4110.3

FORMULATION OF NORMS FOR MAINTENANCE OF LOWER CATEGORY ROADS VIZ. MAJOR DISTRICT ROADS OTHER DISTRICT ROADS AND VILLAGE ROADS

INTRODUCTION

Construction of Roads of various categories in different states of India is costing crores of rupees every year. In order to make the best use of this investment and to avoid deterioration of roads which can result in tremendous loss to the Nation, timely and adequate maintenance cannot be over-emphasised. The problem of maintenance in our country has acquired high priority on account of steep rise in the volume of traffic using our roads and the increase in cost of labour and materials. The problem has been accentuated because the increase in budget for the maintenance of roads has not kept pace with the increase in road length, growth of traffic volume and the rise in prices. This has naturally, resulted in deterioration in the condition of roads and the standard of their up-keep and maintenance has gone down.

This situation came to the notice of Transport Development Council in its meeting held in Mysore during June, 1968 and on the recommendations of the Council a small technical group was formed to fix norms for the maintenance of National Highways and State Highways. This technical group submitted its report which has since been circulated among various State Governments.

During the meeting of State Chief Engineers held on 28th August, 1976 at Madras, it was felt that while maintenance of National Highways was receiving adequate attention on account of availability of required funds, the condition of lower category of roads i.e. Major district roads, other district roads and village roads was going from bad to worse. The length of these roads was increasing in every State but the funds which were being placed at the disposal of the State Public Works Departments were not keeping pace with the requirements, which were increasing not only due to additional length of roads but also due to the rising cost of labour and materials.

It was felt in this meeting that a small group of Chief Engineers may be assigned the duty of recommend-

TABLE-1 UNIT COST OF ORDINARY REPAIRS — NATIONAL HIGHWAYS

COST PER MILE IN RUPEES

	SINGLE LANE (12 FEET WIDTH)												DOUBLE LANE (22 FT WIDTH)											
	TRAFFIC CORRESPONDING TO C.B.R. CURVES A, B C AND D. i.e. <450 COMMERCIAL VEHICLES PER DAY				TRAFFIC CORRESPONDING TO C.B.R. CURVE E i.e. 450 - 1500 COMMERCIAL VEHICLES PER DAY				TRAFFIC CORRESPONDING TO C.B.R. CURVES F & G i.e. > 1500 COMMERCIAL VEHICLES PER DAY				TRAFFIC CORRESPONDING TO CBR CURVES A B C AND D i.e. <450 COMMERCIAL VEHICLES PER DAY				TRAFFIC CORRESPONDING TO C.B.R CURVE E i.e. 450-1500 COMMERCIAL VEHICLES PER DAY				TRAFFIC CORRESPONDING TO C B R. CURVES F & G. i.e > 1500 COMMERCIAL VEHICLES PER DAY			
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4
1. ROAD GANGS	850 (0.5)	850 COOLY + ½ MATE)	850	850	994 (0.6	994 COOLY	994 + ½	994 MATE)	1138 (0.7	1138 COOLY	1138 + ½	1138 MATE)	706 (0.4	706 COOLY	706 + ½	706 MATE)	994 (0.6	994 COOLY + ½	994 MATE)	994	1210 (0.75	1210 COOLY	1210 + ½	1210 MATE)
2. PATCH REPAIRS	420 (0.6 CFT OF	470 TON OF METAL)	540 BITUMEN	+ 200	585 (0.9 TON OF METAL)	648 OF BITUMEN +	735 250 CFT	860	750 (1.2 TON OF	825 OF BITU METAL)	930 MEN +	1080 300 CFT	630 (0.9 TON OF	705 OF BITUMEN + METAL)	810	960 300 CFT.	930 (1.4 TON OF	1020 OF BIT METAL)	1160 MEN + 400 CFT	1360	1125 (1.8 TON OF METAL)	1238 OF BITU MEN +	1395	1620 450 CFT
3. HEAVY BERMS REPAIRS	350	350 300 TO 400	350	350	330	350 400 TO	350 700	550	700	700 600 TO	700 800	700	200	200 150 TO	200 250	200	350	350 250 TO	350 450	350	450	450 400 TO	450 500	450
4. ARBORICULTURE AND LANDSCAPING	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
5. ORIGINAL WORKS TREATED AS REPAIRS	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
6. STRUCTURES	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
7. MISCELLANEOUS SUCH AS - (a) ROAD SIDE DRAINAGE, ROAD SIGNS, COLLECTION OF TRAFFIC DATA ETC.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
(b) INSPECTION BUNGALOWS, REST HOUSES, GODOWNS ETC.,	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
	2770 SAY 2800	2820 SAY 2850	2890 SAY 2900	2990 SAY 3000	3279 SAY 3300	3342 SAY 3350	3429 SAY 3450	3554 SAY 3550	3738 SAY 3750	3813 SAY 3800	3918 SAY 3900	4068 SAY 4100	2680 SAY 2700	2761 SAY 2750	2868 SAY 2850	3016 SAY 3000	3414 SAY 3400	3514 SAY 3500	3654 SAY 3650	3854 SAY 3850	3935 SAY 3950	4049 SAY 4050	4205 SAY 4200	4430 SAY 4450

