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# THIRD IRBD HIGHWAY PROJECT

BY

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## 1. INTRODUCTION

Third IBRD Highway Project in Pakistan was initiated in 1973 after the visit of Appraisal Mission of the World Bank who selected tentatively 15 road stretches. In October/ November, 1976 it was mutually decided to prepare an economic feasibility study of 1634 K.M. of roads out of which, sections of roads, showing acceptable economic returns or internal rate of return and benefit/ cost ratios would be selected for detailed design.

## 2. FEASIBILITY STUDIES

The project was divided into six sections each of which was entrusted to the six local consultants engaged for the project. An advisory consultants, M/s. Louis Berger Inc. USA was employed with the mutual agreement of the Government of Pakistan and the World Bank to coordinate the work of the local consultants. Economic feasibility was completed by September, 1977. In November-December, 1977 a pre-appraisal Mission of the Bank visited Pakistan and reviewed the feasibility reports. After appraising the feasibility studies and in consultation with the Government of Pakistan a length of 832 K.M. of road stretches were selected for detailed design.

Economic & Technical feasibility study was carried out for the following lengths of roads in different provinces of

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Pakistan in 1977 :

| PROVINCE | LENGTH IN KMs |
|---|---|
| Punjab | 627 |
| Sind | 570 |
| Baluchistan | 160 |
| NWFP | 223 |
| Azad Kashmir | 54 |
| Grand Total: | 1634 Kms |

A map of Pakistan is attached.

## 3. DETAILED DESIGN

Detailed engineering design of the selected road stretches (total length 832 Kms) was started in February, 1978. The six local consultants continued to design the sections selected out of feasibility studies conducted by them earlier. The work was completed in November, 1978.

Detailed studies of the following roads were carried out :

| | |
|---|---|
| Lahore - Okara - Khanewal | 267 Kms |
| Okara - Dipalpur | 25 " |
| Hyderabad - Nawab Shah | 83 " |
| Nawab Shah - Khairpur | 241 " |
| Rohri - Reti | 126 " |
| Khairabad - Peshawar | 63 " |
| Peshawar - Charsadda | 27 " |

Total 832 Kms of roads.

For the present Lahore - Okara - Khanewal Highway rehabilitation project is being discussed in detail.

Existing conditions of the highway were studied and following were observed :

3.1 General

The Lahore - Khanewal project road is 267 kms long. It is a rehabilitation project.

The project road was divided into three sections viz:

i) Lahore - Pattoko Section (11.281 - 66 kms). The start is near Radio Pakistan Station No.2.

ii) Pattoko - Sahiwal Section (66-149 kms).

iii) Sahiwal - Khanewal Section (149-267.271 kms, project end point). The project end point is near Khanewal (Milestone 175).

AASHTO standard and Highway Capacity Manual have been generally followed in all the design except limitations imposed due to financial constraints, major being

a) Urban - areas having acute/sharp curves. No bye-passes are to be provided.

b) Existing curves of 65 Kph are to remain as they are.

c) Structures are not to be touched for want of geometric requirements such as roadway widths etc., or re-alignment for improvement purposes.

d) Dual carriageway, though justified in Lahore - Okara section is not to be considered.

and other deficiencies have been observed.

The general rideability is very poor with P.S.I. of less than 2.

3.2.4 Structures

There are 392 irrigation and drainage structures, out of which there are 24 bridges and 368 culverts of various types. 14 culverts are structurally unsound. 52 culverts are redundant, which are no longer in use. Instead, new culverts closeby have been either constructed or available now.

Superstructures of two bridges have been found to be unsound.

Many bridges are quite narrow. A few bridges have been found to be 4.4 metreswide only.

Several culverts are found to be silted up.

Several culverts/bridges need minor repairs such as parapet walls, wingwalls, railings etc.

3.2.5 Traffic

The project road is having high traffic volume. Refer to Table-1 which indicates the AADT in 1977 and 1992 for non-motorized and motorized traffic.

