refers to the asymptotic stage of growth curve. This vehicle linkage intensity can be regarded as appropriate for layout planning for optimising road system. The optimality would be more durable.

Let us assure, for convenience, that this particular stage of stable vehicular traffic would reach in 1985. So estimated inter-nodal linkage intensity with reference to year 1985 is taken as basis for optimising highway system.
ECONOMIC TRACK COST.

Track cost has two components: One refers to capital cost and other refers to maintenance cost of the roads.

Capital cost of the State-Highway.

The estimation of the construction cost of State Highway per mile is based on per mile cost given in the report of Maharashtra Regional Transport survey.\(^1\) The cost estimate refers to year 1964-65. This cost estimate is obsolete as the wage rate and prices of other input materials are nearly doubled from the period 1964-65 to 1974-75. Assuming that there would be no further rise in the cost, the construction cost with reference to 1974-75 would be equal to approximately double of the cost in 1964-65.

The average construction cost of the bituminous State Highway in 1964-65 was estimated equal to 2.5 lakhs rupees per mile including work of minor bridges excluding cost of major bridges\(^2\).

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\(^2\) Ibid.
Capital cost based on accounting prices:

For our analysis it is not financial cost but economic cost based on accounting prices of the inputs is relevant. Economic cost of the road construction is estimated on the following basis.

i) The accounting price of the labour is equal to zero.

ii) The accounting price of the foreign exchange is twice that of official rate of exchange.

iii) The price index of construction cost on the basis of 1964-65 is taken 200 for 1974-75.

So the price index quotient is $\frac{200}{100} = 2$

iv) The labour cost component of the road construction constitutes 80 percent of the total construction cost.

v) The import component of the construction cost constitutes 5 percent of the total cost. This is mainly due to use of asphalt.

Thus the estimated economic cost of the construction one mile of bitueneous State Highway with reference to 1974-75 is 1.25 lakhs. The road is capital goods. So interest cost investment is to be taken as capital cost of road per mile per annum\(^2\), Table 10.3. On the basis of the rate of interest equal to 9 percent per annum\(^2\), the annual capital cost per mile is equal to Rs. 11,250.

The maintenance expenditure per mile is to be taken into consideration.

---

### Table 10.3

<table>
<thead>
<tr>
<th>Input</th>
<th>Percentage in total cost</th>
<th>Financial cost</th>
<th>Accounting price coefficient</th>
<th>Economic cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>80</td>
<td>4 lakhs</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Foreign exchange component</td>
<td>5</td>
<td>0.25 lakhs</td>
<td>2</td>
<td>0.5 lakhs</td>
</tr>
<tr>
<td>Other material cost</td>
<td>15</td>
<td>0.75 lakhs</td>
<td>1</td>
<td>0.75 lakhs</td>
</tr>
<tr>
<td>Total cost per mile</td>
<td>100</td>
<td>5 lakhs</td>
<td>-</td>
<td>1.25 lakhs</td>
</tr>
</tbody>
</table>
Maintenance expenditure.

The maintenance expenditure is to be taken into consideration while estimating the cost of track. The maintenance expenditure has two components, one varies according to vehicle density and other one depends on time. No reliable data is available indicating the exact proportion of each component in the total maintenance expenditure. On the basis of discussion with experienced engineers in India, the proportion of each is taken as 50 percent. This implies that half of maintenance expenditure per annum can be taken as fixed i.e. independent of vehicle density on the road and half as variable maintenance cost as function of vehicle traffic density. This particular variable maintenance cost can be treated as part of operating cost of the vehicle and the fixed maintenance cost is to be treated as part of capital cost of the track for applying optimum model for lay-out planning.

The per mile total maintenance expenditure for bituminous state highway on the basis of administrative norms was Rs. 5951/-\(^1\) The cost of road construction has been doubled in 1974-75 hence the maintenance expenditure for 1975 is to be doubled that of in 1966, so maintenance expenditure is to be taken equal to Rs.11,902/- for 1975

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The fixed maintenance expenditure independent of vehicular traffic would 50 percent of Rs. 11,902/- i.e. Rs. 5,951/- for 1975. The economic cost on the basis of accounting prices would be as follows:

Table 10.4

<table>
<thead>
<tr>
<th>Components</th>
<th>Percentage in total cost</th>
<th>Financial cost</th>
<th>Accounting price coefficient</th>
<th>Economic cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>30</td>
<td>4760.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Foreign exchange</td>
<td>5</td>
<td>297.6</td>
<td>2</td>
<td>595.2</td>
</tr>
<tr>
<td>Other inputs</td>
<td>15</td>
<td>392.6</td>
<td>1</td>
<td>892.6</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>5951.0</td>
<td></td>
<td>1437.8</td>
</tr>
</tbody>
</table>

The total track cost consists of interest on investment for Highway construction and fixed maintenance expenditure per mile per annum. The economic track cost would be Rs. 12,737.8 comprising Rs. 11,250/- as interest cost of investment in highway construction and 1,487.8 as fixed maintenance expenditure per mile per annum. This gives us per mile per day economic track cost equal to Rs. 34.3.
Operating cost of the vehicle.