TABLE -2 UNIT COST OF PERIODIC RENEWALS - NATIONAL HIGHWAYS

TRAFFIC CLASSIFICATION	SINGLE LANE (12 FT. WIDTH)				DOUBLE LANE (22 FT. WIDTH)			
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4
1 COST OF RENEWAL PER YEAR PER MILE FOR TRAFFIC CORRESPONDING TO CURVES A, B, C AND D OF CBR DESIGN CHART CD 2000 i.e. <450 COMMERCIAL VEHICLES PER DAY	1688 $\frac{SD_1^{12}}{4}$	1825 $\frac{SD_2^{12}}{4}$	2025 $\frac{SD_3^{12}}{4}$	2300 $\frac{SD_4^{12}}{4}$	2470 $\frac{SD_1^{22}}{5}$	3670 $\frac{SD_2^{22}}{5}$	2940 $\frac{SD_3^{22}}{5}$	3370 $\frac{SD_4^{22}}{5}$
2. COST OF RENEWAL PER YEAR PER MILE FOR TRAFFIC CORRESPONDING TO CURVE E i.e. 450 - 1500 COMMERCIAL VEHICLES PER DAY	2250 $\frac{SD_1^{12}}{3}$	2433 $\frac{SD_2^{12}}{3}$	2700 $\frac{SD_3^{12}}{3}$	3067 $\frac{SD_4^{12}}{3}$	3688 $\frac{SD_1^{22}}{4}$	3338 $\frac{SD_2^{22}}{4}$	3700 $\frac{SD_3^{22}}{4}$	4213 $\frac{SD_4^{22}}{4}$
3. COST OF RENEWAL PER YEAR PER MILE FOR TRAFFIC CORRESPONDING TO CURVES F AND G i.e. >1500 COMMERCIAL VEHICLES PER DAY	3367 $\frac{PC_1^{12}}{6}$	3683 $\frac{PC_2^{12}}{6}$	4133 $\frac{PC_3^{12}}{6}$	4767 $\frac{PC_4^{12}}{6}$	6157 $\frac{PC_1^{22}}{6}$	6750 $\frac{PC_2^{22}}{6}$	7567 $\frac{PC_3^{22}}{6}$	8733 $\frac{PC_4^{22}}{6}$

NOTES:

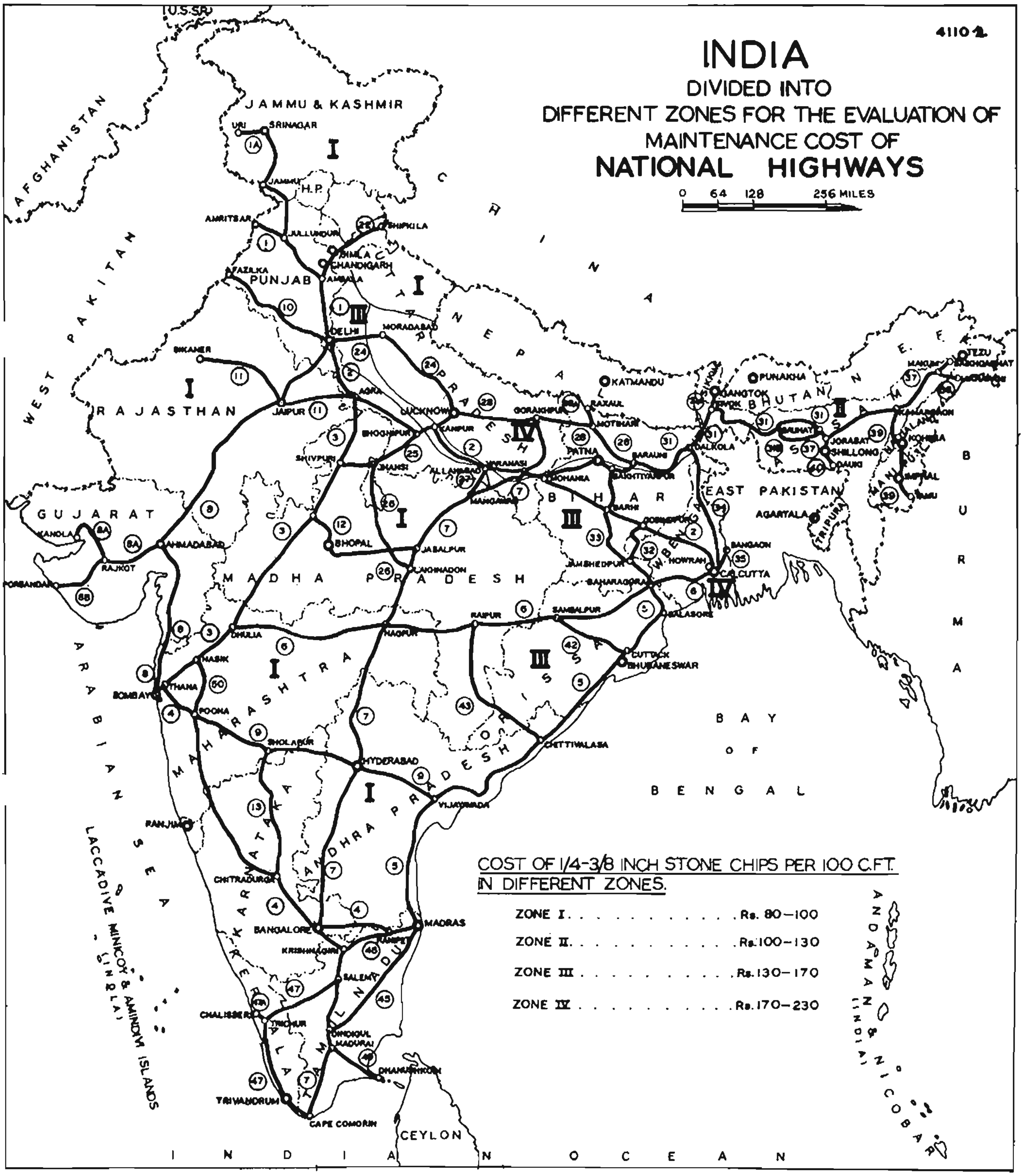
SD = COST OF SINGLE COAT SURFACE DRESSING WITH 3½ cft. OF CHIPS AND 25 lbs. OF BITUMEN

P.C. = COST OF LEVELLING THE SURFACE, PATCH REPAIRING AND PROVIDING ¾ IN. PREMIX CARPET WITH SEAL COAT AS PER I.R.C. SPECIFICATIONS

SUFFIXES 1, 2, 3, AND 4 REPRESENT THE NUMBER OF THE ZONE

SUFFIXES 12 AND 22 REPRESENT THE LANE WIDTH. THUS SD_1^{12} REPRESENTS THE COST OF SINGLE COAT SURFACE DRESSING IN ZONE 1 FOR 12 FT. WIDTH

