सत्यमेव जयते

GOVERNMENT OF ANDHRA PRADESH
PUBLIC WORKS (R&B) DEPARTMENT

FINAL

FEASIBILITY REPORT

FOR

(1) **STRENGTHENING OF NH-5 FROM VIJAYAWADA TO ELURU** (Km 3.40 TO Km 75.00) INCLUDING FOUR LANING FROM Km 3.40 TO Km 13.00 AND A BYPASS FOR ELURU TOWN

&

(2) **STRENGTHENING OF NH-9 FROM NANDIGAMA TO VIJAYAWADA** (Km 217.00 TO Km 265.00) INCLUDING FOUR LANING FROM Km 252.00 TO Km 265.00

VOL. - I

MAIN TEXT AND APPENDICES

MAY, 1993

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11, GREEN PARK, NEW DELHI-110016, TEL.: 668846, 669418, 6855252
TELEX: 031-73236 CINT IN, FAX: (011)-6855252, GRAM: ELEMICO (NEW DELHI)
DELHI, KOTPUTLI, BANGALORE, BHUBANESWAR, MADRAS, BOMBAY, MALAYSIA.

GOVERNMENT OF ANDHRA PRADESH

PUBLIC WORKS (R&B) DEPARTMENT

FINAL

FEASIBILITY REPORT

FOR

(1) STRENGTHENING OF NH-5 FROM VIJAYAWADA TO ELURU (Km 3.40 TO Km 75.00) INCLUDING FOUR LANING FROM Km 3.40 TO Km 13.00 AND BYPASS FOR ELURU TOWN

&

(2) STRENGTHENING OF NH-9 FROM NANDIGAMA TO VIJAYAWADA (Km 217.00 TO Km 265.00) INCLUDING FOUR LANING FROM Km 252.00 to Km 265.00

VOLUME -I

MAIN TEXT AND APPENDICES

MAY, 1993

CONTENTS

CONTENTS

VOLUME I -MAIN REPORT

CHAPTER-I

EXECUTIVE SUMMARY

1.0 BACKGROUND OF THE PROJECT

In the State of Andhra Pradesh, National Highway Nos.5 and 9 are the the most important National Highways, carrying heavy traffic. NH-5, connects the two mega towns of Madras and Calcutta, passing through Vijayawada, Eluru, Visakhapatnam and Bhubaneshwar important towns of huge commercial activities. Visakhapatnam is one of the major sea ports on the eastern coast of the country, handling large volume of mineral ores and other commodities.

Similarly, NH-9 starts from Pune in the State of Maharashtra, taking off from NH-4, and after passing through Hyderabad, the capital city of Andhra Pradesh, joins NH-5 at Vijayawada and thus is a major National Highway connecting NH-4 and NH-5 . Vijayawada itself is the second biggest town of the Andhra Pradesh, having a population of about 6.00 lakhs and is a big commercial and business centre.

The project envisages preparation of (i) Feasibility Report, and (ii) Detailed project report of the following sections.

i) Strengthening of NH-5 from Vijayawada to Eluru, km. 3.4 to km. 75.0 including 4-laning from km.3.4 to km.13.0 and a bypass at Eluru town.

ii) Strengthening of NH-9 from Nandigama to Vijayawada, km.217.0 to km.265.0 including 4-laning from km.252.0 to km.265.0.

This report presents the Feasibility Study recently completed by the I.C.T.

The cost of work on above two stretches is proposed to be financed from the Asian Development Bank under Package-III.

PRESENTATION OF STUDY

The Feasibility Report has been prepared and presented in three volumes as under :

<u>VOLUME I-MAIN TEXT AND APPENDICES</u>

- Executive Summary
- State Socio-economic Profile
- Socio-economic Profile of the Project Influence Area
- Methodology Adopted for the Studies
- Traffic Surveys and Analysis
- Project Road Description

- Environmental Issues
- Project Cost Estimates
- Economic Evaluation
- Conclusions and Recommendations

VOLUME II - PRELIMINARY DESIGN

- Project Road Inventory
- Engineering Survey and Investigation Data
- Design Standards and Specifications
- Pavement and Bridge Designs

VOLUME III - DRAWINGS

- Location Map
- Layout Plans
- Typical Cross Sections (showing pavement details)
- Drawings for Cross-drainage and other Structures
- Road Junction Design
- Land Acquisition Plans.

2.0 SOCIO-ECONOMIC PROFILE OF STATE

For 1990-91, the Net State Domestic Product at constant prices was Rs.11,815 crores registering an increase of 3.2 per cent over that of 1989-90. At current prices, the Net State Domestic Product was Rs.28.745 crores registering an increase of 16.50 per cent over that of the preceding year.

The per capita State Income at current prices increased from Rs.3,934 in 1989-90 to Rs.4,507 in 1990-91 registering an increase of 14.6 per cent. At constant (1980-81) prices, the per capita income increased from Rs.1,826 in 1989-90 to Rs.1,853 in 1990-91 recording an increase of 1.5 per cent.

3.0 SOCIO-ECONOMIC PROFILE OF THE PROJECT INFLUENCE AREA

The project influence area covers two districts of Krishna and West Godavari.

Agriculture is the principal activity. Main crops in the districts are rice, jowar, maize, sugarcane, chillies, tobacco, black gram, green gram & groundnut.

The districts have important minerals like limestone, clay, roughstone, colour granite, lime, kankar, dolomite, quartz, mica, etc.

There are about 1,200 medium and large scale industries in the two districts with a capital investment of about Rs.6,000 crores, providing employment to about 70 lakh persons. The industries are based on agricultural produce, mineral products, forest produce etc. The main industries are sugar mills, chemical factories, steel

mills, granite quarries, food processing units, rice mills, brick kilns etc.

The motor vehicle position in the two districts is as under:

	Krishna Dist. (Nos.)	W. Godavari Dist. (Nos.)
State carriages	1172	591
Goods vehicles	12581	2806
Cars/Jeeps	8414	1823

4.0 METHODOLOGY

The consultants after studying and reviewing the various aspects and availability of the secondary data about the project roads and the project influence area and assessing the impact on demand for transport, of the development plans in the influence area, have prepared the Feasibility Project Report covering broadly the following aspects.

i) Socio-economic profile data of the state and the Project Influence Area.

ii) Reconnaissance survey to examine the general character of the area and the project roads.

iii) Preliminary topographical survey and other features like buildings, places of worship and utility lines etc.

Longitudinal-sections and cross sections were taken and bench marks established.

iv) Alignment survey to find the suitability of the existing alignment and the geometric improvements.

v) Inventorisation and Condition survey of the existing project roads covering all geometric features, utility services, culverts, bridges, pavement thickness/composition and road surface condition etc.

vi) Soil and Material survey investigations to determine the availability and suitability of the various soil and materials to be used in the project work.

vii) Traffic surveys

a) The past data on traffic counts taken by the state PWD.

b) Seven day classified traffic count at km 13/2, 45/6 and 50/8 on NH-5 and km 219/6 and 253/4 on NH-9 to determine the present traffic.

c) Origin-Destination survey at km 50/8 on NH-5 and km 253/4 on NH-9 to appreciate the influence of

various zones adjacent to the project under consideration in attracting and generating traffic and to establish the need for a bypass at Eluru on NH-5.

d) Axle load survey in both directions for one day (24 hours) on NH-5 and NH-9 to derive the VDF based on axle damaging coefficients determined from AASHTO study.

e) Inventory survey.

f) Roughness study

g) Benkelman Beam deflection study (C.G.R.A. method).

The allowable deflections have been adopted as under as per the recent guide lines for pavement design of ADB-III road projects issued by MOST.

ESAL (MSA)	Allowable Deflections (mm)
Upto 30	0.70
30-50	0.60
50-75	0.55
> 75	0.50

h) Dynamic Cone Penetrometer Tests

viii) Pavement Design

a) The design of pavement for 10 years life as per the above mentioned MOST guidelines.

b) The new flexible pavement in the additional carriageway (for 4-laning) and Eluru bypass on the basis of CBR method as per the above mentioned MOST guidelines.

c) Alternative flexible pavement design based on SHELL Design Curves. However, the resulting pavement thickness in both these cases is almost the same.

d) The overlay on the existing deficient road crust based on Benkelman Beam test results and overlay design charts given in the above mentioned MOST guidelines.

ix) Bridge Deisgn

Preliminary design for bridges based on the relevant IRC codes of practice.

x) Environmental study

An initial environmental examination (IEE) as per requirements of the Bank's Environmental Guide Lines for selected Infrastructure Projects (Highway and Roads).

xi) Cost Estimate

The project cost worked out on the basis of the present market rates for various items of work, modified where necessary, to reflect the use of modern technology equipment.

xii) Economic Analysis

Economic evaluation for the improvement of the project roads and Eluru bypass as per the IRC Manual on Economic Analysis using the updated VOC tables of the IRC special Publication - 30.

5. TRAFFIC ANALYSIS

5.1 The traffic analysis showed that traffic on project roads is of mixed character consisting of fast and slow moving vehicles. Commercial vehicles are predominant comprising as much as 80 per cent.

Traffic on the project roads is as under:

N.H	LOCATION (Km.)	PCUS/DAYS
NH-5	13.2	20,644
-DO-	45.6	20,321
-DO-	50.8	17,547
NH-9	219.6	15,213
-DO-	253.4	32,581

5.2 The analysis of the Origin - Destination survey conducted at km 50/8 on NH-5 and km 253/4 on NH-9 also shows that about 80% of the truck traffic is through traffic.

5.3 The average annual growth rate for various types of vehicles works out as :

		1993-94	1995-2004	2005-2018
Cars	-	7.73 %	7.73 %	6.96 %
Buses	-	7.03 %	7.03 %	6.59 %
Trucks	-	6.72 %	6.38 %	6.04 %
Two-Wheelers	-	10.12 %	9.31 %	8.50 %

5.4 a) Necessity of 4-laning

The present 1993 traffic on the existing 2-lane carriageway of NH-5 from km 3/40 to km 13/0 is 20,644 PCUs/day which would increase to 28,846 PCUs/day by 1998 when this project is proposed to be completed.

The present 1993 traffic on the existing 2-lane carriageway of NH-9 from km 252/0 to 265/0 is 32,581 PCUs/day which has already exceeded the 2-lane capacity.

Hence, widening of the carriageway to four-lanes is necessary in the above mentioned two reaches.

b) Need for Eluru bypass

The reach of NH-5 from km 58/0 to km 67/0 passes through busy and congested market/business area of Eluru town with available ROW varying from 12 to 15 m only. The Madras-Calcutta railway line crosses the highway at four locations within the town. All these obstacles are a great hazard for the smooth flow of traffic through town, causing delay and discomfort. Hence, the construction of a bypass to Eluru town is very essential. Bypass alignment on the western side of town has, in fact, been already approved by MOST in 1988-89 and the State PWD has acquired the land accordingly.

5.5 The axle load survey carried out at km 50/8 on NH-5 and km 252/8 of NH-9, shows that vehicle damage factors are 3.35 for NH-5 and 3.10 for NH-9. However, as per MOST guidelines, VDF of 3.50 has been adopted.

5.6 Roughness survey carried out indicates average roughness value as 3740 mm/km for NH-5 and 4024 mm/km for NH-9.

6. PROJECT ROAD DESCRIPTION

Both these portions of the National Highway 5 and 9 traverse through predominantly black cotton soil and are agriculturally rich. The terrain is generally plain and the road gradients are flat. The alignment is also straight but at many locations there are sharp curves. The pavement thickness is deficient w.r.t. the traffic needs. The surface of the pavement is rough having an IRI between 3.4 to 4.5 m/km and condition of pavement from low to medium with rutting, potholes, undulations etc. The width of carriageway is generally 6.70 m with earthern shoulders. Within the limits of Vijayawada town, the volume of peak hour traffic is very high, justifying 4-laning on priority. Eluru town on NH-5 also requires bypass on priority, for which the Ministry of Surface Transport has already taken a decision in 1988-89 and land acquired for it. Improvement in the geometrics of the road has generally been limited within the right of way which

varies from 20 to 30 m, but at three locations land/houses have been proposed for acquisition. On NH-9, in Paritala village in km 239, there is a narrow neck in the alignment. Two alternatives have been proposed in this report. One to acquire 5 houses and a strip of land within the town to improve the geometrics. And the other to provide a bypass to the village. Ministry has to take a decision.

There are three major bridges on NH-9 and three on NH-5, which are being retained. In respect of minor bridges, although the carriageway width is less in most of the cases, these have still been proposed for retention as per decision taken jointly with the MOST/PWD. Some of the culverts are also being proposed for reconstruction.

7 PAVEMENT DESIGN

7.1 The design standards as applicable to National Highways in plain terrain have been adopted. The specifications proposed are those given in MOST specifications.

7.2 The overlay requirement on the existing pavement has been assessed on the basis of Benkelman Beam deflection studies. Allowable deflection and overlays have been adopted as per the recent guidelines for pavement design of ADB III road projects issued by MOST. The pavement thickness for the new carriageway has been designed on the basis of 7 per cent CBR value of the borrow area soil.

The subgrade is proposed to be compacted to high values of density obtained by modified AASHTO compaction.

7.3 The specifications adopted are as follows :

	Item of work	Reach	Specifications (thickness in mm)
i)	Strengthening	NH-5 a) km 13/0-75/0 (excluding km 53/8-69/2) b) km 3/40-13/0 NH-9 a) km 217/0-252/0	DBM = 130 BC = 40
		b) km 252/0-265/0	DBM = 150 BC = 40
ii)	New carriageway	NH-5 4 laning km 3/40-13/0	GSB = 300 WMM = 300 DBM = 130 BC = 40

	NH-9 4 laning km 252/0-265/0 Eluru bypass NH-5, km 53/8-69/2	GSB = 300 WMM = 300 DBM = 150 BC = 40
iii) Service road (5.5 m)	NH-5, km 5/40-9/60	GSB = 300 WMM = 300 MSS
iv) Paved shoulders (1.5m)	NH-5 & NH-9	GSB = 300 WMM = 450 MSS
	Eluru byepass	GSB = 300 WMM = 470 MSS

GSB = Granular Sub-base, WMM = Wet Mix Macadam,
DBM = Dense Bituminous Macadam, BC = Bituminous Concrete
MSS = Mix Seal Surfacing

8. RAIL OVERBRIDGES

Two ROBs with 4-lane carriageways are proposed to be constructed on Eluru bypass on NH-5 as the proposed bypass alignment crosses the Madras-Calcutta South-Central Railway Line at two places.

i) ROB at Ch. 0.80
ii) ROB at Ch. 16.950

9. BRIDGES

9.1 In the Draft Feasibility Report, proposals for construction/replacement of bridges were framed based on the latest guidelines contained in the Ministry of Surface Transport (Roads Wing)'s Circular No. RW/33044/2/88-D.O.II dated 21.9.90 regarding "Width of bridges on National Highways". However, during joint inspection with MOST and PWD Officers, some existing 2 lane bridges with lesser carriageway width as compared to latest guidelines were proposed to be retained as such since condition of the structures is good. Accordingly the following modified programme for bridges is recommended in Chapter 5 of Vol. 2 of the Report.

NH-5 (Total = 22 Nos. + 2 ROBs)

i) 2 lane existing major bridges proposed to be retained - 4 nos.

ii) 2 lane existing minor bridges proposed to be retained - 6 nos.

iii) 2 lane additional major bridge proposed on 4 lane section - 1 no.

iv) New 2 lane major bidges proposed on Eluru bypass - 2 nos.

v) New 2 lane minor bridges proposed on Eluru bypass. - 7 nos.

vi) 4 lane minor bridges proposed at existing locations - 2 nos.

vii) 2 lane minor bridges already under construction - 1 no.

viii) ROBs proposed on Eluru bypass. - 2 nos.

9.2 NH-9 (Total = 10 nos.)

i) 2 lane existing major bridges proposed to be retained - 2 nos.

ii) 2 lane existing minor bridges proposed to be retained - 6 nos.

iii) 2 lane additional major bridge proposed on 4 laning section - 1 no.

iv) 2 lane additional minor bridges proposed on 4 laning section - 2 nos.

v) 4 lane minor bridge proposed at the existing location - 1 no.

vi) Replacement of 2 lane minor bridge at the existing location - 1 no.

10. PROJECT COST

The cost of the project based on market rates works out to Rs. 1625 millions as under :

a) Land Acquisition - 3.332

b) Shifting of utilities - 8.619

c) Road project cost - 1612.851 [NH-5 - Rs. 516.761 million]
---------[NH-9 - Rs.1096.090 million]

Total - 1624.802

Say Rs. 1625 million

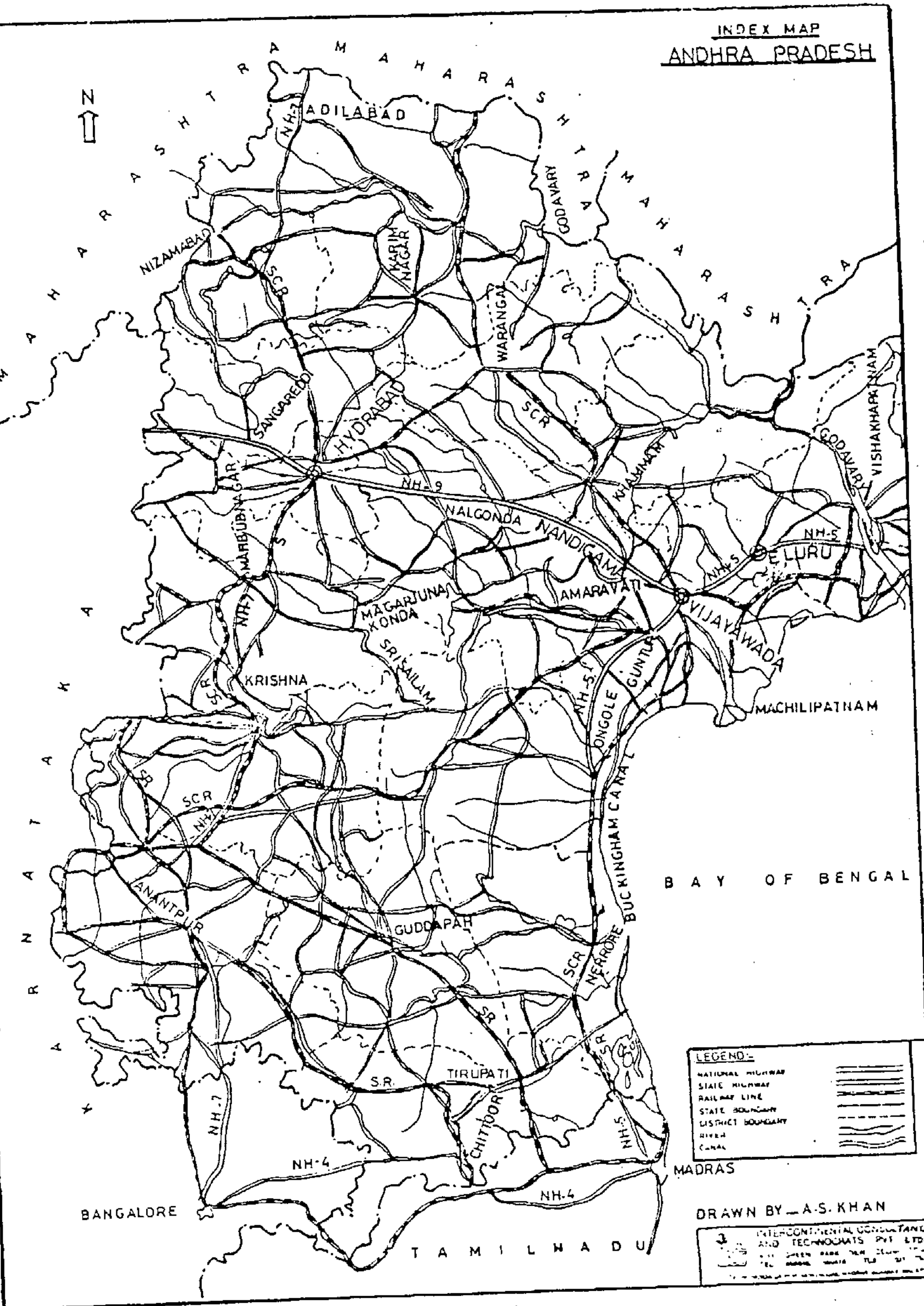
The road project cost of Rs. 1612.851 millions includes 10% contingencies, 2% for laboratory equipment, camp, quarters, vehicles etc. and 5% for supervision charges.

11. ECONOMIC ANALYSIS

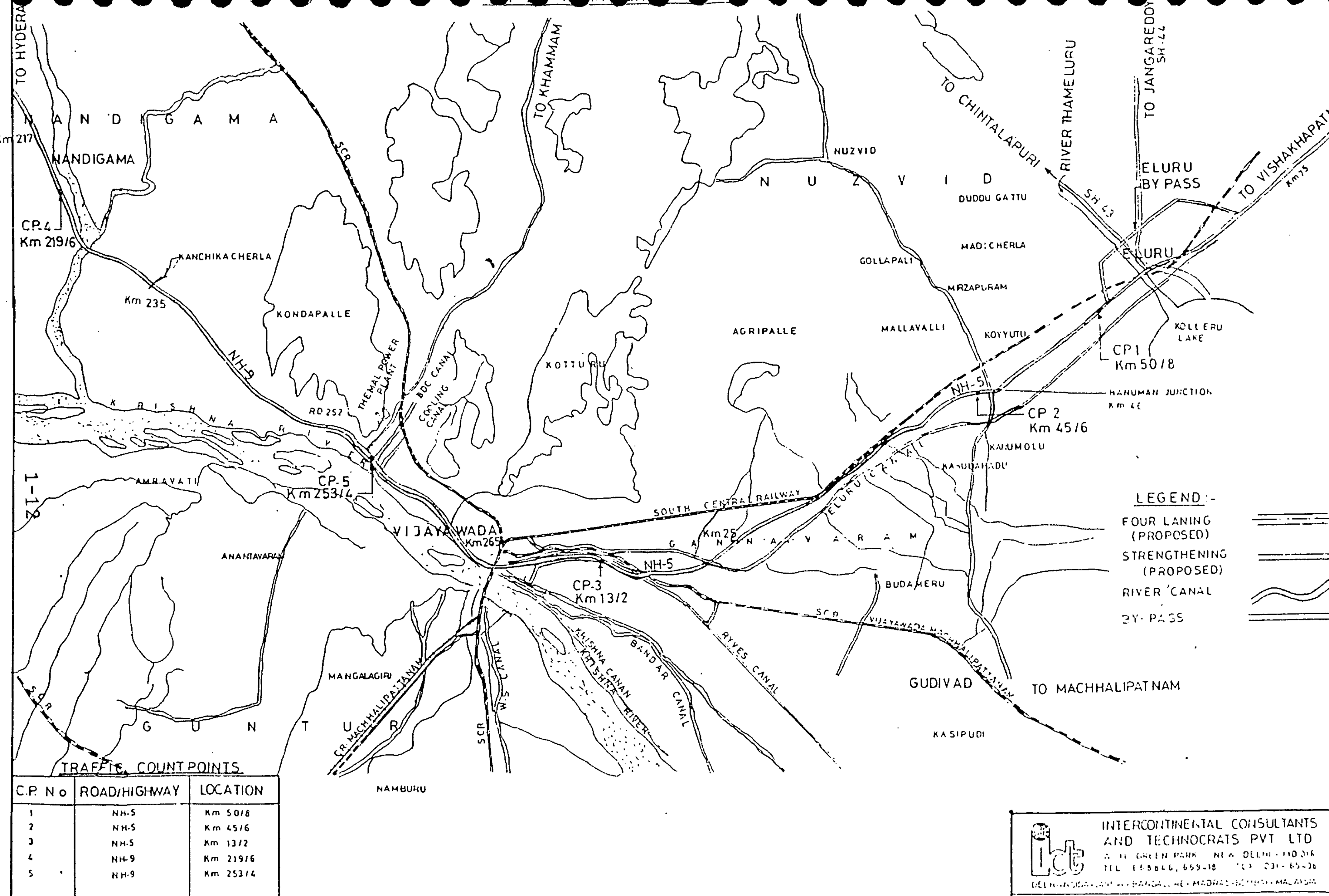
As per economic evaluation, the EIRRs are as under :

	EIRR (%)	EIRR (%) (As per Sensitivity Analysis)
NH-5	30.7 - 31.8	20.7 - 25.3
Eluru bypass	15.3	
NH-9	32.3 - 49.0	35.5 - 41.7

This idicates that the project is economically viable.


INDEX MAP
ANDHRA PRADESH
N
MAHARASHTRA
ADILABAD
NIZAMABAD
KARIM NAGAR
GODAVARY
WARANGAL
SANGAREDDI
HYDRABAD
SCR
NH-9
NALGONDA
NANDIGAMA
KHAMMAM
VISHAKHAPATNAM
ELURU
NH-5
AMARAVATI
VIJAYAWADA
MARBUBNAGAR
NH-7
NAGARJUNA KONDA
SRISAILAM
KRISHNA
GUNTUR
ONGOLE
MACHILIPATNAM
BUCKINGHAM CANAL
BAY OF BENGAL
KARNATAKA
ANANTPUR
GUDDAPAH
NERRORE
SR
TIRUPATI
CHITTOOR
NH-4
MADRAS
BANGALORE
TAMILNADU
LEGEND:-
DRAWN BY – A.S. KHAN

NH-9:- NANDIGAMA TO VIJAYAWADA



TRAFFIC COUNT POINTS

C.P. No	ROAD/HIGHWAY	LOCATION
1	NH-5	Km 50/8
2	NH-5	Km 45/6
3	NH-5	Km 13/2
4	NH-9	Km 219/6
5	NH-9	Km 253/4

CHAPTER 2

ECONOMIC PROFILE OF ANDHRA PRADESH

2.1 The State of Andhra Pradesh is now the largest State in South India. It is bounded on the north by Orissa and Madhya Pradesh, on the west by Maharashtra and Karnataka, on the south by Tamil Nadu and on the east by the Bay of Bengal. It has a sea coast about 974 km long. Rivers Krishna and Godavari flow through the State. Tungabadra is an important tributary of the river Krishna. Other rivers flowing through the State are Pennar, Vamsadhara and Nagarali. The panorama of the State ranges from mountainous north to fertile agricultural plains and beautiful sea coast. The salient features of the State are shown in Annexure-2.1.

2.2 AREA AND POPULATION

Andhra Pradesh covers an area of 275,068 sq.km. constituting about 8.4 per cent of the total area of the country. Its population, according to 1991 census was 6,63,54,559 and population-wise, it ranked fifth in the country. The density of population in 1991 was 241 per sq.km. against 261 in the country as a whole. The growth of population during the decade 1981-91 was 23.91 per cent against 23.10 per cent in the previous decade and against 23.56 per cent for the country. Males outnumber females, the number of females per thousand males being 973. The percentage of literates to the total population in the State in 1991 was 45.11 against 35.66 in 1981 registering a significant improvement in literacy. The percentage of literacy for males was 56.24 and for females 33.71. In comparison, the percentage of literates in the country as a whole was 52.11; 63.86 for males and 39.42 for females. The main languages spoken are Telugu and Urdu. Hyderabad is the capital and the largest city of the State with a population of about 2.26 million. There are 30 other cities, notable among them being Visakhapatnam, Vijayawada, Warangal, Guntur, Nellore, Kakinada, Rajahmundry and Kurnool. There are 252 towns and 27,379 inhabited villages in the State. The State has been divided for administrative purposes into 23 districts.

2.3 CLIMATE

The climate is generally hot and humid during most parts of the year. The maximum temeperature goes up to 45 deg.C and the minimum remains at about 13 deg.C. The south-west monsoon (June-September) accounts for about two-third of the total rainfall in the year, the North-east monsoon accounting for the remaining one-third. In 1991-92, the State as a whole received an average rainfall of 890 mm of which South-west monsoon accounted for 664 mm. The distribution of rainfall in different regions in the State in 1991-92 is shown in Table 1.

Table 1
Distribution of rainfall in the State
(in millimeters)

	Coastal Andhra	Rayala-seema	Telen-gana	Whole State
i) South-west Monsoon	762	409	685	666
ii) North-east Monsoon	359	334	58	224
	1121	743	743	890

The season-wise and region-wise average rainfall for different years is given in Annexure 2.2.

2.4 AGRICULTURE

2.4.1 Andhra Pradesh is a predominantly agricultural State with 70 per cent of the population dependent on agriculture and allied activities and the primary sector accounts for about 40 per cent of the Net State Domestic Product. The more important land use statistics for the year 1988-89 are shown in Table 2.

Table 2
Land use pattern

(Thousand hectares)

1.	Total geographical area	27,440
2.	Area under forests	5,836
3.	Uncultivable	2,259
4.	Non-agricultural	2,278
5.	Cultivable waste	847
6.	Pasture	881
7.	Misc. trees etc.	270
8.	Other fallow	1,428
9.	Current fallow	2,630
10.	Net sown area	11,011

Source : Directorate of Economics and Statistics, Andhra Pradesh

Thus the net sown area constitutes about 40 per cent of the total area. The net irrigated area was 42.56 lakh hectares in 1988-89; it increased to 42.85 lakh hectares in 1989-90 and to 43.06 lakh hectares in 1990-91. Canals are the principal means of irrigation and accounted for 18.69 lakh hectares in 1990-91. The other sources of irrigation are tanks and wells. The area irrigated by different sources in different years is given in Annexure-2.3.

2.4.2 The main crops grown in the State are rice, jowar, maize and pulses under foodgrains and ground-nut, oilseeds, chillies, cotton and sugarcane under cash crops. The annual production of some of the important crops is given in Table 3.

Table 3
Production of important crops in the State
(000 tons)

	Crop	1990-91	1991-92
1.	Rice	96,54	94,65
2.	Jowar	8,52	6,73
3.	Maize	6,45	6,39
4.	Pulses	6,95	8,16
5.	Groundnut	22,67	22,36
6.	Chillis	3,47	2,60
7.	Cotton	11,10	13,14
8.	Sugarcane	126,68	148,33

Source : Directorate of Economics and Statistics, Andhra Pradesh

The total foodgrains production in 1990-91 was 123.30 lakh tonnes and it slightly dropped to 119.72 lakh tonnes in 1991-92. The reduction in foodgrains production in 1991-92 is attributed to reduction in areas under cereals and millets and also to near drought conditions in the months of July, August and September. The area under forests (5836000 hectares) constitutes about 21 per cent of the total area.

2.4.3 The State Plan includes special schemes for protection and regeneration of forests which are supplemented by a Centrally sponsored scheme. The State has considerable potential for the development of horticulture as it has a variety of soils and tropical climate conditions suitable for cultivating a wide range of fruits, vegetables, flowers and ornamental plants. The State Plan also provides for development of fisheries and for welfare of fishermen.

2.5 MINERALS

The State has a virtual monopoly of quality chrysolite asbestos in the country. It accounts for about 86 per cent of the country's total production of barytes. Other important minerals in the State are copper ore, manganese, mica, coal and limestone. The State ranks sixth in the production of manganese ore and second in the production of mica and limestone. Singareni coal mines produce non-coking coal required for power houses, Railways, cement and fertiliser plants and other industries.

2.6 INDUSTRY

2.6.1 Several major industries are in operation in the State, specially around Hyderabad and Visakhapatnam. These manufacture machine tools, synthetic drugs, pharmaceuticals, heavy electrical machinery, ships, fertilisers, electronic equipment, aeronautical parts, cement and cement products, chemicals etc. According to Annual Survey of Indutries (1987-88), the State occupies second position in the country as regards the number of registered factories. There are 14,101 registered factories in the State accounting for 13.7 per cent of the factories in the country. As between 1970-71 and 1987-88, the number of factories in the State increased from 5,448 to 14,101, employment from 3.25 lakhs to 7.13 lakhs, value of output from Rs.686 crores to Rs.9,137 crores, the value added by manufacture from Rs.125 crores to Rs.1,245 crores. Annexure-2.4 shows the share of seven major industries in the gross output and value added in 1987-88. The Industrial Development Corporation in the State provides technical guidance for promoting industries.

2.6.2 Small scale industries

The Industrial Policy announced by the Government of India during July 1991 providing for several new liberalising measures for the promotion of small scale industries has given a new fillip to the small scale sector in the State. The number of registered small scale industrial units in the State was 1,03,275 by the end of 1991, providing employment to about 9.25 lakh persons. The District Industries Centres are the nodal agencies which play an important part in promoting this sector. Some of the organisations responsible for promoting small industries in the State are Andhra Pradesh Leather Industries Development Corporation (LIDC, AP), Andhra Pradesh Khadi and Village Industries Board, Andhra Pradesh Handicrafts Development Corporation. An Indian Institute of Fashion Technology is being established at Venkatagiri, Nellore district.

2.6.3 Sericulture is an important industry in the State. The State Plan provides for programmes comprising maintenance of infrastructure, procurement of tasar seed cocoons, participation in fairs and exhibitions and assistance under co-operative sector like share capital contribution to Sericulture Co-operative Societies, workshed-cum-houses for silk weavers' co-operative societies, Thrift fund-cum-savings security schemes and rebate on sale of silk cloth etc.

2.6.4 The Electronics Development Corporation in the State has undertaken various electronic projects at Gannavaram (Krishna district), Warangal,Tirupati and Medak Districts. The objectives of the Corporation are to develop and promote electronic industries and co-ordinate technology development in the State. The Corporation seeks to promote

projects in the fields of telecommunications, software export and development of hardware/softwork technology park at Hyderabad in association with the Department of Electronics, Government of India.

2.7 POWER

2.7.1 The installed capacity in the State which was only 213 MW in 1960-61 increased to 4,972 MW by the end of 1991-92. Out of this, the thermal capacity accounts for 2,519 MW. including the State's share of 807 MW in the Central projects and 99 MW of gas capacity and the Hydel capacity accounts for the balance of 2,453 MW. The power consumption which was only 0.6 billion KWH in 1960-61 increased to 16.1 billion KWH in 1990-91. The proportion of villages electrified increased from 8.9 per cent to nearly 100 per cent. About 90 per cent of Harijanwadas and a little over half of the hamlets have also been electrified by 1991-92. The details relating to installed capacity, power generation, consumption and rural electrification are given in Annexure-2.5.

An additional 0.81 lakh agricultural pumpsets were energised during 1991-92 bringing the total number of agricultural connections to 12.74 lakhs by the end of March 1992. Consumption of power for agricultural purposes during 1990-91 constituted 39.4 per cent of the total consumption in the State, as compared to 37 per cent in 1989-90. The per capita consumption of power in the State was 267 KWH in 1991-92. An additional number of 823 hamlets and 2307 Harijanwadas have since been electrified.

The power generation during 1991-92 was 18,243 M.KWH as against 18,004 M.KWH in 1990-91 showing a small increase of 1.3 per cent. The share of hydel and thermal is 55.2 and 47.8 per cent respectively.

The hydel and thermal power generation in the State is shown in Table 4.

Table 4
Power Generation in the State

Million K.W.H.

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92 (P)
HYDRO	5453 (44.6)	6517 (47.2)	5864 (42.3)	6880 (48.6)	7802 (51.9)	9902 (55.0)	9517 (52.2)
THERMAL	6772 (55.4)	7282 (52.8)	7985 (57.7)	7263 (51.4)	7222 (48.1)	8102 (45.0)	8726 (47.8)
TOTAL:	12225	13799	13849	14143	15024	18004	18243

Source : Survey of Economic Trends and State Plans, 1992-93

2.7.2 Non-conventional energy development

The Non-conventional Energy Development Corporation of Andhra Pradesh is a State owned Corporation responsible for energy renewal programmes which are sponsored by the Department of Non-Conventional Energy Sources of the Government of India. The programmes being implemented are:

- National Project on bio-gas development
- National project on Institutional biogas plants
- National project on improved chulhas
- Solar energy Programmes
- Wind Energy Programmes
- Urjagram
- Energy Conservation projects
- Training programmes and
- Power generation through Non-conventional Energy Sources.

2.8 TRANSPORT

2.8.1 Roads

The Roads and Buildings Department in Andhra Pradesh is responsible for maintaining State Roads, National Highways and all State Government buildings.

The Roads and Buildings Department is headed by Engineer-in-Chief (R&B) (Roads and Administration), Additional Secretary to Government (Technical), Transport, R&B Department and six Chief Engineers viz., (1) Chief Engineer (Buildings), (2) Chief Engineer (National Highways), (3) Chief Engineer (Designs and Planning) and (4) Chief Engineer (Cyclone Reconstruction Project), (5) Chief

Engineer (R&B) ADB & CAD and (6) Member, Commissionerate of Tenders.

The Roads and Building Department is responsible for execution of all original and maintence works pertaining to roads, bridges and buildings in charge of the State Government. The road works under tribal development, drought prone area programme, the Central Road Fund, Railway safety works (over and under bridges) are also executed by the Department.

As at the end of 1991-92, the State had a total road length of 41,455 km, excluding National Highways, classified as follows:

Table 5
Length of State roads

	State Highways	Major District Roads (incl. Z.P. Roads)	(Km.) Total
B.T. Roads	8,821	21,194	30,015
W.B.M.roads	80	8,306	8,386
Unmetalled roads	264	2,790	3,054
	-------	--------	--------
Total	9,165	32,290	41,455

The total length of National Highways in the State is 2,587 km which includes about 92 kms of urban links. Surface-wise, only 2 km is cement concrete and the rest is of B.T. type. A list of National Highways passing through Andhra Pradesh is given at Annexure 2.6 and the expenditure on National Highways is given at Annexure 2.7.

In addition to the state roads, there is a wide network of rural roads with a total length of 1,06,437 km with 17,883 km under the R&B Department and the balance of 88,554 km under the Panchayat Raj Department.

The expenditure on the development of roads in the State is mainly from the state plan allocation. The outlays on road development since the second Five Year Plan are given in Table 6.

Table 6
Outlay on Roads in the State

(Rs. crores)

Second Five Year Plan (1956-1961)	5.86
Third Five Year Plan (1961-1966)	8.35
Annual Plans from 1966 to 1969	4.41
Fourth Five Year Plan (1969-1975)	10.25
Fifth Five Year Plan (1975-1980)	31.81
Sixth Five Year Plan (1980-1985)	46.80
Seventh Five Year Plan (1985-1990)	99.35

The Plan allocations for the road sector have been quite low. In the Seventh Plan of the total Plan outlay of the state road sector accounted for only 1.98 per cent, the corresponding figure for All India being 5.11 per cent. The yearwise grants and expenditure on roads under the Plan since 1983-84 are shown in Table 7.

Table 7
Expenditure on Roads

Year	Grant (Rs. in crores)	Expenditure (Rs. in Crores)
1983-84	10.00	9.79
1984-85	11.05	10.88
1985-86	13.00	13.01
1986-87	21.83	21.44
1987-88	20.00	20.02
1988-89	24.50	24.81
1889-90	20.50	20.07
1990-91	24.42	24.75
1991-92	22.00	22.17
1992-93	22.00	7.96 (to end of August 1992)

Source : Directorate of Economics and Statistics, Andhra Pradesh

On account of financial constraints, the outlay proposed for the Eighth Plan is only Rs. 95 crores. The details of year-wise expenditure on roads under capital, maintenance etc. are given at Annexure 2.8.

Maintenance of roads : The allocation for the maintenance of roads has been short of requirement from year to year. The year to year requirements, allocation and expenditure on maintenance since 1983-84 are shown in Table 8.

Table 8
Maintenance of Roads

Year	Requirement of funds	Allocation (Rs. in crores)	Expenditure (Rs. in crores)
1983-84	63.40	36.02	36.13
1984-85	67.20	40.02	40.72
1985-86	70.00	48.53	48.13
1986-87	70.00	54.57	55.18
1987-88	91.22	49.15	48.83
1988-89	95.78	56.55	58.25
1889-90	102.00	62.30	64.49
1990-91	126.00	84.27	87.39
1991-92	150.00	116.97*	121.91
1992-93	170.00	122.91**	55.93 (to end of Aug.,1992

* (Including Rs. 26.77 crores for rural roads + Rs. 4.64 crores for Godavari Pushkaram Works, city roads, roads around Tirupati etc.)

** (Including Rs. 39 crores for rural roads + Rs. 0.85 crore for Krishna Pushkaram works)

The norms for assessment of maintenance of various types of roads of R&B Deptt., Andhra Pradesh are shown in the Annexure 2.9. The maintenance requirement for 1992-93 is Rs. 170 crores against which the allocation is Rs. 122.91 crores which includes Rs. 39 crores for rural roads and Rs. 0.85 crore for Krishna Pushkaram works. There is reported to be heavy back-log of maintenance which requires a total amount of Rs. 270 crores.

The allocations for certain other categories of roads which are funded outside the B&R Department are given in Table 9.