Traffic forecast is at full growth rate. The AADT in 1977 varies from 3549 to 2610 and AADT in 1992 is estimated to be from 10116 to 4537 in various links of the project road.

3.2.6 Loadometer Studies

Many loadometer studies have been carried out. Average loadings have been worked out for loaded/empty trucks and buses as given below :

| Category | Max. | Min. | Average |
|---|---|---|---|
| Loaded Trucks | 45000 lbs. | 25000 lbs. | 34535 |
| Empty | 13290 | 10850 | 12132 |
| Buses | 26100 | 25900 | 25000 |

The average percentage rear axle weight is 72% with a range of 67-78%.

3.3 Recommendations

i) Lahore to Okara (11.281 - 111 kms) need a four lane divided highway. However, due to financial constraints, two-lane highway is designed for initial construction as an improvement of the existing carriageway.

ii) The highway cross-section recommended is a two-lane carriageway having 7.3 metres paved widths, two meters untreated shoulders on either side.

iii) Generally highway curves have been designed for 80 Kph. No improvement in horizontal alignment has been carried out in urban areas. In rural areas the existing curves which are found to be adequate for 65 Kph or more have been left untouched.

iv) General grade-raise is recommended throughout, varying from 0.5 to 1.2 meters above natural

surface level to the bottom of sub-base.

## 4. PAVEMENT STRUCTURAL DESIGN

### 4.1 General

Pavement structural design is based on a number of factors, the major being the subgrade soils strength, the traffic loading and the environmental conditions besides the type, quality and quantity of available construction materials etc.

Based on the laboratory test data on the construction and foundation materials and subject to the environmental conditions, the pavement structure has been designed by following "AASHTO Interim Guide" for design of pavement structures 1972 to meet the anticipated equivalent traffic axles loading. Alternative designs using Road Note 29 have also been calculated and compared with AASHTO, Interim Guide designs.

Economic study for various design alternatives have been made. Comparisons between tripple-surface treatment and asphalt concrete surfacing as well as stage-construction involving overlays etc. to arrive at an economical solution have been carried out.

It was established in the soils and pavement foundation evaluation that no overlay on the existing pavement structure is feasible, and pavement design for Lahore - Bhai Pheru section is discussed in detail.

### 4.2. Traffic

Based on the loadometer studies, the total gross

weight of trucks and Buses alongwith the axle load distribution was determined. Equivalent 18 kips standard axles load applications have been worked out for the various anticipated traffic volumes (ADT), using AASHTO factors. These equivalent standard axles are computed for 10 and 20 year periods.

Also time period has been deduced whereby three (3) million equivalent standard 18 kip single axle load applications are achieved.

These computations are attached as APPENDIX-1, 2,3 & 4. The loadmeter studies conducted are given in APPENDIX-11.

4.3 Soil Support Value

Ninety percentile value of CBR for the subgrade soils has been adopted as design CBR value. Two design values are used viz. 3% and 7% according to the type of material.

The design CBR values were converted to soil support value (s) as given by a correlation in the AASHTO Interim Guide for Design of Pavement Structures 1972. This is shown plotted on the nomograph attached (see FIGURE-1).

4.4 Regional Factor

The AASHTO design envisages adjustment of the design structural number of pavement as per the climatic conditions. The project road receives annual rainfall of more than 250 mm of rain ranging between 150 mm in Multan to 450 mm in Lahore. The area lies in flat

terrain with poor drainage pattern. A regional factor of "1" has been used for the design purposes.

4.5 Structural Number

Under AASHTO procedure of pavement design, the pavement structural elements are required to produce a minimum structural strength designated by structural number, called "SN". This "SN" is related to the traffic loading and the underlying soil subgrade strength.

The AASHTO monograph used for the design is shown in FIGURE-1 for a serviceability index of 2.5.

Total equivalent 18 kips single axle load applications relevant to the road section under design, are used to read off the structural number (SN) from the monograph. This gives the minimum requirement of the SN.