6 1/2



4110 2
INDIA
DIVIDED INTO
DIFFERENT ZONES FOR THE EVALUATION OF
MAINTENANCE COST OF
NATIONAL HIGHWAYS
0 64 128 256 MILES
COST OF 1/4-3/8 INCH STONE CHIPS PER 100 C.FT.
IN DIFFERENT ZONES.
ZONE I . . . . Rs. 80–100
ZONE II . . . . Rs. 100–130
ZONE III . . . . Rs. 130–170
ZONE IV . . . . Rs. 170–230
U.S.S.R.
AFGHANISTAN
WEST PAKISTAN
CHINA
NEPAL
BHUTAN
EAST PAKISTAN
BURMA
CEYLON
JAMMU & KASHMIR
H.P.
PUNJAB
RAJASTHAN
GUJARAT
UTTAR PRADESH
MADHA PRADESH
BIHAR
W. BENGAL
MAHARASHTRA
ORISSA
ANDHRA PRADESH
KARNATAKA
KERALA
TAMIL NADU
ASSAM
TRIPURA
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
LACCADIVE MINICOY & AMINDIVI ISLANDS (INDIA)
ANDAMAN & NICOBAR (INDIA)
SRINAGAR
URI
JAMMU
AMRITSAR
JULLUNDUR
SIMLA
CHANDIGARH
AMBALA
FAZILKA
DELHI
MORADABAD
BIKANER
JAIPUR
AGRA
LUCKNOW
KANPUR
GORAKHPUR
RAXAUL
MOTIHARI
KATMANDU
PUNAKHA
GANGTOK
PATNA
BARAUNI
DALKOLA
GAUHATI
JORABAT
SHILLONG
DAUKI
IMPHAL
KOHIMA
TEZU
SHIVPURI
JHANSI
ALLAHABAD
VARANASI
MOHANIA
BARHI
BHOPAL
JABALPUR
LAKHNADON
AGARTALA
KANDLA
RAJKOT
PORBANDAR
AHMADABAD
JAMSHEDPUR
BAHARAGORA
CALCUTTA
BANGAON
BALASORE
RAIPUR
SAMBALPUR
NAGPUR
DHULIA
NASIK
THANA
BOMBAY
POONA
CUTTACK
BHUBANESWAR
SHOLAPUR
HYDERABAD
CHITTIVALASA
VIJAYAWADA
PANJIM
CHITRADURGA
BANGALORE
MADRAS
KRISHNAGIRI
RANIPET
SALEM
CHALISSERI
TRICHUR
DINDIGUL
MADURAI
DHANUSHKODI
TRIVANDRUM
CAPE COMORIN

ing suitable norms for the maintenance of these lower category roads so that the respective State Public Works Departments are able to put up their case before their Finance Departments and before the Finance Commission for allocation of adequate funds for the maintenance of these roads.

COMPOSITION OF COMMITTEE

As a result of the decision arrived at this meeting, a committee was set up with the constitution as follows :

1. Shri H.C. Malhotra,
   Chief Engineer, Himachal Pradesh ...Convenor
2. Shri M.D. Patel,
   Secretary and Chief Engineer,
   Gujarat, P.W.D.
3. Shri K. Krishna Mohan Rao,
   Chief Engineer,
   Andhra Pradesh, P.W.D.
4. Shri C.V. Padamnabhan,
   Chief Engineer, Highways and
   Rural Works, Tamil Nadu
5. Shri A.K. Dass Gupta,
   Chief Engineer, West Bengal
6. Shri B.M. Mukherjee,
   Secretary & Chief Engineer,
   Manipur, P.W.D.
7. Shri R.T. Atre,
   Additional Chief Engineer,
   Maharashtra
8. Shri A. Chowdhary,
   Chief Engineer P.W.D. Gauhati (Assam)
9. Shri N. Sen,
   Chief Engineer (Roads)
   Ministry of Shipping & Transport,
   Govt. of India.

The committee held 2 meetings, first on 1st August, 1977 and the Second meeting on 7th August, 1978. In the first meeting, a note was put up before the committee, in which various vital points which needed decision were discussed and the recommendations were finalised. In the second meeting, the report prepared on the basis of the discussions and decisions taken in the first meeting was finalised.

FRAME WORK OF THE REPORT

The committee studied thoroughly the report of the technical group, for the maintenance norms for National Highways and State Highways. These norms have been prepared by dividing the country into four zones depending upon the cost of stone chips which, according to the technical group, was the single most important factor which was responsible for the variation in the costs of ordinary repairs between different areas. The present group is of the considered view that there are many more reasons for variation in cost which have to be taken into account while working out unit cost of maintenance. The division of the country into a few zones were formulated for National Highways to work out the total maintenance cost of National Highways. In the present study norms per km of roads in various States have to be recommended and therefore, division of country into zones will pose practicable problem when there is no much variation from State to State and even within each State. The group has, therefore worked out typical estimates for Earthen Roads, Water Bound Macadam Roads and Black topped roads separately for hilly areas and plains. The rates of material and labour may be changed according to a State or Region to work out the unit rates of maintenance. This will not only give realistic norms for individual States and will also enable the State Public Works Departments to revise the norms as the prices of materials and labour keep on changing.

COMPONENTS OF MAINTENANCE

The maintenance cost can be divided into the following sub-heads :

i) Ordinary Repairs
ii) Periodic Renewals

iii) Special Repairs and Flood & Rain Damages
iv) Premium on account of location

The terminology for different heads of repairs varies from State to State. It is considered advisable that the terminology followed by the Technical Group on National and State Highways should be followed in this report as well by all State Highway Departments on a uniform pattern.

BASIC RATES

Before working out norms for maintenance of roads it is necessary to determine basic rates on which the analysis of cost is worked out. Accordingly a Statement is attached at Annexure-II which gives basic rates of labour and materials on which the norms have been based. This has been given separately so that the different states can compare their basic rates with those adopted for this report and make modifications to suit their actual conditions of working.

METHOD FOLLOWED IN COMPUTING COSTS

The cost of maintenance under various components has been worked out as discussed in the following paragraphs:

I. ORDINARY REPAIRS

The annual repairs are aimed at keeping road pavement and shoulders in proper shape and condition and free from under-growth and other obstructions. It also includes attending periodically to the drainage system for its efficient functioning. In addition, it includes the following items :

i) Patch repairs
ii) Heavy Berm Repairs
iii) Repairs to Arboriculture and Landscaping
iv) Maintenance and repair to Road Side drainage, Road signs, Inspection Bungalows, Rest Houses and Godowns and Road side stock-yards, and collection of traffic data.