Table 9

S.No.	Category of roads	1992-93 (Rs. lakhs)
1.	Mineral roads	70.00
2.	Sugar cane Cess works	401.54
3.	Tribal sub-plan	132.00 (1991-92)
4.	Central Road Fund works	1212.80
5.	ONGC assisted roads	200.00
6.	Coastal Road from TADA to Ichapuam	(Allocation not yet decided)
7.	ADB assisted road	2000.00
8.	Cyclone damaged roads	125.00

2.8.2 Rural roads

The State Government sanctioned Rs. 100 crores under Non-Plan in 1991-92 as one time provision for upgradation of existing rural roads of the Panchayati Raj Department and roads taken over from Zila Parishads. Out of Rs. 100 crores, the Government allocated Rs. 26.77 crores in 1991-92 and Rs. 39 crores in 1992-93. A Master Plan for rural roads has been drawn up with the help of National Transport Planning and Research Centre, Trivandrum. The plan mainly aims at providing 100% connectivity to all the villages. The cost of the rural roads programme is estimated at Rs. 2,836 crores to be spread over 8th, 9th and 10th plan periods.

2.9 PAVEMENT MANAGEMENT SYSTEM

A Technical Assistance grant has been provided to the State Government by the ADB to help in settig up a computerised pavement management system for State Highways and more heavily trafficked major district roads. The system is in position now.

Traffic census is conducted on the State roads on specific points, once every two years by the State Roads and Buildings Department. The vehicular traffic on the roads is increasing at an alarming rate and there is heavy traffic particularly on roads which carry agricultural produce including commercial crops like sugarcane, tobacco

etc. It is necessary to strengthen the weak bridges and carriageways, specially in water logged areas like delta project command areas. There are proposals in the Eighth Plan to improve and strengthen the road network. In particular, it is proposed to construct bypasses in congested towns, improve geometrics of roads, provide missing bridges and to reconstruct some of the existing weak and narrow bridges.

There is a well-organised Traffic Engineering Cell in the R&B Department to collect and compile statistical data and to undertake studies on the nature and volume of traffic on different roads, losses due to congestion and accidents, factors affecting speed, safety and convenience in the use of roadways and for the evaluation of the effects of various improvements and of the provision of various road facilities.

The State has a system of toll fee collection on major new bridges on the National Highways. During 1990-91, the total toll fee collected was Rs.201.33 lakhs on six bridges in Kamareddy, Vijayawada, Gudur, Anantapur, Srikakulam and Rajahmundry Divisions.

A separate organisation has been functioning in the R&B Department since 1975 to look after the maintenance and upkeep of tools and plants and the entire departmental machinery in the State. The organisation is responsible inter-alia for planning and purchase of machinery, preparation of project reports wherever required, co-ordination and transfer of T&P among different Divisions, running departmental workshops, maintainence of statistical data and other records etc.

There are 21 ferries in the State under the control of the R&B Department. During 1989-90, a total revenue of Rs.37.30 lakhs was realised from the operation of these ferries.

2.10 ROAD ACCIDENTS

The number of road accidents in the State has gone up from 11,635 in 1986 to 17,633 in 1991, i.e., by about 51%. Annexure 2.10 gives details of the total number of accidents between 1986 and 1991, number of vehicles involved, persons killed and injured both for the State as a whole as also for Krishna and West Godavari districts.

2.11 ROAD TRANSPORT

2.11.1 There has been a phenomenal increase in the total number of vehicles on road in the state, from 6.62 lakhs in 1986-87 to 15.20 lakhs in 1991-92 i.e. about 230% per cent. A detailed statement showing the vehicle population in the state during 1987-1992 is given at Annexure 2.11. The

number of vehicles registered during the last three years is given in Table 10.

Table 10
No. of Registered Motor vehicles

		1989-90	1990-91	1991-92
1.	State carriages	15,097	16,100	16,854
2.	Goods Vehicles	65,800	74,065	81,455
3.	Contract carriages	38,162	44,065	50,286
4.	Tractor-Trailers	36,683	40,751	41,261
5.	Motor cars and jeeps	89,529	1,01,795	1,06,981
6.	Two-wheelers	10,03,985	11,87,530	12,17,322
7.	Others	12,667	9,431	5,544
	Total	12,61,923	14,72,908	15,19,703

2.11.2 Receipts for road taxes

The total amount received from road taxes in 1991-92 amounted to Rs. 204.26 crores. Annexure 2.12 gives the details of the receipts from total road taxes.

2.11.3 Transport department

The Transport Department was primarily established for enforcement of the provisions of the Motor Vehicle Act, 1988 and the Andhra Pradesh Motor Vehicle Act, 1963 and the Rules framed under these two Acts. The Department is headed by the Transport Commissioner. There is a State Transport Authority constituted under section 6.8 of the Motor Vehicle Act, 1988 with the Transport Commissioner as the Chairman. Its main functions are to co-ordinate and regulate the activities and policies of the Regional Transport Authorities in respect of long distance and inter-state routes.

Andhra Pradesh State Road Transport Corporation

By the year 1991-92, 95 per cent of the State carriage routes have been nationalised leaving only 5 per cent to be operated by the private operators. City services in Hyderabad, Vishakapatanam and Vijayawada cities and Kothagudem and Warrangal towns have been completely nationalised. The nationalised services are operated by the Andhra Pradesh State Road Transport Coproration. The corporation had a fleet of 14,368 buses as in June 1991, and operated 368 million km. The vehicular utilisation was 282 kms per day and the occupancy ratio was 75. In recent years, the Corporation has been operating at a loss. After providing for depreciation, it incurred a loss of Rs. 11.92 crores in 1990-91 and Rs. 20,63 crores in 1989-90. Annexure 2.13 gives the physical performance of the

Corporation since 1985-86 and Annexure 2.14 shows the financial performance.

2.12 PORTS

The State has a major port at Visakhapatnam, two intermediate ports at Kakinada and Machilipatnam and seven minor ports at Bhavanpadu, Kalingapatnam, Beemunipatnam, Narsapur, Nizampatnam and Krishnapatnam. The intermediate and minor ports are looked after by the State Ports Department.

The Eighth Plan provides for the development of Kakinada port as a deep water port with ADB assistance. The recent Annual Plans include ADB funded works like island breakwater and provision of three alongside berths including land acquisition, consultancy etc. The Plan also includes works like transit sheds, wharf walls etc.

For Machilipatnam port, the Plan provides for survey and investigation, water supply, transit sheds etc. Provision has been made in 1992-93 for repairs to damaged ports of Kakinada, Machilipatnam and Nizampatnam under the Cyclone Emergency Reconstruction project.

2.13 RAILWAYS

In 1989-90, the state had a total rail route length of 5,020 km which includes 3,373 km of broad gauge, 1,610 km of metre gauge and 37 km of narow gauge. The number of stations was 668.

2.14 AVIATION

The important airports in the State are at Hyderabad, Tirupati, Vijayawada and Visakhapatnam and they connect Bombay, Delhi, Calcutta, Bangalore and Madras. The other airports are Cuddappah, Rajahmundry, Renugunta, Vizag and Warangal and they are connected by Vayudoot service.

2.15 TOURISM

Andhra Pradesh has a rich heritage in art and culture and has a number of fascinating places of great tourist interest. The State has rocks, forests, lush green fields, water falls and lakes and beautiful beaches washed by blue sea. The countryside is beautiful, watered by thirty four rivers which include Krishna and Godavari. A few of the tourist attractions are :

The city of Hyderabad founded in 1591, with its salubrious climate offers fascinating glimpses of past splendours, the legacy of four hundred years of its history. It is specially known for its Charminar, a monument with four graceful minarets. The Salarjung Museum is one of the

largest one-man collection of antiques in the world. The historic Golconda fort lies 11 km west of the city. Warangal, 157 km from Hyderabad, is noted for its beautiful lakes, splendid temples and wild life. Nagarjunasagar, called Vijayapuri in ancient times, is an Important Buddhist site, 150 km from Hyderabad. There is a big dam erected at this place. The Mogalarajapuram caves near Vijayawada have three ancient cave temples. Tirupathi in the foothills of Tirumala marks the location of one of the most venerated shrines in the country and attracts a very large number of pilgrims and visitors all the year round. The State has also a number of wild life sanctuaries.

The number of Indian tourists to the State increased from 185 lakhs in 1990 to 207 lakhs in 1991. The number of foreign tourists who visited the State in 1991 was about 33,000. All tourist spots are well connected by rail, road and air.

2.16 STATE G.D.P.

New series of National Accounts Statistics with 1980-81 as base year have been introduced replacing 1970-71 series. The statement at Annexures 2.15 and 2.16 show the Net State Domestic Product of Andhra Pradesh by industry of origin at current and constant prices and per capita income.

At constant prices, the Net State Domestic Product amounted to Rs.11,454 in 1989-90 registering an increase of 2.9 per cent over that of the preceding year, while at current prices, it was Rs. 24,676 cores showing an increase of 12.1 per cent over 1988-89.

For 1990-91, the Net State Domestic Product at constant prices was Rs.11,815 crores registering an increase of 3.2 per cent over that of 1989-90. At current prices, the Net State Domestic Product was Rs.28,745 crores registering an increase of 16.5 per cent over that of the preceding year.

The composition of Net State Domestic Product at constant (1980-81) prices which is given in Table 11 reveals an increasing share of tertiary sector in the total State Domestic Product.

Table 11
Composition of Net State Domestic Product at constant (1980-81) prices

(Rs. in crores)

Sl. No.	Sector	YEAR		
		1988-89	1989-90 (P)	1990-91 (Q)
1.	Primary	4730 (42.5)	4743 (41.4)	4713 (39.9)
2.	Secondary	1860 (16.7)	1890 (16.5)	2837 (17.2)
3.	Tertiary	4539 (40.8)	4820 (42.1)	5065 (42.9)
	Total:	11129	11453	11815

P = Provisional
Q = Quick

(Figures in the parenthesis are percentages)
Source: Directorate of Economics & Statistics, Andhra Pradesh.

The per capita State Income at current prices increased from Rs.3,934 in 1989-90 to Rs.4,507 in 1990-91 registering an increase of 14.6 per cent. At constant (1980-81) prices, the per capita income increased from Rs.1,826 in 1989-90 to Rs.1,853 recording an increase of 1.5 per cent.

ANNEXURE-2.1

SALIENT FEATURES OF ANDHRA PRADESH

S.No.	Item	Year	Unit	Numbers
1.	Area		Sq.Km.	275,068
2.	Population (Total)	1991	lakhs	663.54
	Male	1991	lakhs	336.37
	Female	1991	lakhs	327.17
3.	Population growth rate	1981-91	%	23.91
4.	Density of population	1991	per sq.km.	241
5.	Literacy	1991	% to total population	45.11
6.	Net State Domestic Product (current prices)	1990-91 (est.)	Rs. crores	28,745
7.	Net State Domestic Product (constant prices)	1990-91 (est.)	Rs. crores	11,815
8.	Per capita Income (current prices)	1990-91	Rs.	4,507
9.	Per capita Income (constant prices)	1990-91	Rs.	1,853
10.	Total geographical area	1988-89	000 hectares	27740
11.	Net area sown	1988-89	000 hectares	11011
12.	Total forest area	1988-89	000 hectares	5836
13.	Total irrigated area	1988-89	000 hectares	4306
14.	Total foodgrains production	1990-91	lakh tonnes	123.30
15.	No. of factories	1987-88	Nos.	14101
16.	Power generation capacity	1991-92	M.W	4,972
17.	Total State road length (excluding N.H.)	1991-92	Kms.	41,455
18.	Length of National Highways	1991-92	Kms.	2,587
19.	Length of railway route	1990	Kms.	5,095
20.	No. of motor vehicles	1986	Nos.	669249
21.	No. of road accidents	1991	Nos.	17633
22.	No. of tourists	1991	000'	207.08

ANNEXURE - 2.2

SEASON-WISE, REGION-WISE AVERAGE RAINFALL DURING 1983-84 TO 1991-92

(In Millimeters)

Year	South West Monsoon				North East Monsoon			
	Coastal Andhra	Rayala-seema	Telegana	Andhra Pradesh	Coastal Andhra	Rayala-seema	Telengana	Andhra Pradesh
1	2	3	4	5	6	7	8	9
Normal	603.00	379.00	764.00	634.00	318.00	224.00	98.00	206.00
1983-84	810.00	598.00	1114.00	906.00	277.00	170.00	207.00	227.00
1984-85	523.00	332.00	570.00	510.00	218.00	171.00	99.00	158.00
1985-86	531.00	316.00	585.00	517.00	337.00	218.00	117.00	221.00
1986-87	610.00	301.00	704.00	597.00	342.00	162.00	62.00	189.00
1987-88	407.00	333.00	594.00	475.00	548.00	348.00	265.00	390.00
1988-89	846.00	707.00	1142.00	994.00	142.00	101.00	41.00	91.00
1989-90	843.00	532.00	1089.00	896.00	120.00	130.00	43.00	88.00
1990-91	535.00	347.00	869.00	647.00	389.00	299.00	181.00	283.00
1991-92	762.00	409.00	685.00	666.00	359.00	334.00	58.00	224.00

Source : Directorate and Economics and Statistics, Andhra Pradesh - 'Publication'

ANNEXURE - 2.3

NET AREA IRRIGATED UNDER DIFFERENT SOURCE OF IRRIGATION

(Lakh Hectares)

Sl. No.	Sources	1955-56	1960-61	1970-71	1980-81	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
1.	Canals	12.92	13.31	15.79	16.93	17.94	17.84	17.80	15.94	18.69	18.89	18.69
2.	Tanks	10.68	11.51	11.12	9.00	7.74	7.86	7.76	6.63	11.04	10.26	9.68
3.	Wells	2.34	3.28	5.09	7.76	8.36	8.61	8.84	9.92	11.33	12.09	13.03
4.	Others	1.03	0.99	1.13	0.93	1.17	1.06	1.10	1.21	1.50	1.61	1.66
	Total:	26.97	29.09	33.13	34.62	35.21	35.37	35.50	33.70	42.56	42.85	43.06

Source: Survey of Economic Trends and State Plan 1992-93 (Vol. VII) (Page 43)

ANNEXURE - 2.4

INDUSTRIAL PRODUCTION IN ANDHRA PRADESH

(Rs. Crores)

Sl. No.	Industry	Gross Output		Value added in 1987-88	
		Actual	% to Total	Actual	% to Total
1.	Food Products	2236.08	24.5	176.58	14.2
2.	Rubber, Plastic Products etc.	1130.83	12.4	61.99	5.0
3.	Electrical Machinery	985.52	10.8	192.77	15.5
4.	Chemical and Chemical Products	702.60	7.7	105.13	8.4
5.	Basic metal & alloys	568.69	6.2	81.75	6.6
6.	Beverages and Tobacco	559.54	6.1	159.08	12.8
7.	Electricity	726.49	7.9	58.69	4.7
	TOTAL :	6909.75	75.6	835.99	67.2
ALL INDUSTRIES :		9136.54	100.0	1245.03	100.0

Source : Survey of Economic Trends and State Plan 1992-93 (Vol. VII) (Page 43)

ANNEXURE-2.5

PROGRESS OF INSTALLED CAPACITY GENERATION & CONSUMPTION OF ELECTRICITY IN ANDHRA PRADESH

Sl. No.	Particulars	Unit	1960-61	1970-71	1980-81	1984-85	1989-90	1990-91	1991-92 (P)
I.	Installed Capacity								
	(a) Hydro	MW	124	268	1038	1963	2422	2452	2453
	(b) Thermal	"	89	337	1260	1193	143	1679	1712
	(c) Share from central sector	"	-	-	-	162	717	762	807
	Total:	MW	213	605	2298	3318	4542	4893	4972
II.	Generation	MKWH	785	2875	7276	12551	15024	18004	18243
III.	Consumption	MKWH							
	(a) Domestic	"	64	179	546	1026	1839	2078	N.A.
	(b) Commercial	"	31	128	216	314	446	514	N.A.
	(c) Industrial	"	435	1448	2546	4076	4573	5571	N.A.
	(d) Agriculture	"	50	394	941	2393	5276	6343	N.A.
	(e) Others	"	15	37	1048	2294	2366	1587	N.A.
	Total:		595	2186	5297	10103	14500	16093	N.A.
IV.	NUMBER OF CONSUMERS	Lakh Nos.							
	(a) Domestic	"	2.27	7.03	15.41	23.75	44.29	48.94	53.37
	(b) Commercial	"	0.17	2.10	3.15	3.62	4.84	5.11	5.39
	(c) Industrial	"	0.06	0.22	0.55	0.75	1.15	1.18	1.36
	(d) Agriculture	"	0.18	1.86	4.23	5.94	11.09	11.93	12.74
	(e) Others	"	0.03	0.10	0.48	0.68	1.04	1.19	1.23
	Total:		2.71	11.31	23.82	34.74	62.41	68.35	73.99
V.	RURAL ELECTRIFICATION								
A.	(a) TOTAL NO.of villages	"	27221	27221	27221	27221	27379	27379	27379
	(b) No. of villages Electrified	"	2433	8078	18053	22854	27358	27385	27385
	Percentage of villages Electrified		8.9	29.7	66.3	84.0	99.9	99.9	99.9
B.	(a) Total No of Hamlets		32750	32750	32750	32750	32750	32750	32750
	(b) No. of Hamlets Electrified		N.A.	N.A.	7490	9956	15904	16577	17400
	Percentage of Hamlets Electrified		-	-	22.9	30.4	48.6	50.6	53.1
C.	(a) Total No. of Harijanawadas		-	-	31813	31813	33851	33851	37725
	(b) No. of Harijanawadas Electrified		-	-	16035	24180	29899	31198	33505
	Percentage of Harijanawadas Electrified		-	-	50.4	76.0	88.3	92.2	88.8

Source: Survey of Economic Trends and State Plan 1992-93 Volume VII (Page 48-49)

P= Provisional

ANNEXURE 2.6

NATIONAL HIGHWAYS PASSING THROUGH ANDHRA PRADESH

Position as on 20.2.1989

Sl. No.	N.H. No.	Route	Length in km
1.	4	Jn. with NH-3 near Thane-Pune-Bengaum-Hubli-Bangalore-Ranipat-Madras.	84
2.	5	Jn. with NH-6 near Jharpokharia-Cuttack-Bhubaneswar-Vishakha-patnam-Vijayawada-Madras	1014
3.	7	Varanasi-Mangawan-Rewa-Jabalpur-Lakhnadon-Nagpur-Hyderabad-Kurnool-Bangalore-Krishnagiri-Salem-Dindigul-Madurai-Cape Comrin (Kanyakumari)	772
4.	9	Pune-Sholapur-Hyderabad-Vijayawada	392
5.	16	Nizamabad-Jagdalpur	235
6.	43	Raipur-Vizianagaram-Jn. with NH-5 near Natayalasa	90
			2587

ANNEXURE 2.7

EXPENDITURE INCURRED BY ANDHRA GOVERNMENT ON THE DEVELOPMENT OF NATIONAL HIGHWAYS

	ANDHRA PRADESH (Rs. lakhs)
1985-86	1853.40
1986-87	2397.42
1987-88	990.81
1988-89	1282.11
1989-90	2168.82
1990-91	2219.59
1991-92	2472.80
1992-93	3050.97

ANNEXURE 2.8

ANNUAL EXPENDITURE OF ROAD SECTOR
(Rupees Lakhs)

HEAD OF \ YEAR EXPENDITURE \	1990-91	1989-90	1988-89	1987-88	1986-87
Capital					
National Highways*	-	0.97	-	-	-
State Highways	326.52	204.90	178.01	86.67	169.82
Major District Roads	2002.26	1703.88	1826.94	1642.00	1575.00
Other District Roads	14.82	27.49	69.25	22.69	274.51
Sub-total	2343.59	1937.24	2074.20	1751.32	2019.32
Maintenance					
National Highways*	12.86	6.95	6.19	6.19	6.13
State Highways	2285.79	1753.38	1659.20	1816.09	1631.27
Major District Roads	5582.02	4341.13	3875.68	2892.65	3560.16
Other District Roads	71.77	1.02	131.41	-	1.28
Sub-total	7952.44	6102.48	5672.48	4714.92	5199.28
Avenue (Plantation)	4.17	3.31	2.91	6.68	8.31
Tools and Plant	249.47	202.08	235.99	209.71	173.32
Total	10549.68	8246.01	7985.58	6682.63	7400.15

Source : State Administrative Reports, T.R&B Department, Govt. of A.P., Hderabad.

* Within town limits only

ANNEXURE - 2.9

NORMS AND REGULATION OF EXPENDITURE ON MAINTENANCE OF VARIOUS TYPES OF (R&B) ROADS IN ANDHRA PRADESH RUPEES PER KM. PER YEAR BASED ON THE S S R 1991-1992

(in Rupees)

	State Highways B.T. Surface Roads as per guidelines of Technical Groups Report					
	Single lane Roads			Double lane Roads		
	Zone-I Rayal-aseema	Zone-II Telangana	Zone-III Coastal Andhra	Zone-I Rayal-aseema	Zone-II Telangana	Zone-III Coastal Andhra
Less than 450 CVPD	39,860	39,830	40,310	50,910	50,680	51,410
450 to 1500 CVPD	50,700	50,460	51,180	64,560	64,530	65,300
More than 1500 CVPD	67,000	68,780	70,070	90,930	93,400	95,340

	Major District Roads and other District roads of Andhra Pradesh based on Malhotra Committee Report and SSR 1992-93					
	Single lane Roads			Double lane Roads		
	Eastern	W.B.M.	B.T. Surface	Eastern	W.B.M.	B.T. Surface
			Plain Area			
Less than 450 CVPD,	33,870	39,850	35,420	-	49,810	44,280
More than 450 CVPD	-	45,820	40,730	-	57,280	50,910
			Hilly Area			
Less than 450 CVPD	33,580	43,630	49,140	-	54,550	61,420
More than 450 CVPD	-	50,180	56,510	-	67,730	70,650

ANNEXURE-2.10

STATEMENT SHOWING NUMBER OF ROAD ACCIDENTS OF A.P. STATE AND PARTICULARLY KRISHNA & WEST GODAVARI DISTRICTS FROM 1986 TO 1991.

	ANDHRA PRADESH STATE				KRISHNA DISTRICT				WEST GODAVARI DISTRICT			
Year (1)	Total No. of accidents (2)	No. of vehicles involved (3)	Persons killed (4)	Persons injured (5)	Total No. of accidents (6)	No. of vehicles involved (7)	Persons killed (8)	Persons injured (9)	Total No. of accidents (10)	No. of vehicles involved (11)	Persons killed (12)	Persons injured (13)
1986	11635	11635	3704	10576	408	408	152	391	502	502	184	427
1987	13996	13996	3835	11607	401	401	180	301	568	568	193	560
1988	13712	13712	4091	12829	420	420	191	271	555	555	173	466
1989	14646	14646	4756	14725	453	453	155	407	540	540	245	521
1990	16042	16042	5211	17356	400	400	146	308	556	556	248	594
1991	16633	17633	5598	17545	432	432	162	341	575	575	272	533

Source: Building & Roads Department, Andhra Pradesh

ANNEXURE - 2.11

VEHICLE POPULATION IN ANDHRA PRADESH
(ON ROADS)

Category of Vehicles			As on 31.3.87	As on 31.3.88	As on 31.3.89	As on 31.3.90	As on 31.3.91	As on 31.3.92
A.	TRANSPORT							
1)	Stage Carriages							
	a)	APSRTC	9,682	11,447	12,447	13,487	14,119	14,997
	b)	Private	2,558	1,963	1,740	1,610	1,981	1,857
2)	Goods Vehicles							
	a)	Articulated Vehicles	103	37	-	37	-	1,030
	b)	Other goods vehicles	55,812	55,317	58,504	65,763	74,065	80,425
3.	Contract Carriages							
	a)	All India Tourist Buses	48	47	25	25	51	58
	b)	Contract carriages (more than 13 seaters only)	1,343	1,522	2,016	2,261	1,927	2,337
	c)	Taxi Cabs	253	184	37	-	63	109
	d)	All India Tourist Taxi Cabs	-	-	-	-	-	-
	e)	Other Taxi Cabs (7,6,5,4, seaters)	4,693	5,070	6,777	7,753	9,933	11,482
	f)	Auto-rick-shaws	21,019	21,865	24,635	28,123	32,262	33,560
	g)	Private Service vehicles	-	-	-	-	-	1,285
	h)	School buses	-	-	-	-	-	979

Category of Vehicles			As on 31.3.87	As on 31.3.88	As on 31.3.89	As on 31.3.90	As on 31.3.91	As on 31.3.92
4.	Trailers							
	a)	Jeeps	783	526	-	530	517	-
	b)	Goods	39	34	-	35	-	-
5.	Tractor-Trailers		26,995	30,822	30,822	36,118	40,234	41,261
B.	NON-TRANSPORT							
6.	Motor Cars		49,975	57,377	63,543	65,787	75,142	79,972
7.	Jeeps		12,138	13,673	-	23,742	26,653	27,009
8.	2-Wheelers							
	i)	Upto 60 cc	3,97,448	4,69,800	8,49,132	10,03,985	11,87,530	6,51,320
	ii)	Beyond 60 cc	2,25,962	2,63,751				5,66,002
			6,23,410	7,33,551	8,49,132	10,03,985	11,87,530	12,17,322
9.	a)	Tractors	10,019	10,054	7,980	8,001	4,934	4,092
	b)	Omni buses	2,101	2,084	2,802	2,850	1,927	694
	c)	Cranes	25	211	237	240	413	145
	d)	Rigs	-	-	-	-	-	58
	e)	Road Rollers	594	391	418	421	366	333
	f)	Fire Engines & Tankers	335	406	-	525	246	215
	g)	Invalid Carriers	15	122	128	130	-	-
	h)	Motorised Cycle rick-shaws	7	29	2	-	2	-
10.	Others		-	-	500	500	1,543	7
	Total		6,62,644	9,46,956	10,80,031	12,61,923	14,72,908	15,19,703

Source : Annual administration Report of the Transport Department, Andhra Pradesh for 1991-92

ANNEXURE - 2.12

RECEIPTS FROM ROAD TAXES (1991-92)
(Rs. in Crores)

Sl. No.	Name of the District	u/s 86	u/s 200	Other fees	Total fees	Regular tax	Regular life tax	Arreas of life tax	Total Tax	Grand Total
1	Srikakulam	370110	3901660	1344318	5616088	34880307	1082295	99112	36061714	41677802
2	Vizianagaram	351295	1071016	1159840	2582151	30825157	986219	95637	31907013	34489164
3	Visakhapatnam	1646000	3440000	6426000	11512000	69537000	8619000	1013000	79169000	90681000
4	E. Godavari	1386611	2976932	6514659	10878202	79650889	6879201	914270	87444360	98352562
5	W. Godavari	1413340	2324194	5552237	9289771	61728499	5955213	734123	68417835	77707606
6	Vijayawada	5369478	4558703	15616777	25544958	193689475	6968182	1525094	202182751	227727709
7	Guntur	1115435	1222270	6650652	8988357	103680225	4802455	344395	108827075	117815432
8	Ongole	792105	1211738	2761415	4765258	45181912	1650894	91934	46924740	51689998
9	Nellore	1124094	4802829	4354297	10281220	50592085	2404022	255246	53251353	63532573
10	Chittoor	1130906	5724366	5091697	11946969	112443274	3193593	180561	115817428	127764397
11	Anantapur	1935717	3874205	3426331	9236253	74563448	3361954	622878	78548280	87784533
12	Cuddapah	669196	1222925	2424471	4316592	51489458	1841801	16730	53346989	57663581
13	Kurnool	1130625	2266690	3649235	7046550	63341025	2689858	507064	66537947	73584497
14	Mahaboonagar	437276	1026893	1958811	3422980	35495933	2231228	70253	37797414	41220394
15	Nalgonda	356124	1652221	2570213	4578558	38000362	2508314	192507	40701183	45279741
16	Khammam	346431	2378270	2553521	5278222	35804219	2616956	321804	38742979	44021201
17	Warangal	583155	807400	3095672	4486227	42865334	4093125	408643	47367106	51853333
18	Karimnagar	593660	1444051	3795740	5833451	48621790	5672432	415014	54709236	60542687
19	Nizamabad	479290	3922455	3776657	8178402	42004634	4374001	432506	46811141	54989543
20	Adilabad	706932	6666262	1889468	9262662	33876791	2022758	178177	36077729	45340391
21	Medak	388329	4261543	1348261	5998133	31552928	1652835	85265	33291028	39289161
22	R.R. District	705812	2384076	2904140	5994028	58345053	4705157	562790	63613000	69607028
23	S/RTA, Hyd.bad	6017136	13157946	25924636	45099718	206565805	40035701	5485971	252087477	297187195
24	S.T.A.	-	-	2210295	2210295	140667091	-	-	140667091	142877386
	Total	29049057	76298645	116999543	222347245	1685402694	120347194	14552944	1820301869	2042678914

Source : Annual Administration Report of the Transport Department, Andhra Pradesh for 1991-92

ANNEXURE - 2.13

PHYSICAL PERFORMANCE OF ANDHRA PRADESH STATE ROAD TRANSPORT COPRORATION

S.NO.	ITEMS	UNIT	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92 Upto June 91
1	Effective Fleet	Nos.	8114	9137	10571	11710	12647	13669	14368
2	Fleet Utilisation *	%	93.41	95.35	95.95	95.50	96.55	90.62	92.55
3	Volume of Operation	Kms./Crs.	84.20	96.05	113.34	124.50	136.79	135.99	36.81
4	Vehicle Utilisation	Kms./Day	284.00	288.00	293.00	291.00	296.00	27.30	282.00
5	Passengers	Nos./Lakhs/Day	48.46	55.40	64.19	72.50	83.25	93.20	95.05
6	Occupancy Ratio	%	76.00	76.00	73.00	74.00	76.00	73.00	75.00
7	Accident Rate	Nos./Lakh kms.	0.20	0.19	0.18	0.22	0.15	0.16	0.19
8	Break-down Rate	Nos./0.1 lakh kms.	0.62	0.47	0.43	0.43	0.33	0.39	0.40
9	Cancellations	%	5.60	6.08	4.48	5.12	4.34	7.47	8.91
10	Non-Revenue Kms.	%	1.85	1.72	1.61	1.48	1.39	**1.50	**1.42
11	H.S.D. Oil	Kms./Ltr.	4.75	4.85	4.92	4.93	4.94	4.90	4.97
12	Lub Oil	Kms./Ltr.	1106	1383	1340	1494	1342	1107	926
13	Average Type Life	Kms./type	85433	93543	104075	102879	107423	108709	110703
14	Employees	Nos.	71830	79755	90792	96986	104986	112052	114806
15	Bus Staff Ratio*	Nos./Bus Held	8.32	8.30	***7.97	7.99	8.08	7.96	7.93
16	Employees Productivity	Kms./Day	32.00	33.00	34.00	35.00	36.00	33.00	35.00
17	Gross Earnings	Rs./Crs.	359.71	413.02	526.67	577.42	676.43	785.64	230.84
18	Total Expenditure	Rs./Crs.	348.41	405.94	503.28	575.27	697.06	797.56	225.33
19	Annual Profit/Loss	Rs./Crs.	11.30	7.08	23.39	2.15	-20.63	-11.92	5.51

* Excluding Hired Buses

** Methodology Changed

*** Many posts remained unfilled at the time of Nationalisation

Source : Note on Andhra Pradesh State Road Transport Corporation, Govt. of Andhra Pradesh 1991-92

ANNEXURE - 2.14

FINANCIAL PERFORMANCE OF ANDHRA PRADESH STATE ROAD TRANSPORT CORPORATION SINCE 1985-86

RUPEES IN CRORES

S.NO.	YEAR	GROSS EARNINGS	EXPENDITURE BEFORE INTEREST TO CENTRAL, STATE GOVTS. & DEPRECIATION	PROFIT/LOSS BEFORE PAYMENT OF INT. TO CENTRAL/STATE GOVTS. & DEPRECIATION	INTEREST TO CENTRAL/STATE GOVTS.	PROFIT BEFORE DEPRECIATION AFTER PAYMENT OF INT. TO STATE GOVT.	DEPRECIATION	NET LOSS (-) PROFIT (+)
1	1985-86	359.71	303.24	56.47	8.79	47.68	36.37	(+)11.30
2	1986-87	413.02	351.15	61.87	10.06	51.81	44.74	(+) 7.08
3	1987-88	526.67	426.27	100.41	10.82	89.59	66.20	(+)23.39
4	1988-89	577.42	489.56	87.86	10.88	76.98	74.82	(+) 2.15
5	1989-90	676.43	594.63	81.8	13.83	67.97	88.59	(-)20.63
6	1990-91	785.64	692.47	93.17	11.91	81.26	93.18	(-)11.92
7	1991-92 (UPTO JUNE, 91)	230.84	193.64	37.21	2.65	34.55	29.04	(+) 5.51

Source : Note on Andhra Pradesh State Road Transport Corporation, Govt. of Andhra Pradesh 1991-92

Annexure 2.15

NET STATE DOMESTIC PRODUCT OF ANDHRA PRADESH BY INDUSTRY OF ORIGIN AT CURRENT PRICES

(Rs. Crores)

S.No.	Industry	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90 (P)	1990-91 (Q)
1.	Agriculture Forestry & Fishing											
1.1	Agriculture	3157.05	3948.44	3939.82	4905.76	4647.18	4718.43	4663.48	6050.16	8066.23	8898.02	10638.88
1.2	Forestry & Logging	93.43	93.24	99.22	111.46	103.03	139.40	127.22	95.78	230.97	280.25	341.08
1.3	Fishing	88.36	89.24	107.14	124.67	206.98	223.01	248.29	267.71	266.88	311.27	416.49
2.	Mining & Quarrying	75.26	106.25	121.18	138.32	159.89	233.18	264.84	145.68	254.68	221.38	242.00
Sub-total (1-2) Primary		3414.10	4237.17	4267.36	5280.21	5117.08	5314.02	5303.83	6559.51	8818.76	9710.92	11638.45
3.	Manufacturing											
3.1	Registered	428.61	536.94	730.67	799.88	845.32	1052.56	1072.79	1446.38	1660.2	1772.74	1983.24
3.2	Un-registered	393.11	440.61	448.54	486.91	517.07	601.64	627.34	680.16	839.54	992.11	1072.8
4.	Electricity, Gas & Water supply	3.21	15.02	4.6	28.77	56.13	54.12	57.95	91.55	69.03	74.18	78.91
5.	Construction	391.68	462.19	613.55	631.96	753.05	907.10	1051.10	1241.85	1453.03	1597.78	1786.34
Sub-total (3-5) Secondary sector		1216.61	1454.76	1797.36	1947.52	2171.57	2615.42	2809.18	3459.94	4021.8	4436.81	4921.29
6.	Trade Hotels and Restaurants	1086.57	1337.68	1397.11	1741.88	1742.97	2187.92	2327.43	2697.08	3346.00	3670.00	4360.00
7.	Transport Sector and Communications											
7.1	Railways	41.66	74.80	111.90	105.57	119.19	169.80	165.78	191.74	211.35	257.08	312.70
7.2	Transport by other means and storage	236.67	269.59	315.74	415.38	494.54	568.33	609.27	856.62	1019.00	1133.26	1252.97
7.3	Communications	38.97	45.52	56.52	65.83	72.37	71.26	80.43	164.77	213.72	244.55	279.82
8.	Financing, Insurance, Real Estate and Business Services											
8.1	Banking and Insurance	172.11	234.70	301.24	318.57	379.19	438.78	541.42	590.44	915.93	1060.13	1227.03
8.2	Ownership of dwellings, Real estates and Business services	328.18	376.83	407.18	437.19	484.21	457.48	569.96	650.59	874.75	988.17	1109.98
9.	Community, Social and Personnel Services											
9.1	Public Administration	283.29	336.10	379.44	446.04	514.33	559.44	600.04	737.62	915.89	1156.01	1441.59
9.2	Other Services	505.79	607.11	667.89	757.92	866.41	1029.08	1234.51	1483.37	1679.28	2019.20	2200.27
Sub-total (6-9) Tertiary Sector		2693.24	3282.33	3637.02	4288.38	4673.21	5482.09	6128.84	7381.23	9175.92	10528.40	12815.18
Total State Domestic Product		7323.95	8974.26	9701.74	11516.11	11961.86	14241.85	13411.53	17400.68	22016.48	24676.13	28744.92
Per captia Income (Rs.)		1380.00	1657.00	1756.00	2046.00	2086.00	2296.00	2394.00	2373.00	3572.00	3934.00	4507.00

P : Provisional, Q : Quick Estimate

Source : Survey of Economic Trends and State Plan 1992-93 (P-26)

ANNEXURE -2.16

NET STATE DOMESTIC PRODUCT OF ANDHRA PRADESH BY INDUSTRY OF ORIGIN AT CONSTANT (1980-81) PRICES

(Rs. Crores)

S.No.	Industry	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90 (P)	1990-91 (Q)
1.	Agriculture Forestry & Fishing											
1.1	Agriculture	3157.05	3872.29	3833.44	4017.82	3645.55	3656.97	3240.70	3692.88	4460.49	4465.14	4422.71
1.2	Forestry & Logging	93.43	75.56	61.89	71.80	58.10	45.63	45.54	28.16	90.93	98.48	106.65
1.3	Fishing	88.36	87.49	78.33	88.33	82.25	80.09	85.77	84.33	75.93	85.80	87.67
2.	Mining & Quarrying	75.26	82.93	84.78	85.95	86.25	95.62	100.58	77.03	102.56	93.60	95.95
Sub-total (1-2) Primary		3414.10	4118.27	4058.44	4264.92	3872.16	3878.31	3472.59	3882.40	4729.91	4743.02	4712.98
3.	Manufacturing											
3.1	Registered	428.61	507.43	544.78	543.36	598.47	676.87	680.25	701.55	788.64	800.20	869.88
3.2	Un-registered	393.11	400.97	408.99	417.17	425.50	434.03	442.72	451.57	460.61	469.80	479.20
4.	Electricity, Gas & Water supply	3.21	13.10	3.82	21.62	38.52	35.55	34.93	50.00	34.34	35.01	33.97
5.	Construction	391.68	426.66	463.51	436.84	456.17	438.28	414.80	535.28	576.59	585.27	654.34
Sub-total (3-5) Secondary sector		1216.61	1348.16	1421.10	1418.99	1518.66	1584.73	1572.70	1738.40	1860.18	1890.28	2037.39
6.	Trade Hotels and Restaurants	1086.57	1289.43	1285.63	1341.15	1256.62	1550.54	1522.83	1621.16	1850.43	1908.16	1938.32
7.	Transport Sector and Communications											
7.1	Railways	41.66	50.21	48.69	45.69	50.61	53.35	51.44	53.97	58.02	61.35	64.87
7.2	Transport by other means and storage	236.67	248.29	260.46	273.24	286.65	300.71	315.46	330.94	465.82	510.98	564.97
7.3	Communications	38.97	42.88	47.68	51.56	55.32	57.45	60.10	63.38	65.52	68.40	71.40
8.	Financing, Insurance, Real Estate and Business Services											
8.1	Banking and Insurance	172.11	190.60	222.90	246.53	277.55	300.08	349.85	360.13	567.21	611.88	660.06
8.2	Ownership of dwellings, Real estates and Business services	328.18	342.29	357.06	372.81	389.22	406.29	424.34	466.34	491.44	517.89	537.32
9.	Community, Social and Personnel Services											
9.1	Public Administration	283.29	295.34	307.24	335.86	357.42	361.00	359.52	401.10	455.64	545.62	620.68
9.2	Other Services	505.79	514.89	524.50	534.11	564.47	574.57	564.47	574.57	585.30	596.06	607.03
Sub-total (6-9) Tertiary Sector		2693.24	2973.91	3054.16	3200.96	3237.86	3603.99	3648.01	3871.59	4539.38	4820.34	5064.65
Total State Domestic Product		7323.95	8440.36	8533.70	8884.87	8628.68	9067.03	8693.30	9492.39	11129.47	11453.64	11815.02
Per captia Income (Rs.)		1380.00	1558.00	1545.00	1578.00	1505.00	1552.00	1461.00	1567.00	1806.00	1826.00	1855.00

P : Provisional, Q : Quick Estimate

Source : Survey of Economic Trends and State Plan 1992-93 (P-25)

CHAPTER 3

SOCIO-ECONOMIC PROFILE OF THE PROJECT INFLUENCE AREA

3.1 The project which comprises improvement works on specified length of NH-5 and NH-9 falls in the districts of Krishna and West Godavari in Andhra Pradesh. NH-5 originates from Madras in Tamil Nadu State and passes through Andhra Pradesh and Orissa and terminates at junction with NH-6 in Bihar. The highway connects the Visakhapatnam and Kakinada ports to the interior of Andhra Pradesh facilitating the movement of export and import cargo. NH-9 originates from Pune in Maharashtra, passes through Andhra Pradesh and terminates at Vijayawada. Both the roads pass through Vijayawada which is an important town in Andhra Pradesh. Socio-economic profile of the two districts of Krishna and West Godavari which constitute the project influence area is briefly set out in the following paragraphs.