For optimising road system operating cost of the vehicle is crucial. As argued earlier, the operating cost of the vehicle is to be estimated on the basis of accounting prices of the input components. The estimated operating cost on the basis of accounting prices is to be termed as 'Economic operating cost.' This operating cost has been estimated on the basis of financial cost components of operating cost of vehicle per mile in 1966. The economic operating cost is to be estimated with reference to year 1985. Assuming that the cost referring to 1975 would not undergo any significant change, we can take the same for 1985. On the basis of financial cost in 1966 the operating cost for 1975 has been estimated on the following important considerations.

1) The financial cost in 1966 is converted into financial cost in 1975 on the basis of price index coefficient of input component as price index in 1975 of input component with base price index in 1966 of input components year 1960 except in the case of petroleum products.

In the case of petroleum products, price index coefficient based on relative change in the price of crude petroleum products in the world market between year is used. 1

---

1. However it is only since February 1971 that prices have been raised, starting with the increase from $ 2.18 to $ 2.74 in April 1972, to $ 3.06 in August 1973 and to $ 5.17 in November 1973. The big jump to $ 11.65 came in January 1974. "Maitra Prayatosh, "The Energy Crisis: Some Implications, Economic Affairs (India) January - February 1976 - p. 53."
ii) Accounting price of foreign exchange is taken twice that of official rate of exchange. This implies that the accounting price coefficient for foreign exchange cost component is 2.

iii) Foreign exchange cost component of petroleum products tyres, is assumed to constitute the 50 percent of the cost of these input products. This is based on the input output table of Indian economy.¹

iv) Foreign exchange component of spare parts required for repairing and the capital cost of vehicle excluding taxes is assumed to constitute 20 percent of the total cost of these items. The price of the vehicle for 1975 is taken Rs. 51,566/-.
Rate of interest is taken 18 percent per annum for estimating the interest cost. The life of the vehicle is assumed 300,000 miles. This cost excludes taxes.

v) Average variable maintenance expenditure of the track comprises only 5 percent foreign exchange component.

vi) Repairing expenditure is assumed to have two important components viz: spare parts and labour, constituting 75 percent and 25 percent respectively.

vii) The labour component related to average variable maintenance expenditure and wage bill related to driver, cleaner and Motor mechanics is taken as having zero accounting price.
The economic operating cost based on accounting prices of input component depends upon following factors:

a) Accounting price coefficient of input component.

b) Percentage of input component cost into total operating cost excluding taxes.

c) Price index coefficient of input component.

The relevant data is revealed in Table

On the basis of these factors, the economic operating cost has been estimated by applying following formula.

\[
\text{Operating cost of vehicle per mile} = \left( \frac{\text{Accounting price coefficient of input component} \times \text{Percentage input component cost} \times \text{price index coefficient}}{} \right)
\]

The estimated economic operating cost per mile for heavy vehicle is 1.88 Rs. in 1975 as revealed in Table. Assuming no further change in the same; this estimated economic operating cost would be used for 1985.
### TABLE 10.5

**OPERATING COST OF THE HEAVY VEHICLE**

*(PER MILE) EXCLUDING TAXES (In Rs.)*

<table>
<thead>
<tr>
<th>Input component.</th>
<th>Financial Cost</th>
<th>Economic Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1966</td>
<td>1975</td>
</tr>
<tr>
<td>Cost of diesel oil per mile.</td>
<td>7</td>
<td>17.47</td>
</tr>
<tr>
<td>Mobile and lubricants.</td>
<td>1.70</td>
<td>6.0</td>
</tr>
<tr>
<td>Tyre depreciation 8-25 - 20 ply.</td>
<td>14.0</td>
<td>23.23</td>
</tr>
<tr>
<td>Repairs.</td>
<td>3.65</td>
<td>15.60</td>
</tr>
<tr>
<td>Depreciation of vehicle.</td>
<td>9.00</td>
<td>15.53</td>
</tr>
<tr>
<td>Interest cost on investment in the vehicle.</td>
<td>-</td>
<td>30.94</td>
</tr>
<tr>
<td>Average variable maintenance expenditure of the track.</td>
<td>1.00</td>
<td>2.00</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>103.16</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Rs. 1.63**

---

**Source:**


Average variable maintenance expenditure is based on data from Nanjundappa D.M. Road User Taxation and Road Finance in Indian Economy p. 31.
<table>
<thead>
<tr>
<th>Input component</th>
<th>1966</th>
<th>1976</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil price index with reference to 1971 = 100 in World Market.</td>
<td>100</td>
<td>534</td>
</tr>
<tr>
<td>Petroleum product price index in India.</td>
<td>135.6</td>
<td>367</td>
</tr>
<tr>
<td>Tyres.</td>
<td>128.7</td>
<td>210</td>
</tr>
<tr>
<td>Vehicle and Spare parts (Transport equipment)</td>
<td>117.5</td>
<td>202.7</td>
</tr>
</tbody>
</table>

Source - Eastern Economist Annual No. 1976 Pp 1336-1340