(a) ROAD GANGS

For general up-keep of the road pavements, shoulders etc. the technical group from the joint experience recommends the strength of road gangs to be as follows :

i) Black topped roads	0.3 persons per km
ii) Water Bound macadam roads	0.4 persons per km
iii) Earthen roads	0.5 persons per km

For Supervisory staff, it was felt that we should provide Mates at the rate of 1/20 persons per KM and Road Inspectors or Road Supervisors or work Assistants at the rate of 1/48 persons per km. Higher strength of maintenance gangs has been recommended for earthen roads and water bound macadam roads because they need greater attention than black topped roads. In the typical estimate the salary of the road gangs and supervisory staff as is prevalent in Himachal Pradesh P.W.D. has been taken into account. So far as the other States are concerned, the pay scales prevalent there can be substituted to work out the cost per kilometre.

(b) PATCH REPAIRS

On account of wear and tear brought about by the traffic and action of other similar factors, like the destructive effects of climatic elements, the road surface is constantly under-going deterioration and the road gangs are required to attend to these defects as soon as they come to light by simple patch repairs employing most elementary equipment and using materials like bitumen, stone and sand. Idea of these patch repairs is to prevent further deterioration and disintegration of the crust which may need very heavy expense to bring the pavement back to normal traffic worthy condition.

Provision has been made for 5 cu.m. of stone grit 10 mm gauge per km and 0.6 M.T. of bitumen per km length of road. No labour charges have been provided for patch repairs because this work is expected to be done by the road gangs. No provision has been made for patch repairs in the Analysis of cost for earthen roads and water bound macadam roads, because these roads do not need such repairs.

(c) Heavy Berm Repairs

Most of the members of the committee were of the opinion that a provision of Rs 400/- per km on lumpsum basis was necessary for carrying out heavy repairs to berms. The berms are required to be used for parking and for over-taking and passing, and therefore, it is very necessary to keep them in proper shape. No special provision has been made for this item in case of earthen roads for obvious reasons.

(d) Repairs to Arboriculture and Landscaping

Maintenance of roads also included proper up-keep and general repairs of the road sides by maintaining the existing avenues of trees and shrubs and for planting fresh avenues and their maintenance & protection. Road has to be kept free of all obstructions and

wherever any trees get uprooted due to storms and winds, these have to be removed speedily. Periodical lopping of trees and maintaining tree guards and fencing is also required to be done. Provision of Rs 220/- per km for this work is necessary for all types of roads. This provision will, however, not be required in case of States where the road-side plantations are being looked after by the State Forest Departments out of their funds.

(e) **Original work to be treated as Repairs**

On every road,some jobs of the nature of original works are required to be undertaken for the proper up-keep of the road. If such items are to be charged to the Capital head, it becomes difficult to undertake such works expeditiously because it requires considerable time to get sanction of the competent authority for the original works. It is, therefore, very essential that certain amount should be available within the maintenance estimates of the road for carrying out such essential items. It has, therefore, been decided to provide Rs. 250/- per km for original works to be treated as repairs.

(f) **Structures**

Permanent works like culverts, bridges, retaining walls, breast walls etc. require proper maintenance and up-keep. If this repair is neglected it may lead to deterioration of the structures which may require considerable amount to rebuild them. An amount of Rs 275/- per km is necessary for this item of work for all types or roads.

(g) **Road Side Drainage and Road Signs**

Road side drains are necessary for collecting run-off water from the road-way and draining it away so that it does not enter the bed of pavement and weaken it. This item of maintenance is very vital because its neglect can lead to softening of the sub-grade which may cause failure or distoration of the pavement surface. It may also lead to scouring of the shoulders and drains and slips and cuts in road embankment. It is very necessary that the road side drainage system is maintained properly to function efficiently, otherwise it may lead to damages to the road, the repairs to which may cost very heavy expense. Similarly the proper maintenance of Road Signs and Traffic Aid Devices is necessary to give proper guidance to the traffic and to ensure road safety. For this purpose a sum of Rs 165/- per km is the barest minimum and must be provided on all types of roads. This provision also includes the expense of collecting Traffic Data.

(h) **Maintenance of Inspection Bungalows, Rest Houses and Godowns :**

Inspection Bungalows and Rest Houses are necessary for touring officers as a facility for their inspection tours. Similarly,godown buildings have to be set up to store essential maintenance material for use in case of any damage to the road. For proper annual repair and maintenance to these buildings a sum of Rs 250/- per km has been recommended to be made. This provision includes the salary of Rest House Chowkidar and Mali and any other expenditure contingent to the up-keep of Rest Houses and Inspection Bungalows.

(i) **Watch and Ward of Road Side Stock-Yards and Godowns :**

The road side godowns are normally located in out of the way places, away from habitation. Similarly we require to store grit, stone metal and bitumen along the road side. It is essential to keep a proper watch and ward over these materials to avoid theft and pilferage. A sum of Rs 100 per km has, therefore, been provided for this purpose.

II. PERIODIC RENEWALS

All types of roads whether black topped, water bound macadam or earthen roads, need periodical renewals to keep the surface traffic worthy. It is felt that on earthen roads it is necessary to lay one layer of loose moorum or grity earth in thickness of 15 cm every 3 year. Provision has accordingly been made for this while working out norms for earthen roads.

In case of water bound macadam roads, it is necessary to lay an additional layer of 7.5 cm thickness of stone metal every 3rd year after sacrifying the old surface and to properly consolidate the additional layer with a road roller.

In case of black topped surfacing, separate treatment is recommended for roads in hilly areas and roads in Plains. In case of roads in plains, it is suggested that a renewals cycle of 4 years may be followed and every 4th year surface dressing may be provided using bitumen at the rate of 12 kg per 100 sq. m and hard stone grit 10 mm gauge at the rate of 1.067 cu. m. per 100 sq. m.

As the road gets wavy during the period of 4 years, it is necessary to provide levelling course for correcting such defects of pavement by patch work before laying the renewal coat. An amount of 10 per cent of the cost of renewal coat is necessary for this levelling course. In case of plain roads carrying heavy traffic or in special locations, premixed carpet may be laid instead of surface dressing repeating the cycle every six year. The additional cost may be met out of the premium to be provided for such locations as detailed in subsequent paragraphs.