3.2 KRISHNA DISTRICT

Krishna district with its headquarters at Machilipatnam is a coastal district. It was originally called Machilipatnam district and was later renamed as Krishna district after river Krishna in the State. In 1925, Krishna district was divided into Krishna and West Godavari districts. The Krishna district has a coastline of 88 km. It is surrounded on the east by West Godavari district and the Bay of Bengal, in the south by the Bay of Bengal, on the west by Guntur and Nalgonda districts and in the north by the Khammum district. The district is divided into 49 Mandals covered by four revenue divisions viz. Bandar, Vijayawada, Gudivada and Nuzvid. The district consists of delta and upland zones. The upland is undulating broken by low ranges of Eastern Ghats. The main sources of irrigation in the upland are tanks. The Nagarjunasagar dam also benefits the area. The delta land is being irrigated by the canals of river Krishna. Some of the important places of commercial and tourist importance in the district are Vijayawada (the second largest city in the State), Machilipatnam (the district headquarters), Vuyyuru, Challapalli, Manginapudi, Chilakalapudi, Kuchipudi.

3.3 WEST GODAVARI DISTRICT

West Godavari district is situated to the west of river Godavari which runs through the district and falls into the Bay of Bengal. The district is bounded on the north and west by Khammam district, on the east by the river Godavari and on the south by Krishna district.

The district can be divided into three natural regions, viz. delta, upland and Agency areas. There are three revenue divisions, viz. Eluru, Kovvur and Narasapuram. The district has been further divided into 46 Revenue Mandals.

3.4 AREA AND POPULATION

The Krishna district has an area of 8,727 sq. km. which constitutes 3.2 per cent of the area of the state. The West Godavari district has an area of 7,780 sq. km. constituting 2.8 per cent of the area of the State. The population in the two districts vis-a-vis the State is given in Table 1.

Table 1
Population in Krishna and West Godavari Districts

District	Population (millions)			Per cent rate of growth	
	1971	1981	1991	1971-81	1981-91
Krishna	2.49	3.05	3.69	22.50	20.98
West Godavari	2.37	2.87	3.51	21.09	22.29
Andhra Pradesh State	43.50	53.60	66.30	23.10	23.82

In Krishna district,the urban population is 1.32 million and the rural population 2.37 million. The corresponding figures of urban and rural population in West Godavari are 0.73 million and 2.78 million respectively.

The density of population in the two districts was as follows:

	(population per sq.km. of area) 1981	1991
Krishna	349	422
West Godavari	371	452
Andhra Pradesh State (Total)	195	241

3.5 CLIMATE

The Krishna District has tropical climate with extremely hot summers and cold winters. April to June are the hottest months. The monsoon usually breaks in the middle of June and brings good rains upto the middle of October. The normal rainfall in the district is 1,028 mm, two third of which is received through the South-west monsoon. The average rainfall recorded during the year 1988-89 is 1200 mm.

There are three types of soil viz. (i) Black cotton which covers 57.6% of the villages (ii) Sandy-clay loams covering 22.3%, and (iii) Red loamy soil covering 19.4% of the villages. A small belt of sandy soil forms 0.7% on the sea-coast.

The climate of West Godavari district is similar to that of Krishna district. The temperature goes upto 38 deg.C in

May-June and drops to about 20 deg.C in December-January. The south-west monsoon season for the rains is from June to September, when the district gets most of its rains. The north-east winter rains are much less and come between November and January. The total rainfall in 1989-90, when it was the heaviest compared to the previous 5 years, was 1,943 mm of which 1,228 mm was during June-September. However, during the preceding 5 years and in 1990-91, the rainfall was less than 1,200 mm.

3.6 AGRICULTURE

Krishna district

The district has fertile soil. Agriculture is the principal activity. The position regarding land utilisation in the district is shown in Table 2.

Table 2

Land Utilisation - Krishna District (1988-89)

(Lakh acres.)

1.	Net area sown	4.90
2.	Forest area	0.66
3.	Barren/Uncultivable land	0.67
4.	Non-agricultural uses	1.05
5.	Net area irrigated	3.60
6.	Gross cropped area	7.36

The area under principal crops in 1988-89 is indicated in Table 3.

Table 3

Area under Different Crops in Krishna District in 1988-89

	Crops	Area (lakh hectares)
1.	Paddy	3.75
2.	Black gram	1.14
3.	Green gram	1.10
4.	Groundnut	0.31
5	Sugarcane	0.14
6.	Chillies	0.10
7.	Tobbaco	0.04

Krishna delta system and Nagarjunasagar projects are the main sources of irrigation followed by tank irrigation and tube wells. The production of important crops in the Krishna district during recent years is given in Table 4.

Table 4

Production of Principal Crops in Krishna District
(Average of preceding 5 years' production)
(Tonnes)

	1986-87	1987-88	1988-89
1. Rice	13,89,742	12,74,408	18,20,197
2. Black gram	1,24,513	1,18,819	1,14,916
3. Green gram	10,875	11,715	10,357
4. Groundnut	26,992	31,843	33,974
5. Sugarcane	8,60,957	10,95,307	10,47,676
6. Chillies	20,400	21,728	44,171
7. Tobacco	10,877	6,967	10,794

Source : Handbook of Statistics - Krishna District

West Godavari district

The position regarding land utilisation in the district in recent years is shown in Table 5.

Table 5

Land Utilisation - West Godavari

('000 hectares)

		1988-89	1990-91
1. Forest area	...	81,181	81,126
2. Barren land	...	48,039	46,323
3. Land put to agricultural use		91,621	92,596
4. Cultural waste	...	41,834	38,801
5. Permanent pastures	...	23,926	23,325
6. Land under misc. crops	...	8,131	8,071
7. Fallow land	...	41,711	32,328
8. Net area sown	...	4,42,405	4,52,428

Source : Handbook of Statistics - Godavari District

The forest area in the discrict covers 10.4% of the total area. The species grown are bamboos and other wood useful for timber, fuel and other minor forest produce like adda leaves, beedi leaves, soapnuts, tamarind and fruits. The main sources of irrigation are tube wells, bore wells, tanks etc.

Area under principal crops during recent years is given in Table 6.

Table 6

Area under Principal Crops (hectares)

	1988-89	1989-90	1990-91
1. Paddy	4,48,440	4,91,703	4,37,048
2. Sugarcane	24,213	22,939	24,689
3. Tobacco	27,490	26,636	27,096
4. Oilseeds	21,768	20,888	22,167
5. Pulses	23,990	19,872	22,978
6. Chillies	6,781	7,730	6,829
7. Groundnut	8,997	8,825	9,389
8. Fruits & vegetables	68,280	67,766	61,778

Source : Handbook of Statistics - West Godavari District.

The production of principal crops in the district is shown in Table 7.

Table 7

Production of Principal Crops in West Godavari District

('000 tonnes)

	1988-89	1989-90	1990-91
1. Rice	14,88	10,28	10,07
2. Jowar	2	2	1
3. Maize	10	12	5
4. Sugarcane			
i) Cane	17,64	11,48	17,33
ii) Gur	195	176	181
5. Chillies	9	9	7
6. Groundnut	12	11	11
7. Tobacco			
i) Varginia	17	16	15
ii) Nata	30	30	224

Source: Handbook of Statistics - West Godavari district 1990-91.

3.7 INDUSTRY AND MINING

3.7.1 There are about 1,200 medium and large scale industries in the two districts with a capital investment of nearly Rs.6,000 crores, providing employment to more than 70 lakh persons.

The industries are based on agricultural produce, mineral products, forest produce etc. The main industries are sugar mills, chemical factories, steel mills, granite quarries, food processing units, rice mills, brick kilns etc. The

first stage of the Visakhapatnam steel plant which was inaugurated in May 1990 has started functioning.

The number of industries in the two districts are given in Table 8.

Table 8

Number of Industries in Krishna and West Godavari Districts

	Major industries	Medium industries	Minor industries	Total
Krishna district	10	1133	1243	2386
West Godavari district	27	-	4882	4909

Krishna district

The total number of rice mills in Krishna district in 1988 was 1103 with a capacity of 8.12 lakh tonnes.

The number of factories producing major items in the district in 1988 together with the number of workers at each place is given in Table 9.

Table 9

Factories in Krishna District

	No.of factories	No. of workers
1. Food products	1169	12,725
2. Wood and wood products	201	756
3. Cotton textiles	29	957
4. Transport equipment	44	472
5. Chemicals and chemical products	48	1,558
6. Non-metallic mineral products	96	2,495

West Godavari district

The main industrial units in West Godavari district are rice bran, oil, soya oil, refined oils, deoiled cakes, fatty acids and glycerine, sugar, straw board, edible oils etc. These units are located mainly at Tanuku, Prathipadu, Tadepalligudem, Poolapalli, Ganapavaram and Bhimadole.

Edible oil is an important commodity produced from forest fruits of oil palm. The oil palm processing unit is at Pedavegi. Andhra Pradesh Co-operative Oil Seeds Growers' Federation Ltd. had established one tonne crushing capacity at Padavegi for the benefit of oil palm growers of West Godavari and Krishna districts. The factory was commissioned in August, 1992.

3.7.2 Oil and Natural Gas Commission

The activity of the Oil and Natural Gas Commission (ONGC) for exloration of gas and oil is in full swing in the Krishna and Godavari districts. The oil and gas exploration from the various bore wells is being transported to Visakhapatnam oil refineries. The regional office of the ONGC is located at Rajahmundry in the East Godavari district.

3.7.3 MINERALS

The Krishna district has several important minerals like limestone, clay, rough stone, colour granite, lime kanker etc. Annexure 3.1 shows the production of main minerals in Krishna district in 1988-89.

The West Godavari district possesses several minerals like ball clay, fire clay, limestone, dolomite, quartz and mica etc.

The thermal power station at Vijayawada has an installed capacity of 2 x 210 MW. Nearly all the inhabited villages in the Krishna district have been electrified.

Of the total number of 484 towns and villages in the West Godavari district, 469 have been electrified.

3.8 TRANSPORT

Krishna district

The district is well served by roads and railways. The length of roads in the district at the end of 1988-89 was 5,774 km as per details given in Table 10.

Table 10

Length of roads as on 31st March, 1989

	Pavement Type				
	CC	BT	WBM	VM	Total
A. PWD Roads					
(a) State Highways	2	303	-	-	305
(b) Major District Roads	9	1265	327	199	1800
Sub-Total:	11	1568	327	199	2105
B. Zilla Parishad Roads					
(a) Major District Roads	-	57	358	47	462
(b) Other District Roads	-	17	333	131	481
(c) Village roads	-	17	578	652	1247
Sub-Total:	-	91	1269	830	2190
C. Mandal Praja Parishad Roads	-	3	267	1209	1479
Grand Total:	11	1662	1863	2238	5774

In addition to the above, there were 127 km of National Highways in the district as on the 31st March, 1989.

The motor vehicle position in the Krishna district for the recent years is shown in Annexure 3.2. As at the end of 1989-90, there were 1,172 state carriages, 12,581 goods vehicles and 8,414 cars and jeeps on road.

The working of Andhra Pradesh State Road Transport Corporation (APSRTC) in Kishna district during 1988-89 is shown in Annexure-3.3. The average number of buses in use in the district was 759 and the total number of km operated was 8,20,000. The number of passengers carried was 1,458 lakhs. 923 villages are connected by the RTC and 49 villages by private bus routes.

The total length of railway route in the district was 187 km as on 31st March, 1989 (all broad guage), which included 58 km of double line and 129 km of single line. About 16 km have been electrified. The number of railway stations is 37.

Vijayawada city situated at the head of Krishna delta is the chief commercial centre of the district and is an important railway junction. The district has an aerodrome at Gannavaram, about 16 km away, and a minor sea port at Machilipatnam.

West Godavari district

During 1990-91, the important works shown in Table 11 were completed in the district:

Table 11

Road Works completed is West Godavari District

Road	Expenditure
Improvement to the road from Mogalturu to Kalipatnam including construction of two bridges across Upputeru vaju on Mogalturu-Bhimavaram road, Wakalipatnam	Rs.119 lakhs

Source: State Roads & Buildings Department Administrative Report, Andhra Pradesh.

The number of motor vehicles in the district as on 31.3.91 is shown in Annexure 3.4. The district had at the end of 1990-91, 591 buses, 2806 goods vehicles and 1823 cars and jeeps.

ANNEXUE 3.1

PRODUCTION OF PRINCIPAL MINERALS IN KRISHNA DISTRICT DURING 1988-89

S.NO.	NAME OF THE MINERAL	PRODUCTION DURING 1988-89
1.	MAJOR MINERALS	
	Limestone	8,67,350 mt.
	Clay	5,000 mt.
	Iron Ore	3,035 mt.
	Quartz	300 mt.
2.	MINOR MINERALS	
	Rough stone	80,343 Cum.
	Sand	87,990 Cum.
	Gravel	230 Cum.
	Bricks	3,50,000 Cum.
	Colour Granite	50 Cum.
	Lime kanker	2,039 Cum.

Source : Hand book of statistics, Krishna District Andhra Pradesh (1988-89)

ANNEXURE 3.2

MOTOR VEHICLES POSITION IN KRISHNA DISTRICT

S.NO.	FLOOR	1987-88		1988-89		1989-90	
		Roll	Road	Roll	Road	Roll	Road
1.	STAGE CARRIAGES :						
	a) APSRTC	755	755	864	864	1058	1058
	b) Private	278	273	235	209	122	114
2.	GOODS VEHICLES	10756	10102	11717	10960	13263	12581
3.	CARS AND JEEPS						
	a) Cars	5328	4436	5319	5319	5594	5594
	b) Jeeps	671	595	2157	2157	2820	2820
4.	MOTOR CYCLES	4493	4475]				
			]	33081	33081	34777	34777
	Scooters	11218	9529]				
	Mopeds	18691	16124	31945	31945	32654	32654
5.	Taxies	791	734	1145	1145	1548	1392
6.	Tractors	552	532	657	657	722	722
7.	OTHERS						
	a) Tractors & Trailors	3227	2581	2803	2518	3062	2831
	b) Tractors & Trailors exempted	262	254	3439	3439	2535	2535
	c) Auto-rikshaws	543	510	907	611	898	644
	d) Omni Buses	53	53	196	196	198	198

Source : Deputy Transport Commissioner, Vijayawada Hand Book of Statistics, Krishna District Andhra Pradesh

ANNEXURE 3.3

WORKING OF APSRTC IN KRISHNA DISTRICT
DURING THE YEAR 1988-89

S.NO.	ITEM	KRISHNA DIVISION	DURING 1988-89 MACHILIPATNAM DIVISION	KRISHNA DISTRICT
1.	Average No. of Buses in Use :			
	i) R.T.C.	436	254	690
	ii) Hired	52	17	69
	iii) Total	488	271	759
2.	Average No. of Kilometres per Day (in lakhs)	1.46	0.79	2.25
3.	Total No. of Kilometres Operated (in lakhs)	531.93	288.18	820.11
4.	No. of Passengers Carried (in lakhs)	1000.80	456.80	1457.60
Earnings Realised :				
	Passenger Earnings (As per Coaching Earnings) (Rs. in lakhs.)	2325.93	1338.55	3664.48
	Luggage Earnings (Rs. in lakhs)	6.38	4.78	11.16

Source : Hand book of statistics, Krishna District 1988-89, Andhra Pradesh

ANNEXURE 3.4

STATEMENT SHOWING THE VEHICULAR STRENGTH IN WEST GODAVARI DISTRICT AS ON 31-3-1991

SL. NO.	CLASS OF VEHICLES	ON ROLL	ON ROAD
1.	Buses (including APSRTC Vehicles)	593	591
2.	Goods Carriages (Public Carriers)	2856	2806
3.	Private Carriers	18	18
4.	Tractors and Trailors	4986	4926
5.	Contract Carriages	33	22
6.	Taxi Cabs (including 7 seaters & 6 seaters)	1151	1104
7.	Private Service Vehicles	34	34
8.	School Buses	25	21
9.	Tractors	999	785
10.	Omini Buses	--	--
11.	Rigs	--	--
12.	Road Rollers	8	6
13.	Fire Engines	23	23
14.	Others	19	14
15.	Cars	1377	1377
16.	Jeeps	446	446
17.	(a) Motor Cycles (below 60 c.c.)	36278	36278
	(b) Motor Cycles (above 60 c.c.)	27781	27781

Source : Deputy Transport Commissioner, West Godavari, Eluru.
Hand book of statistics, West Godavari District
Andhra Pradesh 1990-91.

CHAPTER 4
METHODOLOGY

4.1 INTRODUCTION

The project involves strengthening of the existing 2 lane carriageway of NH-9 from Nandigama to Vijaywada (km 217 to 265)and NH-5 from Vijaywada to Eluru (km 3.40 to 75) including widening to 4-lanes of km 252 to 265 on NH-9 and Kms 3.40 to 13 on NH-5 and construction of a bypass at Eluru on NH-5 in Andhra Pradesh. The methodology followed for preparation of the feasibility report was so selected as to reflect the deficiencies in the existing road and bring it up to cater to the future design year traffic. The procedure followed for survey, investigations and design is based on MOST guidelines and IRC Standards, Specifications and Codes of Practice being followed in the country. Wherever these were deficient, reference has been made to selected international practices.

4.2 RECONNAISSANCE

The study began with a quick reconnaissance of the entire alignment so as to bring out the scope of the work to be carried out in detail and to define the various components of the study.The available maps and data were compiled from secondary sources and utilised for assessing the extent and nature of improvements proposed to be carried out under the project. Aspects such as availability of material, land and labour were assessed.

4.3 PRELIMINARY TOPOGRAPHICAL SURVEY

The preliminary topographical survey has been limited to carry out the chaining, establishment of temporary Bench Marks, theodolite survey, plane table survey and levelling. In the theodolite survey, the existing alignments with angles of deviations of the existing horizontal intersection points, tangent distances and apex distances of curves have been noted. The objects like structures and environmental features such as lakes, wells, nallahs, rivers, old monuments, temples, mosques, graveyards, bridges, culverts, hillocks, transmission lines, telephone lines, water supply lines and also the building structures have been noted in a corridor of 60 m width or 30 m on either side of the centre line of the existing road. Besides this, information regarding the width of embankment, exiting road land width, width of carriageway, width of shoulders etc. has also been collected. Longitudinal sections have been taken all along the centre line of the existing road with reference to G.T.S. Bench Marks at 50 m intervals. This will give the profile of existing road and will enable to frame suggestions for improvement of the deficencies, if any. Cross-sections at every 50 m have been taken in a width of 60m, with levels at every 5 m interval. This will give the cross profile of existig road and the adjoining

terrain. Theodolite survey has been carried out for the Eluru bypass corridor beyond the urban development area. The alignment will give the angle of deviation from the main carriageway, the horizontal curves, features within a corridor of 60 m and levels at 50 m intervals all along the alignment.

Temporary bench marks at every 500 m on an average are established along the road and located at site on existing pucca structures and inscribed with identification level marks. These are also connected to the GTS Bench Marks. These will be used as refence points at the time of detailed engineering survey and also during execution of the project.

4.4 ALIGNMENT SURVEY

The project road which has been in existence for many years generally follows a plain terrain. Except for a bypass at Eluru, the alignment was found to be generally acceptable with minor geometric improvements at selected places. For the Eluru bypass, the alignment was surveyed in detail, so as to make it as fluent as possible and restrict the detour involved. The proposal for widening the carriageway to 4 lanes has been worked out keeping in view that the existing carriageway is retained for most of its length. This will not only bring down project cost but also facilitate the management of traffic during construction. The constructon of second carriageway will be taken up first and completed and the traffic diverted on to it. Thereafter, the existing carriageway will be strentghened. For NH-5, 4-laning has been proposed by widening on both sides of the existing carriageway. For NH-9, the new carriageway for 4-laning in km 252 - 260 could be mostly located on one side of the existing carriageway either on left or right side. Advantage has been taken of geometric improvements in deciding the locations of the additional carriageway with respect to the existing carriageway. However, in km 260 - 265, four laning has been proposed by widening on both sides of the existing carriageway.

4.5 INVENTORISATION AND CONDITION SURVEY

A complete inventory and condition survey of the existing roads was carried out covering following features.

(1) Land width

(2) Structures adjacent to the road length

(3) Utilities such as electric lines, telephone lines, etc. crossing the alignment and their location within the land width which may need re-location because of the project.

(4) Roadway width

(5) Pavement width

(6) Pavement thickness and composition

(7) Condition of the road surface

(8) Location, waterway and width of culverts and bridges

(9) Road appurtenances

4.6 SOIL AND MATERIAL INVESTIGATIONS

The preliminary soil and material investigations have been carried out in three parts.

(1) Soil classification and the CBR values of the existing subgrade and the identified borrow areas soil.

(2) Identification of quarries, determining the material characteristics and their suitability for use in pavement courses.

(3) Soil classification and its shear strength for material obtained from bore logs at bridge sites.

4.6.1 Soil samples of the existing subgrade and of identified borrow areas have been taken and the following tests have been carried out.

i) Grain size analysis

ii) Atterberg limits

iii) Optimum moisture content

iv) Field moisture content

v) Proctor density

vi) CBR values after 4 days soaking

4.6.2 Similarly, the material samples from various quarries have been collected and the following tests were carried out to find their suitability for use in road construction.

i) Los Angles test for abrasion or Aggregate Impact Value

ii) Flakiness index

iii) Water absorption

iv) Stripping value

v) Soundness

4.6.3 The bore materials from various bridge sites have been tested for C and Ø value of the soil. The values obtained from these tests will be used in the detailed engineering design.

4.7 TRAFFIC SURVEYS AND ANALYSIS

Realising the importace of arriving at an accurate estimation of present and future traffic on the project road for designing its various features, considerable attention was given on traffic surveys and analysis. The following traffic surveys were carried out.

i) Past data on traffic counts taken as a routine measure by the Public Works Department was collected. This enabled the determination of the historic trend of growth of traffic and its various vehicular components viz. cars, buses, trucks, two-wheelers and slow-moving vehicles.

ii) Seven day traffic count

In addition to the above secondary data, seven day classified traffic count was also taken at km 13/2, 45/6 and 50/8 on NH-5 and km 219/6 and 253/4 on NH-9. This served as a check on the data obtained from the secondary sources.

iii) Origin and destination survey

Origin and destination survey was carried out at km 50/8 on NH-5 and km 253/4 on NH-9 for a period of 24 hours. All the vehicles were intercepted and information on the origin and destination of the travel was collected. The type and weight of commodity carried was also obtained. The analysis of of the origin and destination data enabled appreciation of the influence of various zones adjacent to the project under consideration in attracting and generating traffic and in establishing the need for a bypass at Eluru on NH-5.

iv) Axle load survey

Current design practice for flexible pavement in India is based on assessed estimation of standard axles over the design period. Since commercial vehicles in India tend to be generally over loaded, it was felt that an axle load survey should be carried out to assess the axle load spectrum and to derive the vehicle damage factor on the basis of well established axle damaging co-efficients determined from the ASSHTO study. In the axle load spectrum study, only commercial vehicles in both directions carrying goods were weighed on a permanent vehicle weighing station at km 50/8 on NH-5 and 253/4 on NH-9

by the side of the road. These vehicles included both empty and loaded ones. Buses were not covered, the damaging effect of them being assumed as per standard practice.

v) Intersecton survey

The directional movement of the vehicles was determined during the peak period at all major intersections.

4.8 ROUGHNESS STUDY

The riding quality of the road, also known as its roughness, has a pronounced influence on the road user cost. This has been well established in the Road User Cost Study. The estimation of benefits from road improvements require a good knowledge of the riding quality of the present road and the riding quality of the new pavement proposed. The riding quality was measured with the help of fifth wheel bump integrator in both directions over the project roads.

4.9 BENKELMAN BEAM DEFLECTION STUDY (C.G.R.A. METHOD)

The structural evaluation of the existing pavement was carried out by the Benkelman beam deflection method. The determination of the overlay thickness was done on the basis of MOST Guidelines for pavement design of ADB III road projects. The allowable deflection has been accordingly taken as under :

ESAL (msa)	ALLOWABLE DEFLECTION (mm)
Upto 30	0.70
30-50	0.60
50-75	0.55
> 75	0.50

4.10 DYNAMIC CONE PENETROMETER (DCP) TESTS

DCP tests have been carried out at two kilometre intervals to provide a reasonable sampling of the pavement structure upto a penetration depth of an average 800 mm. DCP equipment has been used for penetrating the pavement and subgrade together from the surfacing downwards. Indicative CBR values for the pavement components and subgrade have been obtained from the relevant CBR-Penetration Curves.

4.11 ECONOMIC PROFILE

The determination of traffic on a transport network is closely governed by the economic profile of the region. In particular, economic indicators like population, location of urban centres, agricultural activity,

industrial activity, the State Domestic Product, per capita income etc. have a pronounced effect on the generation of traffic on a road. In order to assess historic trend of the growth of the above economic indicators, data on economic profile was collected from secondary sources. In addition, transport indicators such as vehicle population and road taxes etc. were also collected. The estimation of the traffic growth rate was done using various approaches such as trend analysis and demand elasticity method.

4.12 PROJECT DESIGN

The design of the various elements of the project had been carried out in conformity with accepted standard and specifications in use in the country. The publications of the Indian Roads Congress and the MOST (Road Wing) have been used.

The design of pavement is done for 10 years life as per MOST guidelines for ADB III road projects.

Earthwork for the embankment filling is to be obtained from the identified borrow areas away from the road.

The four lane divided carriageway has been designed to permit speed of 100 km per hour, with geometric features inbuilt to cater to uninterrupted flow of traffic on the main carriageway. The access to the main carriageway has been selectively determined so as to maintain high level of traffic flow over the fast facility now being designed. The junctions have been identified and appropriate designs have been formulated. The gaps in the median have been located at an interval of around 2 km subject to local needs arising out of important roads meeting or taking off from the carriageway.

Since the road passes through plain territory, the vertical profile permits gentle grade. The vertical profile will be designed taking in view the levels of the existing carriageway and the need to correct two sided camber to a uni-directional crossfall on four laning sections. Horizontal curves have been designed with as large radii as possible keeping, however, a minimum radius of 360 m.

Parallel service roads have been provided wherever urban influence predominates and local traffic is substantial.

The new pavement in the additional carriageway and the bypass at Eluru has been designed on the basis of CBR method and the MOST guidelines for design of flexible pavement for ADB III road projects. Alternatively, the pavement design for new carriageway has also been done as per SHELL DESIGN curves.

Benkelman beam deflection studies have been carried out for evaluation of structural capacity of the existing flexible pavement. As per results of the B.B. tests, the existing road crust is found to be deficient. Strengthening of the existing pavement has been proposed as per overlay design procedure given in the guidelines issued by MOST for pavement design of ADB III road projects.

Paved shoulders 1.50 m wide have been provided on both sides of the carriageway.

The cross drainage structures have been designed as per the current Indian Roads Congress Code of Practice.

4.13 COST ESTIMATE

The quantities of various items of road works have been estimated fairly accurately. The rates provided for various items of work are market based, modified where necessary to reflect the use of modern technology equipment. In the project, it is envisaged that the best available road construction technology would be brought in with international competitive biding.

4.14 ECONOMIC ANALYSIS

As the traffic on the road is quite high, there is considerable congestion causing delay and extra vehicle operating cost to the road user. The proposed project is expected to result in higher speeds on the road and lesser congestion. As a result, benefits will flow into the economy by way of reduced vehicle operating cost. The quantification of benefits from the project has been made using the results of the Road User Cost Study and Manual on Economic Analysis published by the Indian Roads Congress allowing for the congestion factor. The VOC tables of the IRC Special Publication - 30 have been updated.

The proposed improvements will bring in additional benefits due to reduction in road accidents making improved road much safer to travel than the present heavily trafficked 2-lane road. The benefits due to reduction in accidents have not been counted in the economic analysis.

It is also likely that the proposed improvements will generate alround prosperity in the region and attract industrial development and higher agricultural growth. These benefits are difficult to quantify.

The economic analysis has been carried out as per the ADB guidelines and sensitivity analysis has been worked out for accounting for any possible deviation from the estimation made, particularly in regard to traffic growth rate.

Economic analysis has been done separtely for the improvement of the existing roads and for construction of the bypass at Eluru.

Economic internal rates of return (EIRRs) have been calculated from sensitivity analysis for following variations.

a) Base benefits minus 15 per cent

b) Base costs plus 15 per cent

c) Base benefits minus 15 per cent and base costs plus 15 per cent.

4.15 ENVIRONMENTAL STUDY

Initial environmental examination (IEE) of each Project road has been done as per Bank's Environmental Guidelines for Selected Infrastructure Projects (Highways and Roads).

4.16 WORK TO BE DONE FOR DETAILED PROJECT REPORT

For the work of strengthening, 4-laning and construction of Eluru bypass, the preliminary designs and typical drawings already prepared will be updated wherever necessary.

The detailed design and drawings will be prepared as a part of the Detailed Project Report.

CHAPTER 5

TRAFFIC SURVEY AND ANALYSIS

5 GENERAL

The traffic surveys carried out include the following:

i) Classified traffic volume count.
ii) Collection of data on traffic counts at various stations.
iii) Origin-destination survey.
iv) Axle load survey.
v) Roughness survey.

The details of the above surveys and their analysis are given in the following paras.

5 CLASSIFIED VOLUME COUNT

The traffic on the road is mixed in character and consists of fast and slow moving vehicles. Predominantly, commercial vehicles comprise as much as 80%, with cars about 7% and the rest comprising slow moving vehicles. The traffic is quite heavy considering that the roads are only a 2 lane section. In order to form the basis for the pavement design and the economic analysis, classified volume counts (7 days, 24 hours, both directions) were taken at km 13/2, 45/6, 50/8 of NH-5 and km 219/60 and 253/4 of NH-9. The procedure for traffic counts as laid down in the IRC guidelines was followed.

The details of the traffic count are given in Tables 5.1 to 5.5 and an abstract given in Table 5.5A. The conversion of the various types of vehicles into the standard passenger car units (PCUs) was done as per current IRC guidelines.

It will be seen that the traffic is of the order as indicated below:

	KM	PCUs per day
NH-5	13/2	20644
NH-5	45/6	20321
NH-5	50/8	17547
NH-9	219/6	15213
NH-9	253/4	32581

5.3 DATA ON PAST TRAFFIC

As per the normal practice, regular traffic census is being taken at specified locations along the road twice a year. This is done in conformity with the current IRC guidelines. In Andhra Pradesh, it is generally taken in January, and July, each year.

For the present project, past data at km.13.0, 45.6 and 58.8 of NH-5 and km 198.0 and 253.4 of NH-9, in the form of six-monthly counts covering the period from 1989 to 1992 was available with the State PWD/MOST (except for the counts at km 198/0 for which data from Jun. 1987 onwards is available). This data is presented in Tables 5.6 to 5.10.

5.[illegible] ORIGIN - DESTINATION SURVEY

In order to assess the percentage of through traffic on the road and type of commodities carried, an origin and destination (O-D) survey was conducted for one day at km 50/8 on NH-5 and km 253/4 on NH-9. The survey was conducted for a continuous period of 24 hours by roadside interviewing in both directions. It was on random sample basis for all the four or more wheeled vehicles. The O-D survey on NH.5 at km 50/8 also helped to assess the justification of Eluru bypass. The following information was collected.

i) Origin and destination
ii) Commodity being carried by the goods vehicles.

The analysis of the O-D survey results is based on zonal configuration, as per maps enclosed showing various zones, for NH-5 and NH-9 respectively and is given in Tables 5.11 - 5.12. It will be seen that cars and buses mostly originate and terminate in the project area but the truck traffic is essentially through in character. Tables 5.13 - 5.20 give the O-D matrix for different zones; and are shown in Figs. 5.1 and 5.2 respectively.

The O-D matrix for the commercial vehicles commodities wise is given in Tables 5.21 - 5.22.

5[illegible] AXLE LOAD SURVEY

There is a tendency on the part of commercial vehicle operators in India to overload goods vehicles. Such severe over-loading affects the life of pavements and increases the need for frequent repairs and overlay.

In order to estimate the damaging effect of axles, an axle load survey was carried out at km 50/8 of NH-5 and km 252/8 of NH-9 on a permanent weigh-bridge. The commercial vehicles in both directions were made to move to the weighing platform and the loads of the fully loaded vehicle and that of the rear axle were noted. The conversion of axles into standard axles was based on recognised load equivalent factors which are derived from AASHTO test. Table 5.23 gives the load equivalency factors as per AASHTO. Tables 5.24 and 5.25 give the results of the axle load survey for NH-5 and NH-9 respectively.

It will be seen that the vehicle damage factors (VDFs) are 3.35 for NH-5 and 3.1 for NH-9 respectively. However, as per MOST guidelines, it is necessary to provide a minimum VDF of 3.5 and this has been adopted for design of pavement.

5.6 ROUGHNESS SURVEY

The riding quality of the pavement is a crucial factor in determining the vehicle operating cost and secondly the benefits from highway improvements. In order to assess the present riding quality, a run was taken with the Fifth Wheel Bump Integrator over the entire length of the road in both the directions as per standard practice. The results are presented in Table 5.26 for NH-5 and in Table 5.27 for NH-9.

5.7 INTERSECTION STUDY

The directional movement of the vehicles at the following intersections were recorded during the peak period on NH-5 & NH-9. The design of the intersection will be taken up in the detailed engineering.

S.No.	Location (km)	Type of junction
NH-5		
1.	3.4	Y - junction
2.	6.0	Rotary junction
3.	6.25	+ junction
4.	6.60	T-junction
5.	7.00	+ junction
6.	9.60	Y junction
7.	14.00	Y junction
8.	24.40	Staggerd junction
9.	35.20	T - junction
10.	38.60	Y - junction
11.	46.00	+ junction
12.	53.00	T junction
NH-9		
1.	219.40	T-junction
2.	234.20	T-junction
3.	253.20	+ junction (Rotary junction)
4.	259.60	Y-junction
5.	262.50	Y-junction
6.	264.20	+ junction

Note: Study of junctions of roads with proposed bypass for Eluru will be done at the existing crossing at the time of detailed engineering.

5.8. TRAFFIC FORECASTS

5.8.1. Accurate forecasts of traffic volumes are the basic essential requirement for the preparation of any highway project. These forecasts depend upto two factors, i.e. the present day traffic and the traffic growth rates. For this project, the present day traffic has been assessed on the basis of actual traffic volume counts taken at km 13/2, 45/6 and 50/8 of NH-5 and km 219/6 and 253/4 of NH-9. These volume counts were taken in January 1993 and were spread over 7 days. It is learnt from the local engineers that the traffic volumes in the month of January represent average values. The present day traffic has been projected over the next 20 years using growth factors which have been calculated as per details described in paras 5.8.2 to 5.8.8.

5.8.2. Traffic Growth Factors

At present, the traffic growth factors for National Highway projects in India are calculated by the following three methods:-

a) Adopting uniform growth rate of 7.5% as recommended by IRC for adoption in the absence of any other data.

b) Analysing the past trends and obtaining growth rates by regression analysis.

c) Obtaining growth rates by elasticity method, taking into account the growth of socio-economic indicators viz. Population, per capita income and growth in Agricultural, Industrial, Mining and Tourism sectors of the economy.

5.8.3. It is observed that the time series data for the count station at km 58.8 of NH-5 shows a wide variation between the summer and winter counts. Since only four counts for each of the two seasons were available, no reliable results could be expected from regression analysis of data from the particular count station. In respect of count station at km 219/6 on NH-9, nearest P.W.D. count station is at km 198/0 and the same has been taken into consideration for the purpose of analysis. Data from the other four count stations has been subjected to regression analysis and regression equations, for each of the four fast modes of traffic i.e. cars, buses, trucks and two-wheelers from which R^2 values and annual growth rates have been calculated. This analysis is presented in Tables 5.28 to 5.43.

5.8.4 Growth rates of traffic for the project roads have also been calculated by elasticity method using the growth of socio-economic indicators. The calculations are presented in Table 5.44.

5.8.5 Growth rates of the traffic have also been calculated from the vehicle registration in the year 1987 and 1992. The calculations are presented in Table No.5.45.

5.8.6 Table 5.46 presents an abstract of the growth factors obtained by regression analysis, elasticity method, and vehicle registration analysis. As would be expected, all the three sets of growth factors vary although not very significantly. The growth factors for each of the modes have, therefore, been averaged by assigning equal weightage. This has given the following average annual growth rates, which compares favourably with the growth rates worked out on the basis of registration of vehicles in the State.

Cars	-	7.73
Buses	-	7.03
Trucks	-	6.72
2-wheelers	-	10.12

5.8.7 The growth factors mentioned above have been adopted for obtaining the future forecasts. The growth of bicycles has been assumed to be the same as for two wheelers. Animal-drawn vehicles are not expected to grow and have been assiged 0% growth rate. The growth rate of "other" vehicles has been taken as the arithmatical average of the growth rates for buses and trucks.

5.8.8 The growth factors obtained above are likely to taper off after a few years and as such have been used for the projections over the first one year only. The growth factors for the next ten years and the period after ten years have been calculated by using multiplying factors recommended by ADB consultants in this regard which are as follows:-

Mode		Multiplying factors		
		1993-1994	1995-2004	2005-2018
Cars	-	2.0	2.0	1.8
Buses	-	1.6	1.6	1.5
Trucks	-	2.0	1.9	1.8
2-wheelers	-	2.5	2.3	2.1

Based on the above factors the growth rates for various modes for the period 1993 to 2018 as under have been adopted.

Periods	Cars	Buses	Trucks	Two wheelers
1993-1994	7.73	7.03	6.72	10.12
1995-2004	7.73	7.03	6.38	9.31
2005-2018	6.96	6.59	6.04	8.50

5.9 TAFFIC PROJECTIONS

The traffic forecasts based on the above-mentioned growth rates for the five count stations are presented in Table 5.47 to 5.50. These have been used for pavement design and economic analysis of the project. The PCUs shown in the last column of these tables are based on the following conversion factors as per IRC:64-1990

Cars	1.0
Buses	3.0
Trucks/Multi axle vehicles	3.0
LCV	1.5
Tractors without trailor	1.5
Tractors with trailor	4.5
Rickshaw	2.0
2-wheelers	0.5
Cycles	0.5
Animal-drawn vehicles	8.0

TABLE 5.1
TRAFFIC CENSUS
WEEKLY TRAFFIC SUMMARY
TRAFFIC COUNT POINT KM. 13/2 NH-5

DATE	CARS				TRACTOR W/O TRAILOR		BUSES		TRUCKS (LORRIES)		LCV MINI LORRIES		TRACTOR WITH TRAILOR		MULTI-AXLE VEHICLE		SCOOTERS & MOTOR-CYCLES		CYCLES		ANIMAL DRAWN VEHICLES		RICKSHAW	
	MODERN		OTHERS																							
	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN
5-1-93	107	110	503	452	17	20	362	392	2132	1874	225	198	53	40	96	52	1074	1015	1963	1943	27	23	163	127
		217		955		37		754		4006		423		93		148		2089		3906		50		290
6-1-93	103	104	450	414	8	4	384	391	1786	1792	151	150	30	28	28	31	1035	1025	1637	1891	20	19	122	137
		207		864		12		775		3578		301		58		59		2060		3528		39		259
7-1-93	112	121	442	480	1	0	423	361	2179	2144	195	198	52	66	68	68	997	1142	1940	2014	50	60	107	116
		233		922		1		784		4323		393		118		136		2139		3954		110		223
8-1-93	112	110	470	438	2	8	345	395	2065	1873	238	203	48	42	108	51	1088	954	1943	1970	38	25	158	111
		222		908		10		740		3938		441		90		159		2042		3913		63		269
9-1-93	125	112	438	460	5	4	356	421	1932	1971	229	217	84	70	82	54	1035	1089	1747	1902	20	22	194	178
		237		898		9		777		3903		446		154		136		2124		3649		42		372
10-1-93	110	100	507	438	5	0	382	365	1711	1899	182	177	36	36	66	62	980	1029	1668	2076	15	10	137	138
		210		945		5		747		3610		359		72		128		2009		3744		25		275
11-1-93	104	120	485	467	6	6	369	413	1851	2083	243	287	58	67	90	87	1092	982	1568	2155	50	61	167	174
		224		952		12		782		3934		530		125		177		2074		3723		111		341
TOTAL		1550		6444		86		5359		27292		2893		710		943		14537		26417		440		2029
AVERAGE		221		921		12		766		3899		413		101		135		2077		3774		63		290
PCUs		221		921		18		2298		11697		620		455		405		1038		1887		504		580
																				Total PCUs =				20644

TABLE 5.2
TRAFFIC CENSUS
WEEKLY TRAFFIC SUMMARY
TRAFFIC COUNT POINT KM. 45/6 - NH-5

DATE	CARS				TRACTOR W/O TRAILOR		BUSES		TRUCKS (LORRIES)		LCV MINI LORRIES		TRACTOR WITH TRAILOR		MULTI-AXLE VEHICLE		SCOOTERS & MOTOR-CYCLES		CYCLES		ANIMAL DRAWN VEHICLES		RICKSHAW	
	MODERN		OTHERS																					
	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN
4-1-93	85	89	429	433	47	39	433	408	2155	1997	194	199	190	169	76	71	917	1041	854	921	31	31	110	88
		174		862		86		841		4152		393		359		147		1958		1775		62		198
5-1-93	54	51	399	388	41	42	399	477	1882	1934	77	74	108	103	52	34	864	819	703	601	29	19	71	60
		105		787		83		876		3816		151		211		86		1683		1304		48		131
6-1-93	58	62	393	469	30	25	397	419	2155	1821	115	92	29	37	78	48	1006	986	933	849	23	14	79	75
		120		862		55		816		3976		207		66		126		1992		1782		37		154
7-1-93	92	57	419	413	23	26	445	423	2587	2166	241	188	154	199	61	58	997	962	839	990	17	13	85	85
		149		832		49		868		4753		429		353		119		1959		1829		30		170
8-1-93	82	81	489	448	31	22	401	427	2170	1970	150	150	187	180	91	55	1081	1070	1009	984	14	11	78	92
		163		937		53		828		4140		300		367		146		2151		1993		25		170
9-1-93	86	74	477	527	18	19	408	437	2081	2027	130	174	186	158	72	66	1023	1102	825	804	25	18	76	74
		160		1004		37		845		4108		304		344		138		2125		1629		43		150
10-1-93	54	74	396	452	21	79	456	431	2014	2032	96	113	172	112	55	86	931	999	720	770	21	21	82	85
		128		848		100		887		4046		209		284		141		1930		1490		42		167
TOTAL		999		6132		463		5961		28991		1993		1984		903		13798		11802		287		1140
AVERAGE		143		876		66		852		*4142		285		283		129		1971		1686		41		163
								-		(4025)														
PCUs		143		876		99		2556		12075		428		1274		387		986		843		328		326
																				Total PCUs =				20321

* In km. 42 there is a sugar factory, which has seasonal traffic, carrying sugarcane to the factory from adjoining area. The average daily movement of sugarcane is about 1000 MT i.e. 100 trucks loads, which means movement of 200 truck. This movement is for five months in a years. Averaging it for the whole year, the average truck traffic figure has been moderated to 4025 against 4142.