4.6 Layer Coefficients

The pavement structural elements provide individually a certain strength which makes up the resisting structural number. This depends on the type of materials, its grading used, and construction practices amongst others. The project pavement envisage following elements which may be used in various combinations. Layer-coefficients per centimeter thickness are given below :

| | | |
|---|---|---|
| i) | Asphalt Concrete Surfacing | 0.173 |
| ii) | Tripple Surface Treatment | 0.055 |
| iii) | Asphaltic Base | 0.134 |
| iv) | Granular Base | 0.055 |
| v) | Sub-base | 0.047 |
| vi) | Improved subgrade | 0.031 |

Also, existing pavement elements have been designated layer coefficients as given below :

| | |
|---|---|
| Existing Pavement | 0.04 |

4.7 Pavement Components

The pavement design computations are given in APPENDIX-5 to 10. Following alternatives have been studied :

1. Pavement design with subgrade CBR value as 3% and Asphalt concrete surfacing.
2. Pavement Design with subgrade CBR value 3% and Tripple-surface treatments.
3. Pavement Design with subgrade DBR value as 7% and Asphalt concrete surfacing.
4. Pavement Design with Subgrade CBR value as 7% and Tripple surface treatment.
5. Pavement Design with subgrade CBR value as 3% at zero traffic growth rate.
6. Pavement Design with subgrade CBR value as 7% at zero traffic growth rate.
7. Pavement Design Over existing pavement - strengthening of pavement.

From the computation tables it will be observed that the cost per SN per unit area for unit thickness ($SN/m^2/cm$) of granular base-course (G/B) is greater than the Asphaltic base- course. This is so because of the reasons of long haul of construction materials from quaries to the project site. Consequently, Asphaltic-base has been recommended for use in the pavement design.

This would help in better construction procedures. It will be seen that this approach has resulted in adjusting the top surface course thickness in the various reaches. Also, the design of the underlying pavement elements is done with a view of subsequent overlays to meet the traffic loading requirements for 20 year period without affecting the change in them. For overlay purposes, the total SN is determined relevant to the 20 year design period and deduction made from this of the SN provided initially for 10 years traffic. This gives the net SN which is provided for in the form of asphaltic overlay.

The computation tables also give the thicknesses of various components of pavement structure calculated by employing Road Note 29 method for comparison purposes. It would be observed that the AASHTO method gives the pavement components comparable to Road Note 29. The graphs used for Road Note 29 method are shown in FIGURE-2 & 3.

In the design analysis, improved - subgrade has been envisaged with a minimum CBR of 10% or more. The improved subgrade would consist of local soil and sand mix with or without brick ballast crushed; or any similar materials like blend of screening from querry with Chenab river sand etc. This would result in considerable savings in the cost of the pavement. For design, soil support value comparable to CBR of 10 is obtained. Minimum design "SN" for the pavement thickness over the improved subgrade has been determined. The net difference between the two design "SN" requirements, namely

the one with improved subgrade, and the other without improved subgrade soils gives the thickness of improved subgrade when divided by its layer coefficient. For the pavement design, the minimum structural number requirements for each element has been considered.

4.8 Economics of Pavement Design

Two major methods have been compared for economic comparison; viz:

A) Method 1; Using Asphalt Concrete Surfacing.

B) Method 2; Using tripple-surface treatment for first 3 million standard 18 kip axle loads and then overlaying with Asphalt Concrete.

Cost per kilometer of the pavement and the resultant relevant elements has been worked out for each method. This cost is shown in Table-1 & 10 for subgrade CBR of 3% and 7%, attached at the end of the chapter.

4.9 Pavement Strengthening

A study has been made to see the feasibility of strengthening existing pavement. The main aim was to know as to whether the existing pavement could be used without tearing it apart.