In case of hill roads,surface dressing is not recommended, because the roads are full of curves and the grit flies off with the action of pneumatic tyres. It is, therefore, necessary to provide pre-mixed carpet surface on hilly roads with a renewal cycle of six years with a levelling course.

III. SPECIAL REPAIRS INCLUDING RAINS AND FLOOD DAMAGES

In addition to ordinary repairs and periodical renewals there may be occasions for carrying out special repairs which cannot be foreseen or predicted in advance. These repairs may be required to make good the damage caused by nature calamities like cyclones, earthquakes or heavy rains, cloud bursts and floods. The

items required to be executed may be rebuilding the washed away embankment, reconstruction ot culverts, retaining or breast walls or road side drains. The cost of such repairs cannot be estimated correctly and it can be met out of a lumpsum provision. It is the considered view of the committee that a provision of 5 per cent be made for special repairs and 10 per cent for flood and rain damages, the percentage being worked out on total cost of maintenance including not only ordinary repairs and periodical renewals but also the premix required for special location of a stretch of road.

SMALL TOOLS AND PLANT

It is necessary to purchase small Tools and Plant like Shovels, Kassis, Tarring Kit, Brushes, Baskets etc. for which a provision of one per cent of the total cost is necessary. This provision does not include the cost of purchase of Road Rollers and Tar Boilers. These items are supposed to be provided under a separate head "NEW SUPPLY OF MACHINERY AND TOOLS AND PLANT"

IV. SPECIAL PROVISION ON ACCOUNT OF LOCATION OF THE ROAD

While working out norms of road maintenance we have to take into account certain special factors in addition to ordinary repairs, special repairs and renewals. These factors are the terrain, climate, and special soil characteristics as described below. For each special location lumpsum rates per km. have been recommended which should however, be applied for the *actual lengths* falling under these locations and not for the overall length of the road.

(a) **High Rainfall Areas**

On Roads passing through sections where there is a heavy rain fall, renewals will have to be done at shorter intervals. Moreover, the expenses on repairs to the berms and patch repairs will increase. Therefore, more funds are needed for the repair and upkeep of such sections and an additional provision of Rs 770/- per km is recommended for this purpose where rainfall is more than 3000 mm per annum.

(b) Roads in Hilly Areas

In hilly areas the cost of maintenance of Road increases on account of extra work involved in removal of slips maintenance of high retaining walls, breast walls, hair pin bends and greater efficiency in drainage system. The committee felt that provision of Rs 1000/- per km is absolutely necessary to cover the additional expenses involved in hilly sections. This provision does not cover the reconstruction of high retaining walls and restoration of road crust where landslides occur in long stretches of roads. These items will have to be executed by framing separate estimates for restoration.

(c) Snow Bound Areas

Where the hilly roads are located at an elevation of about 2150.00 metres above mean sea level they are liable to snow falls. In these areas snow clearance has to be done to keep the roads open for traffic. In shady reaches of such roads snow lying on the hill side slopes does not melt quickly and the water from the slow melting of the snow seeps into the sub-grade causing damage to the pavement. The side drains and cross drains also get choked up with snow and require clearance. An additional provision of Rs. 300/- per km over and above the provision of other items including allowance for Hilly Sections and heavy rainfall locations, is recommended where the annual snow fall is more than 40 centimetres.

(d) Roads in Desert Areas :

In case of road sections falling within desert areas, work is required to be done for removal of sand from the road surface and this needs extra expenditure. A provision of Rs. 300/- per km is recommended for such sections of the roads.

(e) Roads in Black Cotton Soil :

The Roads built in black cotton soil areas also need extra expenditure on maintenance, because of the poor bearing capacity of the black cotton soil during the wet season and the consequent breaking of pavement. In such areas much greater attention and efficiency in maintaining the road side drainage is also required. Therefore, an additional provision of Rs 300/- per km is recommended for such sections of the roads, where we encounter black cotton soils.

(f) Urban Links

Wherever the roads pass through urban areas like Municipal Committees/Municipal Corporations, they require higher maintenance cost, because of environmental problems, problems of drainage and difficult working conditions where repairs have to be carried out under constant traffic. It is recommended that for such stretches of roads which pass through urban areas an additional amount of Rs 2000/- per km should be provided for actual length of such stretches.

CONSIDERATION OF TRAFFIC INTENSITY :

The norms which have been given in this study are for traffic volume upto 450 commercial vehicles per day i.e. for C.B.R. Curves A, B, C & D. Where traffic volume is higher the maintenance expenditure will increase on account of shorter renewal cycle and greater expense on Patch Repairs. The committee recommends an additional provision of 15% over and above the annual cost per km as computed on the basis of recommendations made so far.

DOUBLE LANE ROADS :

The norms recommended in this report are for single lane roads because predominantly the roads of the

lower categories are single lane in the country. But there are certain exceptions where some of the major district roads carry heavy traffic and have been made double lane. In case of double lane roads cost of renewal will be more because of the increased area of pavement. On the other hand the wear and tear of the pavement will be much less on account of two lane width and the cost of Patch Repair will also be reduced. The cycle of renewal can also be made longer. On account of these reasons, the increase in cost of renewal due to greater surface area will be offset to some extent. The committee has come to the conclusion after careful thought that the cost of renewal, keeping in view the above-factors, will be higher by 60 per cent than the cost in case of single lane pavement. The provision for periodical renewals can therefore, be increased by 60 per cent wherever the roads are double lane. As an alternative, the overall cost of maintenance per km can be increased by 25 per cent for double lane pavement.

V RECOMMENDATIONS

The Committee recommends that all the State PWDs should work out the norms of maintenance of roads per km in their respective States basing the same on the rates of labour and materials prevalent in a particular region and working out the total cost of maintenance required for the roads in their States. It is also recommended that these norms may be revised every 3rd year by each State P.W.D. taking into account, the increase in the cost of material and labour.