TABLE 5.3
TRAFFIC CENSUS
WEEKLY TRAFFIC SUMMARY
TRAFFIC COUNT POINT KM. 50/8 - NH-5

DATE	CARS MODERN		CARS OTHERS		TRACTOR W/O TRAILOR		BUSES		TRUCKS (LORRIES)		LCV MINI LORRIES		TRACTOR WITH TRAILOR		MULTI-AXLE VEHICLE		SCOOTERS & MOTOR-CYCLES		CYCLES		ANIMAL DRAWN VEHICLES		RICKSHAW	
	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN
4-1-93	0	0	347*	422*	0	0	398	406	1925	1821	116	112	47	38	48	59	347	367	356	397	8	11	25	25
		0		769		0		804		3746		228		85		107		714		753		19		50
5-1-93	0	0	380*	406*	0	0	418	406	1939	1949	83	69	25	30	50	37	314	357	352	346	14	20	17	23
		0		786		0		824		3888		152		55		87		671		698		34		40
6-1-93	54	39	399	466	16	16	408	400	2146	1825	119	97	16	33	77	48	334	340	370	327	5	3	33	33
		93		865		32		808		3971		216		49		125		674		697		8		66
7-1-93	50	44	295	369	5	5	404	425	2040	2002	124	155	30	31	43	40	332	295	407	402	3	4	20	25
		94		664		10		829		4042		279		61		83		627		809		7		45
8-1-93	46	31	348	370	1	4	414	438	2151	1911	151	157	39	42	82	45	360	327	366	381	8	7	19	27
		77		718		5		852		4062		308		81		127		687		747		15		46
9-1-93	60	66	484	527	12	11	490	475	2269	2117	186	205	50	38	80	75	448	433	416	348	3	3	24	22
		126		1011		23		965		4386		391		88		155		881		764		6		46
10-1-93	45	42	349	391	0	1	448	434	2010	2036	156	119	32	42	51	62	363	356	373	360	16	18	26	22
		87		740		1		882		4046		275		74		113		719		733		34		48
TOTAL		477		5553		71		5964		28139		1849		493		797		4973		5201		123		341
AVERAGE		95		793		14		852		4020		264		70		114		710		743		18		49
PCUs		95		793		21		2556		12060		396		315		342		355		372		144		98
																				Total PCUs =				17547

* Combined data for modern and other cars

TABLE 5.4
TRAFFIC CENSUS
WEEKLY TRAFFIC SUMMARY
TRAFFIC COUNT POINT KM. 219/6 - NH-9

DATE	CARS				TRACTOR W/O TRAILOR		BUSES		TRUCKS (LORRIES)		LCV MINI LORRIES		TRACTOR WITH TRAILOR		MULTI-AXLE VEHICLE		SCOOTERS & MOTOR-CYCLES		CYCLES		ANIMAL DRAWN VEHICLES		RICKSHAW	
	MODERN		OTHERS																					
	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN
13-1-93	185	152	473	452	15	13	371	401	1444	1535	239	214	143	144	4	4	423	383	1073	906	32	24	236	341
		337		925		28		772		2979		453		287		8		806		1979		56		577
14-1-93	79	64	324	281	19	12	341	324	1238	1235	85	90	53	49	6	4	438	398	1093	1046	15	12	392	428
		143		605		31		665		2473		175		102		10		836		2139		27		820
15-1-93	66	81	398	403	17	15	322	313	1418	1368	178	165	54	65	5	3	407	394	856	760	9	6	308	296
		147		801		32		635		2786		343		119		8		801		1616		15		604
16-1-93	92	53	325	275	7	18	324	320	1325	1324	90	79	54	61	5	25	396	379	1031	1058	17	14	300	354
		145		600		25		644		2649		169		115		30		775		2089		31		654
17-1-93	208	119	469	381	35	25	338	360	1584	1519	225	680	102	108	6	23	480	407	1052	873	36	40	242	357
		327		850		60		698		3103		905		210		29		887		1925		76		599
18-1-93	82	67	362	275	5	20	325	336	1167	1069	106	126	37	38	2	4	412	319	628	574	23	27	249	225
		149		637		25		661		2236		232		75		6		731		1202		50		474
19-1-93	58	52	400	383	21	13	359	339	1358	1264	193	178	54	75	1	5	357	403	680	957	6	7	240	310
		110		783		34		698		2622		371		129		6		760		1637		13		550
TOTAL		1358		5201		235		4773		18548		2648		1037		97		5596		12587		268		4278
AVERAGE		194		743		34		682		2693		378		148		14		799		1798		38		611
PCUs		194		743		51		2046		8079		567		666		42		400		899		304		1222
																					Total PCUs =			15213

TABLE 5.5
TRAFFIC CENSUS
WEEKLY TRAFFIC SUMMARY
TRAFFIC COUNT POINT KM. 253/4 - NH-9

DATE	CARS				TRACTOR W/O TRAILOR		BUSES		TRUCKS (LORRIES)		LCV MINI LORRIES		TRACTOR WITH TRAILOR		MULTI-AXLE VEHICLE		SCOOTERS & MOTOR-CYCLES		CYCLES		ANIMAL-DRAWN VEHICLES		RICKSHAW	
	MODERN		OTHERS																					
	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN	UP	DOWN
13-1-93	149	174	1503	1528	22	15	1265	1288	3415	3455	167	132	28	32	41	29	1376	1424	1074	1149	14	10	140	154
		323		3031		37		2553		6870		299		60		70		2800		2223		24		294
14-1-93	139	120	1182	1318	27	43	1282	1398	3209	3276	95	108	26	31	37	41	1286	1281	840	889	25	26	127	96
		259		2500		70		2680		6485		203		57		78		2567		1729		51		223
15-1-93	115	100	1304	1190	30	28	1449	1406	3429	3444	195	200	40	41	26	27	1485	1361	1135	955	9	13	134	148
		215		2494		58		2855		6873		395		81		53		2846		2090		22		282
16-1-93	171	161	1560	1713	20	5	1312	1055	3654	3552	143	143	35	32	25	19	1393	1496	962	1054	45	19	135	161
		332		3273		25		2367		7206		286		67		44		2889		2016		64		296
17-1-93	133	186	1462	1578	5	5	1416	1315	3170	3266	112	51	37	20	31	29	1378	1395	1238	1217	7	5	88	100
		319		3040		10		2731		6436		163		57		60		2773		2455		12		188
18-1-93	174	160	1530	1505	10	9	1372	1533	3201	3304	178	169	30	31	31	38	1487	1498	1153	1114	6	6	116	118
		334		3035		19		2905		6505		347		61		69		2985		2267		12		234
19-1-93	161	157	1485	1525	5	2	1441	1389	3407	3447	213	217	27	43	25	21	1438	1350	1131	896	6	6	116	118
		318		3010		7		2830		6854		430		70		46		2788		2027		12		234
TOTAL		2100		20383		226		18921		47229		2123		453		420		19648		14807		197		1751
AVERAGE		300		2912		32		*2703 (1988)		+6748 (6415)		303		65		60		2807		2115		28		250
PCUs		300		2912		48		5964		19245		454		293		180		1404		1057		224		500
																					Total PCUs =			32581

* Due to local festival during the traffic volume counting days, there was a huge rush of local tourists as well as local population. On taking the volume of bus traffic in non festival months of March, 93, the actual count comes to 1923 buses. Therefore, the difference 2703-1923 = 780 buses were due to the festival. This has been moderated to 1988 buses, which has been taken into account, while working out the growth rate.

\+ There are about 50 stone crushers between km. 242 to km. 252 crushing on an average 100 MT of aggregates per crusher i.e. 5000 MT for all crushers per day for an average of eight months per year. This generates 500x2 (loaded + empty) = 1000 trucks per day. Moderating it for full year, the net truck traffic reduces to 6415 trucks per day.

TABLE 5.5A

AVERAGE DAILY TRAFFIC VOLUME - BOTH DIRECTIONS

Count Stn.	Cars Modern	Cars Oth.	Tractors w/o Trailor	Buses	Trucks	LCV	Tractor with Trailor	Multi-axle vehicle	Scooter	Cycles	Animal drawn Vehicle	Rickshaw
NH-5												
13/2	221	921	12	766	3899	413	101	135	2077	3774	63	290
45/6	143	876	66	852	4025	285	283	129	1971	1686	41	163
50/8	95	793	14	852	4020	264	70	114	710	743	18	49
NH-9												
[illegible]/6	194	743	34	682	2693	378	148	14	799	1798	38	611
[illegible]/4	300	2912	32	1988	6415	303	65	60	2807	2115	28	250

TABLE 5.6
CLASSIFIED TRAFFIC COUNT
LOCATION KM. 13/2 OF NH5

AVERAGE ANNUAL DAILY TRAFFIC (AADT)

YEAR	BUSES	TRUCKS	CAR/ JEEPS	MULTI-PLE AXLE	TWO WHEEL-ERS	TRAC-TORS	CYCLES	ANIMAL DRAWN	RICKSHAW/ OTHERS
12/89	684	2197	773	62	1449	147	1563	106	209
7/90	616	3247	963	76	1505	196	4250	45	556
1/91	563	3127	902	49	1430	46	1940	20	155
7/91	586	3202	916	47	1490	32	1859	19	128
1/92	595	3277	951	51	1509	32	1727	19	131
7/92	637	3312	962	67	1578	37	1985	25	133

TABLE 5.7
CLASSIFIED TRAFFIC COUNT
LOCATION KM. 45/6 OF NH 5

AVERAGE ANNUAL DAILY TRAFFIC (AADT)

YEAR	BUSES	TRUCKS	CAR/ JEEPS	MULTI-PLE AXLE	TWO WHEEL-ERS	TRAC-TORS	CYCLES	ANIMAL DRAWN	RICKSHAW/ OTHERS
12/89	719	3260	746	65	1494	132	1705	96	132
7/90	655	4145	1106	76	1725	52	4754	45	52
1/91	628	3997	1074	69	1685	170	4329	58	555
7/91	721	4185	1101	83	1741	180	4507	56	575
1/92	692	4248	1136	78	1833	182	4927	51	588
7/92	771	4371	1158	91	1846	187	4360	58	595

TABLE 5.8
CLASSIFIED TRAFFIC COUNT
LOCATION KM. 58/8 OF NH 5

AVERAGE ANNUAL DAILY TRAFFIC (AADT)

YEAR	BUSES	TRUCKS	CAR/ JEEPS	MULTI-PLE AXLE	TWO WHEEL-ERS	TRAC-TORS	CYCLES	ANIMAL DRAWN	RICKSHAW/ OTHERS
12/89	841	3331	999	151	708	87	2115	336	535
7/90	1418	5983	1891	336	1165	256	3188	624	929
1/91	726	3562	902	126	625	116	2199	394	1010
7/91	1514	6172	2009	368	1215	260	3321	649	946
1/92	835	3803	1042	191	695	164	2939	474	654
7/92	1587	6401	2069	438	1226	314	3131	702	1011

TABLE 5.9
CLASSIFIED TRAFFIC COUNT
LOCATION KM. 198/0 OF NH 9

AVERAGE ANNUAL DAILY TRAFFIC (AADT)

YEAR	BUSES	TRUCKS/ MULTI-PLE AXLE	CARS/ JEEPS	TWO WHEEL-ERS	CYCLES	ANIMAL DRAWN	RICKSHAW/ OTHERS
6/87	755	2578	753	313	30	148	222
12/87	783	2631	780	338	35	120	240
6/88	783	2672	784	348	83	110	244
12/88	776	2602	775	337	168	69	155
6/89	786	2689	789	352	224	220	166
12/89	1172	3110	888	360	25	24	25
1/91	1185	3300	947	399	220	34	90
7/91	1201	3325	981	412	234	12	103
1/92	1255	3406	1087	456	269	26	135
7/92	1276	3453	1065	467	254	31	139

TABLE 5.10
CLASSIFIED TRAFFIC GROWTH
LOCATION KM. 253/4 OF NH 9

AVERAGE ANNUAL DAILY TRAFFIC (AADT)

YEAR	BUSES	TRUCKS/ MULTI-PLE AXLE	CAR/ JEEPS	TWO WHEEL-ERS	CYCLES	ANIMAL DRAWN	RICKSHAW/ OTHERS
12/89	2222	5973	2682	2401	1918		1109
7/90	2360	6361	2821	2508	1988		1208
1/91	2489	6669	2934	2638	1975		1299
7/91	2635	6849	3126	2776	2033		1362
1/92	2772	7072	3258	2862	2110		1432
7/92	2929	7366	3390	2985	2216		1500

TABLE 5.11
MODE-WISE DISTRIBUTION OF TRAFFIC ON NH-5

S.NO.	MODE	PERCENTAGE OF TRAFFIC		TOTAL
		EXTERNAL INTERNAL & VICE VERSA	THROUGH	
1.	Cars	50.6	49.4	100
2.	Buses	63.0	37.0	100
3.	Trucks	21.5	78.5	100

TABLE 5.12
MODE-WISE DISTRIBUTION OF TRAFFIC ON NH-9

S.NO.	MODE	PERCENTAGE OF TRAFFIC		TOTAL
		EXTERNAL INTERNAL & VICE VERSA	THROUGH	
1.	Cars	65.8	34.2	100
2.	Buses	29.5	70.5	100
3.	Trucks	14.4	85.6	100

TABLE 5.13

ORIGIN AND DESTINATION STUDIES
DELINEATION OF TRAFFIC ZONES ON NH-5

ZONE NO.	DESCRIPTION
1.	Vijayawada-Hanuman Junction
2.	Eluru-Hanuman Junction
3.	Other parts of Krishna District
4.	Other parts of West Godavari District
5.	Khammam, East Godavari, Guntur, Nalgonda District
6.	All other costal districts (Nellore, Prakasan, Vizag, Vijayanagaram, Srikakulam)
7.	All the Districts of Telangana Region
8.	All the Districts of Rayalaseema Region
9.	Tamil Nadu and Kerala States
10.	Bengal and Orissa States
11.	Karnataka, M.P. Maharashtra, Bihar-States
12.	North East Area
13.	Rest of India States

TABLE 5.14

ORIGIN AND DESTINATION STUDY TRIP MATRIX FOR CARS (BOTH DIRECTIONAL)

LOCATION : KM.50/8 ON NH - 5

ORIGIN ZONES		VIJAYAWADA HANUMAN JUNCTION (1)	ELURU-HANUMAN JUNCTION (2)	OTHER PARTS OF KRISHNA DIST. (3)	OTHER PARTS OF WEST GODAVARI DIST. (4)	KHAMMAM EAST GODAVARI GUNTUR NALGONDA DISTS. (5)	ALL OTHER COASTAL DISTS. (6)	ALL OTHER TELANGANA DISTS. (7)	ALL RAYALASEEMA DISTS. (8)	TAMIL NADU & KERALA STATE (9)	W.BENGAL & ORISSA STATES (10)	KARNATAKA MP, MAHARASHTRA, BIHAR STATES (11)	NORTH EAST AREA (12)	REST OF INDIAN STATES (13)	TOTAL
VIJAYWADA-HANUMAN JUNCTION	1	-	46	-	15	20	3	-	-	-	-	-	-	-	84
ELURU-HANUMAN JUNCTION	2	35	1	39	15	3	-	6	-	-	-	-	-	-	99
OTHER PARTS OF KRISHNA DIST.	3	-	33	-	4	8	3	-	-	-	-	-	-	-	48
OTHER PARTS OF WEST GODAVARI DIST.	4	13	1	3	2	2	1	4	-	-	-	-	-	-	26
KHAMMAM, EAST GODAVARI, GUNTUR NALGONDA DISTS.	5	21	1	3	3	16	4	10	2	-	-	-	-	-	60
OTHER COASTAL DIST.	6	2	1	3	-	3	-	2	-	-	-	-	-	-	11
ALL TELANGANA DISTS.	7	-	7	0	3	-	-	-	-	-	-	-	-	-	10
ALL RAYALASEEMA DISTS.	8	-	-	-	-	1	-	-	-	-	-	-	-	-	1
TAMIL NADU & KERALA STATES	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WEST BENGAL & ORISSA STATES	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KARNATAKA, MP MAHARASHTRA BIHAR - STATES	11	-	-	-	-	-	-	1	-	-	-	-	-	-	1
NORTH EAST STATES	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REST OF INDIAN STATES	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		71	90	48	42	53	11	23	2	-	-	-	-	-	340

TABLE 5.15

ORIGIN AND DESTINATION STUDY TRIP MATRIX FOR BUSES (BOTH DIRECTIONAL)

LOCATION : KM.50/8 ON NH - 5

ORIGIN ZONES		DESTINATION ZONES													
		VIJAYA-WADA HANUMAN JUNCTION (1)	ELURU-HANUMAN JUNCTION (2)	OTHER PARTS OF KRISHNA DIST. (3)	OTHER PARTS OF WEST GODAVARI DIST. (4)	KHAMMAM EAST GODAVARI GUNTUR NALGONDA DISTS. (5)	ALL OTHER COAS-TAL DISTS. (6)	ALL OTHER TELAN-GANA DISTS. (7)	ALL RAYALA SEEMA DISTS. (8)	TAMIL NADU & KERALA STATE (9)	W.BENGAL & ORISSA STATES (10)	KARNATAKA MP, MAHARA-SHTRA, BIHAR STATES (11)	NORTH EAST AREA (12)	REST OF INDIAN STATES (13)	TOTAL
VIJAYWADA-HANUMAN JUNCTION	1	-	69	2	22	10	2	-	-	-	-	-	-	-	105
ELURU-HANUMAN JUNCTION	2	57	3	15	2	5	1	-	-	-	-	-	-	-	83
OTHER PARTS OF KRISHNA DIST.	3	-	17	1	6	3	-	-	-	-	-	-	-	-	27
OTHER PARTS OF WEST GODAVARI DIST.	4	29	2	6	1	7	1	2	-	-	-	-	-	-	48
KHAMMAM, EAST GODAVARI, GUNTUR NALGONDA DISTS.	5	7	-	1	1	1	1	2	-	-	-	-	-	-	13
OTHER COASTAL DISTS.	6	5	-	4	-	-	-	1	-	1	-	-	-	-	11
ALL TELANGANA DISTS.	7	-	4	-	3	6	1	-	-	-	-	-	-	-	14
ALL RAYALASEEMA DISTS.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TAMIL NADU & KERALA STATES	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WEST BENGAL & ORISSA STATES	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KARNATAKA, MP MAHARASTRA, BIHAR - STATES	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NORTH EAST STATES	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REST OF INDIAN STATES	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		98	95	29	35	32	6	5	-	1	-	-	-	-	301

TABLE 5.16

ORIGIN AND DESTINATION STUDY TRIP MATRIX FOR TRUCKS (BOTH DIRECTIONAL)

LOCATION : KM.50/8 ON NH - 5

ORIGIN ZONES		DESTINATION ZONES													
		VIJAYA-WADA HANUMAN JUNCTION (1)	ELURU-HANUMAN JUNCTION (2)	OTHER PARTS OF KRISHNA DIST. (3)	OTHER PARTS OF WEST GODAVARI DIST. (4)	KHAMMAM EAST GODAVARI GUNTUR NALGONDA DISTS. (5)	ALL OTHER COASTAL DISTS. (6)	ALL OTHER TELANGANA DISTS. (7)	ALL RAYALA SEEMA DISTS. (8)	TAMIL NADU & KERALA STATE (9)	W.BENGAL & ORISSA STATES (10)	KARNATAKA MP, MAHARASHTRA, BIHAR STATES (11)	NORTH EAST AREA (12)	REST OF INDIAN STATES (13)	TOTAL
VIJAYWADA-HANUMAN JUNCTION	1	-	17	-	16	25	22	-	-	6	3	5	4	1	99
ELURU-HANUMAN JUNCTION	2	35	3	18	14	9	11	4	-	3	1	-	-	-	98
OTHER PARTS OF KRISHNA DIST.	3	4	6	2	16	25	18	-	-	-	2	1	2	-	76
OTHER PARTS OF WEST GODAVARI DIST.	4	35	3	32	-	19	20	10	4	15	-	8	2	-	148
KHAMMAM, EAST GODAVARI, GUNTUR NALGONDA DISTS.	5	52	12	46	8	22	17	11	3	11	5	7	4	1	199
ALL COASTAL DISTTRICTS	6	37	5	8	11	22	9	10	5	30	4	17	1	-	159
ALL TELANGANA DISTS.	7	-	-	-	9	1	5	-	-	-	2	-	-	-	17
ALL RAYALASEEMA DIST.	8	-	-	-	8	-	1	-	-	-	6	1	-	-	16
TAMIL NADU & KERALA STATES	9	3	3	3	13	6	30	-	-	-	8	1	-	-	67
WEST BENGAL & ORISSA STATES	10	18	1	-	4	11	4	4	-	20	8	10	-	-	80
KARNATAKA, MP, MAHARASHTRA, BIHAR - STATES	11	5	-	-	7	10	17	-	-	11	13	8	-	-	71
NORTH EAST STATES	12	2	5	2	-	4	6	-	-	-	4	4	-	1	28
REST OF INDIAN STATES	13	-	-	-	2	1	1	-	-	-	-	-	-	-	4
TOTAL		191	55	111	108	155	161	39	12	96	56	62	13	3	1062

TABLE 5.17

ORIGIN AND DESTINATION STUDIES
DELINEATION OF TRAFFIC ZONES ON NH-9

ZONE NO.	DESCRIPTION
1.	Vijayawada-Nandigama
2.	Other parts of Krishna District
3.	Districts of (a) Khammam (b) Nalgonda (c) Guntur (d) West Godavari
4.	All other coastal districts. (Nellore, Prakasam, Vizag, East Godavari, Vijayanagaram, Srikakulam).
5.	All the Districts of Telangana Region
6.	All the Districts of Rayalaseema Region
7.	Tamil Nadu State
8.	Kerala State
9.	Maharashtra State
10.	Madhya Pradesh State
11.	Orissa and Bihar States
12.	All other states

TABLE 5.18
ORIGIN AND DESTINATION STUDY TRIP MATRIX FOR CARS (BOTH DIRECTIONAL)

LOCATION : DELINEATION OF TRAFFIC ZONES ON NH-9

ORIGIN ZONES		VIJAYA-WADA HANUMAN JUNCTION (1)	ELURU-HANUMAN JUNCTION (2)	OTHER PARTS OF KRISHNA DIST. (3)	OTHER PARTS OF WEST GODAVARI DIST. (4)	KHAMMAM EAST GODAVARI GUNTUR NALGONDA DISTS. (5)	ALL OTHER COAS-TAL DISTS. (6)	ALL OTHER TELAN-GANA DISTS. (7)	ALL RAYALA SEEMA DISTS. (8)	TAMIL NADU & KERALA STATE (9)	W.BENGAL & ORISSA STATES (10)	KARNATAKA MP, MAHARA-SHTRA, BIHAR STATES (11)	NORTH EAST AREA (12)	REST OF INDIAN STATES (13)	TOTAL
VIJAYWADA-NANDIGAM	1	11	15	9	2	80	-	1	-	-	-	-	-	-	118
OTHER PARTS OF KRISHNA DIST.	2	18	1	16	11	2	2	-	-	-	-	-	-	-	50
KHAMMAM, WEST GODAVARI, GUNTUR NALGONDA DISTS.	3	6	1	8	4	13	1	-	-	-	-	-	-	-	33
OTHER COASTAL DIST.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALL TELANGANA DISTS.	5	23	12	10	10	-	5	1	-	-	1	-	-	-	62
ALL RAYALASEEMA DISTS.	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TAMIL NADU STATE	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KERALA STATE	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAHARASHTRA STATE	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MADHYA PRADESH STATE	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KARNATAKA STATE	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ORISSA & BIHAR STATES	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REST OF INDIAN STATES	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		58	29	43	27	95	8	2	-	-	1	-	-	-	236

TABLE 5.19

ORIGIN AND DESTINATION STUDY TRIP MATRIX FOR TRUCKS (BOTH DIRECTIONAL)

LOCATION : DELINEATION OF TRAFFIC ZONES ON NH-9

ORIGIN ZONES		DESTINATION ZONES													
		VIJAYA-WADA HANUMAN JUNCTION (1)	ELURU-HANUMAN JUNCTION (2)	OTHER PARTS OF KRISHNA DIST. (3)	OTHER PARTS OF WEST GODAVARI DIST. (4)	KHAMMAM EAST GODAVARI GUNTUR NALGONDA DISTS. (5)	ALL OTHER COAS-TAL DISTS. (6)	ALL OTHER TELAN-GANA DISTS. (7)	ALL RAYALA SEEMA DISTS. (8)	TAMIL NADU & KERALA STATE (9)	W.BENGAL & ORISSA STATES (10)	KARNATAKA MP, MAHARA-SHTRA, BIHAR STATES (11)	NORTH EAST AREA (12)	REST OF INDIAN STATES (13)	TOTAL
VIJAYAWADA-NANDIGAM	1	4	15	16	4	30	-	6	-	2	-	-	1	-	78
OTHER PARTS OF KRISHNA DIST.	2	31	6	22	41	9	-	15	-	-	-	-	-	-	124
KHAMMAM, WEST GODAVARI, GUNTUR NALGONDA DIST.	3	25	17	48	38	28	2	21	-	4	1	4	6	-	195
OTHER COASTAL DIST.	4	4	32	32	2	67	-	7	-	9	-	1	4	1	159
OTHER TELENGANA DIST.	5	68	8	23	34	-	4	17	-	1	-	3	12	-	170
ALL RAYALASEEMA DIST.	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TAMIL NADU STATE	7	6	2	12	3	12	2	-	-	1	-	-	-	-	38
KERALA STATE	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAHARASHTRA STATE	9	17	1	4	2	1	-	2	-	-	-	1	-	-	28
MADHYA PRADESH STATE	10	-	-	-	-	-	-	1	-	-	-	-	-	-	1
KARNATAKA STATE	11	-	1	-	2	-	1	1	-	-	-	-	3	-	8
ORISSA & BIHAR STATES	12	1	-	3	1	4	-	-	-	2	-	1	1	-	13
REST OF INDIAN STATES	13	-	-	-	1	-	-	-	-	-	-	-	-	-	1
TOTAL		157	82	160	128	151	9	70	-	19	1	10	27	1	815

TABLE 5.20

ORIGIN AND DESTINATION STUDY TRIP MATRIX FOR BUSES (BOTH DIRECTIONAL)

LOCATION : DELINEATION OF TRAFFIC ZONES ON NH-9

ORIGIN ZONES		DESTINATION ZONES													
		VIJAYA-WADA HANUMAN JUNCTION	ELURU-HANUMAN JUNCTION	OTHER PARTS OF KRISHNA DIST.	OTHER PARTS OF WEST GODAVARI DIST.	KHAMMAM EAST GODAVARI GUNTUR NALGONDA DISTS.	ALL OTHER COAS-TAL DISTS.	ALL OTHER TELAN-GANA DISTS.	ALL RAYALA SEEMA DISTS.	TAMIL NADU & KERALA STATE	W.BENGAL & ORISSA STATES	KARNATAKA MP, MAHARA-SHTRA, BIHAR STATES	NORTH EAST AREA	REST OF INDIAN STATES	TOTAL
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	
VIJAYAWADA-NANDIGAM	1	4	48	16	1	44	-	-	-	-	-	-	-	-	113
OTHER PARTS OF KRISHNA DIST.	2	44	8	13	3	11	-	-	-	-	-	-	-	-	79
KHAMMAM, WEST GODAVARI, GUNTUR NALGONDA DIST.	3	15	8	9	5	32	1	-	-	-	-	-	-	-	70
OTHER COASTAL DIST.	4	-	4	-	2	2	-	-	-	-	-	-	-	-	8
ALL TELANGANA DISTS.	5	20	10	17	15	-	-	-	-	-	-	-	-	-	62
ALL RAYALASEEMA DISTS.	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TAMIL NADU STATE	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KERALA STATE	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAHARASHTRA STATE	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MADHYA PRADESH STATE	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KARNATAKA STATE	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ORISSA & BIHAR STATES	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REST OF INDIAN STATES	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		83	78	55	26	89	1	-	-	-	-	-	-	-	332

TABLE 5.21

COMMODITY-WISE DISTRIBUTION

LOCATION - NANDIGAMA TO VIJAYAWADA AT KM. 253/4 ON NH-9
DURATION - 8.0 AM ON 6/2/93 TO 8.0 AM ON 7/2/93
DIRECTION - TOWARDS VIJAYAWADA

S.NO	COMMODITY	TOTAL NO. OF TURCKS SURVEYED	%	TOTAL WT. OF COMMODITY (IN M.T.)	%
1.	Grocery	132	16.22	1252	16.02
2.	Vegetables	40	4.91	387	4.95
3.	Fruit /dry fruits	34	4.18	325	4.16
4.	Milk/Milk products	2	0.25	19.4	0.25
5.	Cement	130	15.97	1225	15.67
6.	Stone	37	4.55	380	4.86
7.	Iron/Scrap/Steel	44	5.4	427	5.46
8.	Animal/Meat/Fish/ Hen	16	1.97	187.2	2.39
9.	Paper	23	2.83	351	4.49
10.	Scooter/M.Cycles/ Vehicles	2	0.25	10.8	0.14
11.	Sugar	11	1.35	114	1.46
12.	Thread/Cotton	27	3.32	216	2.76
13.	Cloth	1	0.12	5	0.064
14.	Oil	18	2.21	182	2.33
15.	Plastic goods	8	0.98	82	1.05
16.	Sand/Lime	3	0.37	30	0.39
17.	Sulphur	1	0.12	10	0.13
18.	Tobacoo/Bedi/Cig.	6	0.74	44.55	0.57
19.	Rubber/tyre	3	0.37	21	0.27
20.	Wood	33	4.05	319	4.08
21.	Jute	4	0.49	41	0.52
22.	Wine	1	0.12	10.7	0.137
23.	Leather (Taned)	1	0.12	9	0.11
24.	Machinery	5	0.61	30	0.38
25.	Gas (L.P.G.)	10	1.22	99	0.27
26.	Leather	3	0.37	30	0.38
27.	Medicine	7	0.86	65	0.83
28.	Chemicals	26	3.19	234	3.0
29.	Tv/Radio/Electric Eqp.	11	1.35	50	0.64
30.	Others	174	21.38	1659	21.22
31.	Empty	1	0.12	-	-
	Total	814	100	7815.65	100

TABLE 5.22

COMMODITY-WISE DISTRIBUTION

LOCATION - VIJAYWADA TO ELURU AT KM. 50/8 ON NH-5
DURATION - 8.30 AM ON 11-1-93 TO 8.30 AM ON 12-1-93
DIRECTION - TOWARDS ELURU

S.NO	COMMODITY	TOTAL NO. OF TURCKS SURVEYED	%	TOTAL WT. OF COMMODITY (IN M.T.)	%
1.	Grocery	242	23.36	2372	24.7
2.	Vegetables	34	3.28	329	3.43
3.	Fruit /dry fruits	34	3.28	325	3.38
4.	Milk/Milk products	5	0.48	49	0.51
5.	Cement	88	8.49	973	10.13
6.	Stone	51	4.92	524	5.46
7.	Iron/Scrap/Steel	47	4.54	456	4.75
8.	Animal/Meat/Fish/ Hen	56	5.41	655	6.82
9.	Paper	10	0.96	153	1.59
10.	Scooter/M.Cycle/ Vehicle	4	0.39	40	0.42
11.	Sugar	8	0.77	83.0	0.86
12.	Thread/Cotton	19	1.83	152	1.58
13.	Cloth	9	0.87	45	0.47
14.	Oil	43	4.15	679	7.07
15.	Plastic goods	5	0.48	51	0.53
16.	Sand/Lime	9	0.87	90	0.94
17.	Sulphur	3	0.29	30	0.31
18.	Tobacoo/Bedi/Cig.	14	1.35	104.0	1.08
19.	Rubber/tyre	13	1.25	91.0	0.95
20.	Wood	13	1.25	126	1.31
21.	Jute	12	1.16	123	1.28
22.	Wine	4	0.39	43	0.45
23.	Leather (Taned)	1	0.097	9	0.09
24.	Machinery	23	2.22	138	1.44
25.	Gas (L.P.G.)	16	1.54	158.4	1.65
26.	Leather	-	-	-	-
27.	Medicine	1	0.097	9	0.09
28.	Chemicals	62	5.98	558	5.81
29.	TV/Radio/Electric Eqp.	4	0.39	18	0.19
30.	Others	128	12.36	1220	12.7
31.	Empty	78	7.53	-	-
	Total	1036	100	9603.4	100

TABLE 5.23

LOAD EQUIVALENCY FACTORS AS PER ASSHTO

Single Axle		Tandem Axle	
Load(kg)	Equi.Factors	Load(kg)	Equi.Factors
1000	0.0002	5000	0.010
2000	0.003	6000	0.022
3000	0.014	7000	0.045
4000	0.05	8000	0.074
5000	0.13	9000	0.115
6000	0.28	10000	0.172
7000	0.52	11000	0.265
8000	0.93	12000	0.38
9000	1.44	13000	0.53
10000	2.33	14000	0.73
11000	3.50	15000	0.97
12000	5.00	16000	1.27
13000	7.16	17000	1.63
14000	9.88	18000	2.06
15000	13.35	19000	2.60
16000	17.74	20000	3.22
17000	23.17	21000	3.94
18000	29.93	22000	4.65
19000	36.50		
20000	44.50		
21000	53.00		
22000	62.25		

TABLE 5.24

SUMMARY OF AXLE LOAD SURVEY AT KM 50/8 OF NH-5 AND COMPUTATION OF VEHICLE DAMAGE FACTOR (VDF)

S.NO	RANGE OF LOADING (M.T.)	TOTAL NO. OF SINGLE AXLE	EQUIVALENT FACTOR	EQUIVALENT STD AXLE
1	0.0-5	11	7.14×10^{-5}	0.001
2	1.6-2.5	52	3.98×10^{-3}	0.207
3	2.6-3.5	97	0.0195	1.892
4	3.6-4.5	322	0.0607	19.545
5	4.6-5.5	400	0.147	58.800
6	5.6-6.6	234	0.302	70.668
7	6.5-7.5	36	0.557	20.052
8	7.6-8.5	21	0.947	19.887
9	8.6-9.5	36	1.513	54.468
10	9.6-10.5	139	2.301	319.837
11	10.6-11.5	548	3.363	1842.924
12	11.6-12.5	104	4.755	494.520
13	12.6-13.5	18	6.542	117.756
14	13.6-14.5	14	8.789	123.046
15	14.6-15.5	4	11.571	46.284
16	15.6-16.5	6	14.967	89.82
17	16.6-17.5	4	19.061	76.244
18	17.6-18.5	3	23.941	71.823
	TOTAL	2049		3427.776

$$\text{Equivalent Standard Axle} = \frac{3427.776}{2049} = 1.673$$

Equivalent Standard Axle per vehicle = 2 x 1.673
= 3.346 say 3.35

TABLE 5.25

SUMMARY OF AXLE LOAD SURVEY AT KM 252/8 OF NH-9 AND COMPUTATION OF VEHICLE DAMAGE FACTOR (VDF)

S.NO	RANGE OF LOADING (M.T.)	TOTAL NO. OF SINGLE AXLE	EQUIVALENT FACTOR	EQUIVALENT STD AXLE
1	0.0-5	02	7.14×10^{-5}	-
2	1.6-2.5	39	3.98×10^{-3}	0.155
3	2.6-3.5	40	0.0195	0.780
4	3.6-4.5	231	0.0607	14.022
5	4.6-5.5	496	0.147	72.912
6	5.6-6.6	95	0.302	28.690
7	6.5-7.5	18	0.557	10.026
8	7.6-8.5	26	0.947	24.622
9	8.6-9.5	60	1.513	90.780
10	9.6-10.5	211	2.301	485.511
11	10.6-11.5	360	3.363	1210.680
12	11.6-12.5	138	4.755	656.190
13	12.6-13.5	10	6.542	65.420
14	13.6-14.5	1	8.789	8.789
15	14.6-15.5	-	11.571	-
16	15.6-16.5	1	14.967	14.967
17	16.6-17.5	-	19.061	-
18	17.6-18.5	-	23.941	-
	TOTAL	1728		2683.544

Equivalent Standard Axle $= \dfrac{2683.544}{1728} = 1.553$

Equivalent Standard Axle per vehicle = 2 x 1.553
= 3.106 say 3.1

TABLE 5.26

COMPUTATION OF ROUGHNESS OF VIJAYAWADA-ELURU SECTION OF NH-5

1. Length of Test Section : 74 km.
2. Single/Double Carriageway : Double
3. Width of carriageway : 6.7 m
4. Type of Surface : MSS/PC
5. New Construction/ Last Renewal : Renewal
6. Periof of Construction/ Renewal : -
7. Type Pressure : 2.1 kg/cm^2
8. Test Speed : 30 km/hr.
9. No. of standard wheel revolution/km. : 460
10. Name of Testing Team Leader: Mr. K. Mohan

	B.T. Counter Reading		Number of Wheel Revolutions		Average No.		Roughness in mm/km.
Km.	Vijayawada to Nandigama Lane Left	Nandigama to Vijayawada Lane Right	Vijayawada to Nandigama Lane Left	Nandigama to Vijayawada Lane Right	B.T. Counter Reading	No. of Wheel Revolution	
1	2	3	4	5	6	7	8
7	170.00	165.00	461.00	454.00	167.50	458.00	4273.00
8	146.00	154.00	455.00	454.00	150.00	454.00	3860.00
9	148.00	141.00	446.00	450.00	144.50	448.00	3766.00
10	101.00	119.00	452.00	451.00	110.00	451.00	2849.00
11	109.00	121.00	457.00	455.00	115.00	456.00	2947.00
12	142.00	137.00	446.00	444.00	139.50	445.00	3662.00
13	136.00	129.00	442.00	445.00	132.50	443.50	3491.00
14	132.00	130.00	438.00	440.00	131.00	439.00	3487.00
15	130.00	132.00	446.00	447.00	131.00	446.50	3428.00
16	146.00	144.00	437.00	430.00	145.00	433.50	3908.00
17	156.00	164.00	454.00	460.00	160.00	457.00	4091.00
18	149.00	150.00	452.00	456.00	149.50	454.00	3847.00
19	129.00	121.00	456.00	455.00	125.00	455.50	3206.00
20	156.00	155.00	449.00	446.00	155.50	447.50	4060.00
21	164.00	166.00	438.00	437.00	165.00	437.50	4407.00