According to soils and pavement evaluation the existing subgrade density is less than 87%. For design purposes, CBR value has been read off the AASHTO CBR3 point curve at this density (generally 90% density was available, which has been adopted as such). The design

CBR value is given as 1%. Design computations for the pavement gives a total thickness of 104 cms including the existing pavement thickness of 17.5 cms.

4.10 Economic analysis has been carried out between the two pavement treatments viz:

1. Method 1. Using Asphalt concrete surfacing in the initial stage for a 10 year period. Other elements of the pavement structures are designed in such a way that only asphaltic overlay is required after the initial ten (10) years for the next 10 year traffic projection i.e. an overall 20 year design period.

2. Method 2. Using tripple-surface treatment surfacing in the initial stage for a period covering three (3) million equivalent 18 kips single axle load applications. After this period, asphaltic overlay is laid to meet the traffic loading requirements for the first ten (10) year period as in method 1 above. Subsequently another asphaltic overlay is placed similar to method 1 in 1992 for the overall 20 year design period.

The assumptions for the economic analyses are:

a) The cost of first asphaltic overlay in case of method 2, after passing 3 million equivalent standard axles, has been escalated at 15% keeping in view the escalation in the cost of construction inputs as per Nespak survey.

The cost is then discounted at 12 percent to get its present worth.

b) Construction progress per day is expected to be 1.2 kilometer, assuming nine months' construction period in a year for these sections. Effects like decelleration stoppages, and slow movement of traffic is to be accounted for.

c) A stoppage of twenty (20) minutes is assumed when overlay is in progress.

d) Interest rate is taken as 12% per annum.

For pavement designs with subgrade- CBR value of 3% the cost of construction per kilometer of the two methods is shown in Table-FIVE-1.

Cost due to overlay - disturbance in fuel, depreciation, time etc. is shown in TABLE-FIVE 2 and 3 for 10 and 20 year design period. TABLE-FIVE 4 & 5 shows the comperative vehicle user cost for 10 year and 20 year period. TABLE-FIVE-6 & 7 shows the cost due to stoppage-time for 10 & 20 year period. Vehicle user cost is also added up to arrive at the net cost due to these two items. Theescalation at 15% and discounting at 12% is shown, linkwise as well.

TABLE-FIVE 8 & 9 sumps up the above figures and gives the comparison of cost between the two methods, for subgrade CBR values of 3%, for 10 year and 20 year design periods respectively.

The construction cost of pavement with subgrade CBR values as 7% are given in TABLE FIVE 10. TABLE-FIVE 11 & 12 give the cost comparison between the two

months for 10 and 20 year design period respectively, for the subgrade CBR values of 7%.

This shows that the Asphalt concrete surfacing is more economical of the two methods.

TABLE-1

TRAFFIC DATA AND PROJECTION

AADT

| | 1977 | | | | | | 2982 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Motorized | | | | | | Motorized | | | | |
| | Non Motorized | Motor Cycle and Cars | Mini Bus | Bus | Truck | Total Motorized | Non Motorized | Motor Cycle and Cars | Mini Bus | Bus | Truck | Total motorized |
| Lahore-Bhai Pheru. | 450 | 621 | 42 | 794 | 1521 | 2978 | 561 | 1693 | 98 | 2029 | 4690 | 8510 |
| Bhai Pheru-Pattoki | 453 | 499 | 30 | 782 | 1491 | 2802 | 1152 | 1317 | 70 | 2301 | 5276 | 8964 |
| Pattoki-Okara | 711 | 550 | 67 | 804 | 1417 | 2838 | 1174 | 1168 | 157 | 2117 | 4001 | 7443 |
| Okara-Sahiwal | 1456 | 421 | 53 | 620 | 1001 | 2095 | 1978 | 871 | 121 | 1416 | 1888 | 4296 |
| Sahiwal-Chichawatni | 632 | 442 | 74 | 583 | 921 | 2020 | 784 | 1042 | 173 | -1155 | 1656 | 4026 |
| Chichawatni-Khanewal | 707 | 762 | 21 | 386 | 734 | 1908 | 827 | 1510 | 48 | 765 | 1387 | 3710 |