ANNEXURE-I

UNIT COST OF ORDINARY REPAIRS OF STATE ROADS OF DIFFERENT CATEGORIES IN RUPEES PER K.M. PER YEAR

Sl. No.	ITEM OF WORK	SINGLE LANE ROADS HILLY AREAS			PLAIN AREAS		
		EARTHEN ROAD	WBM ROAD	BLACK-TOPPED ROAD	EARTHEN ROAD	WBM ROAD	BLACK-TOPPED ROAD
	ORDINARY REPAIRS						
1.	ROAD GANG	2303.00	1907.00	1511.00	2303.00	1907.00	1511.00
2.	PATCH REPAIRS	—	—	1083.00	—	—	1083.00
3.	HEAVY BERM REPAIRS	—	400.00	400.00	—	400.00	400.00
4.	ARBORICULTURE AND LANDSCAPING	220.00	220.00	220.00	220.00	220.00	220.00
5.	ORIGINAL WORKS TO BE TREATED AS REPAIRS	250.00	250.00	250.00	250.00	250.00	250.00
6.	STRUCTURES	275.00	275.00	275.00	275.00	275.00	275.00
7.	MISCELLANEOUS :—						
	(i) ROAD SIDE DRAINAGE, ROAD SIGNS AND COLLECTION OF TRAFFIC DATA ETC.	165.00	165.00	165.00	165.00	165.00	165.00
	(ii) INSPECTION BUNGALOWS REST HOUSES GODOWNS	250.00	250.00	250.00	250.00	250.00	250.00
8.	WATCH AND WARD OF ROAD SIDE STOCK YARDS AND GODOWNS	100.00	100.00	100.00	100.00	100.00	100.00
	TOTAL ORDINARY REPAIRS	3563.00	3567.00	4254.00	3563.00	3567.00	4254.00
	PERIODICAL RENEWALS	1600.00	4650.00	5135.00	1600.00	4226.00	2460.00
	TOTAL	5163.00	8217.00	9389.00	5163.00	7793.00	6714.00
	SPECIAL PROVISIONS AS PER LOCATION (ON ACTUAL LENGTH OF SECTION INVOLVED)						
	i) ADDITIONAL PROVISION FOR HIGH RAIN FALL AREAS	770.00	770.00	770.00	770.00	700.00	700.00
	ii) ADDITIONAL PROVISION FOR HILLY AREAS	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
	iii) ADDITIONAL PROVISION FOR SNOW BOUND AREAS	300.00	300.00	300.00	—	—	—
	iv) ADDITIONAL PROVISION FOR DESERT AREAS	—	—	—	300.00	300.00	300.00
	v) ADDITIONAL PROVISION FOR BLACK COTTON SOIL AREAS	—	—	—	300.00	300.00	300.00

vi) ADDITIONAL PROVISION FOR URBAN LINK	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00
GRAND TOTAL	WILL	VARY	ACCORDING	TO LOCATION		
i) SPECIAL REPAIRS	50%	OF	THE	GRAND	TOTAL	
ii) RAIN DAMAGES	10%	OF	THE	GRAND	TOTAL	
iii) SMALL TOOLS & PLANTS	1%	OF	THE	GRAND	TOTAL	

ANNEXURE II

STATEMENT OF BASIC RATES

LABOUR RATES :

a) MONTHLY BASIS :

i) Road Inspector	...	450=00 per month
ii) Mate/Head Coolie	...	350=00 per month
iii) Mazdoor:	...	330=00 per month

b) TEMPORARY LABOUR EMPLOYED ON DAILY WAGES :

i) Mistry	...	10=00 per day
ii) Mate	...	5=75 per day
iii) Beldar/coolie	...	5=25 per day
iv) Sprayman	...	9=33 per day
v) Bhishti	...	7=00 per day

MATERIALS :

i) Bitumen	...	1300=00 Per metric tonne
ii) Sand	...	250=00 % cft.
iii) Grit 10 mm size	...	125=00 % cft. or (48.50 per cum. including Contractor's profit).
iv) Stone Metal 38 mm size	...	90=00 % cft. (35.20 per cum. including Contractor's profit).

ANNEXURE III

ANALYSIS FOR COST OF ROAD GANGS

1) EARTHEN ROAD :

Cost per km

ROAD GANG

Mazdoor=0.5 per km @ 330/- p.m. (Average rate)=0.5×330×12	...	1980=00
Mate/Head Coolies=1/20 per km @ 350/- p.m.=1/20×12×350	...	210=00
Road Inspector=1/48 per km. @ Rs 450/- p.m.=1/48 per km ×12×450	...	113=00
Total :		2303=00

Rs 2303=00 only

2) WATER BOUND MACADAM ROADS :

Cost per km.

ROAD GANG :

Mazdoor=0.4 per km @ Rs 330/- p.m.=0.4×330×12	...	1584=00
Mate/Head Coolies=1/20 per km. @ 350/- p.m. +=1/20×12×350	...	210=00
Road Inspector=1/48 per km @ 450/- p.m.=1/48×12×450	...	113=00
Total :		1907=00

Say Rs 1907=00 per km

3) BLACK-TOPPED ROAD :

Cost per km.

ROAD GANG :

Mazdoor; 0.3 per km @ 330/- p.m.=0.3×330×12	...	1188=00
Mate/Head Coolie=1/20 per km @ Rs 350/- p.m.=1/20×12×350	...	210=00
Road Inspector=1/48 per km. @ Rs 450/- p.m.=1/48×12×450	...	113=00
Total :		1511=00

Say Rs 1511=00 per km.

ANNEXURE IV

PATCH REPAIRS-BLACK TOPPED ROADS

Cost per km

1)	Bitumen=0.6 M.T. @ Rs 1300/- per M.T. (M.R.)	...	780=00
2)	Grit 10 mm=5 cu. M. @ Rs 48.50 per cu. m. (M.R.)	...	242=50
3)	Fuel & Sundries; L.S.	...	60=00
	Total :		1082=50

Say Rs 1083=00

No provision has been made for Labour
as this work done by maintenance gangs.

ANNEXURE V

PERIODICAL RENEWAL-EARTHEN ROADS

1) Providing and laying 6" thick gritty soil and consolidation at O.M.C. with Road Roller complete.
Cutting in pick work. Average width of road 6 metres.