1	2	3	4	5	6	7	8
22	142.00	144.00	452.00	457.00	143.00	454.50	3676.00
23	147.00	149.00	444.00	449.00	148.00	446.50	3873.00
24	139.00	146.00	429.00	434.00	142.50	431.50	3859.00
25	164.00	154.00	439.00	444.00	159.00	441.50	4208.00
26	156.00	159.00	439.00	436.00	157.50	437.50	4206.00
27	139.00	143.00	444.00	450.00	142.50	447.00	3712.00
28	144.00	129.00	449.00	455.00	136.50	452.00	3528.00
29	149.00	166.00	429.00	436.00	157.50	432.50	4255.00
30	155.00	156.00	466.00	461.00	155.50	463.50	3920.00
31	147.00	156.00	466.00	463.00	151.50	464.50	3811.00
32	144.00	149.00	437.00	444.00	146.50	440.50	3886.00
33	141.00	140.00	449.00	456.00	140.50	442.50	3628.00
34	129.00	159.00	452.00	460.00	144.00	456.00	3690.00
35	161.00	157.00	426.00	427.00	159.00	426.50	4356.00
36	157.00	155.00	444.00	446.00	156.00	445.00	4096.00
37	164.00	161.00	424.00	429.00	162.50	426.50	4452.00
38	169.00	156.00	470.00	466.00	162.50	468.00	4057.00
39	159.00	137.00	466.00	461.00	148.00	463.50	3731.00
40	171.00	156.00	460.00	456.00	163.50	458.00	4071.00
41	167.00	161.00	437.00	439.00	164.00	438.00	4375.00
42	156.00	166.00	447.00	442.00	161.00	444.50	4232.00
43	155.00	147.00	434.00	429.00	151.00	431.50	4089.00
44	134.00	154.00	439.00	439.00	144.00	439.00	3833.00
45	139.00	161.00	444.00	447.00	150.00	445.50	3934.00
46	144.00	151.00	456.00	460.00	147.50	458.00	3763.00
47	149.00	144.00	437.00	435.00	146.50	436.00	3926.00
48	152.00	155.00	449.00	444.00	153.50	446.50	4017.00
49	139.00	160.00	454.00	459.00	149.50	456.50	3826.00
50	162.00	155.00	455.00	461.00	158.50	458.00	4043.00
51	165.00	157.00	429.00	434.00	161.00	431.50	4359.00
52	171.00	161.00	461.00	454.00	166.00	457.50	4239.00
53	131.00	121.00	449.00	442.00	110.00	445.50	2888.00
54	126.00	129.00	456.00	454.00	127.50	455.00	3274.00
55	146.00	139.00	462.00	456.00	142.50	459.00	3627.00
69	155.00	159.00	449.00	452.00	157.00	450.50	4072.00
70	142.00	147.00	449.00	454.00	144.00	451.50	3739.00
71	149.00	159.00	431.00	436.00	154.00	433.50	4151.00
72	159.00	169.00	459.00	466.00	164.00	462.50	4143.00
73	164.00	139.00	447.00	454.00	151.50	450.50	3929.00
74	159.00	176.00	436.00	430.00	167.50	433.00	4520.00
75	161.00	155.00	447.00	449.00	158.00	448.00	4121.00

TABLE 5.27

COMPUTATION OF ROUGHNESS NANDIGAMA-VIJAYAWADA SECTION OF NH-9

1. Length of Test Section : 48 km.
2. Single/Double Carriageway : Double
3. Width of carriageway : 6.7 m
4. Type of Surface : MSS/PC
5. New Construction/ Last Renewal : Renewal
6. Period of Construction/ Renewal : -
7. Type Pressure : 2.1 kg/cm^2
8. Test Speed : 30 km/hr.
9. No. of Wheel revolution/km.: 460
10. Name of Testing Team Leader: Mr. K. Mohan

Km.	B.T. Counter Reading: Vijayawada to Nandigama Lane Left	B.T. Counter Reading: Nandigama to Vijayawada Lane Right	Number of Wheel Revolutions: Vijayawada to Nandigama Lane Left	Number of Wheel Revolutions: Nandigama to Vijayawada Lane Right	Average No.: B.T. Counter Reading	Average No.: No. of Wheel Revolution	Roughness in mm/km.
1	2	3	4	5	6	7	8
265.00	155.00	164.00	461.00	464.00	159.50	462.50	4029.00
264.00	144.00	139.00	449.00	444.00	141.50	446.50	3703.00
263.00	166.00	166.00	454.00	449.00	166.00	451.50	4296.00
262.00	130.00	132.00	442.00	437.00	131.00	439.50	3483.00
261.00	149.00	150.00	452.00	456.00	149.50	454.00	3847.00
260.00	139.00	149.00	447.00	451.00	144.00	449.00	3747.00
259.00	130.00	142.00	454.00	456.00	136.00	455.00	3492.00
258.00	164.00	166.00	452.00	454.00	165.00	453.00	4256.00
257.00	162.00	157.00	461.00	465.00	159.50	463.00	4025.00
256.00	166.00	160.00	436.00	440.00	163.00	438.00	4348.00
255.00	166.00	159.00	438.00	437.00	162.50	437.50	4340.00
254.00	154.00	148.00	443.00	448.00	151.00	445.50	3960.00
253.00	143.00	156.00	431.00	434.00	149.50	432.50	4039.00
252.00	141.00	146.00	454.00	456.00	143.50	455.00	3685.00
251.00	156.00	159.00	450.00	448.00	157.50	449.00	4098.00

1	2	3	4	5	6	7	8
250.00	154.00	155.00	450.00	452.00	154.50	451.00	4003.00
249.00	155.00	160.00	454.00	456.00	157.50	455.00	4045.00
248.00	169.00	167.00	455.00	455.00	168.00	455.00	4315.00
247.00	166.00	160.00	450.00	450.00	163.00	450.00	4932.00
246.00	180.00	161.00	454.00	452.00	170.50	453.00	4398.00
245.00	166.00	165.00	446.00	449.00	165.50	447.50	4321.00
244.00	184.00	185.00	447.00	452.00	184.50	449.50	4796.00
243.00	128.00	134.00	470.00	466.00	131.00	468.00	3645.00
242.00	136.00	160.00	464.00	461.00	148.00	462.50	3739.00
241.00	140.00	150.00	466.00	464.00	145.00	465.00	3644.00
240.00	128.00	139.00	446.00	454.00	133.50	450.00	3726.00
239.00	186.00	170.00	442.00	447.00	178.00	444.50	4679.00
238.00	157.00	154.00	464.00	464.00	155.50	464.00	3915.00
237.00	156.00	150.00	459.00	454.00	153.00	456.50	3916.00
236.00	154.00	152.00	444.00	449.00	153.00	446.50	4004.00
235.00	139.00	148.00	466.00	461.00	143.50	463.50	3618.00
234.00	147.00	144.00	462.00	460.00	145.50	461.00	3688.00
233.00	158.00	151.00	460.00	464.00	154.50	462.00	3907.00
232.00	148.00	154.00	461.00	460.00	151.00	460.50	3831.00
231.00	164.00	157.00	462.00	462.00	160.50	462.00	4059.00
230.00	161.00	158.00	457.00	459.00	159.50	458.00	4069.00
229.00	162.00	152.00	458.00	458.00	157.00	458.00	4005.00
228.00	156.00	147.00	446.00	447.00	151.50	446.50	3794.00
227.00	154.00	161.00	452.00	459.00	157.50	455.50	4040.00
226.00	156.00	162.00	452.00	455.00	159.00	453.50	4096.00
225.00	154.00	166.00	456.00	459.00	160.00	457.50	4086.00
224.00	148.00	154.00	461.00	460.00	151.00	460.50	3831.00
223.00	144.00	152.00	462.00	466.00	148.00	464.00	3727.00
222.00	139.00	139.00	459.00	456.00	139.00	457.50	3550.00
221.00	136.00	142.00	447.00	449.00	139.00	448.00	4173.00
220.00	132.00	150.00	460.00	458.00	141.00	459.00	3589.00
219.00	154.00	152.00	461.00	457.00	153.00	459.00	3895.00
218.00	150.00	161.00	457.00	459.00	155.50	458.00	3967.00
217.00	156.00	157.00	458.00	452.00	156.50	455.00	4019.00

Table No. 5.28

ANALYSIS OF PAST TRENDS

(NH No. 5 Km 13/2)

CARS

DATE	NUMBERS
Jul-90	963
Jan-91	902
Jul-91	916
Jan-92	951
Jul-92	962
Jan-93	1142

Regression equation
LOG P = 2.926 + 0.027 x

R squared = 0.472

Annual growth rate = 6.39%

Table No. 5.29

ANALYSIS OF PAST TRENDS

(NH No. 5 Km 13/2)

BUSES

DATE	NUMBERS
Jul-90	616
Jan-91	563
Jul-91	586
Jan-92	595
Jul-92	637
Jan-93	766

Regression equation
LOG P = 2.713 + 0.037 x

R squared = 0.526

Annual growth rate = 8.79%

Table No. 5.30

ANALYSIS OF PAST TRENDS

(NH No. 5 Km 13/2)

TRUCKS

DATE	NUMBERS
Jul-90	3247
Jan-91	3127
Jul-91	3202
Jan-92	3277
Jul-92	3312
Jan-93	4034

Regression equation
LOG P = 3.454 + 0.032 x

R squared = 0.549

Annual growth rate = 7.59%

Table No. 5.31

ANALYSIS OF PAST TRENDS

(NH No. 5 Km 13/2)

2-WHLRS

DATE	NUMBERS
Jul-90	1505
Jan-91	1430
Jul-91	1490
Jan-92	1509
Jul-92	1578
Jan-93	2077

Regression equation
LOG P = 3.093 + 0.048 x

R squared = 0.571

Annual growth rate = 11.59%

Table No. 5.32

ANALYSIS OF PAST TRENDS

(NH No. 5 Km 45/6)

CARS

DATE	NUMBERS
Dec-89	746
Jul-90	1106
Jan-91	1074
Jul-91	1101
Jan-92	1136
Jul-92	1158
Jan-93	1019

Regression equation
LOG P = 2.930 + 0.034 x

R squared = 0.321

Annual growth rate = 8.12%

Table No. 5.33

ANALYSIS OF PAST TRENDS

(NH No. 5 Km 45/6)

BUSES

DATE	NUMBERS
Dec-89	719
Jul-90	655
Jan-91	628
Jul-91	721
Jan-92	692
Jul-92	771
Jan-93	852

Regression equation
LOG P = 2.783 + 0.028 x

R squared = 0.484

Annual growth rate = 6.64%

Table No.5.34

ANALYSIS OF PAST TRENDS

(NH No. 5 Km 45/6)

TRUCKS

DATE	NUMBERS
Dec-89	3260
Jul-90	4145
Jan-91	3997
Jul-91	4185
Jan-92	4248
Jul-92	4371
Jan-93	4139

Regression equation
LOG P = 3.535 + 0.027 x

R squared = 0.505

Annual growth rate = 6.51%

Table No. 5.35

ANALYSIS OF PAST TRENDS

(NH No. 5 Km 45/6)

2-WHLRS

DATE	NUMBERS
Dec-89	1494
Jul-90	1725
Jan-91	1685
Jul-91	1741
Jan-92	1833
Jul-92	1846
Jan-93	1971

Regression equation
LOG P = 3.160 + 0.032 x

R squared = 0.873

Annual growth rate = 7.70%

Table No. 5.36

ANALYSIS OF PAST TRENDS

(NH No. 9 Km 198/0 / 219/6)

CARS

DATE	NUMBERS
Jun-87	753
Dec-87	780
Jun-88	784
Dec-88	775
Jun-89	789
Dec-89	888
Jan-91	947
Jul-91	981
Jan-92	1087
Jul-92	1065
Jan-93	937

Regression equation
LOG P = 2.842 + 0.027 x

R squared = 0.819
Annual growth rate = 6.54%

Table No.5.37

ANALYSIS OF PAST TRENDS

(NH No. 9 Km 198/0 / 219/6)

BUSES

DATE	NUMBERS
Jun-87	755
Dec-87	783
Jun-88	783
Dec-88	776
Jun-89	788
Dec-89	1172
Jan-91	1185
Jul-91	1201
Jan-92	1255
Jul-92	1276
Jan-93	682

Regression equation
LOG P = 2.864 + 0.029 x

R squared = 0.270
Annual growth rate = 6.96%

Table No.5.38

ANALYSIS OF PAST TRENDS
(NH No. 9 Km 198/0 / 219/6)

TRUCKS

DATE	NUMBERS
Jun-87	2578
Dec-87	2631
Jun-88	2672
Dec-88	2612
Jun-89	2689
Dec-89	3110
Jan-91	3300
Jul-91	3325
Jan-92	3406
Jul-92	3433
Jan-93	2707

Regression equation
LOG P = 3.395 + 0.019 x

R squared = 0.498
Annual growth rate = 4.50%

Table No.5.39

ANALYSIS OF PAST TRENDS

(NH No. 9 Km 198/0 / 219/6)

2-WHLRS

DATE	NUMBERS
Jun-87	313
Dec-87	338
Jun-88	348
Dec-88	337
Jun-89	352
Dec-89	360
Jan-91	399
Jul-91	412
Jan-92	456
Jul-92	467
Jan-93	799

Regression equation
LOG P = 2.418 + 0.049 x

R squared = 0.703
Annual growth rate = 12.04%

Table No. 5.40

ANALYSIS OF PAST TRENDS

(NH No. 9 Km 253/4)

CARS

DATE	NUMBERS
Dec-89	2682
Jul-90	2821
Jan-91	2934
Jul-91	3126
Jan-92	3258
Jul-92	3390
Jan-93	3212

Regression equation
LOG P = 3.405 + 0.031 x

R squared = 0.857

Annual growth rate = 7.37%

Table No. 5.41

ANALYSIS OF PAST TRENDS

(NH No. 9 Km 253/4)

BUSES

DATE	NUMBERS
Dec-89	2222
Jul-90	2360
Jan-91	2489
Jul-91	2635
Jan-92	2772
Jul-92	2929
Jan-93	2288

Regression equation
LOG P = 3.351 + 0.019 x

R squared = 0.226

Annual growth rate = 4.54%

TABLE NO. 5.42

ANALYSIS OF PAST TRENDS

(NH No. 9 Km 253/4)

TRUCKS

DATE	NUMBERS
Dec-89	5973
Jul-90	6361
Jan-91	6669
Jul-91	6849
Jan-92	7072
Jul-92	7366
Jan-93	6437

Regression equation
LOG P = 3.778 + 0.018 x

R squared = 0.408

Annual growth rate = 4.16%

Table No. 5.43

ANALYSIS OF PAST TRENDS

(NH No. 9 Km 253/4)

2-WHLRS

DATE	NUMBERS
Dec-89	2404
Jul-90	2508
Jan-91	2638
Jul-91	2776
Jan-92	2862
Jul-92	2985
Jan-93	2807

Regression equation
LOG P = 3.362 + 0.027 x

R squared = 0.816

Annual growth rate = 6.48%

TABLE 5.44

CALCULATION OF GROWTH RATES BY ELASTICITY METHOD

Population growth rate	-	2.16% per annum
Growth rate of Net State Domestic Product (As proxy for Real Income per capita)	-	2.90% per annum
Growth rate of agriculture	-	8% per annum
Industrial growth rate	-	2% per annum
Mining growth rate	-	13% per annum
Tourism growth rate	-	10% per annum

Growth rate for Passenger vehicles:

a) Cars	- 2.0	[1.0216 x 1.029 - 1] x 100 =	10.24%
b) Buses	- 1.6	[1.0216 x 1.029 - 1] x 100 =	8.20%
c) Two-wheelers	- 2.5	[1.0216 x 1.029 - 1] x 100 =	12.81%

Growth rate for trucks

2 x [Average growth rate of agriculture (weightage 5), Industrial growth (weightage 6) mining (weightage 1) and tourism (weightage 0.04)] = 2 x (8 x 5 + 2 x 6 + 13 x 1 + 10 x .04)/12.04=10.86%

NOTE:-

The weightage assigned to various economic activities are in proportion to the revised budget estimates of the Andhra Pradesh Government for the year 1991-92 which are as follows:-

Sl. No.	Sector	Revised Budget estimate for 1991-92 in Lakhs Rs.	Weightage
1.	Agriculture	5341	5
2.	Industry	5983	6
3.	Mining	925	1
4.	Tourism	35	0.04

TABLE 5.45

CALCULATION OF GROWTH RATE AS PER REGISTRATION OF VEHICLES IN ANDHRA PRADESH BETWEEN 1987 AND 1992

	1987	1992	Growth Rate
CARS (i/c Taxis, Cabs, Jeeps)	67059	118572	12.0%
BUSES	13631	20228	8.2%
TRUCKS	55915	81455	7.8%
2-WHEELERS	623410	1217322	14.3%

Table No. 5.46

AVERAGE ANNUAL GROWTH RATES IN PER CENT

Sl. No.	NH No.	Km	CARS	BUSES	TRUCKS	2-WHLRS
1.	5	13/2	6.39	8.79	7.59	11.59
		45/6	8.12	6.64	6.51	7.70
2.	9	219/6 (198/0)	6.54	6.96	4.50	12.04
		253/4	7.37	4.54	4.16	6.48
3.	Elasticity method		10.24	8.20	10.86	12.81
	Average of items 1,2&3		7.73	7.03	6.72	10.12
4.	Growth of registered vehicles in AP		12.00	8.20	7.80	14.30

TABLE NO. 5.47

TRAFFIC PROJECTIONS

PROJECT: STRENGTHENING AND FOUR LANING NH NO. 5
SECTION - KM.3/40 TO KM. 13/00

COUNT STATION - NH NO. 5 KM. 13/2

YEAR	CAR/JEEPS TAXIS	BUSES	TRUCKS	LCV	TWO WHEELERS	ANIMAL DRAWN	CYCLES	OTHERS	TOTAL NUMBERS	TOTAL PCUs
Average 1993	1142	766	4034	413	2077	63	3774	403		
GROWTH) RATES %)	7.73	7.03	6.72	6.88	10.12	0.00	10.12	6.88		
YEAR										
1993	1142	766	4034	413	2077	63	3774	403	12672	20644
1994	1230	820	4305	441	2287	63	4156	431	13733	22118
GROWTH) RATES %)	7.73	7.03	6.38	6.71	9.31	0.00	9.31	6.71		
1995	1325	878	4580	471	2500	63	4543	460	14820	23633
1996	1428	939	4872	502	2733	63	4966	491	15994	25250
1997	1538	1005	5183	536	2987	63	5428	524	17264	26987
1998	1657	1076	5513	572	3265	63	5934	559	18639	28846
1999	1785	1152	5865	610	3569	63	6486	596	20126	30840
2000	1923	1233	6239	651	3901	63	7090	636	21736	32977
2001	2072	1319	6637	695	4265	63	7750	679	23480	35268
2002	2232	1412	7061	741	4662	63	8471	725	25367	37727
2003	2404	1511	7511	791	5096	63	9260	773	27409	40358
2004	2590	1618	7991	844	5570	63	10122	825	29623	43189
GROWTH) RATES %)	6.96	6.59	6.04	6.32	8.50	0.00	8.50	6.32		
2005	2770	1725	8474	897	6043	63	10982	877	31831	46021
2006	2963	1838	8985	954	6557	63	11916	933	34209	49041
2007	3169	1959	9528	1014	7115	63	12929	992	36769	52269
2008	3390	2089	10104	1078	7719	63	14028	1054	39525	55717
2009	3626	2226	10714	1147	8376	63	15220	1121	42493	59398
2010	3878	2373	11361	1219	9087	63	16514	1192	45687	63328
2011	4148	2529	12047	1296	9860	63	17918	1267	49128	67524
2012	4437	2696	12775	1378	10698	63	19441	1347	52835	72010
2013	4746	2874	13547	1465	11607	63	21094	1432	56828	76803
2014	5076	3063	14365	1558	12594	63	22887	1523	61129	81921 *
2015	5429	3265	15232	1656	13665	63	24832	1619	65761	87387
2016	5807	3480	16152	1761	14826	63	26943	1721	70753	93230
2017	6211	3709	17128	1872	16087	63	29233	1830	76133	99476
2018	6644	3954	18163	1990	17454	63	31718	1946	81932	106155

* Maximum capacity

TABLE NO. 5.48

TRAFFIC PROJECTIONS

PROJECT: STRENGTHENING NH NO. 5
SECTION - KM.13/00 TO KM. 75/00

COUNT STATION - NH NO. 5 KM. 45/6

YEAR	CAR/JEEPS TAXIS	BUSES	TRUCKS	LCV	TWO WHEELERS	ANIMAL DRAWN	CYCLES	OTHERS	TOTAL NUMBERS	TOTAL PCUs
Average 1993	1019	852	4154	285	1971	41	1686	512		
GROWTH) RATES %)	7.73	7.03	6.72	6.88	10.12	0.00	10.12	6.88		
YEAR										
1993	1019	852	4154	285	1971	41	1686	512	10520	20321
1994	1098	912	4433	305	2170	41	1857	547	11363	21747
GROWTH) RATES %)	7.73	7.03	6.38	6.71	9.31	0.00	9.31	6.71		
1995	1183	976	4716	325	2372	41	2030	584	12227	23213
1996	1274	1045	5017	347	2593	41	2219	623	13159	24782
1997	1373	1118	5337	371	2834	41	2425	665	14164	26459
1998	1479	1197	5677	395	3098	41	2651	709	15247	28249
1999	1593	1281	6039	422	3387	41	2898	757	16418	30168 *
2000	1717	1371	6425	450	3702	41	3168	808	17682	32224
2001	1849	1467	6835	481	4046	41	3463	862	19044	34419
2002	1992	1571	7271	513	4423	41	3785	920	20516	36772
2003	2146	1681	7735	547	4835	41	4138	981	22104	39284
2004	2312	1799	8228	584	5285	41	4523	1047	23819	41975
GROWTH) RATES %)	6.96	6.59	6.04	6.32	8.50	0.00	8.5	6.32		
2005	2473	1918	8725	621	5734	41	4907	1113	25532	44675
2006	2645	2044	9252	660	6222	41	5325	1184	27373	47553
2007	2829	2179	9811	702	6750	41	5777	1258	29347	50618
2008	3026	2322	10403	746	7324	41	6268	1338	31468	53884
2009	3237	2475	11032	793	7947	41	6801	1422	33748	57368
2010	3462	2638	11698	844	8622	41	7379	1512	36196	61082
2011	3703	2812	12405	897	9355	41	8006	1608	38827	65044
2012	3961	2998	13154	954	10150	41	8687	1709	41654	69266
2013	4236	3195	13948	1014	11013	41	9425	1818	44690	73766
2014	4531	3406	14791	1078	11949	41	10226	1932	47954	78566
2015	4846	3630	15684	1146	12965	41	11096	2055	51463	83685
2016	5184	3869	16631	1218	14067	41	12039	2184	55233	89139
2017	5545	4124	17636	1295	15263	41	13062	2322	59288	94963
2018	5930	4396	18701	1377	16560	41	14172	2469	63646	101174

* Maximum capacity

TABLE NO. 5.49

TRAFFIC PROJECTIONS

PROJECT: STRENGTHENING NH NO. 9
SECTION - KM.217 TO KM. 252

COUNT STATION - NH NO. 9 KM. 219/60

YEAR	CAR/JEEPS TAXIS	BUSES	TRUCKS	LCV	TWO WHEELERS	ANIMAL DRAWN	CYCLES	OTHERS	TOTAL NUMBERS	TOTAL PCUs
Average 1993	937	682	2707	378	799	38	1798	793		
GROWTH) RATES %)	7.73	7.03	6.72	6.88	10.12	0.00	10.12	6.88		
YEAR										
1993	937	682	2707	378	799	38	1798	793	8132	15213
1994	1009	730	2889	404	880	38	1980	848	8778	16280
GROWTH) RATES %)	7.73	7.03	6.38	6.71	9.31	0.00	9.31	6.71		
1995	1087	781	3073	431	962	38	2164	905	9441	17376
1996	1172	836	3269	460	1051	38	2366	966	10158	18552
1997	1262	895	3478	491	1149	38	2586	1030	10929	19808
1998	1360	958	3700	524	1256	38	2827	1100	11763	21156
1999	1465	1025	3936	559	1373	38	3090	1173	12659	22591
2000	1578	1097	4187	597	1501	38	3378	1252	13628	24131
2001	1700	1175	4454	637	1641	38	3692	1336	14673	25781
2002	1831	1257	4738	679	1794	38	4036	1426	15799	27541
2003	1973	1345	5041	725	1961	38	4412	1521	17016	29429
2004	2125	1440	5362	773	2143	38	4822	1623	18326	31447 *
GROWTH) RATES %)	6.96	6.59	6.04	6.32	8.50	0.00	8.5	6.32		
2005	2273	1535	5686	822	2325	38	5232	1726	19637	33473
2006	2431	1636	6029	874	2523	38	5677	1835	21043	35629
2007	2600	1744	6393	929	2737	38	6159	1951	22551	37929
2008	2781	1859	6780	988	2970	38	6683	2074	24173	40383
2009	2975	1981	7189	1050	3222	38	7251	2205	25911	42994
2010	3182	2112	7623	1117	3496	38	7867	2344	27779	45781
2011	3403	2251	8084	1187	3793	38	8536	2492	29784	48752
2012	3640	2399	8572	1262	4116	38	9261	2650	31938	51920
2013	3894	2557	9090	1342	4466	38	10048	2817	34252	55299
2014	4165	2726	9639	1427	4845	38	10902	2995	36737	58904
2015	4454	2906	10221	1517	5257	38	11829	3185	39407	62748
2016	4764	3097	10838	1613	5704	38	12835	3386	42275	66844
2017	5096	3301	11493	1715	6189	38	13926	3600	45358	71217
2018	5451	3519	12187	1823	6715	38	15109	3828	48670	75883

* Maximum capacity

TABLE NO. 5.50

TRAFFIC PROJECTIONS

PROJECT: STRENGTHENING AND FOUR LANING NH NO. 9
SECTION - KM.252 TO KM. 265

COUNT STATION - NH NO. 9 KM. 253/40

YEAR	CAR/JEEPS TAXIS	BUSES	TRUCKS	LCV	TWO WHEELERS	ANIMAL DRAWN	CYCLES	OTHERS	TOTAL NUMBERS	TOTAL PCUs
Average 1993	3212	1988	6475	303	2807	28	2115	347		
GROWTH RATES %)	7.73	7.03	6.72	6.88	10.12	0.00	10.12	6.88		
YEAR										
1993	3212	1988	6475	303	2807	28	2115	347	17275	32581
1994	3460	2128	6910	324	3091	28	2329	371	18641	34893
GROWTH RATES %)	7.73	7.03	6.38	6.71	9.31	0.00	9.31	6.71		
1995	3728	2278	7351	346	3379	28	2546	396	20052	37280
1996	4016	2438	7820	369	3693	28	2783	422	21569	39828
1997	4326	2609	8319	394	4037	28	3042	451	23206	42558
1998	4660	2793	8849	420	4413	28	3325	481	24969	45475
1999	5021	2989	9414	448	4824	28	3635	513	26872	48599
2000	5409	3199	10015	478	5273	28	3973	548	28923	51943
2001	5827	3424	10654	510	5764	28	4343	585	31135	55521
2002	6277	3665	11333	545	6301	28	4747	624	33520	59349
2003	6762	3922	12056	581	6887	28	5189	666	36091	63444
2004	7285	4198	12826	620	7528	28	5672	710	38867	67832
GROWTH RATES %)	6.96	6.59	6.04	6.32	8.50	0.00	8.5	6.32		
2005	7792	4475	13601	659	8168	28	6154	755	41632	72223
2006	8334	4770	14422	701	8862	28	6677	803	44597	76901
2007	8914	5084	15293	745	9615	28	7245	853	47777	81884 *
2008	9535	5419	16217	792	10433	28	7861	907	51192	87200
2009	10199	5776	17196	842	11320	28	8529	965	54855	92865
2010	10908	6157	18235	896	12282	28	9254	1026	58786	98907
2011	11668	6562	19337	952	13326	28	10040	1090	63003	105342
2012	12480	6995	20504	1012	14458	28	10894	1159	67530	112204
2013	13348	7456	21743	1076	15687	28	11820	1233	72391	119525
2014	14277	7947	23056	1144	17021	28	12824	1310	77607	127323
2015	15271	8471	24449	1217	18467	28	13914	1393	83210	135647
2016	16334	9029	25926	1294	20037	28	15097	1481	89226	144520
2017	17471	9624	27491	1375	21740	28	16380	1575	95684	153980
2018	18687	10258	29152	1462	23588	28	17773	1674	102622	164072

* Maximum capacity

CHAPTER 6

PROJECT ROAD DESCRIPTION

.1 NATIONAL HIGHWAY No.5

.1.1 National Highway No.5 is one of the most important National Highways of this country connecting two mega towns of Madras and Calcutta, running almost along the eastern coast line of India along the Bay of Bengal in a major portion, passing through agricultural and industrial belts, and through important towns of Nellore, Guntur, Vijayawada, Eluru, Rajahmundry, Visakhapatnam, Srikakulam, Bhubaneswar and on to Calcutta, covering all the 9 coastal Sarkar Districts of Andhra Pradesh, and thus it carries heavy commercial traffic all through. Visakhapatnam is itself one of the largest seaports on the eastern coast of India, handling important mineral ores and other commodities of the region. Vijayawada also is the second largest town of Andhra Pradesh and is a very big commercial and business centre. It is a major Railway Junction and many important trains to South India pass through this junction. The population of Vijayawada is almost 6.00 lakhs as per census of 1991. The kilometrage, for the purpose of this project starts from Vijayawada, which has been taken as zero.

Originally, as per TOR, the project was to start from km.6.25 to km.75.00. A new two-lane bridge over river Krishna was constructed in the year 1987, on NH-5 and its approaches join the old NH-5 in km.3.40. A scheme to construct another 2-lane bridge over river Krishna alongwith approaches, approximately 40 m. downstream of the existing new bridge, to make it a 4-lane bridge with 4-lane approaches is likely to be sanctioned shortly by the Ministry of Surface Transport. During discussions in the Ministry of Surface Transport, alongwith the Chief Engineer of the State and Asian Development Bank T.A. Consultants, on the 4th March, 1993, it was decided by the Ministry to start the project from km.3.40 instead of km.6.25, so as to link it with the approaches of the newly constructed bridge over River Krishna, in order to make the project, more meaningful and useful. Hence the project now covers stretch from km.3.40 to km.75.00 of NH-5 instead of from km 6.25 to 75.00.

The section of NH-5 from Km.3.40 to km.13.00, passes through the urban area of Vijayawada town, with built-up residential & commercial areas on both sides. The Siddhartha Medical College lies in km.9 of this stretch. Between km 3.4 to km 5.20,the land width is not defined because the irrigation department land width is not defined, but beetween km.5.2 to km.10.00, 60 m. wide right of way is available, whereas from km.10.00 to 13.00, the right of way varies from 20 m.

to 25 m. with ribbon development all along this stretch. Acquiring additional land in this stretch will be very difficult and hence any improvement has to be limited within the existing land width. There is an old Hanuman temple at km.10.00 on the right hand side of the road at a distance of about 4 m. from the carriageway width. On the other side of the temple, about 17 m. land width is available with the department. There are utility services, like high tension lines, electric and telephone lines, coaxial cables etc., running within the right of way in this stretch. Several side roads from the residential area, on both sides of the road are joining the main road. The existing open spaces within the ROW has poor drainage and water remains accumulated in the reach km.6.25 to 10.00.

Between km.5.4 to 6.25, the carriageway width is 15 m. whereas in the remaining stretch, the width is generally 7.0 m. The alignment of the road is generally straight and the gradients are flat. The road surface is generally rough having an IRI value between 3.0 to 4.3 m/km. The condition of the pavement is generally poor to fair, having cracks, deformations, such as rutting, settlement, pot holes and patching except in km.10 and 11 which are in fairly good condition, since renewal coats have recently been done in these two km. There is a cross junction at km.6.00, where an important and busy city road (Bunder Road) crosses the National Highway. There is another Y-junction at km.9.80, where the old NH-5 after passing through the town of Vijayawada, joins the present NH-5.

There is a major 2-lane bridge over Bunder canal in km.5.17. It is a curved bridge having spans of 1x12+1x48+1x12 = 72 m. and the canal crossing is at a skew angle. There are 17 culverts in this reach.

National Highway No.9, from Pune in Maharashtra, after passing through Hyderabad, the capital city of Andhra Pradesh, joins NH-5 at Vijayawada. The present traffic in this stretch is 22,644 PCUs, consisting mostly of cars, auto-rickshaws, cycles, two-wheelers, buses, trucks etc. This traffic, when projected becomes 28,846 PCUs, by the time, the project is expected to be completed in the year 1998.

The section of the project road between km.13.00 to 75.00 traverses through the agricultural and industrial belts of Krishna and West Godavari districts of the State. These two districts are commonly known as the 'Rice Bowl' of Andhra Pradesh because of the major paddy crop in the area. The terrain is generally plain. The alignment of the road is generally straight with flat gradients but at certain locations, there are curves, some of which are quite sharp and blind, the details of which are explained in subsequent para. The

right of way varies from 25 m. to 30 m. The existing carriageway width varies between 6.7 to 7.0 metre. The road surface is generally rough, having an I.R.I. value between 3.0 to 4.5 m/km. The condition of the pavement is generally poor to fair, having cracks, deformations such as rutting, settlement, pot holes and patching etc. except in km. 15, 16, 20, 21, 22, 31, 40, 41, 49, 50, 51, 52 and 53, which are fairly in good condition, since renewal coats have recently been done in these km. There are no paved/hard shoulders along this road in this entire reach.

The road passes through three important towns in this stretch: Gannavaram in Km.25-26, Hanuman junction in km.46-47 and Eluru in Km.58 to 67. Eluru town is the district headquarters of West Godavari district. The district headquarters of Krishna district is Machlipatnam, although Vijayawada is within the same district. A State highway from Machlipatnam crosses NH-5 at Hanuman junction. All these three towns are big commercial centres and carry enormous business activities.

The Civil Aerodrome of Vijayawada lies in km. 23 on the right side of the road. There are several medium size industries along the road. There is a major co-operative sugar factory in km. 42, having a crushing capacity of 1250 Mt of sugarcane per day which works for a period of about 4 to 5 months from mid November to mid April every year. During 1991-92, it crushed on an average 1000 MT of sugarcane per day.

There are two other State Highways Nos.43 and 44 joining NH-5 in Eluru town.

The road passes through the agricultural belt of the districts. The area is predominantly black cotton and is very rich and fertile. It lies between the delta regions of Krishna and Godavari rivers, which are major rivers of not only Andhra Pradesh but of India. The major crops are paddy, cotton, sugarcane, oilseeds, tobacco etc.

A medium size Budameru river crosses the National Highway in km.20, where a 2-lane high level major bridge exists in good condition. Besides this, there are two other 2-lane high level major bridges, one in km.15 over Ryves canal and another in km.21 over Eluru canal, which are in good condition. The bridge on Ryves canal is combined with an overbridge over the railway line going to Machlipatnam. There are 9 minor bridges in this stretch at chainages 28.62, 31.63, 35.61, 37.20, 38.80, 41.95, 48.75, 71.22 and 73.61. Out of these, a new 2-lane bridge at km.48.75 over river Ramaleru, having 8 Nos. clear spans of 5 m. each, is under construction under a separate scheme, already sanctioned by the MOST. Hence its cost has not been

included in this project. Besides these, there are two 2-lane high level bridges on West and East Tammileru river and a submersible causeway on Vyasa Kavi river within Eluru town in kms. 62, 66 and 68 respectively. In addition, there are 107 culverts in this reach. The general condition of all these bridges and culverts is given in the condition survey sheets.

The portion of the National Highway passing through Eluru town, between km. 58.00 to 67.00, is highly congested, with the available right of way varying from 12.00 to 15.00 m. The road passes through busy markets and business areas. The Madras-Calcutta South-Central broad gauge main railway line crosses the National Highway at four locations within the town, out of which at three places, there are level crossing and at one place an overbridge. Besides, as stated earlier, there are two high level bridges over west and east Tammileru river within the town. All these obstacles are a great hazard for the smooth flow of through traffic to cross the town. The local traffic also faces lot of difficulty in free movement. Environmentally, it creates a lot of dust, noise and pollution due to exhaust from motorized vehicles. The frequent gate closures of the railway crossings, also delay the movement of the through traffic.

In the portion of the Highway from km.69/200 to 75/00, the road surface is in a bad shape. On the left hand side, there are two drains: one Seethampeta drain from km.69/00 to km 71/250 and the other Gunderu drain from km.73.6 to 75.00. The stretch between km. 71.25 to 73.60 also remain flooded on the left side, during the rainy season. However, this Flood level remains below the road formation level and therefore no raising is required. On the right hand side, there is Godavari canal, all these running parallel to the road, with the result that the subgrade of the road remains saturated during the rainy season. The left side berms and side slopes of the road have been eroded during the last few years on account of the drains on left side.

The present day traffic at km. 45/600 is 20,321 PCUs. By the year 1998, when the project is likely to be completed, the traffic volume increases to 28,249 PCUs.

Considering the chaotic condition of the traffic, the delays, the pollution etc., the Ministry of Surface Transport and the Govt. of Andhra Pradesh had been contemplating construction of a bypass to Eluru town since almost 1978. The Ministry after due considerations approved the scheme for the bypass in the year 1988-89 after thoroughly discussing the various alternative alignments, both on the eastern as well as on the western side of the town. Finally, an alignment on the western side of the town had been approved and the department has since acquired the land

as per approved alignment. As per information available by the department, most of the land compensation has already been disbursed and the land is likely to be made available to the department shortly. The bypass starts from km. 53/800 and joins at km.69/200 of the National Highway. The length of the bypass is 17.88 km. The bypass generally passes through agricultural area and crosses some gardens and a small afforested area. It also crosses the Madras-Calcutta South-Central Railway line at two places, one in km.1.00 and the other in km. 18 of the bypass. It also crosses the river Tammileru and Vyasakavi in km. 12.00 and km. 18.00 respectively. State Highway Nos.43 & 44 cross the bypass at chainages 10.50 and 14.25 of the bypass.

The climate of the region is tropical with very hot summer from April to June. There are two rainy spells, one from South-west monsoon from July to September and the other from North-east monsoon from October to December each year. The average rainfall is about 1000 mm to 1100 mm. The temperature ranges from 38°C in May/June to about 20°C in December/January. In the month of May, the area gets cyclonic rains, which sometimes create havoc.

Based on the above information and data, the whole stretch from km. 3.40 to 75.00 has been divided into the following three homogenous sections:

(i) From Km.3.40 to Km.13.00 lying within the town of Vijayawada.

(ii) From km. 13.00 to km.75.00 excluding the portion from km.53/800 to km.69/200 through Eluru town.

(iii) A bypass to Eluru town, having a length of 17.88 km.

Although the traffic volume and the condition of the road/pavement is practically the same in homogenous sections (i) & (ii) above, they have been separated, because the reach from km.3.40 to 13.00 lies within Vijayawada town, where the peak hour traffic is quite heavy and of mixed character, consisting of cycles, autorickshaws, buses, cars necessitating the bifurcation of up and down traffic. The traffic volume, when projected to the year 1998, i.e., the year of completion of the construction justifies 4- laning of this stretch, as the traffic volume becomes almost 30,000 PCUs.

6.1.2 Identification of deficiencies and scope for improvement

The deficiencies and the improvements are being given, homogenous sectionwise as under:

(i) From km.3.40 to km.13.00:

As explained in earlier paragraphs, the portion being within the town of Vijayawada, and having a traffic volume of 28,246 PCUs by the year 1998, is being proposed for 4-laning. Sufficient right of way is available to accommodate the 4-lanes, without any acquisition of land or houses. The existing alignment is generally straight with smooth curves. The geometrics are fairly good.

The existing pavement is deficient in its crust thickness as is shown in Figures 4-1 to 4-20 of Vol.II. The surface is also rough having an I.R.I. between 3.0 to 4.3 m/km and the condition of the pavement ranges from poor to fair due to cracks, deformations etc. as mentioned in the condition survey sheets of this road. Hence besides 4-laning, strengthening of the pavement, by bituminous overlays is also being recommended to cater for the traffic likely to be generated in the next 10 years after the construction period.