TABLE FIVE-2

VEHICLE USER COSTS

LAHORE -MULTAN ROAD

Design period 10 years.

| Vehicle | Cost per 1000 Kms in Rupees | | | | | Link Distance 000 Kms Annual | AADT Vehicles 000 | Total Cost Million Rs. Col.5x6x7 |
|---|---|---|---|---|---|---|---|---|
| | Fuel | Depre-ciation | Interest | Time | Total Col. 1 to 4 | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | COST DUE TO OVERLAY DISTURBANCE | | | | |
| Car | 130.84 | 271.68 | 364.31 | 1070 | 1836.83 | .411 | .530 | .400 |
| Mini-Bus | 111.77 | 297.51 | 167.09 | 2990 | 3566.37 | " | .074 | .108 |
| Bus | 244.89 | 644.23 | 319.60 | 4260 | 5468.72 | " | .984 | 2.212 |
| Truck | 301.97 | 382.10 | 265.09 | 680 | 1629.16 | " | 1.77 | 1.185 |
| | | | | COST WITHOUT OVERLAY DISTURBANCE | | | | |
| Car | 122.35 | 121.24 | 88.63 | 530 | 862.22 | .411 | .530 | .188 |
| Mini-Bus | 110.97 | 75.44 | 47.27 | 920 | 1153.68 | " | .074 | .035 |
| Bus | 237.67 | 174.71 | 85.61 | 1720 | 2217.99 | " | .984 | .897 |
| Truck | 225.92 | 114.63 | 86.67 | 260 | 687.22 | " | 1.770 | .500 |

TABLE FIVE-3

VEHICLE USER COSTS

LAHORE - MULTAN ROAD

DESIGN PERIOD - 20 YEARS

| Vehicle | Cost per 1000 Kms in Rupees: Fuel | Description | Interest | Time | Total Col. 2 to 5 | Link Distance 000 Kms Annual | AADT Vehicles 000 | Total Cost Million Rs. Col. 7 x 8 x 9 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Cost Due to Overlay Disturbance in 1992** | | | | | | | | |
| Car | 137.20 | 271.68 | 364.31 | 1070 | 1843.19 | .411 | .761 | 0.576 |
| Mini-Bus | 121.09 | 297.51 | 167.09 | 2990 | 3575.69 | .411 | .111 | 0.163 |
| Bus | 265.30 | 644.23 | 319.60 | 4260 | 5489.13 | .411 | 1.631 | 3.680 |
| Truck | 327.13 | 382.10 | 265.09 | 680 | 1654.32 | .411 | 3.150 | 2.142 |
| **Cost without Overlay Disturbance in 1992** | | | | | | | | |
| Car | 112.35 | 152.14 | 120.50 | 710 | 1094.99 | .411 | .761 | 0.342 |
| Mini-Bus | 98.63 | 97.75 | 57.16 | 1220 | 1473.54 | .411 | .111 | 0.067 |
| Bus | 219.87 | 245.68 | 117.00 | 2400 | 2982.55 | .411 | 1.631 | 1.999 |
| Truck | 268.05 | 162.39 | 109.61 | 350 | 890.05 | .411 | 3.150 | 1.152 |

TABLE FIVE-4

COMPARATIVE VEHICLE-USER-COST DUE TO OVERLAY DISTURBANCE

(Rs. in million)

| | With Overlay | Without Overlay | Additional vehicle-user-cost due to Overlay |
|---|---|---|---|
| Car | 0.400 | .188 | .212 |
| Mini Bus | 0.108 | .035 | .073 |
| Bus | 2.212 | .897 | 1.315 |
| Truck | 1.185 | .500 | .685 |
| | | Total: | Rs. 2.285 million |

Total length of Project = 267 Km

Cost per Kilometer = $\frac{2285}{267}$ = Rs. 8600 or 8.6 in (000)