1000 × 6 × 0.15 = 900 cubic metre @ Rs 184/- per % cum.	...	1656=00
(As per Analysis given below); Carriage of earth average lead 1½ km or 1 mile 900 cu. m. @ 2.54 per cum. (As per H.P. Schedule of Rates, 1968)	...	2286=00
Labour for laying gravel earth (work to be done by road gangs)	...	NIL
Consolidation with Road Roller 6000 sq. metre @ Rs 13/0 per sq. metre (%) (As per Analysis given below);	...	780=00
Total :		4722=00
Say Rs 4700=00		

Cost per kilometre... Rs 4700=00
Cost for every 3rd Year; 4700/3 = 1567=00
Say Rs 1600=00

2) Providing and laying 6" thick (loose) gritty soil and consolidation at O.M.C. with road rollers complete.

Cost per km

1. Cutting in pick work soil. Details of cost for 1000 cft.	...	47=25

Beldars & Coolies 9 Nos. @ Rs 5.25 per day
Cost for 1000 cft. Rs 47.25
Cost for % Cum Rs 166.84
Add 10% Contractor's profit & overheads : Rs 16.68
Rs 183.52 Say Rs 184=00

3) Consolidation of 6" thick gritty soil with road roller.

Details of cost per 1000 Sft.	...	6=00
Hire charges for road rollers 1/20 days @ Rs 120/- per day		
Chowkidar 1/20 Nos. @ Rs 5.25 per day;	...	0=26
Steam coal 0.42 mounds @ Rs 10/- per mound	...	4=20
Sundries; L.S.	...	0=60
		11.06
Add 10% Contractor's profit and overheads;	...	1.11
		12=17

Cost per 1000 sft. =Rs 12.17
Cost per % sq. metre =Rs 13.10 Say Rs. 13/-

ANNEXURE VI

RENEWAL OF WATER BOUND MACADAM ROAD (HILLY AREAS)

Cycle of renewal = 3 years

a)	Scarifying=1000×3.55	=	3350 Sq.m.	
	10% for curves;	=	335 Sq.m.	
			3685 Sq.m.	
	@ 14.35 (H.P. Schedule of Rate 1968+Cost Index)			=529=00
b)	Collection and stacking of 38 mm gauge hard stone metal.			
	1000×3.35×.075	=	251=00	
	10% for curves;	=	25=10	
		=	276=10Cu. M	
	@ Rs 35.20 per cu.m.			=9719=00
c)	Laying wearing coat.			
	Qty. as per (b) 276.10 cu.m.			
	@ 13.40 per cu.m. (H.P. Schedule of Rate 1968+Cost Index)			=3700=00
				13948=00

Cost of renewal per year
=1/3×13948 =4650=00
Say Rs 4650=00

ANNEXURE VII

RENEWAL OF WATER BOUND MACADAM (PLAIN AREAS)

Cycle of renewal = 3 Years

a)	Scarifying=1000×3.35=3350 Sq. m. @ 14.35 per % Sq.m. (H.P. Schedule of Rate, 1968+Cost Index)	...	480=00
b)	Collection and stacking of 1½" gauge hard stone ballast. 1000×3.35×0.075=251=00 @ 35.20 per cu.m.	...	8835=00
c)	Laying wearing coat 251.00 Cu. m. @ Rs 13.40 per cu.m. (H.P. Schedule of Rates plus premium)	...	3363=00
			12678=00

Cost of renewal per year 1/3×12678=4226=00

ANNEXURE-VIII

PERIODICAL RENEWALS BLACK TOPPED ROADS (PLAIN AREAS)

Cost per km.

1. Cycle of renewal=4 Years.

Surfacing dressing=1/4×1000×3.35=837.50		
@ Rs. 2.67 per Sq m. (As per analysis given below	...	2236=00
Levelling course of renewal 10% of above item.	...	224=00
		2460=00

Analysis of repainting with hot bitumen (Burmah shell mexphalts 80/100 or equivalent) using 25 lbs. of bitumen with 3½ cft. of hard stone grit 3/8" gauge per 100 Sft. of road surface complete.

Detail of cost for 18,000 Sft.

MATERIAL :

Bitumen @ 25 lbs./% Sft.		
25×18000=2.01 Tonnes. Tons. 2.01 @ 1300/- per ton (M.R.)	...	2613=00
100×2240		
Hard stone grit 3/8" gauge @ 3½ cft. per 100 sft.		
18000×3½=630 100 cft. 630 @ 125/- per % cft. (M.R.)	...	788=00
100		
Steam coal for heating bitumen @ 4 Cft. per ton of bitumen.=4×2.01=8 cwt.	...	114=00
or 11.4 Mds. Mds. 11.04 @ 10/- per Md		
Labour for cleaning road surface, heating and spraying bitumen & gritting etc.		
a) For cleaning :		
Mate; Each 1 No. @ 5.75	...	5=75
Beldars @ 0.45 per 1000 Sft. Each. 8 Nos. @ 5.25	...	42=00
Coolie @ 0.90 per 1000 Sft. Each. 16 Nos. @ 5.25	...	84=00
b) For heating and spraying :		
Bitumen		
Spraymen; Each. 1 No. @ 9.33	...	9=33
Mistry; Each. 3/4 No. @ 10.00	...	7=50
c) For screening and spraying grit.		
Mate; Each. 1 No. @ 5=75	...	5=75
Beldar; @ 1.6 per % Cft. of grit.		
1.6×6.30 = 10.1 Nos. Say 10 Nos. Each 10 Nos. @ 5=25	...	52=50
100		
Coolies @ 1.6 per % Sft. of Grit. Each. 10 Nos. @ 5=25	...	52=50
d) Miscellaneous :		
Chowkidar (i.e. for barrier for night watch and for road roller).		
Each. 2½ Nos. @ 5=25 P/D	...	13=12
Bhishti Each. 1 No. @ 7=00 P/D	...	7=00
Hire charges for road rollers. Per Day. 1 Day @ 120/- P D.	...	120=00
Hire charges for Boiler;-do- 1 Day @ 28/- P/D	...	28=00
Hire charges for Sprying Unit;-do- 1 Day @ 28/- P/D	...	28=00
Brushes etc. for cleaning wire brushes (with thick wires);	...	1=87
Each. 3/4 Nos. @ 2=50 Each		
Soft brushes; Each. 3/4 Nos. @ 2=50 Each	...	5=00
Brooms and Gunny Bags. Each. L.S.	...	1=50
Sundries L.S.		4=50
		4056=75
Add 10% for contractors' profit and overheads; cost of 18000 Sft.	...	405=68
		4462=43