It is proposed to widen the existing road on either side of the existing carriageway to make it a four-lane divided highway, with 7.0 m. wide carriageway each, with a central verge with unidirectional camber. From km.5.2 to km.10.20, where 60 m. wide land width is available, the width of central verge has been kept as 2.50 m. whereas in the remaining length from km. 3.4 to 5.2 and km.10.2 to 13.0, the central verge is proposed to be 1.20 m. wide especially because in the stretch from km.10.2 to 13.0, the existing land width is just sufficient to accommodate 4 lanes with a central verge of 1.20 m. only.

At present, the shoulders are kacha with depressions and pot holes. As a policy, 1.50 m. wide paved shoulders on the outer edges of the 4-lane carriageway have been proposed from km.3.4 to km.10.0.

In the stretch from km.5.40 to 10.00, in the residential and commercial built up area, a 5.50 m. wide service road on both the sides has been proposed. There is a high tension line on the left hand side runnning parallel to the road, which is proposed to be shifted in order to provide 5.5m wide service road on that side. Provision of these service roads is

considered essential as a number of cross roads and by-lanes are joining the main Highway, and by providing these service roads, the junction points will be got reduced considerably. It is also proposed to shift the street lights in the central verge portion.

Provision is also being made for roadside drains with proper outfalls. The space between the 4-lane carriageway and the service roads is being proposed to be developed as a green belt, as at present, it remains full with stagnant water with no proper drainage. For drainage of this water, road side drains and subsidiary drains are being proposed for which a proper drainage plan will be prepared while doing the detailed engineering.

Another bottleneck is Hanuman temple at km.10.0. Since about 17.0 m. wide land is available on the other side of the temple, it has been proposed to bifurcate the two carriageways with the central verge of about 10 m and thus 4-laning can be done without any difficulty. However, as a facility for the visitors to the temple, a pedestrian overbridge is being proposed at this location. Possibility of providing an underpass was also studied but considering the drainage, safety cleanliness etc., this alternative has not been considered desirable. The State P.W.D. has also recommended, not to provide an underpass/subway vide their letter No. 1112/92/DCE II/DEE IV/AEE 21/92 dt.17.5.93 (copy encl.).

The existing major bridge over Bunder canal at chainage 5.17 is being retained, being in good condition. Another 2-lane bridge is being proposed up-stream of the existing bridge to make it a 4-lane bridge.

The two important junctions at km.6.00 and km. 9.80 are deficient in design standards. The same are proposed to be reconstructed as per standards laid down by the IRC/MOST.

There are 17 culverts in this reach, which are deficient either in the width of roadway or in their general condition. Hence, out of 17 culverts, two are proposed to be widened to 4-lane, 10 are proposed for reconstruction at the same site and five to be replaced with new culverts at slightly shifted location as per the site requirements.

There are 19 trees, which are coming in the alignment of the 4-laning, which will require cutting. These have been kept as the minimum. However, compensatory planting of new trees, generally double the number, is being recommended.

It is also proposed to provide two bus laybys on each side of the road for city bus services. A truck layby

is also being proposed in km 11. The exact location of these laybys shall be decided at the time of detailed engineering.

(ii) From km.13.00 to km.75.00 excluding the stretch from km.53/800 to km.69/200.

In this reach, the alignment is fairly straight, but there are S-curves and simple sharp curves also at certain locations. The curves in km.36-37 and in km.50-51 are quite sharp as well as blind and, therefore, are prone to accidents. At each of these sites, there are ponds on the left side. It is proposed to realign these curves, to make them smooth with larger radii and to improve the sight distances to avoid blindness. In doing so, some land and a few houses are proposed to be acquired. Part of the ponds will also be acquired. However, the department does not envisage any difficulty in acquiring the same. At other curve locations, their geometrics will be improved, within the right of way, so that land acquisition is not involved. Cutting of 4 trees is involved in realignment portions, but this cannot be avoided. Detailed plans showing the proposed improvements will be submitted in the DPR.

The terrain is plain and the gradients are flat in general, except in case of the three major bridges in km 15, 20 & 21, where properly designed grades have already been provided in the approaches to these bridges.

The road in km 17,18 and 19 runs almost at ground level and during rainy season, the berms are submerged and occasionally this main pavement also gets submerged, Hence it has been proposed to raise these kms by about a metre and a half above the ground level and provide a new pavement,with cross drainage works.

The existing carriageway width varies from 6.7 to 7.0 m. with earthern shoulders. The road formation width also varies between 10.5 to 12.0 m. It is especially deficient in the approaches to the three major bridges.

The pavement thickness is deficient as compared to design requirements as shown in Fig. 4-1 to 4-20 of vol. II. Its I.R.I. value ranges from 3.0 to 4.5 m/km. The pavement surface is generally poor to fair, except in those km where renewals were done in the recent past. The surface has undulations, cracks, patches etc. as given in detail in the condition survey sheets.

It has been proposed to make good the road formation width to 12.00 m with side slopes as 1:3 (V:H) and to make up the deficiency in crust thickness by overlays with D.B.M. and B.C. Only flexible overlays have been proposed on the existing flexible pavement.

The existing pavement is also deficient in the cross camber, hence a levelling and camber correction layer of D.B.M. 75 mm thick average has been proposed, before laying of the overlays. However, the exact thickness of PCC shall be worked out in DPR as per MOST's guidelines.

As stated earlier, 1.50 m. wide paved shoulders have been proposed on both sides of the road edge. It is proposed to pave the remaining space within the right of way in Hanuman Junction with 2 layers of WMM and 20 mm thick MSS over a sub-base of granular material, so as to leave no kacha portion.

These towns have a lot of temporary encroachments and the same need to be got removed. The department, however, does not envisage any difficulty in removing them.

At Hanuman junction in km.46, there is a big old Hanuman temple by the side of the main road, which although not coming in the alignment of the main carriageway, will need proper barricading from the side of the main road.

There are several big and small, X, T and Y junctions on this road, which will require construction. Provision has, therefore, been made for their improvement/construction in the estimate. Wherever possible standard junction drawings of the MOST shall be adopted. For non-standard junctions, proper designs shall be made as per MOST guidelines

As stated earlier, there are 3 major 2-lane bridges in km 15, 20 and 21, which are in good condition and the same are being retained. However, repairs to railing footpath slabs and expansion joints are required to be done, for which provision has been made in the estimate.

Besides these, there are 9 minor bridges as stated earlier, out of which one bridge is already under construction in km.48.75 under a separate scheme. Two bridges at chainages 37/200 at Ampapuram and at km 41.95 at Veerapalli are proposed to be retained as their carriageway width is sufficient as per MOST norms and also being in good condition, except for minor repairs to railings. Four minor bridges at chainages 28.62, 31.63, 35.61 and 38.80 although having less than 12 m overall width are also being retained being in good condition as per joint decision of the MOST/Deptt/Consultants. For the remaining two bridges at chainage 71.22 and 73.61, it is proposed to first construct new two lane bridges on the down stream side and use the existing bridges for the traffic to

move. After completion of the new bridges, the existing bridges shall be dismantled and new bridges extented to make them four lane bridges. This has been necessiated, as provision of diversions at these locations is not possible. This decision has also been taken in consultations and approval of the MOST/Deptt.

There are 107 culverts in this reach, out of which 4 have insufficient overall width and seven are in poor condition. The same are proposed for widening and reconstruction respectively. The remaining culverts are proposed to be retained. The details are given in the condition survey sheets of the culverts.

In the portion from km 69/200 to 75.00, the two drains on the left side have inundated the left side berms and side slopes due to constant flooding every year. The width of the berms at some places has been reduced to almost one metre. Restoration of the berms to 2.50 m. width will not help.It is proposed to protect them from further erosion by providing a toe wall upto flood level and to widen the existing pavement on the right side, i.e. towards Godavari canal side, where sufficient land width is available. In doing so, part of the existing carriageway on the left side will act as paved shoulder on that side. A typical cross section showing the proposal has been given in Vol.III (Drawings).

The Irrigation Department of the Govt. of Andhra Pradesh is remodelling the Gunduru drain by excavation of the existing drain and providing a bund all along. This aspect has been taken into consideration, while providing for a new bridge in replacement of the existing bridge at chainage 73.61.

The provision of bus and truck laybys shall be made at the time of detailed engineering.

(iii) Eluru Bypass

As stated earlier, the Ministry of Surface Transport, Government of India, in consultation with the State Government, have already taken a decision to construct a bypass to Eluru town and after studying 4 or 5 alternative alignments, have finalized the alignment on the western side of the town, having a length of 17.88km. and for which the land has already been acquired and possession being given to the department.

The bypass starts from km.53/800 and joins at km.69/200 of the existing National Highway. The alignment is straight, except four curves, two at starting and ending points and two in between. It passes through agricultural land.

At present, only two lanes are proposed, keeping provision for addition of another two lanes at a subsequent stage. As such, the present two lanes are proposed to be constructed, eccentric with the centre line of the right of way, which is 60 m wide throughout, so that when 4-laning is done later, it become concentric.

The bypass crosses the Madras-Calcutta, South Central Railway line at two locations in km 1.0 and 18.0. At these locations, four lane Road over bridges, alongwith four lane approaches are being proposed, in consultation with the MOST/Deptt. as widening of 2 lane ROB to 4-lane, with high embankment becomes difficult at a later stage. The bypass also crosses two major rivers, Tammileru and Vyasakavi, where 2-lane high level bridges have been proposed. Besides these, there are seven minor bridges on the bypass over irrigation channels, drains and natural drainages, as given in the list of bridges, proposed for construction.

54 culverts are also proposed in the entire length of 17.88 km. as per requirement.

No human resettlement problem is envisaged in this stretch, as the alignment does not pass through any inhabited area.

There are approximately 382 trees, which are required to be cut, for which it is proposed to plant new trees, generally double the number and also as per Ministry's circulasr dated 20.5.76.

Two State Highways No.43 and 44 cross the bypass at chainages 10.50 and 14.25 respectively, where properly designed cross junctions are proposed to be constructed.

Misc. Items

In addition to the above, the following provisions under Misc. Items have also been made for all the three homogenous sections:

a) Road Signs
b) Pavement markings
c) New km. and hectameter stones
d) Temporary diversions
e) Mandatory provisions for project execution
f) Project documentation
g) Landscaping and improving environment.

6.2 NATIONAL HIGHWAY No.9

6.2.1 National Highway No.9 takes off from NH-4 at Pune in the State of Maharashtra and after passing through Hyderabad, the capital city of Andhra Pradesh, joins NH-5 at Vijayawada. It passes through the districts of Sangareddi, Hyderabad, Nalgonda and Krishna. Thus, it is an important National Highway, which connects two major National Highways, Nos.4 & 5, and also connects Hyderabad with Vijayawada, the two largest towns of Andhra Pradesh, one the State capital and the other a big commercial and business centre. It is, therefore, of great socio-economic importance.

The distance from Hyderabad to Vijayawada is 270 km. but in this project, portion of the National Highway from km.217 at Nandigama upto km.265.00, the Municipal limits of Vijayawada town has been included.

This stretch of road passes through the agricultural belt of the State. The terrain is generally plain and the gradients are flat. The area is predominantly black cotton soil and is rich and fertile. The main crops are paddy, cotton, oil seeds, tobacco, chillies, pulses, sugarcane, out of which paddy is the main crop.

In the stretch between km.242 to 252, there are hillocks on the left side of the road, slightly away from the main road, where good quality hard rock is available. As such,a number of stone crushers have been established all along this stretch of the road on both the sides. The requirement of stone aggregates for the construction industry such as roads, buildings, bridges etc. of the entire area is met from these crushers.

There is a major river Muneru, crossing the National Highway in km.226. An old, narrow and weak steel girder bridge exists at present. But a new 2-lane, high level road bridge is under construction by U.P. State Bridge Corporation Ltd., under a separate sanction from the Ministry of Surface Transport. Its approaches are also under construction under the same sanction. The bridge is expected to be completed by June 1993 and the approaches are also likely to be ready soon thereafter.

River Krishna is running almost parallel to the National Highway, not very far off from it. From km 252 to 270, it is only about a km or even less away from it.

There is a major road crossing at km.253/150, having a large diameter rotary in the centre. The road on the left side, leads to the Vijayawada Thermal Power station (VTPS), which is one of the biggest Thermal

Power Station of the State, situated about a km from the junction. This road further connects Khammam, another district headquarter of the State. On the right side, the road leads to Krishna river, which is about a km away from the junction. There are quite a number of temporary eating and repair shops at this point, which are all temporary encroachments.

The climate, rainfall etc. is same, as explained in case of NH-5.

The alignment of the road in some stretches is straight, but in a major portion, there are a number of curves, some of which are quite sharp, requiring improvement.The right of way varies from 25 m. to 30 m. The carriageway width is generally 6.7 m. The berms are kacha (earthern). The department is, however, providing paved shoulders in the Abadi portion under a separate sanction from the Ministry. The NH passes through two important towns in this reach: one, Nandigama, in km.218-219 and the other Kanchi-ka-Charla in Km.235-236. Both these towns are being commercial centres of activity. Although sufficient right of way is available, due to commercial activities, a number of temporary encroachments have come up along the highway.

In km.253, there are two bridges, one over Budameru diversion channel (BDC) and the other over Cooling Water Channel (CWC) carrying 2000 cusecs of water from Krishna river to the Vijayawada Thermal Power Station for cooling and other purposes. This water after use is discharged back in the Budameru diversion channel. The present design discharge of BDC is 7500 cusecs from Budameru river and approximately 1500 cusecs from VTPS.

Besides these, there are 8 minor bridges and 92 culverts in the project road. The details of these are given in subsequent para.

The condition of the road surface is generally poor to fair, having an IRI value between 3.5 to 5.0 m/km and having rutting, patching, pot holes, cracks etc.

The present volume of traffic at km. 219.60 is 15,213 PCUs and at km.253.40 it is 32,581 PCUs.

The portion of the highway from km.252.0 to km.265.0 can be taken as within the urban area, especially from km.261.0 to 265.0, which is within the town of Vijayawada and that of the Thermal Power Station in km.253, where a number of commuters regularly come from Vijayawada.

In the portion between km.261.0 to km.265.0, there are a number of utility services along the road, such as electric lines, transformer poles, telephone lines, coaxial cables etc., which will require shifting.

Thus the project road can conveniently be divided in two homogenous sections as under:

(i) From Km.217.00 to km.252.00
(ii) From Km.252.00 to Km.265.00

6.2.2. Identification of deficiencies and scope for improvement.

(i) From km.217.00 to km.252.00

The general description of the road has already been given in earlier paragraphs.

The alignment of the road is partly straight and partly in curves. The curves are quite sharp at places. It is proposed to improve the curves within the right of way.

The pavement thickness is generally deficient as compared to the design requirement. The width of the carriageway is also less than 7.0 m in general. It is proposed to make up the carriageway width to 7.0 m. and after providing an average 75 mm thick bituminous layer for camber correction and removal of undulations, strengthening of the pavement is proposed with an overlay layer of DBM and BC as per the design requirement.

The approaches to the bridge over River Muneru in Km.226-227 under construction through a separate scheme will be deficient in the pavement thickness, as per information given by the department. Hence provision has been made for providing overlay on the pavement of the approaches, as per design requirement.

It is also proposed to provide 1.50 m wide paved shoulders on both sides of the road in the entire stretch, except in those Abadi portions, where the department is already providing paved shoulders under a separate scheme.

The highway passes through Paritala village in km 239, which is fairly a large village. Towards Vijayawada end of the village, there is a narrow neck, as well as a sharp curve in the alignment. On the left hand side, there is a graveyard and then a high bund, whereas on the right hand side, there are a few houses. There are three alternative solutions to this problem. One alternative is to provide a bypass on the left hand side (northern side) of the village, about 2 km in length, covering the bund and through agricultual land. The second alternative is to acquire 5 houses and a strip of land through the village and improve the geometrics of the alignment. The third alternative is to provide a bypass on the right side (southern side)

of the village passing through rich agricultural land. All these alternatives were discussed in detail with the officers in the MOST as well as the State Govt. The consultnats were informed by the State Deptt. that acquisition of agricultural land will pose problem, whereas it is possible for them to acquire the houses and strip of land through the village. The departmental officers have also taken the house owner's verbal consent and have discussed the matter with Secretary R & B Govt. of Andhra Pradesh and the Deputy Commissioner of the District, who have favoured for the second alternative. Hence, it is proposed to improve the alignment through the village, by acquiring 5 houses and strip of land. The Govt. shall have to pay reasonable compensation and alternative land for their rehabilitation. However, the alternative of providing a bypass has also been considered in this report. The approximate length of the bypass from southern side of the village has been taken as three km. It will involve acquisition of approximately 18 hectares of agricultural land, keeping the right of way as 60 m in width. Once a final decision is taken by the Ministry/Deptt to provide a bypass, the detailed engineering will be carried out.

In km 239 itself, in the approaches to the Paritala bridge, there is a dip in the road, which gets submerged during high abnormal floods. This stretch from chainage 238.55 to 239.25 is, therefore, being proposed to be raised above the flood level.

The surface of the road, particularly in km.240 and 241, is very bad. These kilometers are forming part of the approaches to the Paritala bridge. The surface is very rough having irregular settlements, basically due to the poor subgrade. It is proposed to relay the subgrade and provide new pavement in the defective lengths.

There are 5 minor and one major bridge in this reach, besides the major bridge over river Muneru, at chainages 230.36, 233.22, 246.02,247.45, 251.64 and 240.06 respectively. The minor bridges are deficient in carriageway widths, but they are being retained as,their condition is good, except bridge at chainage 230.36, which is proposed for reconstruction, being in bad condition. Major bridge at Paritala at chainage 240.06 is proposed for retention, but it requires repairs to railing and footpath slabs, for which necessary provision has been made. These provisions are being made as per joint decision of the MOST/Deptt./Consultants.

There are 72 culverts in this reach, as per details given in Table 1.3 of Vol.II. Out of these, four are proposed for widening because the carriageway width is deficient and 10 are proposed for reconstruction due to

their poor condition. The rest of the culverts are proposed for retention.

There is only one tree, which needs to be cut in km.217.0.

Bus laybys are proposed at Nandigama and Kanchi-ka-Charla towns, whereas no truck layby is proposed in this section.

(ii) Km.252.00 to km.265.00

The general description of the road of this section has already been given in earlier paragraphs.

The alignment of the road in this reach is mostly in curves, with very little straight reaches. Some of the curves are quite sharp as well.

The pavement thickness is generally deficient as compared to the design requirement. The width of the pavement and the roadway width are also deficient i.e., less than 7.0 m. and 12.0 m. respectively. The shoulders are earthern, except in km.260 to 265 where paved shoulders exist in varying widths ranging from 1.0 to 2.0 m.

The surface of the pavement is rough, having an I.R.I. value between 3.5 to 4.3 m/km. The condition of the pavement is comparatively better as compared to the section from km 217.0 to km 252.0. There are cracks and deformations in the surface ranging from low to medium category.

The present day traffic volume is 32,581 PCUs which more than justifies immediate 4-laning of this section. The traffic mostly is of mixed type having cars, buses, trucks, 2-wheelers, cycles etc. creating a lot of traffic congestion on the road. In view of the heavy traffic, this section has been proposed for 4-laning, with 7.0 m. wide carriageway on either side with a central verge and 1.50 m wide paved shoulders on outer edges of the two carriageways. The width of the central verge in km 261 to 265 has been kept as 1.20 m, whereas in km 252 to 261, it has been kept as 5.00 m including kerb shyness..

Since the land width varies from 25 to 30 m, there is no scope of service road in the city portion and hence it has not been proposed.

It is proposed to provide additional 2-lanes in such a manner, that the geometrics of the curves get improved. Accordingly at some stretches, additional 2-lanes have been provided on the left side, at some locations on the right side and at some locations, 4-laning has been done by widening centrally on both sides. An attempt

has been made to confine the improvement within the right of way, except at chainage 255/200, where the department has already acquired land to improve the curve alignment. The cuves shall be designed to have a ruling design speed of 100 km/hr or a minimum design speed of 80 km/hr which will be feasible.

There are two 2-lane high level bridges in km 253, one over Budameru diversion channel (B.D.C.) and the other over V.T.P.S. canal as explained earlier. These are being retained as they are in good condition. Two new

2-lane bridges, just parallel to the existing bridges on u/s side are being proposed to make them 4-lane bridges.

There are two more minor bridges at chainages 254.65 and 262.19. The bridge at chainage 254.65 is proposed to be reconstructed for a 4-lane carriageway, as the same is in poor condition. The bridge at ch.262.19 is being retained and an additional 2-lane bridge is being proposed to make it a 4-lane bridge.

There are 20 culverts in this reach, out of which one at ch.255.34 is proposed for widening and the rest are proposed for reconstruction with 4-lane carriageway width, as the same are in poor condition.

There are 90 trees, which are coming in the alignment, while 4-laning, as per list given in Table 1.12 of Vol.II, which will need cutting. These have been kept to the minimum. However, compensatory planting of new trees generally double the number, is being recommended.

Electric poles, telephone lines, coaxial cables, transformer poles shall be required to be shifted while 4-laning, at various locations. Street lighting is proposed to be shifted to the central verge.

There are no human resettlement problems in this section, nor any houses are proposed to be acquired.

Bus laybys are proposed near village Kondapally in km.258 and in the urban area of Vijayawada town in Km. 263 and a truck layby is being proposed in km 255.

Provision of Misc. items has also been proposed on similar lines as in the case of NH-5.

GOVERNMENT OF ANDHRA PRADESH
PUBLIC WORKS(R&B) DEPARTMENT

From:
Sri C.Parandhama Reddy,BE,MIE.,
Chief Engineer(R&B),
National Highways,
Hyderabad.

To
Sree N.C.Saxena,
Executive Director,
Intercontinental consultants and Technocrats Pvt. Ltd.,
A-11, Green Park,
New Delhi-110016.

Lr.No.1112/92/DCEII/DEEIV/AEE21/92,dt.17-5-93.

Gentleman,

Sub:-Strengthening and 4 laning of NH5 and NH9 from Vijayawada to Eluru and Nandigama to Vijayawada respectively under ADB package-III.

Ref:-ICT:271:407 dt.24-4-93 of Inter continental consultants and Technocrats pvt.Ltd. addressed to the Chief Engineer(C) Roads MOST, New Delhi and copy marked to CE,NH, Hyderabad.

-o-

In the reference cited above under item 5 it was informed that at km 10, at the site of Hanuman temple, possibility of providing an under pass be also studied vis-a-vis an over bridge.

In this connection it is informed that the subway is not possible at km 10 of V-V sec. NH5(at the site of Hanuman temple) and M/s.Intercontinental consultants and Technocrats Pvtd.Ltd. may examine this issue in detail and decide the issue at the earliest.

Yours faithfully,
Sd/-
Deputy Chief Engineer(D)II
for Chief Engineer(NH)

18-5-93
Deputy Executive Engineer
N.H.Designs II
for Chief Engineer (NH)
18.5.93

GOVERNMENT OF ANDHRA PRADESH
PUBLIC WORKS(R&B) DEPARTMENT

From:
Sri C.Parandhama Reddy, B.E.,M.I.E.,
Chief Engineer(R&B),
National Highways,
Hyderabad.

To
M/s.Intercontinental consultants,
and Technocrats Pvt.Ltd.,
A-11,Green Park,
New Delhi-110016.

Lr.No.1112/92/DCEII/DEE4/AEE21/92,dt.26-5-93.

Gentleman,

Sub:-Feasibility studies/detailed engineering of N.H.5 and N.H.9 from Vijayawada to Eluru and Vijayawada to Nandigama underADB loan - Strip plans and Draft feasibility report - Reg.

Ref:-Your Lr.No.ICT/271/KM/460,dt.5-5-93.

-o-

The consultants are requested to take the following points into consideration while finalising the Draft feasibility report.

1)To show the existing land width and proposed land width in the detailed plans and area of the land to be acquired with name of the village. The survey Nos. may be obtained from the revenue authorities in consultation with concerned Superintending Engineer of this department.

2)To make provision for raising of road in km 16 to 18 of N.H.5 and km 239 to 240 of N.H.9 in the estimate.

3)To provide profile corrective course based on levels and as per IRC guidelines in the estimate with 10% extra provision for variation.

4)To furnish the design of high embankment on approaches to R.O.Bs and Major bridges in order to finalise the General arrangement drawings(G.A.D.) of the bridge portions and to enclose G.A.Ds with draft feasibility report.

5)To make provision for acquisition of houses and trees in km 239 of N.H.9 of Paritala village in the estimate as land acquisition for byepass at Paritala villlage will involve additional cost and time, and it is desirable to retain existing alignment.

6)The Project may be divided into the following packages.

Package 1:- Widening to 4 lane and strengthening from km 3/4 to 13/0 of N.H.5 and km 252 to 265 of N.H.9.

Package 2:- Strengthening the road from km 13/0 to 75/0 of N.H.5 excluding Eluru byepass.

Package 3:-Construction of byepass for Eluru town from km 53/800 to 69/200.

Package 4:-Strengthening the road from km 217 to 252 of N.H.9.

Package 5:-Consturction of Road over bridges on N.H.5 on Eluru byepass at Chainages 1.0 and 18.0.

Yours faithfully,
Sd/-
(C.PARANDHAMA REDDY)
Chief Engineer (N.H.)

Deputy Executive Engineer
N.H.Designs II
for Chief Engineer (NH)

CHAPTER 7

INITIAL ENVIRONMENT EXAMINATION

7.1 ENVIRONMENTAL ISSUES - NH-5

The proposed project mainly consists of three homogenous sections as under:

I. Strengthening from Km.3.40 to Km.75.00
II. Four-laning from Km.3.40 to Km.13.00
III. A bypass to Eluru town.

The road from km.3.40 to km. 13.00 runs through the urban area of Vijayawada town. There is sufficient Right Of Way available for providing a four-lane carriageway without disturbing the ribbon development in this stretch. Due to heavy traffic, there is a lot of congestion, pollution and noise. By construction of a four-lane carriageway, it will have a beneficial impact due to smooth flow of the traffic, in the form of traffic decongestion and concommitant reduction in pollution level within the township. An initial environmental assessment reveals :

Approximately 20 nos. of trees will need cutting which are coming in the alignment. This felling of trees has been kept to the minimum. However, compensatory planting of trees, generally double in number, shall be required.

There is an old temple in km.10 of this stretch where it is proposed to take the two-lane carriageway on either side of the temple, leaving sufficient space for the visitors to the temple. However, provision is also being made to provide a pedestrian over-bridge as a facility for the visitors to visit the temple which will avoid any traffic hazard to visitors at this spot.

In the portion of the highway from Km.13.00 to km.75.00, strengthening is proposed. There are two locations where the curves/alignment have to be improved; (i) in km.36 and the other (ii) in km.50. The curve in km.50 especially has a blind corner and is presently always prone to accidents. At both these locations, there are tanks/ponds. In realigning a portion of these tanks/ponds shall be acquired. At these points, there appears little likelihood of major problems, especially as in the latter case, it is possible to widen the pond by digging up an adjacent area. It is understood that the Department does not envisage any difficulty in acquiring the land in these realigned portions. In order to prevent silting of the tanks, it is proposed to provide masonry retaining walls along the toe of the embankment. However, a more detailed analysis of the situation will be done later at the time of submission of Detailed Project Report.

The byepass to Eluru town starts from km.53.8 and again joins at km.69.2 of NH-5. The land for this bypass has since been acquired for the construction purposes as informed by the department and it is presumed that environmental clearance has been obtained for this stretch. Although at present only two lanes of the carriageway are being provided in this bypass, the alignment has been kept so as to provide for additional two-lane carriageway (four-laning) at a subsequent stage, so that after four-laning, it is centrally placed with respect to the Right Of Way. The alignment of the bypass more or less passes through agricultural area. In two locations, there are gardens also. In the alignment of the bypass, two railway overbridges and a major bridge over river Tammileru are being provided. Within the parameters set by engineering technicalities, the felling of trees will be kept to the minimum and compensatory planting, generally double in number, and afforestation along the route shall be provided. Here again with the construction of the bypass and removal of through traffic from the centre of the town, it will clearly have a positive environmental impact in the form of traffic decongestion and simultaneous reduction in pollution levels within the township. There are no human resettlement problems envisaged in this stretch.

The stretch of the NH under this project passes through two important towns besides the township of Eluru, i.e. Gannavaram and Hanuman junction. There are temporary encroachments within these towns which shall have to be got removed at the time of strengthening and providing shoulders on either side of the highway. No delays are envisaged by the Department because of the temporary encroachments, which are recommended to be removed.

During the construction stage, there will be the problem of dust and noise due to the deployment of heavy road construction machinery such as trucks, road rollers, pavers etc. It is proposed to constantly sprinkle the roadside berms with water in order to minimise the dust nuisance. So far as the noise is concerned, it is not likely to be of a high order and which in any case is going to be a temporary phase.

Further information as per the requirements of the Ministry of Environment is enclosed in the Questionnaire, duly filled in, at Annexure 7.1.

.2 ENVIRONMENTAL ISSUES - NH-9

The proposed project mainly consists of two homogenous sections as under:

I. Strengthening of NH from Km.217.00 to Km.252.00
II. Four-laning and strengthening from Km.252.00 to 265.00

The stretch of the NH from Km.252.00 to km.265.00 runs partly in the rural area and party in the urban area of

Vijayawada town. There is sufficient Right Of Way available for providing four-lane carriageway without disturbing the ribbon development. At present due to heavy traffic, there is a lot of congestion, pollution and noise in the urban portion. By constructing a four-lane carriageway, it will have a beneficial impact due to smooth flow of the traffic in the form of traffic decongestion and concomitant reduction in pollution level within the township. An initial environmental assessment reveals.

Approximately, 60 nos. of trees will need cutting which are coming in the alignment. This felling of trees has been kept to the minimum. However, compensatory planting of trees, generally double in number, shall be required.

The alignment of the existing road is zig-zag and it is proposed to improve the curves at several locations. However this realignment will be confined within the Right of Way only except at one location in 256/2 km., where the Department has already acquired the land.

There are two bridges in km.254.00, one on Vijayawada Thermal Power Station (VTPS) Cooling Water Channel and the other on Budameru diversion channel. It is proposed to keep the existing two bridges and construct another two new bridges on the second carriageway.

There is a big junction of a cross road with a large diameter rotary in km. 254. The cross road on one side leads to Vijayawada Thermal Power Station and on the other side to Krishna river. This junction is being redesigned for a four-lane carriageway. There are temporary encroachments on the land which will have to be removed as they are coming in the alignment of the second carriageway.

In the portion of the highway from Km.217 to 252.00 there are a few locations where the curves/alignment have to be improved. Here again, the improvements are being proposed so that they remain within the Right Of Way.

The NH in Km.239.00 passes through Paritala village where there is a narrow neck. It is proposed to acquire about 5 houses and a strip of land in order to improve the alignment, visibility and to provided paved shoulders. However, the department does not envisage any difficulty in acquiring these houses on reasonable compensation. Alternative sites for these displaced persons shall have to be provided by the Government for their rehabilitation. The stretch of the NH under this project passes through two important towns i.e., Nandigama in kim.218.00-219.00 and Kanchi-ka-charla in km.236.00-237.00. There are temporary encroachments within these towns which shall have to be got removed at the time of strengthening and providing shoulders on either side of the highway. No delays in the construction are envisaged by the Department because of the temporary encroachments, which have been recommended to be removed.

During the construction stage, there will be the problem of dust and noise due to the deployment of heavy road construction machinery such as trucks, road rollers, pavers etc. It is proposed to constantly sprinkle the roadside berms with water in order to minimise the dust nuisance. So far as the noise is concerned, it is not likely to be of a high order and which in any case is going to be a temporary phase.

Further information as per the requirements of the Govt. of India, Ministry of Environmental is enclosed in Questionaire, duly filled in, at Annexure 7.2.

ANNEXURE 7.1

ENVIRONMENTAL APPRAISAL QUESTIONNAIRE

1.0	GENERAL	
1.1	Name of the Project	Strengthening of NH-5 from Vijayawada to Eluru, km.3.40 to 75.0 including 4-laning from km.3.40 to 13.0 and a Bypass to Eluru town.
	a) Objectives of the proposal	Preparation of Feasibility Report for the above project
	b) Brief description of the project proposals	Strengthening of existing 2-lane carriageway and four-laning of relevant portions of NH-5 from km 3.4 to km 13.00
	c) Project justification/need	Poor condition of road pavement and heavy increase in traffic volume.
	d) Present status of the project	Feasibility assessment
	e) Operational Plan (time schedule of major activities or project steps)	Dependent on sanction
1.2	Location of the project	
	a) Place	Vijayawada to Eluru km.3.4 to km. 75.0 less 15.4 km (53.80 km - 69.2 km) plus 17.88 km bypass at Eluru.
	b) Districts	Krishna and West Godavari.
	c) State	Andhra Pradesh
1.3	Approximate area/ population to be served	6.00 lakh people and 90,000 hectare of area
1.4	Overall project cost-	Rs. 1096.090 million
1.5	Number of tracks-broad gauge/metre gauge -	Not Applicable -
1.6	Type of traction electric/diesel/steam etc.	Not Applicable

1.7	Size and magnitude of the project	
	a) Length of Roads/ Highways	75 Km. including bypass
	b) Width of Roads/ Highways	1. 65.4 km. of 2-lane carriageway width of 7m. with a formation width of 12m. 2. 9.6km 4-lane dual carriageway 7m each with a central median of 2.5/1.2m; formation width 24m.
	c) Total land to be acquired	1. Land has already been acquired for the bypass. 2. Portions of discussed/dry pond and tank are to be acquired. Area 0.74 hectares 3. Temporary encroachment at Gannavaram and Hanuman junction will need to be removed. The State PWD does not anticipate problems.
1.8	Alternative alignments/sites examination	Bypass was deemed necessary to relieve congestion in Eluru town. Land acquisition near pond/tank is necessary to improve road alignment. The present blind corners are accident prone.
2.0	ENVIRONMENTAL SETTING/ PROJECT LOCATION	
2.1	Environmental characteristics of the area transversed along the alignment for a strip of 10 km each on both sides for a Rail/Road/Highway project to be delineated and marked on a base map 1:50,000.	
	i) National Park	]
	ii) Recreation area	]
	iii) Non-hunting area	]
	iv) Wildlife sanctuary	]

v)	Natural reserves	Not Applicable
vi)	Mangrove forests	
vii)	Biosphere reserve	
viii)	Primary (virgin) forest	
ix)	Declared watershed areas to be used for community potable water supply.	
x)	Swamp lands/wet lands	
xi)	Agricultural lands	Approximately 85% of the road length passes through agricultural area.
xii)	Land occupied by ethnic minorities	Not Applicable
xiii)	Industrial	Approx. 2% of the road length lies in an indústrial belt.
xiv)	Residential	Together with government and public institutions occupies 13% stretch of the project road.
xv)	Commercial	
xvi)	Irrigated areas	Included under agricultural lands
xvii)	Non-irrigated crop lands	
xviii)	Tree groves	A total of approx. 180 m lies within the preunits of 6 horticulture/timber plantations
xix)	Grazing land and permanent pastures	Not Applicable
xx)	Historical gap and cultural sites and monuments	Not Applicable
xxi)	Religious sites, temples, churches etc.	There are temples, churches, grave yard and other religious structures along the road in normal course, but none of them is being disturbed.

xxii) Governmental and Public Institutions	Nothing specific
xxiii) Others (specifty)	
Description of these identified critical areas focussed on the following:	
Ecosystems (i), (iii-x) as above	Not Applicable
- Total size of the ecosystem	
- Major ecological functions (e.g. habitat, breeding area, soil stabilization, hydrologic regulation)	
- Major social functions (recreations etc.)	
- Number of people depending on the functions of the ecosystems (visitors, serving potable water etc.)	
- Impact of rail/road/highway construction/operation on the functions of critical ecosystems (pollution, destruction etc.)	
Land-use (ii), xiii) - (xv), (xx) - (xxii) as above	
- Significance of critical land use/environmental items	Not affected
- Impacts of rail/road/highway construction/operation on critical land use or items (pollution, visual disturbance etc.)	Land use not disturbed, pollution will reduce
(xii) as above	Not Applicable
- Brief description of ethnic community	

	- Impacts of rail/road/highway projects on ethnic community	
	- Reaction within the community on the project	
2.2	Details of forest land involved	Forest land not affected by project.
	i) Legal status of forests (namely reserved, unclassed, etc.)	
	ii) The details of flora existing in the area including the density of vegetation	
	iii) Topography of the area indicating gradient aspect, altitude, etc.	
	iv) Its vulnerability to erosion, whether it forms a part of a seriously eroded area or not;	
	v) Whether it forms a part of national park, wildlife sanctuary, natural reserve, biosphere reserve etc., if so, details of the area involved.	
	vi) Rare/endangered species of flora, if any, found in the area.	
	vii) Whether it is a habitat for migrating fauna or forms a breeding ground for them:	
	viii) Any other feature of the area relevant to the proposal.	

2.3	If the project for which forest land is required, involves displacement of people or requires a few materials from any forest area, the details of proposals for their rehabilitation and procurement of those materials, respectively should be furnished.	Forest land not required
2.4	Proposed steps to be taken to compensate for the loss of the forest area, the vegetation and wildlife.	Forest land not affected.
2.5	Stripping and site cleaning	
	- size of the area to be stripped	Between km 3.4 to 13.0, in a width of about 15 m and in Eluru Bypass in a width of 30 m approx.
	- location (to be shown on map)	Area - 70 Hectares
	- soil type	Clayey sand
	- volume and quality of earth removed	1 lakhs cu.m. Will be adjusted in filling pot holes along the road side.
	- location of dump sites (to be shown on the map)	Not Applicable
2.6	Details of bridges/ overbridges/tunnels/ cutting etc. :-	No tunnels. 2 minor bridges require reconstruction. 5 new culverts to be built.
	- size of area to be cut (length, height) - location (to be shown on map) - soil type - volume and quality of earth removed - location of eventual dump sites (to be shown on map)	Not Applicable

2.7	Details of embankments/ landfills etc.	
	- size of area to be filled	70 Hectares
	- location (to be shown on the map)	Between km 3.4 and 13.00 and in Eluru Bypass
	- volume and quantity required for filling	15 lakh cu.m.
	- soil type	Sandy clay
2.8	Particulars during the last 2-3 decades regarding soil erosion, floods, silting, earthquakes, settling, landslides, cyclones etc.	Project area affected by occasional cyclone rains in the month of May.
2.9	Measures being adopted against such calamities	A stretch from km 16.00 to 18.00 proposed for raising above the flood level
2.10	Likely modifications of the hydrology in the area leading to canalisation, alteration of water flow, alteration of surface drainage, alteration of underground drainage etc.	Not affected, as it is an existing road
2.11	Likely hazards to safety of workers and nearby residents due to quarrying hazards including use of explosives	Not envisaged, as no new measures are being introduced
2.12	a) Has an air quality impact assessment been carried out as per guidelines and report enclosed. b) Has a noise impact assessment been carried out as per guidelines and report enclosed.	Location of the project is such that the envisaged smooth flow of traffic is likely to ameliorate both noise and pollution levels as compared to a no-project situation.
2.13	Hazards to acquatic ecology/flooding due to runoff contamination.	Not Applicable

2.14	Likely health hazards to passengers and nearby residents due to escape of sanitary wastes, spill of hazardous materials etc.	Not Applicable
2.15	Pollution of ground water from fills.	Not envisaged
2.16	Fuel supply arrangement to the labour force during construction period.	Contractor will be obliged to provide Kerosene/cooking coal.

3. <u>PROPOSED SAFEGUARDS</u>

3.1	Measures proposed for the protection and renewal of forests,agricultural land, grazing land, top soil, natural resources, water resources etc.	At the pond site it seems possible to dig a compensatory area in the vicinity.
3.2	Measures adopted during construction for	
	- balancing cut and fill	Not Applicable
	- rehabilitation of dump sites	Not Applicable
	- reclaiming borrow pits	Contractor will be obliged to follow guidelines given in IRC:10-1962.
	- securing embankment soil	From marked borrow areas
	- slope stabilisation	Side slopes of 3 Horiz to 1 vertical in normal heights being provided, so that they remain stable
	- preventing soil erosion	Not envisaged
	- preventing siltation	Not applicable
	- containing blasting and bulldozing	Not Applicable
3.3	Measures to control corridor type of development along the alignment	Government intervention imperative in enforcing existing legislation.