TABLE FIVE-5

COMPARATIVE VEHICLE USER COST OF OVERLAY DISTURBANCE

Design Period = 20 years

Figure in (000)

| Vehicle | With Overlay | Without Overlay | Net Additional Cost in case of Overlay |
|---|---|---|---|
| Car | 576.0 | 342.0 | 234.0 |
| Mini-Bus | 163.0 | 67.0 | 96.0 |
| Bus | 3680.0 | 1999.0 | 1681.0 |
| Truck | 2142.0 | 1152.0 | 990.0 |
| | | Total: | 3001.0 |

Total Length of Project = 267 Kms

Cost per Kilometer = $\frac{3001}{267}$ = Rs. 11.24 (000)

TABLE FIVE-6

ADDITIONAL STOPPAGE TIME-COST DUE TO OVERLAY

Design Period = 10 Years

Figure in Million

| | Time value for vehicle passenger & Crew per Minute. | Total Time stoppage at 3 links (20 min-utes.) | Total Vehi-cle. | Overlay Constru-ction period days. | Total Cost 2x3x4 |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Car | 1.57 | 31.40 | 530 | 273 | 4.55 |
| Mini Bus | 1.01 | 20.20 | 074 | 273 | 0.41 |
| Bus | 1.55 | 31.00 | 084 | 273 | 8.33 |
| Truck | 0.26 | 5.20 | 1770 | 273 | 2.51 |
| | | | | | 15.80 |

Total cost per kilometer = $\frac{15800}{267}$ = Rs. 59.18

Vehicle Users Cost ✕ Cost from Table-4 ✕ Net Cost = 8.60

= Rs. 67.78

or = Rs. 67.8 (000)

| Link | Period in year | Net Cost | Escalated at 15% | Discounted at 12% |
|---|---|---|---|---|
| Lahore-Bhai Pheru | 3 | 67.8 | 103.1 | 73.4 |
| Bhaipheru-Pattoki | 3 | 67.8 | 103.1 | 73.4 |
| Pattoki-Okara | 4 | 67.8 | 118.6 | 75.4 |
| Okara-Sahiwal | 6 | 67.8 | 156.8 | 79.5 |
| Sahiwal-Chichawatni | 6 | 67.8 | 156.8 | 78.5 |
| Chichawatni- Khanewal | 7 | 67.8 | 180.3 | 81.6 |

Assuming 9 months construction period and 20 minutes stoppage at the 3 links where overlay is in operation.

TABLE FIVE-7

ADDITIONAL STOPPAGE TIME COST IN CASE OF OVERLAY

Design Period = 20 years

Fig.(000)

| Vehicle | Time value for vehicle Passenger & Crew per Minute. | Total Time value stoppage at 3 link (20 Minute) | Total Vehicles. | Overlay Construction Period Days. | Total Cost (000) (3x4x5) |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Car | 1.57 | 31.40 | 761 | 273 | 6523.4 |
| Mini-Bus | 1.01 | 20.20 | 111 | 273 | 612.1 |
| Bus | 1.55 | 31.00 | 1631 | 273 | 13803.2 |
| Truck | 0.26 | 5.20 | 3150 | 273 | 4471.7 |
| | | | | | 25410.4 |

Total time value cost per kilometer = $\frac{25410}{267}$ = 95.17

Total disturbance cost per Kilometer from Table-5 = 11.24

Net Cost = 106.41

Upto 1997 add for 15% escalation, Cost/km = 865.86

Discount at 12% Cost/Km. = 158.00

Assuming 9 months construction period and 20 minutes total stoppage at the 3 links where overlay is in operation.