Cost per Sqm. Rs 2.67

ANNEXURE-IX

BLACK-TOPPED (PREMIX CARPET) (HILLY AREAS)

Cost per km

PERIODICAL REPAIRS :

1)	1/6th length to be taken for premix carpet and seal coat			
	Premix carpet=1/6×1000×3.35	=558.00 Sqm.		
	10% for curves;	56.00 Sqm.		
		614=00 Sqm.		
	@ 6.25 per Sqm. (Analysis given below)		...	3838=00
2)	Seal coat 614 Sqm. @ Rs 1.30 per Sqm. (As per Analysis given below :		...	829=00
	Levelling course for renewals 10% of Item No. 1 & 2.		...	467=00
				5134=00

Cost per Km. 5135=00

Analysis of rate for 3/4" thick premix carpet surfacing with 2.44 cum. of stone grit 3/8" gauge and 122 kg. of hot bitumen (Burmah shell shels par B.S. or equivalent) per 100 Sq.m. of road surface complete.

Details of 100 Sqm.

MATERIALS :

i)	Bitumen @ 230/- kg. % Sqm.=230 Kg @ 1300 (M.R.)	299=00

ii)	Grit @ 2.44 cum. % Sq.=2.44		
	Hard stone grit 3/8" gauge @ 2.44 Cum. % Sqm. 2.44 Cum @ 48=50 (MR)	...	118=34
	Steam coal for heating bitumen @ 4 cwt. per ton of bitumen 0.50 @ 10/- (M.R.) or 0.7 Mds.	...	7=00

LABOUR

Labour for cleaning road surface heating bitumen applying tack coat mixing & Spreading Grit.

a)	For cleaning :		
	Mate 7/100 Nos. Each. 5=75	...	0=40
	Beldar @ 1.3 per % Sft. 1.3 Nos. Each. 5.25	...	6=30
	Coolie @ 1.3 % Sft. 1.3 Nos. Each. 5.25	...	6=30
b)	For heating bitumen :		
	Beldar @ 44 Nos. per tonne of Bitumen=4X230=.920 or .92 Nos. Each. 5.25	...	4=83
c)	For applying tack coat.		
	Beldar @ 0.65 per 1000 Sft. or .7 Nos. % Sqm. @ 5.25	...	3=68
d)	For screening and spreading premixed grit.		
	Mistry 1/6 No. Each. @ 10=00	...	1=67
	Beldar @ 5.25 Nos. per % Sft. of Grit. 18.5 Nos. Each. @ 5.25	...	97=13
			544=65

MISCELLANEOUS :

Chowkidar (at barrier) for night watch and for road roller. 0.23 Nos. Each. 5.25	...	1=21
Bhishti; 1/10 No. Each 7.00	...	0=70
Hire charges for Road roller. 1/10 Day, 1 Day. 120=00	...	12=00
Hire charges for boiler; 1/10 Day. 1 Day. 28=00	...	2=80
Hire charges for mixer 1/10 Day. 1 Day. 28=00	...	2=80
Brushes etc. for cleaning wire brushes; 1/10 Nos. Each. 2=50	...	0=25
Soft wire brushes; 3/10 Nos. Each. 2.50	...	0=75
Brooms & Gunny Bags; L.S.	...	3=00
Sundries; L.S.	...	0=50
		568=66
Add 10% for contractor's profit and overheads;	...	56=87
		625=53

Rate per 100 Sq.m =625.50
Rate per Sqm. Rs 6 25

Laying seal coat with 8 lbs hot bitumen (Burmah shell mexphalts 80/100) 1 Cft of approved sand per 100 Sft. of Road Surface complete.

Details of cost per 10,000 Sft.

MATERIAL :

	Unit	Qty.	Rate	Amount
1)	Bitumen @ @ 8 lbs/100 Sft.			
	8X10000=0.36 Tonnes. Tonnes.	0.36 Tonnes	1300=00 (M.R.)	468=00
	100X2240			
2)	Approved sand @ 1 Cft. % Cft.			
	10000X1=100 Cft. Cft.	100 Cft.	250=00 (MR)	250=00
	100			
3)	Steam coal for running roller			
	and heating bitumen.			
	i) For heating bitumen @ 4 Cwts.			
	per tonne of bitumen ·			
	=4X0.46=1.44 or 2 Mds. Mds.	2 Mds.	10=00 (M.R.)	20=00
4)	Labour for cleaning of road surfacing heating			
	and spraying bitumen for spreading.			
	a) For cleaning :			
	Mate;	Each. 1 No.	5=75	5=75
	Beldar @ 1.3 per 100 Sft.	Each. 13 Nos.	5=25	68=25
	Coolies @ 1.3 per 100 Sft.	Each. 13 Nos.	5=25	68=25
	b) For heating and spraying bitumen;			
	Mistry;	Each. 3/4 Nos.	10=00	7=50
	Sprayman.	Each. 1 No.	9=33	9=33
	Beldar @ 7 Nos. per ton of		5=25	13=13
	bitumen 7X0.36X =2.52 Nos.	Each. 2.52		
	c) For screening and spreading sand, beldar			
	@ 1.6 per % Cft.			
	1.6X100/100=1.6 Nos.	Each. 1.6 Nos.	5=25	8=40
	Coolies; 1.6 per % Cft of sand.			
	1.6X100/100=1.6 Nos.	Each. 1.6 Nos.	5=25	8=40

MISCELLANEOUS :

d) Chowkidar i.e. for barrier		5=25	13=13
for night watch and for Road Roller	Each 2½ Nos.		
Bhishti;	Each. 1 No.	7=00	7=00
Hire charges for Road Roller per day	Per Day. 1 Day.	120=00	120=00
Hire charges for Boiler per day	Per Day. 1 Day.	28=00	28=00
Hire charges for Spray Unit	Per Day. 1 Day	28=00	28=00
Wire Brushes (with thick wire)	Each 1 No.	2=50	2=50
Sundries.	L.S.		3=00
			1131=14
Add 10% for Contractors profit and overheads;			113=11
			1244=25

Cost for 10,000 Sft. =1244.25
Cost for 100 Sft. =12.44
Cost per Sqm. =1.34 Say Rs 1.30 only.