3.4	Likely effect of the proposal on the socio-economic development of the area	Positive
3.5	What types of mitigative measures have been incorporated for abatement of noise e.g. noise screens or plantation etc., in the project.	For noise, no specific measures are necessary, as it is an existing road. For felling of unavoidable trees, approx. double the number of trees, proposed for plantation.
3.6	Details of creation of green belts and corridor plantation along the alignment incorporated in the project proposal and funds allocated for the same. Give area of green belt proposed to be created on both sides of the alignment in addition to number of trees proposed to be planted.	There are no specific proposals for providing green belts, as it is an existing road. However lump sum provision of Rs 50000/- per km has been made to provide additional arboriculture
3.7	Measures proposed for off-setting adverse impact on fragile eco-system.	Not Applicable
3.8	Measures proposed to ensure that uncontrolled development will not occur.	Ref. 3.3 above
3.9	Measures undertaken to ensure :	
	a) Limitation of pollution of irrigation waters.	Silting of tank will be minimized by providing masonry retaining walls along toe of embankment.
	b) Limitation of pollution of sources for potable water supply system.	Not Applicable
3.10	Measures proposed to be adopted to offset adverse social impacts.	Not Applicable

ANNEXURE 7.2

ENVIRONMENTAL APPRAISAL QUESTIONNAIRE

1.0	GENERAL	
1.1	Name of the Project	Strengthening of NH-9 from Nandigama to Vijayawada, km.217 to km 265 including four laning from km. 252 to km. 265.
	a) Objectives of the proposal	Preparation of Feasibility Report for the above project
	b) Brief description of the project proposals	Strengthening of existing 2-lane carriageway and four-laning of relevant portions of NH-9 from km 217.00 to km 265.00
	c) Project justification/need	Poor condition of road pavement and heavy increase in traffic volume.
	d) Present status of the project	Feasibility assessment
	e) Operational Plan (time schedule of major activities or project steps)	Dependent on sanction
1.2	Location of the project	
	a) Place	Nandigama to Vijayawada km.217 to km.265 of NH-9
	b) Districts	Krishna Distt.
	c) State	Andhra Pradesh
1.3	Approximate area/ population to be served	By the year 2007, AD, approx, 3.75 lakh people on the 4 lane stretch and 1.5 lakh people on the 2 lane strech.
1.4	Overall project cost-	Rs. 516.761 million
1.5	Number of tracks-broad gauge/metre gauge -	Not Applicable
1.6	Type of traction electric/diesel/steam etc.	Not Applicable

1.7	Size and magnitude of the project	
	a) Length of Roads/ Highways	48 Km.
	b) Width of Roads/ Highways	1. 35 km. of two lane carriage-way width of 7m. with a formation width of 12m.
		2. 13 km 4-lane dual carriageway 7m each with a central median of 2.5/1.2.m Formation width 24m.
	c) Total land to be acquired	1.94 hectares and 5 old houses.
1.8	Alternative alignments/sites examination	Not applicable only the geometrics of the road requires improvement.

2.0 ENVIRONMENTAL SETTING/ PROJECT LOCATION

2.1 Environmental characteristics of the area traversed along the alignment for a strip of 10 km each on both sides for a Rail/Road/Highway project to be delineated and marked on a base map 1:50,000.

i)	National Park	Not Applicable
ii)	Recreation area	
iii)	Non-hunting area	
iv)	Wildlife sanctuary	
v)	Natural reserves	
vi)	Mangrove forests	
vii)	Biosphere reserve	
viii)	Primary (virgin) forest	
ix)	Declared watershed areas to be used for community potable water supply.	

x)	Swamp lands/wet lands]	]
xi)	Agricultural lands	Approximately 70% of the road length passes through agricultural area.
xii)	Land occupied by ethnic minorities	Not Applicable
xiii)	Industrial	Approx. 20% of the road length passes through industrial area.
xiv)	Residential]	Together with government and and other institutions are affected by approx. 10 % of the road
xv)	Commercial]	
xvi)	Irrigated areas]	Approximately 70% of the road passes through irrigated/non-irrigated land.
xvii)	Non-irrigated crop lands]	
xviii)	Tree groves	Not Applicable
xix)	Grazing land and permanent pastures	Not Applicable
xx)	Historical gap and cultural sites and monuments	Not Applicable
xxi)	Religious sites, temples, churches etc.	There are temples churches, grave yard and other religious structures along the road in normal course, but none of them is being disturbed.
xxii)	Governmental and Public Institutions]	Nothing specific
xxiii)	Others (specifty)]	

Description of these identified critical areas focussed on the following:

Ecosystems (i), (iii-x) as above	Not Applicable

- Total size of the eco-system

- Major ecological functions (e.g. habitat, breeding area, soil stabilization, hydrologic regulation)	
- Major social functions (recreations etc.)	
- Number of people depending on the functions of the ecosystems (visitors, serving potable water etc.)	
- Impact of rail/road/highway construction/operation on the functions of critical ecosystems (pollution, destruction etc.)	
Land-use (ii), xiii) - (xv), (xx) - (xxii) as above	
- Significance of critical land use/environmental items	The Vijayawada Thermal Power Station draws heavy commuter traffic from the city
- Impacts of rail/road/highway construction/operation on critical land use or items (pollution, visual disturbance etc.)	Road will decrease congestion of the traffic between the city and VTPS, after 4-laning in this stretch. Land use will not be disturbed. Pollution will reduce after road improvement.
(xii) as above	Not Applicable
- Brief description of ethnic community] - Impacts of rail/road/highway projects on ethnic community] - Reaction within the community on the project]	Ethnic minorities not affected
2.2 Details of forest land involved	Forest land not affected by project.
i) Legal status of forests (namely reserved, unclassed, etc.)	

ii) The details of flora existing in the area including the density of vegetation

iii) Topography of the area indicating gradient aspect, altitude, etc.

iv) Its vulnerability to erosion, whether it forms a part of a seriously eroded area or not;

v) Whether it forms a part of national park, wildlife sanctuary, natural reserve, biosphere reserve etc., if so, details of the area involved.

vi) Rare/endangered species of flora, if any, found in the area.

vii) Whether it is a habitat for migrating fauna or forms a breeding ground for them:

viii) Any other feature of the area relevant to the proposal.

2.3	If the project for which forest land is required, involves displacement of people or requires a few materials from any forest area, the details of proposals for their rehabilitation and procurement of those materials, respectively should be furnished.	Forest land not required
2.4	Proposed steps to be taken to compensate for the loss of the forest area, the vegetation and wildlife.	Forest land not required

2.5	Stripping and site cleaning	
	- size of the area to be stripped	14-16 m along the length of the existing carriageway in a length of about 13 km.
	- location (to be shown on map)	Marked on accompanying map.
	- soil type	Sand and clayey sand
	- volume and quality of earth removed	About 18000 cu.m. top soil for removing jungle growth to widen the road to 4-lane.
	- location of dump sites (to be shown on the map)	In filling the road side pot holes.
2.6	Details of bridges/ overbridges/tunnels/ cutting etc. :-	No tunnels, 1 major and 3 minor bridges require widening.
	- size of area to be cut (length, height) - location (to be shown on map) - soil type - volume and quality of earth removed - location of eventual dump sites (to be shown on map)	Not Applicable
2.7	Details of embankments/ landfills etc.	
	- size of area to be filled	12 Hectares
	- location (to be shown on the map)	Between km 252.00 to 262.00
	- volume and quantity required for filling	3.00 lakh cu.m
	- soil type	Sandy clay
2.8	Particulars during the last 2-3 decades regarding soil erosion, floods, silting, earth-quakes, settling, land-slides, cyclones etc.	Project area affected by occasional cyclone rains in the month of May.

2.9	Measures being adopted against such clamities	Road from km 238.55m to 239.25 proposed for raising above the flood level.
2.10	Likely modifications of the hydrology in the area leading to canalisation, alteration of water flow, alteration of surface drainage, alteration of underground drainage etc.	Not affected, as it is an existing very old road.
2.11	Likely hazards to safety of workers and nearby residents due to quarrying hazards including use of explosives	Not envisaged as no new features are being introduced.
2.12	a) Has an air quality impact assessment been carried out as per guidelines and report enclosed. b) Has a noise impact assessment been carried out as per guidelines and report enclosed.	Location of the project is such that the envisaged smooth flow of traffic is likely to ameliorate both noise and pollution levels as compared to a no-project situation.
2.13	Hazards to acquatic ecology/flooding due to runoff contamination.	Not Applicable
2.14	Likely health hazards to passengers and nearby residents due to escape of sanitary wastes, spill of hazardous materials etc.	Not Applicable
2.15	Pollution of ground water from fills.	Not envisaged
2.16	Fuel supply arrangement to the labour force during construction period.	The contractors will ensure supply of Kerosene or cooking coal to labour.
3.	PROPOSED SAFEGUARDS	
3.1	Measures proposed for the protection and renewal of forests,agricultural land, grazing land, top soil, natural resources, water resources etc.	Negligible damage envisaged

3.2	Measures adopted during construction for	
	- balancing cut and fill	Not Applicable
	- rehabilitation of dump sites	Not Applicable
	- reclaiming borrow pits	Supervision during consruction should ensure that it follows IRC:10-1961 guidelines.
	- securing embankment soil	From marked borrow areas.
	- slope stabilisation	Side slopes of 3 Horizontal to 1 Vertical in normal heights being provided, so that they remain stable
	- preventing soil erosion	Not envisaged
	- preventing siltation	Not envisaged
	- containing blasting and bulldozing	Not Applicable
3.3	Measures to control corridor type of development along the alignment	Government intervention imperative in enforcing existing legislation.
3.4	Likely effect of the proposal on the socio-economic development of the area	Positive
3.5	What types of mitigative measures have been incorporated for abatement of noise e.g. noise screens or plantation etc., in the project.	For noise, no specific measures are necessary, as it is an existing road. For felling of unavoidable trees, approximately double the number of trees, proposed for plantation.
3.6	Details of creation of green belts and corridor plantation along the alignment incorporated in the project proposal and funds allocated for the same. Give area of green belt proposed to be created on both sides of the alignment in addition to number of trees proposed to be planted.	A minimum of 180 trees will be planted in accordance with the technical guidelines for roads and highways. There are no specific proposals for providing green belts, as it is an existing road. However lump sum provision of Rs 50,000/- per km has been made to provide additional arboriculture.

3.7	Measures proposed for off-setting adverse impact on fragile eco-system.	Not Applicable
3.8	Measures proposed to ensure that uncontrolled development will not occur.	Govt. intervention imperative in enforcing existing legislation.
3.9	Measures undertaken to ensure :	
	a) Limitation of pollution of irrigation waters.	Not Applicable
	b) Limitation of pollution of sources for potable water supply system.	Not Applicable
3.10	Measures proposed to be adopted to offset adverse social impacts.	Not Applicable

CHAPTER 8

PROJECT COST ESTIMATES

8.1 GENERAL

The cost estimate of the whole project have been divided into five groups; three for NH-5 and two for NH-9, as under :

NH-5

i) Four laning and strengthening of NH-5 from km. 3.4 to km. 13.0.

ii) Strengthening of NH-5 from km. 13.0 to km. 75.0 excluding portion through Eluru town but including realignments.

iii) Construction of the bypass for Eluru town from km. 0.00 to km 17.88

NH-9

i) 4-laning and strengthening of NH-9 from km. 252.0 to km. 265.0

ii) Strengthening of NH-9 from km. 217.0 to km. 252.0

An alternative proposal has also been made in this report to provide a realignment of NH-9 in Paritala village in km. 239 from outside the village on southern side. Its cost has been worked out seperately alongwith the alternative total cost of the project.

8.2 COST ESTIMATES

8.2.1 In the portion of the project road marked (i) in para 8.1 above, provision for the following items has been made in the estimates :

(a) Widening the road formation width to 22 m and providing dual carriageway each 7.0 m wide to make it a 4-lane divided carriageway.

(b) Strengthening the portion of the existing pavement being retained and utilized for 4-laning.

(c) Providing 1.5 m wide paved shoulders on outer edges of both the carriageways.

(d) A central median varying in width from 1.2m to 2.5m.

(e) Widening/reconstruction of the existing cross-drainage works.

(f) Roadside drains

(g) 5.5 m wide service road on both the sides from km.5.40 to km.9.6.

(h) Development of space between the main carriageway and the service road, as a green belt.

(i) An overbridge for pedestrains in km 10 near Hanuman temple, as a facility for visitors to the temple

(j) Provision for improvement of junctions.

(k) Shifting of utility services.

(l) Providing a new 2-lane Bridge on Bunder Canal in 4-laning portion.

8.2.2 In the portion of the project road marked (ii) in para 8.1 above, provision for the following items has been made in the estimate

(a) Strengthening of the existing pavement.

(b) Providing 1.5 m wide paved shoulders on both sides of the carriageway.

(c) Widening/reconstruction of existing cross drainage works.

(d) Provision for improvement of juctions.

(e) Shifting of utility services

(f) Realignment of certain portions of the road.

(g) Acquisition of land and houses in realigned portions.

8.2.3 In respect of the cost of Eluru bypass, the following provisions have been made.

(a) Earthwork in embankment and approaches to the two R.O.Bs and the major bridge over the rivers Tammileru and Vyasakavi.

(b) Carriageway 7.0 m wide

(c) 1.5 m wide paved shoulders on both sides.

(d) Provision for construction of two R.O.Bs of 4 lane wide over South Central broad gauge Railway line.

(e) Major Bridges over rivers Tammileru and Vyasakavi

(f) Seven minor bridges

(g) 54 Culverts.

(h) Provision of junctions at State Highway Crossings and at take off and joining points with the National Highway & other link roads.

8.2.4 In the portion of NH-9, where 4-laning in proposed, provision of following items has been mad din the estimate:

(a) Widening of the road formation width to 24 m and providing dual carriagewy each 7.0 m wide, to make a 4-lane divided carriageway, including realignment of curves.

(b) Strengthening the portion of the existing pavement being retained and utilized for 4-laning.

(c) Providing 1.5m wide paved shoulders on outer edges of the carriageway.

(d) A central median of 1.2 m / 4.5 m.

(e) Widening/reconstruction of existing cross-drainage works.

(f) Roadside drains.

(g) Provision for improvement of junctions.

(h) Shifting of utility services.

(i) Providing new bridges on Budameru Diversion Channel and cooling water channel for the additional two carriageway in 4-laning portion.

(j) Acquistion land for improvement of curves.

8.2.5 In the portion from km 217.0 to km 252.0 of NH-9 where only strengthening is proposed, the following provisions have been made.

(a) Earthwork in making the formation width to 12.0 m, whereever it falls short, including realignment of curves.

(b) Strengthening of the existing pavement.

(c) Providing 1.5 m wide paved shoulders on both sides of the road.

(d) Widening/reconstruction of the existing cross-drainage works.

(e) Provision for improvement of junctions.

(f) Acquisition of land/houses in Paritalla Village

8.2.6 The details of the cost estimates have been worked out for various items, for a typical cross section of 1 km length. The rate for cross Drainage structures have been based on per meter span of the culvert/bridges. Rate for road side drain and shifting of utility services have been adopted on per running meter basis. Rates for other items have been based on lump sum basis.

8.3 RATES

The rates for various items of the work have been analysed, based on the current departmental schedule of rates cum market rates, prevelant in the area.

8.4 CONTINGENCIES

A provision of 10% has been made towards contingencies in the feasibility estimate to cover the cost of contingent items and to account for any variations at the time of detailed engineering.

8.5 A provision of 2% has been made towards the cost of laboratory equipment, camp offices, quarters and vehicles etc., as advised by the ADB T.A. Consultants.

8.6 AGENCY CHARGES

A provision of 5% has been made towards Supervision charges as advised by the ADB T.A. Concultants.

8.7 The cost of various packages and total cost of the project including miscellaneous items, contingencies, agency charges work out as follows:

Package No.	Discription	Cost Rs. in Millions			Total
		Land Acqui-sition	Shifting of Utility Services	Road & Bridge Works	
NH-5	i) Strengthening and 4-laning of NH-5, KM 3.4 TO 13.0	-	3.652	226.398	230.050
	ii) Strengthening of NH-5 km 13.00 to 75.00 excluding portion through Eluru town	1.076	0.830	419.495	421.401
	iii) Bypass to Eluru town km 0.00 to 17.88	-	1.000	450.197	451.197
	Cost of NH-5	1.076	5.482	1096.090	1102.648

Package No.	Discription	Cost Rs. in Millions			Total
		Land Acquisition	Shifting of Utility Services	Road & Bridge Works	
NH-9	iv) Stregthening and 4-laning of NH-9, km 252.0 to km 265	1.014	3.000	255.492	259.506
	v) Strengthening of NH-9, km 217 to km 252.0	1.242	0.137	261.269	262.648
	Cost of NH-9	2.256	3.137	516.761	522.154
Total cost of the project		3.332	8.619	1612.851	1624.802

Say Rs. 1625.000 Million

8.8 The cost of various packages and total cost of the contingencies, agency charges etc. in case of realignment of NH-9 in Paritala village is approved by the Ministry works out as follows

Package No.	Discription	Cost Rs. in Millions			Total
		Land Acquisition	Shifting of Utility Services	Road & Bridge Works	
NH-5	i) Strengthening and 4-laning of NH-5, KM 3.4 TO 13.0	-	3.652	226.398	230.050
	ii) Strengthening of NH-5 km 13.00 to 75.00 excluding portion through Eluru town	1.076	0.830	419.495	421.401
	iii) Bypass to Eluru town km 0.00 to 17.88	-	1.000	450.197	451.197
	Cost of NH-5	1.076	5.482	1096.090	1102.648

Package No.	Discription	Cost Rs. in Millions			Total
		Land Acqui-sition	Shifting of Utility Services	Road & Bridge Works	
NH-9	iv) Stregthening and 4-laning of NH-9, km 252.0 to km 265	1.014	3.000	255.492	259.506
	v) Strengthening of NH-9, km 217 to km 252.0 including realignment in Paritala Village in km 239	10.252	0.137	273.835	291.547
	Cost of NH-9	11.266	3.137	529.327	551.053
Total cost of the project		12.342	8.619	1625.417	1646.378

Say Rs. 1646.000 Million

PROJECT COST

STRENGTHENING OF EXISTING NH-9 FROM
NANDIGAMA (KM 217) TO VIJAYWADA (KM 265)

AND

NH-5 FROM VIJAYAWADA (KM3.40) TO ELURU (KM 75)
IN ANDHRA PRADESH
(INCLUDING FOUR LANING OF NH9 FROM KM 252 TO KM 265
AND NH-5 FROM KM 3.4 TO KM 13)

AND

ELURU BYPASS FROM KM 00.00 TO KM 17.88

SL. No.	DESCRIPTION OF WORK	BASIC COST	OVERHEADS	AMOUNT (RS. IN MILLION)
1.	Land acquisition	2.924	0.408	3.332
2.	Shifting of utilities	8.619	-	8.619
3.	Road and Bridge works	1369.027	243.824	1612.851
	Total	1380.570	244.232	1624.802

Say Rs 1625 million

GENERAL ABSTRACT OF COST

NH-5 AND NH-9

LAND ACQUISITION
RS IN MILLION

SL. NO	SECTION	BASIC COST	CONTIGENCIES, WORK & AGENCY CHARGES	AMOUNT (RS)
1.	NH5	0.944	0.132	1.076
2.	NH9	1.980	0.276	2.256
	Total	2.924	0.408	3.332

Say Rs 3.332 millions

ABSTRACT OF COST

NH-5

LAND ACQUISATION

SL.NO	ITEM OF WORK	UNIT	QTY	RATE	AMOUNT (RS)
1.	Land	Hect.	0.68	5 lakhs	340000
2.	Houses	sqm.	604.00	1000	604000
				Total	944000
Add 3% for contigencies					28320
					972320
Add 1.5% for work charges					14585
					986905
Add 9% for Agency charges					88821
				Total	1075726

Say Rs 1.076 million

ABSRACT OF COST

NH-9

LAND ACQUISATION

SL.NO	ITEM OF WORK	UNIT	QTY	UNIT RATE (RS)	AMOUNT (RS)
1	Land	Hect.	1.84	5 lakhs	920000
2	Boundary wall	LM	100	600	60000
3	Houses	sqm.	1000	1000	1000000
			Total		1980000
Add 3% for contigencies					59400
					2039400
Add 1.5% for work charges					30591
					2069991
Add 9% for agency charges					186299
				Grand Total	2256290

Say Rs 2.256 million

GENERAL ABSTRACT OF COST

NH-5 AND NH-9

SHIFTING OF UTILITIES

SL.NO	SECTION	BASIC COST	CANTAGES	AMOUNT (RS IN MILLION)
1.	NH5	5.482	-	Rs 5.482
2.	NH9	3.137	-	Rs 3.137
			Total	Rs 8.619

ABSTRACT OF COST

NH-5

SHIFTING OF UTILITIES

S.NO	ITEM	UNIT	QANTITY	UNIT RATE (RS)	AMOUNT (RS IN MILLION)
SECTION - I (KM 3.4 TO KM 13.0)					
1.	Electric lines to be shifted	m	8720 (222)	200	1.744
2.	Telephone Poles	m	3750 (91)	50	0.1875
3.	Transformers	Nos.	3	10000	0.030
4.	Trees	Nos.	19	1.5	0.010
5.	High Tension wire	m	4200m	400	1.68
			Total		3.6515

Say Rs 3.652 million

S.NO	ITEM	UNIT	QANTITY	UNIT RATE (RS)	AMOUNT (RS IN MILLION)
SECTION - II (KM 13 TO KM 55 & KM 69 TO 75)					
1.	Electric lines to be shifted	m	3550 (93)	200	0.710
2.	Telephone Poles	m	1950 (49)	50	0.0975
3.	Transformers	Nos.	2	10000	0.020
4.	Trees	Nos.	4	L.S	0.002
			Total		0.8295

Say Rs 0.83 million

SECTION -III (ELURU BYPASS)

Lumpsum amount for all items — Rs. 1.00 million

Total Sections I, II and III — Rs. 5.482 million

Note : Figures in brackets indicate the No. of poles of the Services to be shifted

ABSTRACT OF COST

NH-9

SHIFTING OF UTILITIES

S.NO	ITEM	UNIT	QTY	UNIT RATE	AMOUNT (RS IN MILLION)
SECTION - I (KM 217.00 TO KM 252)					
1.	Electric lines to be shifted	m	600 (15)	200	0.120
2.	Telephone lines	m	320 (7)	50	0.016
3.	Trees	Nos.	1	L.S	0.0005
				Total Rs	0.1365
				Say Rs 0.137 million	
SECTION - II (KM 252 TO KM 265)					
1.	Electric lines to be shifted	m	5380 (178)	200	1.076
2.	Telephone lines	m	3600 (49)	50	0.180
3.	Transformers	Nos.	5	10000	0.050
4.	Co-axial Cable	km	12.6	100000	1.260
5.	Trees	Nos.	90	L.S	0.050
				Total	2.616
				Say Rs 3.0 million	
Total Sections I and II				Rs. 3.137 million	

Note : Figures in brackets indicate the No. of Poles of the services to be sifted

GENERAL ABSTRACT OF COST (ROAD AND BRIDGE WORKS)

STRENGTHENING OF EXISTING NH-9 FROM NANDIGAMA (KM 217) TO VIJAYAWADA (KM 265)

AND

NH-5 FROM VIJAYAWADA (KM3.40) TO ELURU (KM 75) IN ANDHRA PRADESH (INCLUDING FOUR LANING OF NH-9 FROM KM 252 TO KM 265 AND NH-5 FROM KM 3.4 TO KM 13)

AND

ELURU BYPASS FROM KM 00.00 TO KM 17.88

NAME OF ROAD	SECTION	BASIC COST	10% PHYSICAL CONTIN-GENCIES	2% FOR LAB., EQUIP., CAMP, QRS., VEHICLES	5% SUPER-VISION CHARGES	TOTAL COST (RS. IN MILLION)
1.NH-9	NANDIGAMA TO VIJAYWADA	438.640	43.864	9.650	24.607	516.761
2.NH-5	VIJAYAWADA TO ELURU	930.387	93.039	20.469	52.195	1096.090
		1369.027	136.903	30.119	76.802	1612.851

GENERAL ABSTRACT OF COST (ROAD & BRIDGE WORKS)

NH-5

Strengthening of NH-5 from km. 3.4 to km. 75.00 including four laning from km. 3.4 to km. 13.0 and Eluru Bypass from km 0.00 to km 17.88

SECTION	DESCRIPTION	BASIC COST	10% PHYSICAL CONTINGENIES	2% FOR LAB. EQUIP. CAMP, QRS., VEHICLES	5% SUPERVISION CHARGES	TOTAL COST (RS. IN MILLION)
A.	Four laning from km 3.4 to km 13.0	192.172	19.217	4.228	10.781	226.398
B.	Strengthening from km 13.0 to km 75.0 excluding Eluru bypass	356.077	35.608	7.834	19.976	419.495
C.	Eluru bypass from km 0.00 to km 17.880	382.138	38.214	8.407	21.438	450.197
	Total	930.387	93.039	20.469	52.195	1096.090

GENERAL ABSTRACT OF COST (ROAD AND BRIDGE WORKS)

NH-9

STRENGTHENING OF NH-9 FROM KM. 217 TO KM. 265 INCLUDING FOUR LANING FROM KM. 252 TO KM. 265

SECTION	DESCRIPTION	BASIC COST	10% PHYSICAL CONTINGENICES	2% FOR LAB., EQUIP., CAMP, QRS., VEHICLES	5% SUPERVISION CHARGES	TOTAL COST (RS. IN MILLION)
A.	Four laning from km 252.000 to km 265.000	216.868	21.687	4.771	12.166	255.492
B.	Strengthening from km 217.0 to km 252.0	221.772	22.177	4.879	12.441	261.269
		438.640	43.864	9.650	24.607	516.761

SECTION-A ABSTRACT OF COST (ROAD AND BRIDGE WORKS)

FOUR-LANING OF NH-5 FROM KM 3.40 TO KM 13.00 WITH CENTRAL MEDIAN INCLUDING SERVICE ROADS AND DEVELOPMENT OF OPEN SPACES

SL NO.	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (Rs. in million)
1.	Strengthening and 4-laning of road with central median	km	9.60	12.485	119.856
2.	Service Roads 5.50 m width km 5.40 to km 9.6	km	8.40	2.959	24.856
3.	Widening/Replacement of culverts				
	a) RCC slab culverts (4 lane)	LM	15.00	123240	1.849
	b) RCC slab culverts (2 lane)	LM	21.00	61620	1.294
	c) Hume pipe culverts	LM	192.00	4475	0.859
4.	a) Side drains km 6.25 to km 9.5	LM	6500.00	1310.00	8.515
	b) Small drains 9.5 to 13 3.4 to 6.25	LM	12700.00	406.00	5.156
5.	a) Providing C.C kerbs	LM	19200.00	223.00	4.282
	b) Providing Chequred tiles in Central Verge	Sqm	24000	182.50	4.380
6.	Construction of Junctions	Nos	7 As per details		2.500
7.	Development of open spaces	LS		L.S	2.500
8.	Construction of Pedestrain Overbridge near Hanuman temple at km 10.00	LS		L.S	1.000
9.	Cost of Bridges	LM	1 No (75 mts) As per details		13.125
10	Busbuys	Nos	10	L.S	2.000
			Total		192.172
	Add 10% Physical Contingencies				19.217
					211.389
	Add 2% for lab equipment, camp,qrs and vehicles				4.228
					215.617
	Add 5% for supervision				10.781
			Grand Total		226.398

NH-5

SECTION-B ABSTRACT OF COST (ROAD AND BRIDGE WORKS)

STRENGTHENING OF NH-5 FROM KM 13.00 TO KM 75.00 (INCLUDING RAISING AND REALIGNMENT LENGTH (4.20 KM) AND EXCLUDING ELURU FROM 53.800 TO KM 69.200

SL. NO.	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (Rs. in million)
1.	a) Strengthening of roads from 13 to 46 (33-3.70)	km	29.300	6.651	194.874
	b) From km 46.00 to km 75.00 (29.0-0.5-15.4)	km	13.100	6.710	87.901
	c) Raising and realignments	km	4.200	8.958	37.624
2.	Reconstruction of culverts				
	a) RCC slab culverts (12 m)	LM	6.00	61620	0.370
	b) Hume pipe culverts	LM	144.00	4475	0.644
3.	Protection works				
	a) Retaining walls	LM	1000.00	3000	3.000
	b) Stone Pitching	Cum		L.S	2.000
4.	Construction of Road junctions	Nos.	17 as per details		3.700
5.	Development of open spaces	Sqm.	31260.00	320	10.000
6.	Cost of bridges	Nos.	2 as per details		12.214
7.	Truck bys	Nos.	1	L.S	0.150
8.	Bus bys	Nos.	3	L.S	0.600
9.	Improvement of curve	Nos.	2	L.S	3.000
			Total		356.077
	Add 10% Physical Contigniencies				35.608
					391.685
	Add 2% for lab equipment, camp,qrs and vehicles				7.834
					399.519
	Add 5% for supervision				19.976
			Grand Total		419.495

SECTION-C ABSTRACT OF COST (ROAD AND BRIDGE WORKS)

ELURU BYPASS (KM 0.00-KM 17.880)

SL. NO.	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (Rs. in million)
1.	Construction of bypass	km	15.88	13.945	221.447
2.	Construction of Approaches to ROBs	km	2.00	27.890	55.780
3.	a) Construction of RCC culverts	LM	43.00	61620	2.650
	b) Construction of Hume Pipe culverts	LM	630.00	4475	2.819
4.	Stone pitching	Cum	42000.00	260	10.920
5.	Road Junctions	Nos.	8	as per details	3.000
6.	Cost of bridges	Nos.	9 (480m)	-do-	73.202
7.	Cost of R.O.Bs	Nos.	2	L.S.	12.320
				Total	382.138
	Add 10% Physical Contingencies				38.214
					420.352
	Add 2% for lab equipment, camp,qrs and vehicles				8.407
					428.759
	Add 5% for supervision				21.438
		Grand Total			450.197

SECTION-A ABSTRACT OF COST (ROAD AND BRIDGE WORKS)

FOUR- LANING OF NH-9 FROM KM 252 TO KM 265.00 WITH CENTRAL/SIDE WIDENING

SL. NO.	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (Rs. in million)
1.	Strengthening and 4-laning of road with central widening with 1.2 m median.	km	3.70	11.96	44.252
2.a)	Strengthening and 4-laning of road with one side widening 4.5 m median	km	9.30	12.35 (7.131+5.218)	114.855
b)	Extra for change over points	LM	Lumpsum		2.500
3.	Reconstruction/widening of culverts				
	a) RCC slab culverts (24 m)	LM	44.50	123240	5.484
	b) Hume pipe culverts	LM	72.00	4475	0.322
4.	Side Drains	LM	7000	406.00	2.842
5.	Providing C.C kerb	LM	26000	223.00	5.798
6.	Improvement of median and open spaces	LS	As per details		8.482
7.	Construction of Road Junctions	Nos	4	L.S	1.300
8.	Cost of Bridges	Nos	4(146 mts) as per details		24.083
9.	Improvement of curves	Nos	4	L.S	6.000
10.	Truck bys	Nos	1	L.S	0.150
11.	Bus bys	Nos	4	L.S	0.800
					216.868
	Add 10% Physical Contingencies				21.687
					238.555
	Add 2% for lab equipment, camp,qrs and vehicles				4.771
					243.326
	Add 5% for supervision				12.166
		Grand Total			255.492

NH-9

SECTION-B ABSTRACT OF COST (ROAD AND BRIDGE WORKS)

STRENGTHENING OF ROAD FROM KM 217 TO KM 252.00 (INCLUDING RAISING PORTION FROM KM 238.550 TO KM 239.250)

SL. NO.	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (Rs. in million)
1.	Strengthening of roads	km	34.300	6.13	210.259
2.	Raising	km	0.700	7.85	5.495
3.	Reconstruction/widening of culverts				
	a) RCC slab culverts (12m)	LM	18.00	61620	1.109
	b) Hume pipe culverts	LM	26.00	4475	0.116
4.	Road junctions	Nos.	6	L.S	1.200
5.	Construction/Repairing of Bridges	Nos.	1(11.54)	L.S	1.443
6.	Improvement of Curves	Nos.	1	L.S	2.000
7.	Truck bay	Nos.	1	L.S	0.150
			Total		221.772
	Add 10% Physical Contingencies				22.177
					243.949
	Add 2% for lab equipment, camp,qrs and vehicles				4.879
					248.828
	Add 5% for supervision				12.441
			Grand Total		261.269

ALTERNATIVE PROJECT COST
(including cost of Land Acquisition and shifting of utilities)

STRENGTHENING OF EXISTING NH-9 FROM
NANDIGAMA (KM 217) TO VIJAYAWADA (KM 265)

AND

NH-5 FROM VIJAYAWADA (KM 3.40) TO ELURU (KM 75)
IN ANDHRA PRADESH
(INCLUDING 4 LANING OF NH-9 FROM KM 252 TO KM 265
AND NH-5 FROM KM 3.4 TO KM 13.0)

AND

ELURU BYPASS FROM KM 0.00 TO KM 17.88

SI No.	Discription	Basic Cost	Overheads	Amount (Rs. in million)
1.	Land Acquisition	10.834	1.508	12.324
2.	Shifting of utilities	8.619	-	8.619
3.	Road & Bridge works	1379.694	245.723	1625.417
		1399.147	247.231	1646.370

Abstract of Cost of Land Acquisition
NH-5 AND NH-9

SI No.	Section	Basic Cost	Overheads	Amount (Rs. in million)
1.	NH-5	0.944	0.132	1.076
2.	NH-9*	9.890	1.376	11.266
		10.834	1.508	12.342

* Figures arrived as under :

SI No.	Section	Basic Cost	Overheads	Amount (Rs. in million)
1.	As per first proposal	1.980	0.276	2.256
2.	Less portions deleted	1.090	0.150	1.240
3.	Add for acquisition of realigned length	9.000	1.250	10.250
		9.890	1.376	11.266

Cost of shifting of services remains same for NH-5 and NH-9.

ALTERNATE PROJECT COST
(with realignment in NH-9 in Paritala village)

Section	Discription	Basic Cost	10% Contg.	2% Vehicle etc.	5% Super- vision	Total Cost (Rs. in million)
A.	4 laning from km 252.00 to km 265.00	216.868	21.687	4.771	12.166	255.492
B.	Strengthening from km 217.00 to km 252.00	232.439	23.244	5.113	13.039	273.835
		449.307	44.931	9.884	25.205	529.327
NH-5	Same	930.387	93.039	20.469	52.195	1096.090
Total for NH-5 & NH-9		1379.694	137.970	30.353	77.400	1625.417

NH-9

ABSTRACT OF COST OF REALIGNMENT IN PARITALA VILLAGE

Sl. No.	Discription	Basic Cost	Overheads	Amount (Rs. in million)
1.	Road & Bridge works	29.196	5.200	34.396
2.	Cost of Land Acquisition	9.000	1.250	10.250
	Total	38.196	6.450	44.646
	LESS COST AS PER FIRST PROPOSAL THROUGH VILLAGE			
1.	Road & Bridge works	18.529	3.301	21.830
2.	Cost of land & house acquisition	1.090	0.150	1.240
	Total	19.619	3.451	23.070

NET INCREASE IN COST

SECTION KM 217.00 TO KM 252.00 OF NH-9
DUE TO REALIGNMENT IN PARITALA VILLAGE

1.	Road & Bridge works	10.667	1.899	12.566
2.	Land Acquisition	7.910	1.100	9.010
	Total	18.577	2.999	21.576

ALTERNATIVE COST OF NH-9 (KM 217 TO KM 252) WITH REALIGNMENT IN PARITALA VILLAGE ROAD AND BRIDGE WORKS ONLY

Section	Discription	Basic Cost	10% Contg.	2% Vehicle etc.	5% Super-vision	Total Cost (Rs. in million)
B	Km 217 to Km 252	221.772	22.177	4.879	12.441	261.269
	Add for increase	10.667	1.067	0.234	0.598	12.566
	Total	232.439	23.244	5.113	13.039	273.835

NH-9 ALTERNATIVE COST OF REALIGNMENT IN PARITALA VILLAGE IN KM 239.00

) COST OF REALIGNMENT PORTION (Approx. length 3.00 km)

Sl. No.	Discription	Unit	Qty	Rate	Amount (Rs. in million)
.	Construction of realigned length	km	3.00	9.377	28.131
2(a)	Construction of RCC culverts	LM	10	61620	0.616
(b)	Construction of HP culverts	LM	78	4475	0.349
.	Road Junctions	Nos	2	50,000	0.100
	Total				Rs. 29.196
	Add 10% physical contingencies				Rs. 2.920
					Rs. 32.116
	Add 2% for lab. equip., camp, qrs. etc.				Rs. 0.642
					Rs. 32.750
	Add 5% for supervision				Rs. 1.638
	Grand Total				Rs. 34.396

(ii) COST TO BE DEDUCTED FROM FIRST PROPOSAL

1.	Strengthening from Km 236.75 to Km 238.55	Km	1.80	6.13	11.034
2.	Raising from Km 238.55 to Km 239.25 (0.70 Km)	Km	0.70	7.85	5.495
3.	Other improvements	L.S			2.000

Total	Rs.	18.529
Add 10% contingencies	Rs.	1.853
	Rs.	20.382
Add 2% lab. equip. etc.	Rs.	0.408
	Rs.	20.790
Add 5% supervision	Rs.	1.040
Gand Total	Rs.	21.830

(iii) (a) COST OF LAND ACQUISITION FOR THE REALIGNED PORTION

Length = 3 km.
Width = 60 m.
Area = 3000 x 30 = 18 Hectares

Cost @ Rs.5.0 lakhs = 18 x 5,00,000 = Rs. 9.0 million
per Hactare

Add 3% contigencies	=	Rs. 0.270
		Rs. 9.270
Add 1.5% for work charge	=	Rs. 0.130
		Rs. 9.400
Add 9% for agency charges	=	Rs. 0.850
Total	=	Rs.10.25 million

(b) Less cost of acquisition of 5 houses and strip of land inside the Paritala village	=	Rs.	1.090
Add 3% contigencies	=	Rs.	0.033
		Rs.	1.123
Add 1.5% for work charge	=	Rs.	0.017
		Rs.	1.140
Add 9% for agency charges	=	Rs.	0.100
Total	=	Rs.	1.240 million

ANNEXURE I

NH-5

ABSTRACT OF COST

4 LANNING KM 3.4 TO 13.00 WITH CONCENTRIC WIDENING WITH 2.5 M CENTRAL MEDIAN AND SHOULDERS ON OUTER EDGES

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	1.872	8200	15350
1.02	Scarifying existing road surface, including bitumen surface complete as per Technical Specification Clause 305	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	5610	16	89760
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	3250	59.50	193375
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	12178	94	1144732
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	5610	39	218790
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	1280	26	33280

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	400	54.5	21800
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	5050.5	413	2085857
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	4575	555	2539125
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	13300	10.3	136990
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	35400	4.5	159300
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	13300	6	79800
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	2153	1990	4284470
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	560	2170	1215200
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	39	117000
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
			Total		Rs.12484829

Say Rs 12.485 million

ANNEXURE II

NH-5

ABSTRACT OF COST

STRENGTHENING FROM KM 13 TO 46

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	0.952	8200	7806
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	3690	16	59040
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	1994	59.5	118643
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	5437	94	511078
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	3690	39	143910
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	1040	26	27040

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	2051	413	847063
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	1575	555	874125
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	3300	10.30	33990
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	27400	4.5	123300
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	3300	6	19800
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	1513	1990	3010870
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	280	2170	607600
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	39	117000
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
			Total		Rs.6651265

Say Rs 6.651 million

ANNEXURE III

NH-5

ABSTRACT OF COST

STRENGTHENING FROM KM 46 TO 75

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	0.952	8200	7806
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	3690	16	59040
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	1994	59.5	118643
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	5437	94	511078
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	3690	39	143910
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	1040	26	27040

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	2051	420	861420
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	1575	565	889875
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	3300	10.30	33990
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	27400	4.5	123300
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	3300	6	19800
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	1513	2006	3035078
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	280	2185	611800
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	39.20	117600
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
			Total		Rs. 6710380

Say 6.710 million

ANNEXURE IV

NH-5

ABSTRACT OF COST

NEW CONSTRUCTION (ELURU BYPASS)
(KM 0.00 TO KM 17.88)

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	31.74	8200	260268
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	-	-	-
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	51480	94	4839120
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	11359	94	1067746
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	-	-	-
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	-	-	-

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
2.07	Stripping of top surface	Sqm.	31740	25	793500
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	4078.5	420	1712970
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	3645	565	2059425
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	10000	10.3	103000
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	14000	4.5	63000
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	10000	6	60000
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	1050	2006	2106300
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	280	2185	611800
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	39.20	117600
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
			Total		Rs. 13944729

Say Rs 13.944 million

ANNEXURE V

NH-5

ABSTRACT OF COST

RAISING AND REALIGNMENT OF ROAD
(KM 16.00-19.00 RAISING, KM 35.90-KM 36.30 AND KM 49.15-49.65 REALIGNMENT

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	1.454	8200	11923
.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	-	-	-
.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	16493	59.5	981334
.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	11359	94	1067746
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	-	-	-
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	-	-	-