TABLE FIVE-8

ECONOMIC STUDY FOR PAVEMENT DESIGN

Design for 10 Years

Sub-grade CBR = 3%

(Figures in '000')

| Link | T.S.T. cost in 1982 per Km. | T.S.T. Overlay cost after passing three million Axles (cost per Km) | Additional cost due to traffic disruption per Kilometer | T.S.T. cost per Km Present worth. | Asphalt Concrete cost per Km present worth. | Remarks |
|---|---|---|---|---|---|---|
| Lahore-Bhai Pheru. | 1431.3 | 256.9 | 73.4 | 1761.6 | 1688.8 | Asphalt Concrete Surfacing is economical |
| Bhai Pheru-Pattoki | 1431.3 | 269.6 | 73.4 | 1774.3 | 1688.8 | " |
| Pattoki-Okara | 1431.3 | 237.5 | 75.4 | 1744.2 | 1688.8 | " |
| Okara -Sahiwal | 1431.3 | 208.6 | 79.5 | 1719.4 | 1496.7 | " |
| Sahiwal-Chichawatni | 1431.3 | 208.6 | 79.5 | 1719.4 | 1496.7 | " |
| Chichawatni-Khanewal | 1431.3 | 213.9 | 81.6 | 1726.8 | 1319.6 | " |

TABLE FIVE-9

ECONOMIC STUDY FOR PAVEMENT DESIGN

DESIGN FOR 20 YEARS

Fig. in (000)

SUB- GRADE C.B.R. = 3%

| | T.S.T. (1st Year) Pavement | | | | | A/C (1st Year) Pavement | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1st Year Cost in 1982 per Km + Overlay cost after passing 3 million Axles. | | Overlay cost in 1992 | Additional cost due to traffic disruption per kilometer in case of Surfacing in 1997 | Total cost per Km. | 1st Year cost. | Asphalt Overlay in 1992 per Km. | Total cost (Present worth) | Remarks |
| Lahore-Bhaipheru | 1761.6 | | 293.5 | - | 2055.1 | 1688.8 | 293.5 | 1982.3 | Asphalt Concrete Surfacing is economical |
| Bhaipheru-Pattoki | 1774.3 | | 324.4 | - | 2098.7 | 1688.8 | 310.0 | 1998.8 | |
| Pattoki-Okara | 1744.2 | | 247.1 | - | 1991.3 | 1688.8 | 262.6 | 1951.4 | |
| Okara-Sahiwal | 1719.4 | | 231.7 | - | 1951.1 | 1496.7 | 231.7 | 1728.4 | |
| Sahiwal-Chichawatni | 1719.4 | | 231.7 | - | 1951.1 | 1496.7 | 231.7 | 1728.4 | |
| Chichawatni-Khanewal | 1726.8 | a | 89.9 | | | 1319.6 | 231.7 | 1551.3 | |
| | | b | + 102.75 | 158 | 2077.95 | | | | |

a- Surfacing in 1992
b- Surfacing in 1997

TABLE FIVE-10

COST OF CONSTRUCTION/KILOMETER

(SUB GRADE C.B.R. = 7%)

| SECTION | A/C IST YEAR COST. | T.S.T. PLUS ASPHALT OVERLAY | | | OVERLAY COST FOR NEXT 10 YEARS | |
|---|---|---|---|---|---|---|
| | | Ist. Year Cost. | For 3x106 AXLE Passing | | | |
| | | | Overlay Period | Cost of Overlay | A/C(Initial surfacing). | TST(Initial Surfacing) |
| Lahore-Bhaipheru | 1,154,779 | 930,806 | 3 years | 201,603 | 177,885 | 189,744 |
| Bhaipheru-Pattoki | 1,54,779 | 930.806 | 3½ years | 213,462 | 177,885 | 189,744 |
| Pattoki-Okara | 1,154,779 | 930,806 | 4 years | 177,885 | 177,885 | 177,885 |
| Okara-Sahiwal | 1,047,306 | 930,806 | 6 years | 177,885 | 177,885 | 177,885 |
| Sahiwal-Chichawatni. | 1,047,306 | 930,806 | 7½ years | 177,885 | 177,885 | * - |

* T.S.T. Surfacing shall be done in 1992 & 1997, at a cost of Rs.61,754 per surfacing.

(continued)