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	4078.5	413	1684421
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	3645	555	2022975
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	10000	10.3	103000
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	14000	4.5	63000
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	10000	6	60000
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Sqm.	1050	1990	2089500
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	280	2170	607600
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	39	117000
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
			Total		Rs 8958499

Say Rs 8.958 million

ANNEXURE VI

NH-5

ABSTRACT OF COST

SERVICE ROAD (5.5 m Wide)
(FROM KM 5.4 TO 9.6)

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	1.3	8200	10660
1.02	Scarifying existing road surface, including bitumen surface complete as per Techical Specification Clause 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	-	-	-
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	5055	59.50	300773
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	5713	94	537022
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	-	-	-
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	-	-	-

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	1763	413	728119
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	1673	555	928515
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	5500	10.30	56650
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.			
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	5500	6	33000
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	-	-	-
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	-	-	-
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	5500	39	214500
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
			Total		Rs. 2959239

Say Rs 2.959 million

NH-9

ABSTRACT OF COST

FOUR LANING WITH CONCENTRIC WIDENING (1.2 m MEDIAN)
KM 261.30 TO KM 265.00

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	1.754	8200	14383
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	5610	16	89760
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	2660	59.5	158270
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	12359	94	1161746
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	5610	39	218790
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	-	-	-

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	588	54.5	32046
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	4679	368	1721872
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	4245	473	2007885
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	12000	10.3	123600
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	19000	4.5	85500
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	12000	6	72000
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	2550	1900	4845000
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	560	2084	1167040
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	37.4	112200
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
		Total			Rs. 11960092

Say Rs 11.960 million

NH-9

ABSTRACT OF COST

4 LANING - STRENGTHENING OF EXISTING 2 LANE WITH ONE SIDE SHOULDER AND PROVIDING ADDITIONAL 2 LANE WITH ONE SIDE SHOULDER WITH 4.5 MEDIAN (252-261.3)

COST PER KM

PART A: STRENGTHENING

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	0.497	8200	4075
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Cum.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	1845	16	29520
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	1444	59.5	85918
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	2805	94	263670
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	1845	39	71955
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	520	26	13520

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	1079	368	397072
.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	570	473	269610
.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	1800	10.3	18540
.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	27400	4.5	123300
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	1800	6	10800
.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	1653	1900	3140700
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	280	2084	583520
.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	1500	37.4	56100
.06	Road Furniture	km	1	100000	100000
.07	Arboriculture	km	1	50000	50000
			Total		Rs.5218300

C/o to page no. 8.39

COST PER KM

PART B: ADDITIONAL 2 LANING

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	1.987	8200	16293
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	-	-	-
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	8085	59.5	481058
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	8698	94	817612
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	-	-	-
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	-	-	-

Item	Description	Unit	Estimated Quantity	United Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	2671	54.5	145570
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	3370	368	1240160
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	3053	473	1444069
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	8500	10.3	87550
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	14000	4.5	63000
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	8500	6	51000
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	1050	1900	1995000
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Cum.	280	2084	583520
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	1500	37.4	56100
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
		Total			Rs. 7130932
		B/o from page no.8.37			Rs. 5218300
					12349232
					Say Rs 12.350 million

ANNEXURE IX

NH-9

ABSTRACT OF COST

2 LANE STRENGTHENING WITH SHOULDERS ON BOTH SIDES
(KM 217- KM 252)

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	0.872	8200	7150
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	2760	16	44160
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	1100	59.5	65450
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	5051	94	474794
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	2760	39	107640
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	1080	26	28080

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	2051	368	754768
.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	1575	473	744975
.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 sqm.	Sqm.	3300	10.3	33990
.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	27400	4.5	123300
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	3300	6	19800
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Cum.	1513	1900	2874700
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Sqm.	280	2084	583520
.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	37.40	112200
.06	Road Furniture	km	1	100000	100000
.07	Arboriculture	km	1	50000	50000
			Total		Rs. 6124527

Say Rs 6.130 million

ANNEXURE X - I

NH-9

ABSTRACT OF COST

RAISING
(KM 238.55 TO KM 239.25)

COST PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	2.424	8200	19877
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	-	-	-
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	7934.4	59.5	472097
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	11359	94	1067746
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	-	-	-
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	-	-	-

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	4078.5	368	1500888
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	3645	473	1724085
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	10000	10.3	103000
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	14000	4.5	63000
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	10000	6	60000
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Sqm.	1050	1900	199500
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Sqm.	280	2084	583520
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	37.40	112200
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
			Total		Rs. 7851413

Say Rs 7.850 million

ANNEXURE X - II

NH-9

ABSTRACT OF COST

REALIGNMENT IN PARITALA VILLAGE

RATE PER KM

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
1.01	Clearing and grubbing road land complete as per Technical Specification Clause 201 for road & bridges	hect.	2.574	8200	21107
1.02	Scarifying existing road surface, including bitumen surface complete as per Tech. Spec. Cl. 305.	Sqm.	-	-	-
2.01	Roadway excavation necessary for construction of roadway complete as per Technical Specification Clause 301 in ordinary soil	Cum.	-	-	-
2.02	Construction of embankment with approved material complete as per Technical Specification Clause 305 with all leads and lifts.	Cum.	22740	59.5	1353030
2.03	Construction of subgrade and earthen shoulders with approved material complete as per Technical Specification Clause 305 with all leads and lifts, satisfying the soaked CBR value as indicated in the drawings	Cum.	11359	94	1067746
2.04	Construction of embankment subgrade and earthen shoulders with suitable materials deposited at site from roadway and drainage excavation complete asper Tech. Specification Clause 305.	Cum.	-	-	-
2.05	Loosening and recompacting subgrade in all kinds of soil complete as per Technical Specification Clauses 301 and 305.	Cum.	-	-	-

Item	Description	Unit	Estimated Quantity	Unit Rate	Amount Rs.
2.06	Filling of median/island as per Technical Specification Clause 407 with ordinary soil	Cum.	-	-	-
2.07	Stripping of top of field land (150 mm thick).	Sqm.	25740	25	643500
3.01	Constructing granular subbase complete as per Technical Specification Clause 401. Grade I. (30% CBR)	Cum.	4078.5	368	150088
3.02	Constructing wet mix macadam base complete as per Technical Specification Clause 406.	Cum.	3645	473	172408
4.01	Providing bituminous primer coat over granular surface with emulsion complete as per Technical Specification Cl. 502 a) @ 9.8 to 12.2 Kg/10 Sqm.	Sqm.	10000	10.3	103000
4.02	Providing bituminous tack coat complete as per Technical Specification Clause 503 a) @ 5 kg/10 Sqm. on bituminous surface.	Sqm.	14000	4.5	63000
	b) @ 7.5 kg/10 Sqm. on granular surface treated with primer/ hungry bituminous surface	Sqm.	10000	6	60000
4.03	Providing dense bituminous macadam course complete as per Technical Specification Clause 507.	Sqm.	1050	1900	199500
4.04	Providing bituminous concrete wearing course complete as per Technical Specification Clause 512.	Sqm.	280	2084	583520
4.05	Providing Mix Seal Surfacing complete as per Technical Specification clause 510	Sqm.	3000	37.40	112200
4.06	Road Furniture	km	1	100000	100000
4.07	Arboriculture	km	1	50000	50000
		Total			Rs. 9377076

Say Rs 9.377 million

ANNEXURE XI

ANALYSIS OF RATE 12M. LENGTH (WIDTH OF CULVERT OUTER TO OUTER PARAPETS.

	SLAB CULVET 4m Span		QTY.	RATE	COST (Rs.)
1	Earthwork in foundation (m^3)		172.3	25.0	4307.5
2	M1 5 (1:2:4)	m.m	47.0	1520.0	71440.00
3	M2 5 grade	m.m	22.0	1855.0	40810.00
4	Steel Reinforcement	tonnes	1.91	20000.0	38200.00
5	Brick Masonry (m^3)	(1:3)	82.21	797.0	65521.37
6	Plaster 20 mm thick	(sqm)	86.1	35.0	3013.5
7	Filter media	(mm)m	60.24	359.0	21626.16
8	Expansion Joint	(LM)	24 m	64.0	1536.00
	Total				246454.53

For 1 m. length and for 4 m. span = Rs. 20537.88

Therefore, for 1 m. width for 1 m. span = Rs. 5134.46

say Rs. 5135 per m. length per m. span

For 12 m width = 5135 x 12 = Rs. 61620 per culvert

For 4-lane = Rs. 2 x 61620
= Rs. 1,23,240 per meter span.

ANNEXURE XII

ANALYSIS OF RATE H.P. CULVERT (1 m) FOR 14 m.

SLAB CULVET 4m Span	QTY.	RATE	COST (Rs.)
1 Earthwork in excavation (m^3)	32.0	25.0	800.0
2 MIS CC (1:2:4) (m^3)	2.70	1520.0	4104.0
3 Brick Masonry (1:3)	6.0	816.0	4896.00
4. Stone pitching in apron etc (m^3)	14.4	260.00	3770.00
5. Hume Pipe NP_3 1 m (RM)	14.00	3261.00	45654.00
6. Plastering (CM 1:3)(sqm.)	10.12	37.00	374.44
7. Granular material (m^3)	8.0	233.00	1864.00
8. Filter Media (m^3)	3.3	359.00	1184.70
Total			62647.14

Cost per m. length = 4474.79 per m. length
say Rs. 4475 per m. length.

ANNEXURE XIII

ANALYSIS OF RATE
NH-5 AND NH-9

ITEM OF WORK: CONSTRUCTING SURFACE DRAIN (LINED) TO LINES AND GRADES (OPEN DRAIN) 0.6 m wide.

TAKING LENGTH 1000 METERS. UNIT : L.M.

ITEM	UNIT	QTY.	RATE	COST (Rs.)
1 Earthwork in excavation $1000 \times \frac{(0.6+0.4) \times 0.6}{2}$ = 300 Cum	Cum	300	20.00	6000
2 Plain cement concrete 1:3:6 in foundation and plinth 1000 x 0.4 x 0.1 = 40 Cum	Cum	40	1197	47880
3 Brick work 1:3 CM 2 x 1000 x 0.23 x 0.9 = 414 Cum	Cum	414	797	329958
4. 12 mm thick cement plaster (1:3) $1000 \times 0.6 = 600\ m^2$	Sqm	600	20	12000
5. Iron grating	-	-	L.S.	10000
				405838

$$\text{Rate/m run} = \frac{405838}{1000} = 405.84$$

say Rs. 406 per m run.

ANNEXURE XIV

ANALYSIS OF RATE
NH-5 AND NH-9

Rate per LM

PROVIDING CONCRETE KERBS

CEMENT CONCRETE 1:2:4 FOR 1 M LENGTH

$$= 1\ [0.155 \times 0.455 + 0.300 \times \frac{(0.15 + 0.195)]}{2}$$

= [0.069 + 0.051] = 0.120 Cum

Cost of 0.120 cum at the rate of Rs. 1443 Cum
= Rs. 173.160

Extra cost for the casting machine = Rs. 50.00

= Rs. 223.16

Say rate per LM = 223.00

Annexure 15.

Analysis of Rate

Applicable for NH-5

Analysis of rate for collection of materials at plant site location km 46.

Name of Section : VIJAYAWADA - ELURU (4-LANING AND STRENGTHENING).

Sl. Nos.	Details	For bases and sub-bases (non-bituminous)					For Bituminous course				Remarks
		Grade-I	Grade-II	Grade-III	Type-A	Type-B					
		90-45 mm	63-45 mm	53-22.4 mm	13.2 to 180 micron	11.2 to 180 micron	53to 2.8mm	45to 22.4mm	22.4to 2.8mm	2.8 to 90 micron stone dust	
1.	Name of Quarry :	KETHNAKONDA					KETHNAKONDA				
2.	Lead in kms. :	55.	55.	55.	55.	55.	55.	55.	55.	55.	
3.	Rate at Quarry +25% for machine crushing +Rs.18.90 for blasting	68.30	80.78	129.53	178.65	153.90	88.90	105.40	176.15	50.00	
4.	Carriage Charges	80.70	80.70	80.70	80.70	80.70	80.70	80.70	80.70	80.70	
5.	Seignorage and extra for loading +IA/NA etc.	25.33	25.33	25.33	25.33	25.33	25.33	25.33	29.26	29.26	
	Total Rs.	174.33	186.81	235.56	284.68	259.93	194.43	211.43	286.11	159.96	
	Say Rs.	174.30	186.80	235.60	284.70	260.00	195.00	211.40	286.10	160.00	

Analysis of Rate

Applicable for NH-5

Analysis of rate for collection of materials at plant site location 54 km.

Name of Section : Eluru byepass & strengthening in km 46-54,69-75.

Sl. Nos.	Details	For bases and sub-bases (non-bituminous)					For Bituminous course			
		Grade-I	Grade-II	Grade-III	Type-A	Type-B				
		90-45 mm	63-45 mm	53-22.4 mm	13.2 mm	11.2 mm	53to 2.8mm	45to 22.4mm	22.4to 2.8mm	2.8 to 90
1.	Name of Quarry :	Akonduru	Akonduru	Akonduru	Akonduru	Akonduru	Akonduru	Akonduru	Akonduru	Akonduru
2.	Lead in kms. :	72.	72.	72.	72.	72.	72.	72.	72.	72.
3.	Rate at Quarry +25% for machine crushing +Rs.18.90 for blasting	68.30	80.78	129.53	178.65	153.90	88.90	105.40	190.91	50.00
4.	Carriage Charges	94.30	94.30	94.30	94.30	94.30	94.30	94.30	94.30	94.30
5.	Seignorage and extra for loading +IA/NA etc.	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30
	Total Rs.	176.90	189.38	238.13	287.25	262.50	197.50	214.00	299.51	158.60
	Say Rs.	177.00	189.40	238.10	287.25	262.50	197.50	214.00	299.50	160.00

Annexure 17.

Analysis of Rate

Applicable for NH-9

Analysis of rate for collection of materials at plant site at km 241.

Name of Section : NANDIGAMA - VIJAYAWADA.

Sl. Nos.	Details	For bases and sub-bases (non-bituminous)					For Bituminous course			
		Grade-I	Grade-II	Grade-III	Type-A	Type-B				
		90-45 mm	63-45 mm	53-22.4 mm	13.2 to 180 micron	11.2 to 180 micron	53to 2.8mm	45to 22.4mm	22.4to 2.8mm	2.8 to 90 micron stone dust
1.	Name of Quarry :	DONABONDA					DONABONDA			
2.	Lead in kms. :	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	Rate at Quarry +25% for machine crushing +Rs.18.90 for blasting	68.30	80.78	129.53	178.65	153.90	88.90	105.40	190.91	50.00
4.	Carriage Charges	28.30	28.30	28.30	28.30	28.30	28.30	28.30	28.30	28.30
5.	Seignorage and extra for loading +IA/NA etc.	24.53	24.53	24.53	24.53	24.53	24.53	24.53	28.46	24.53
	Total Rs.	121.13	133.61	182.36	231.48	206.73	141.73	158.23	228.98	102.83
	Say Rs.	121.10	133.60	182.40	231.50	206.70	141.70	158.20	229.00	102.80

Annexure 18.

Analysis of Rates

Applicable For NH-5 and NH-9

Item 1.01

Clearing and Grubbing road land complete as per T.S. clause 201.

Unit	1 Hectare		
Taking area	100 m^2		
i) Beldar	1 No.	@ Rs. 34.80	Rs. 34.80
ii) Coolie	1 No.	@ Rs. 31.80	Rs. 31.80
		Total =	Rs. 66.60
Add 23% for LI, LA and MAA		=	Rs. 15.32
		Total =	Rs. 81.92

$$\text{Rate/hectare} = \frac{81.92 \times 10000}{100} = 8192$$

Say Rs. 8200.00

Note : L.I. = Labour Importation } -13%
L.A. = Labour Amenities
MAA = Municipal Area Allowance -10%
Total = -23%

23% As per Andhra Pradesh schedule of Rates.

Annexure 19.

Analysis of Rate

Applicable for NH-5 and NH-9

Item of Work : Roadway excavation necessary for construction of roadway complete as per Tech specification no 301.

Unit - 1 m3

Serial No.	Item	
1.	Excavation in all types of soil as per SSR item no. 20-A.	Rs. 11.85
2.	Add 23% (13+10) on above items as per SSR for LI, LA and MAA.	Rs. 2.73
3.	Add for royalty for earth	Rs. 1.18
	Total =	Rs. 15.76
	Say =	Rs. 16.00 per cum.

Annexure 20.

Analysis of Rate

Applicable for NH-5 and NH-9

Item of Work : Earthwork in embankment in all types of soil complete as per technical specification CL.305.

Av. Lead = 8 km   Unit = 1 cum.

Analysis for 10 cum

Serial No.	Item	
1.	Cost of excavation as per SSR. No. 9A	= Rs. 118.50
2.	18% Extra for compaction	= Rs. 21.33
3.	Add labour and hire charges for OMC as per SSR. No. 22C	= Rs. 91.50
4.*	Conveyance charges for 8 km lead @ Rs. 31.00/cum	= Rs. 310.00
5.	Add 23% (13+10) on item No. 1, 2 & 3 as per SSR for LI,LA & MAA	= Rs. 53.21
	Total for 10 cum	= Rs. 594.54

Say = Rs. 59.50 per cum

* Average lead of earth cartage is 8 km from quarry.

Annexure 21.

Analysis of Rate

Applicable for NH-5 and NH-9

Item of Work : Earthwork in sub-grade construction compacted to 98% IS heavy compaction clause 305. (Sand, Gravel mix 1:1.5)

1. Cost of sand (0.5 m3) @ Rs. 6.30/m3 + Rs 20.55 for seignorages + Rs. 28.50 for conveyance charges (6 km) = Rs. 55.35	= Rs.	27.6
2. Cost of gravel (0.75 m3) @ Rs. 7.80/m3 + Rs. 6.85 for seignorages + conveyance charges Rs.39.00 (lead 15 km) = Rs. 53.65	= Rs.	40.2
3. Mixing (1/4 labour rate @ Rs. 40)	= Rs.	10.0
4. Spreading & rolling (Item S.6)	= Rs.	13.5
5. 23% for LI, LA and MAA on Rs. 10.00	= Rs.	2.3
Total	= Rs.	93.7

Say = Rs. 94.00 per

Annexure 22.

Analysis of Rate

Applicable for NH-5 and NH-9

Item of Work : Construction of embankment with excavated materials from embankment, drains etc to be deposited at site and compacted as per spec.

Average lead = 1000 m   Unit = 1 cum

Serial No.	Item	
1.	Carriage charges by mechanical means including loading and unloading as per spec.	= Rs. 22.70
2.	Add labour and hire charges for OMC as per SSR 22-C	= Rs. 9.15
3.	Add 23% (13+10) as per SSR for LA,LI and MAA	= Rs. 7.32
	Total	= RS. 39.17 per cum
	Say	= Rs. 39.00 per cum

Annexure 23.

Analysis of Rate

Applicable for NH-5 and NH-9

Item of Work : Earthwork for loosening and recompacting at subgrade level in all kinds of soil.

Unit - cum

Serial No.	Item	
1.	Excavation in all types of soil as per SSR item No. 9A	= Rs. 11.85
2.	Labour and hire charges for watering and compaction as per SSR item 22-C	= Rs. 9.15
3.	Add 23% (13+10) on above items as per SSR for LA, LI and MAA	= Rs. 4.83
	Total	= Rs. 25.83
	Say	= Rs. 26.00 per cum

ANALYSIS OF RATE

FOR NH-5 AND NH-9

ITEM OF WORK :- FILLING OF MEDIAN/ ISLAND WITH SOIL AS PER TECHNICAL SPECIFICATION CLAUSE 407.

UNIT - 1 CUM.

1.	Carriage charges by mechanical means with average lead of 8 km. including excavation in all tyes of soil (31.00 + 11.85) including loading and unloading.	= Rs.42.85
2.	Extra for laying earth as per specification in layers SSR item 22.8	= Rs. 1.81
3.	Add 23% (13+10) as per SSR for LA, L.I. & M.A.A	= Rs.10.27
	TOTAL	= RS. 54.93
	SAY Rs.	= 54.50 Per Cum.

ANALYSIS OF RATE

NH-5 & NH-9

ITEM OF WORK - PROVIDING BITUMINOUS PRIMER COAT/TACK COAT OVER WMM SURFACE AT 10 Kg. PER 10 Sqm.

UNIT - 1 Sqm.

DETAILS OF COST FOR 100 Sqm.

1.	Material Bitumen = 100 Kg. for 100 sqm. = 0.10 MT at Rs. 6292 per tonne	Rs 629.20
2.	Mazdoor for cleaning 5 Nos. @ Rs.40.00	Rs 200.00
3.	Mazdoor for tack coat 1.5 Nos. @ Rs. 40.00	Rs. 60.00
4.	Sprayers 1/10 Nos. @ Rs.60.00	Rs. 6.00
5.	Tarring mate 1/10 No. @ Rs. 60.00	Rs. 6.00
6.	Fuel - L.S.	Rs. 32.00
7.	Tar boiler - L.S.	Rs. 15.00
8.	Misc. brushes etc.	Rs. 25.00
9.	Add 23% on item (2) and (3)	Rs. 59.80
		Rs.1033.00

Rate per sqm.=1033/100 = 10.33/sqm.

Say Rs.10.30 /sqm.

ANNEXURE 26

ANALYSIS OF RATE
NH-5 & NH-9

ITEM OF WORK - PROVIDING TACK COAT OVER EXISTING BITUMINOUS SURFACE AT 5 Kg PER 10 Sqm.

UNIT - 1 Sqm.

DETAILS OF COST FOR 100 Sqm.

1.	Bitumen (Rate of application as per MOST Specification) = 100 x 5/1 = 0.05 MT. at Rs 6292 per tonne	Rs 314.60
2.	Mazdoor for cleaning 0.4 Nos. @ Rs.40.00	Rs 16.00
3.	Mazdoor for tack coat 1.2 Nos. @ Rs. 40.00	Rs. 48.00
4.	Sprayers 0.1 Nos. @ Rs.60.00	Rs. 6.00
5.	Tarring mate 1/30 No. @ Rs. 60.00	Rs. 2.00
6.	Fuel - L.S.	Rs. 25.00
7.	Tar boiler -L.S.	Rs. 10.00
8.	Misc. brushes etc.	Rs. 5.00
9.	Add 23% on item (2) and (3)	Rs. 14.72
		Rs. 441.32

Rate per sqm. = 441.32/100 = Rs. 4.41/sqm.

Say Rs. 4.5/sqm.

ANNEXURE 27

ANALYSIS OF RATE
NH-5 & NH-9

ITEM OF WORK - PROVIDING TACK COAT OVER GRANULAR SURFACE TREATED WITH PRIMER AT 7.50 Kg PER 10 Sqm.

UNIT - 1 Sqm.

DETAILS OF COST FOR 100 Sqm.

1.	Material Bitumen = 100 x 7.5/10 x 1/1000 = 0.075 MT at Rs 6293 per tonne	Rs 471.90
2.	Mazdoor for cleaning 0.4 Nos. @ Rs.40.00	Rs 16.00
3.	Mazdoor for tack coat 1.2 Nos. @ Rs. 40.00	Rs. 48.00
4.	Sprayers 0.1 Nos. @ Rs.60.00	Rs. 6.00
5.	Tarring mate 1/30 No. @ Rs. 60.00	Rs. 2.00
6.	Fuel - L.S.	Rs. 25.00
7.	Tar boiler L.S.	Rs. 10.00
8.	Misc. brushes etc.	Rs. 5.00
9.	Add 23% on item (2) and (3)	Rs. 14.72
		Rs. 598.62

Rate per sqm. = 598.62/100

Say Rs. 6.00 /sqm.

Annexure 28.

Analysis of Rate

Applicable for NH-5

(4-LANING AND STRENGTHENING UPTO KM 46)
(XN : VIJAYAWADA - ELURU)

Item of Work : Providing and laying granular sub-base grading grade I.

Unit : 1 cum.

1.	Collection of 90-45 mm size stone aggregate 5/100 x 1.40 = 0.07 cum at Rs. 174.30 per cum.	= Rs. 12.20
2.	Collection of 53-22.4 mm size stone aggregate 15/100 x 1.40 = 0.21 cum at Rs. 235.60 per cum.	= Rs. 49.48
3.	Collection of 45-22.4 mm size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 211.40 per cum.	= Rs. 59.19
4.	Collection of 22.4-11.2 micron size stone aggregate 30/100 x 1.40 = 0.42 at Rs. 286.10 per cum.	= Rs. 120.10
5.	Collection of 11.2-2.8 micron size stone aggregate 30/100 x 1.40 = 0.42 at Rs. 260.00 per cum.	= Rs. 109.20
6.	For laying and consolidation for 1.4 cum at Rs. 45.00	= Rs. 63.00
	Total	= Rs. 413.17
	Say	= Rs. 413.00 per cum.

Annexure 29.

Analysis of Rate

Applicable for NH-5

(4-LANING AND STRENGTHENING UPTO KM 46)
(XN : VIJAYAWADA - ELURU)

Item of Work : Providing and laying granular sub-base grading grade III.

Unit : 1 cum.

1.	Collection of 90-45 mm size stone aggregate 5/100 x 1.40 = 0.07 cum at Rs. 174.30 per cum.	= Rs.	12.20
2.	Collection of 53-22.4 mm size stone aggregate 10/100 x 1.40 = 0.14 cum at Rs. 235.60 per cum.	= Rs.	32.98
3.	Collection of 45-22.4 mm size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 211.40 per cum.	= Rs.	59.19
4.	Collection of 22.4-11.2 micron size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 286.10 per cum.	= Rs.	80.11
5.	Collection of 11.2-2.8 micron size stone aggregate 20/100 x 1.40 = 0.28 at Rs. 260.00 per cum.	= Rs.	72.80
6.	Collection of stone dust 20/100 x 1.40 = 0.28 at Rs. 160.00 per cum.	= Rs.	44.80
7.	For laying and consolidation for 1.4 cum at Rs. 45.00	= Rs.	63.00
	Total	= Rs.	365.08
	Say	= Rs.	365.00 per cum.

Annexure 30.

Analysis of Rate

Applicable for NH-5

(4-LANING AND STRENGTHENING UPTO KM 46)
(XN : VIJAYAWADA - ELURU)

Item of Work : Providing and laying wet mix macadam as per Technical Specification clause 406

Mix density = 2100 kg/cum Unit : 1 cum.

Serial No.	Item	
1.	Collection of 53-22.4 mm size stone aggregate 5/100 x 2100/1400 = 0.072 cum at Rs. 235.60 per cum	= Rs. 16.96
2.	Collection of 45-22.4 mm size stone aggregate 35/100 x 2100/1400 = 0.509 cum at Rs. 211.40 per cum	= Rs. 107.60
3.	Collection of 22.4-11.2 mm micron size stone aggregate 20/100 x 2100/1400 = 0.291 cum at Rs. 286.10 per cum	= Rs. 83.25
4.	Collection of 11.2-2.8 micron size stone aggregate 25/100 x 2100/1310 = 0.40 cum at Rs. 260.00 per cum	= Rs. 104.00
5.	Collection of stone dust 15/100 x 2100/1310 = 0.24 cum at Rs. 160.00 per cum	= Rs. 38.40
6.	Mixing, laying and consolidation by mechanical means as per analysis of rate attached	= Rs. 205.00
	Total	= Rs. 555.21 per cum
	Say	= Rs. 555.00 per cum

Annexure 31.

Analysis of Rate

Applicable for NH-5
Road Section : Four Laning/Strengthening.

Item of Work : Providing Dense Bituminous Macadam

Assume Density = 2400 kg/cum.
Binder required = 5.0 x 2400/100 = 132.0 kg.
Weight of aggregate = 2400-120 = 2268 kg.

Unit : 1 cum.

1.	Collection of 26.5 mm to 22.4 mm stone aggregate 5/100 x 2268/1440 = 0.078 cum at Rs. 211.40 per cum.	= Rs. 16.48
2.	Collection of 22.4 mm to 11.2 mm stone aggregate 25/100 x 2268/1440 = 0.39 cum at Rs. 286.10 per cum.	= Rs. 111.58
3.	Collection of 13.2 mm to 2.8 mm stone aggregate 30/100 x 2268/1440 = 0.47 cum at Rs. 284.70 per cum.	= Rs. 133.81
4.	Collection of stone dust 2.8 mm to 90 micron 40/100 x 2268/1440 = 0.63 cum at Rs.160.00 per cum.	= Rs. 100.80
5.	Bitumen 132 kg. at Rs. 6292.00 per tonne grade 60/70	= Rs. 830.52
6.	Add 5% lime 5/100 x 2268 = 113.40 kg at Rs. 1.50 per kg. (Market Rate)	= Rs. 170.10
7.	Mixing and laying 2.4 tonnes as per analysis attached	= Rs. 626.00
	Total	= Rs. 1989.29
	Say	= Rs. 1990.00 per cum.

Annexure 32.

Analysis of Rate

Applicable for NH-5
Road Section : NH-5 Four Laning And Strengthening upto 46 km.

Item of Work : Providing Bituminous Concrete

Assume Density	=	2500 kg/cum.
Binder concrete at 6.5%	=	162.5 kg.
Weight of aggregate = 2500-162.5	=	2337.50 kg. say 2338 kg.

Unit : 1 cum.

1.	Collection of 22.4 mm to 11.2 mm stone aggregate 25/100 x 2338/1440 = 0.405 cum at Rs. 286.10 per cum.	= Rs. 115.87
2.	Collection of 11.2 mm to 2.8 mm stone aggregate 30/100 x 2338/1440 = 0.487 cum at Rs. 260.00 per cum.	= Rs. 126.62
3.	Collection of stone dust 2.8 mm to 90 mixron 40/100 x 2338/1440 = 0.649 cum at Rs. 160.00 per cum.	= Rs. 103.84
4.	Collection of Lime filler 5/100 x 2338 = 116.9 kg at Rs. 1.50 kg.	= Rs. 175.35
5.	Bitumen 162.5 kg at Rs. 6292.00 per tonne	= Rs. 1022.45
6.	Mixing and laying completion 2.5 tonnes as per analysis attached	= Rs. 626.00
	Total	= Rs. 2170.13
	Say	= Rs. 2170 per cum.

Annexure 33.

Analysis of Rate

Applicable for NH-5

Section : ELURU BYEPASS AND STRENGTHENING IN KM 46-54, 69-75.

Item of Work : Providing and laying upper granular sub-base grading grade I.

Unit : 1 cum.

1.	Collection of 90-45 mm size stone aggregate 5/100 x 1.40 = 0.07 cum at Rs. 177.00 per cum.	= Rs. 12.39
2.	Collection of 53-22.4 mm size stone aggregate 15/100 x 1.40 = 0.21 cum at Rs. 238.10 per cum.	= Rs. 50.00
3.	Collection of 45-22.4 mm size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 214.00 per cum.	= Rs. 59.92
4.	Collection of 22.4-11.2 micron size stone aggregate 30/100 x 1.40 = 0.42 cum at Rs. 299.50 per cum.	= Rs. 125.79
5.	Collection of 11.2-2.8 micron size stone aggregate 30/100 x 1.40 = 0.42 cum at Rs. 262.50 per cum.	= Rs. 110.25
7.	For laying and consolidation for 1.4 cum at Rs. 45.00	= Rs. 63.00
	Total	= Rs. 421.35
	Say	= Rs. 420.00 per cum.

Annexure 34.

Analysis of Rate

Applicable for NH-5

Section : ELURU BYEPASS AND STRENGTHENING IN KM 46-54,69-75

Item of Work : Providing and laying lower sub-base granular grading grade III.

Unit : 1 cum.

1.	Collection of 90-45 mm size stone aggregate 5/100 x 1.40 = 0.07 cum at Rs. 177.00 per cum.	= Rs.	12.39
2.	Collection of 53-22.4 mm size stone aggregate 10/100 x 1.40 = 0.14 cum at Rs. 238.10 per cum.	= Rs.	33.33
3.	Collection of 45-22.4 mm size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 214.00 per cum.	= Rs.	59.92
4.	Collection of 22.4-11.2 micron size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 299.50 per cum.	= Rs.	83.86
5.	Collection of 11.2-2.8 micron size stone aggregate 20/100 x 1.40 = 0.28 at Rs. 262.50 per cum.	= Rs.	73.50
6.	Collection of stone dust 20/100 x 1.40 = 0.28 at Rs. 160.00 per cum.	= Rs.	44.80
7.	For laying and consolidation for 1.4 cum at Rs. 45.00	= Rs.	63.00
	Total	= Rs.	370.80
	Say	= Rs.	375.00 per cum.

Annexure 35.

Analysis of Rate

Applicable for NH-5

Section : ELURU BYEPASS AND STRENGTHENING IN KM 46-54,69-75

Item of Work : Providing and laying wet mix macadam as per Technical Specification clause 406

Mix density = 2100 kg/cum | Unit : 1 cum.

Serial No.	Item	Amount
1.	Collection of 53-22.4 mm size stone aggregate 5/100 x 2100/1440 = 0.072 cum at Rs. 238.10 per cum	= Rs. 17.14
2.	Collection of 45-22.4 mm size stone aggregate 35/100 x 2100/1440 = 0.509 cum at Rs. 214.00 per cum	= Rs. 108.93
3.	Collection of 22.4-11.2 mm micron size stone aggregate 20/100 x 2100/1440 = 0.291 cum at Rs. 299.50 per cum	= Rs. 87.16
4.	Collection of 11.2-2.8 micron size stone aggregate 25/100 x 2100/1310 = 0.40 cum at Rs. 262.50 per cum	= Rs. 105.00
5.	Collection of stone dust 15/100 x 2100/1310 = 0.24 cum at Rs. 160.00 per cum	= Rs. 38.40
6.	Mixing, laying and consolidation by mechanical means as per analysis of rate attached	= Rs. 205.00
	Total	= Rs. 561.63 per cum
	Say	= Rs. 565.00 per cum

Annexure 36.

Analysis of Rate

Applicable for NH-5
Section : ELURU BYEPASS AND STRENGTHENING IN KM 46-54,69-75

Item of Work : Providing Dense Bituminous Macadam

Assume Density = 2400 kg/cum.
Binder required = 5.5 x 2400/100 = 132.0 kg.
Weight of aggregate = 2400-132 = 2268 kg.

Unit : 1 cum.

1.	Collection of 26.5 mm to 22.4 mm stone aggregate 5/100 x 2268/1440 = 0.078 cum at Rs. 238.10 per cum.	= Rs. 18.57
2.	Collection of 22.4 mm to 11.2 mm stone aggregate 25/100 x 2268/1440 = 0.39 cum at Rs. 299.50 per cum.	= Rs. 116.81
3.	Collection of 13.2 mm to 2.8 mm stone aggregate 30/100 x 2268/1440 = 0.47 cum at Rs. 287.25 per cum.	= Rs. 135.00
4.	Collection of stone dust 2.8 mm to 90 micron 40/100 x 2268/1440 = 0.63 cum at Rs. 160.00 per cum.	= Rs. 100.80
5.	Bitumen 132 kg. at Rs. 6292.00 per tonne grade 60/70	= Rs. 830.52
6.	Add 5% lime 5/100 x 2268 = 113.40 kg at Rs. 1.50 per kg. (Market Rate)	= Rs. 170.10
7.	Mixing and laying 2.4 tonnes as per analysis attached	= Rs. 626.00
	Total	= Rs. 1997.80
	Say	= Rs. 2006 per cum.

Annexure 37.

Analysis of Rate

Applicable for NH-5

Section : ELURU BYEPASS AND STRENGTHENING IN KM 46-54,69-75

Item of Work : Providing Bituminous Concrete

Assume Density	=	2500 kg/cum.
Binder concrete at 6.5%	=	162.5 kg.
Weight of aggregate = 2500-162.5	=	2337.50 kg. say 2338 kg.

Unit : 1 cum.

1.	Collection of 22.4 mm to 11.2 mm stone aggregate 25/100 x 2338/1440 = 0.405 cum at Rs. 299.50 per cum.	= Rs. 121.30
2.	Collection of 11.2 mm to 2.8 mm stone aggregate 30/100 x 2338/1440 = 0.487 cum at Rs. 262.50 per cum.	= Rs. 127.84
3.	Collection of stone dust 2.8 mm to 90 micron 40/100 x 2338/1440 = 0.649 cum at Rs. 160.00 per cum.	= Rs. 103.84
4.	Collection of Lime filler 5/100 x 2338 = 116.9 kg at Rs. 1.50 kg.	= Rs. 175.35
5.	Bitumen 162.5 kg at Rs. 6292.00 per tonne	= Rs. 1022.45
6.	Mixing and laying completion 2.5 tonnes as per analysis attached	= Rs. 626.00
	Total	= Rs. 2176.78
	Say	= Rs. 2185.00 per cum.

Annexure 38.

Analysis of Rate

Applicable for NH-9
(Xn: Nandigama - Vijayawada)

Item of Work : Providing and laying upper granular sub-base grading I

Unit = 1 cum

Serial No.	Item		
1.	Collection of 90-45mm size stone aggregate 5/100 x 1.40 = 0.07 cum at Rs. 121.10 per cum	= Rs.	8.48
2.	Collection of 53-22.4 mm size stone aggregate 15/100 x 1.40 = 0.21 cum at Rs. 182.40 per cum	= Rs.	27.36
3.	Collection of 45-22.4 mm size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 158.20 per cum	= Rs.	44.30
4.	Collection of 22.4-11.2 micron size stone aggregate 30/100 x 1.40 = 0.42 cum at Rs. 229.00 per cum	= Rs.	96.18
5.	Collection of 11.2-2.8 micron size stone aggregate 30/100 x 1.40 = 0.42 cum at Rs. 206.70 per cum	= Rs.	86.81
6.	For laying and consolidation for 1.4 cum	= Rs.	105.00
	Total	= Rs.	368.13
	Say	= Rs.	368.00 per cum

Annexure 39.

Analysis of Rate

Applicable for NH-9
(Xn: Nandigama - Vijayawada)

Item of Work : Providing and laying lower granular sub-base grading III

Unit = 1 cum

Serial No.	Item		
1.	Collection of 90-45mm size stone aggregate 5/100 x 1.40 = 0.07 cum at Rs. 121.10 per cum	= Rs.	8.48
2.	Collection of 53-22.4 mm size stone aggregate 15/100 x 1.40 = 0.21 cum at Rs. 182.40 per cum	= Rs.	25.54
3.	Collection of 45-22.4 mm size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 158.20 per cum	= Rs.	44.30
4.	Collection of 22.4-11.2 micron size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 229.00 per cum	= Rs.	64.12
5.	Collection of 11.2-2.8 micron size stone aggregate 20/100 x 1.40 = 0.28 cum at Rs. 206.700 per cum	= Rs.	57.88
6.	Collection of stone dust 20/100 x 1.40 = 0.28 cum at Rs. 102.80 per cum	= Rs.	28.78
7.	For laying and consolidation for 1.4 cum	= Rs.	105.00
	Total	= Rs.	334.00
	Say	= Rs.	334.00 per cum

Annexure 40.

Analysis of Rate

Applicable for NH-9

Item of Work : Providing and laying wet mix macadam as per Technical Specification clause 406.

Mix density = 2100 kg/cum Unit = 1 cum

Serial No.	Item	
1.	Collection of 53-22.4 mm size stone aggregate 5/100 x 2100/1400 = 0.072 cum at Rs. 182.40 per cum	= Rs. 13.13
2.	Collection of 45-22.4 mm size stone aggregate 35/100 x 2100/1400 = 0.509 cum at Rs. 158.20 per cum	= Rs. 80.52
3.	Collection of 22.4-11.2 mm micron size stone aggregate 20/100 x 2100/1400 = 0.291 cum at Rs. 229.00 per cum	= Rs. 66.64
4.	Collection of 11.2-2.8 micron size stone aggregate 25/100 x 2100/1310 = 0.40 cum at Rs. 206.70 per cum	= Rs. 82.68
5.	Collection of stone dust 15/100 x 2100/1310 = .24 cum at Rs. 102.80 per cum	= Rs. 24.67
6.	Mixing, laying and consolidation by mechanical means as per analysis of rate attached	= Rs. 205.00
	Total	= Rs. 472.64 per cum
	Say	= Rs. 473.00 per cum

Annexure 41.

Analysis of Rate

Applicable for NH-9

Item of Work : Providing Dense Bituminous Macadam

Assume Density = 2400 kg/cum.
Binder required = 5.5 x 2400/100 = 132.0 kg.
Weight of aggregate = 2400-132 = 2268 kg.

Unit : 1 cum.

1.	Collection of 26.5 mm to 22.4 mm stone aggregate 5/100 x 2268/1440 = 0.078 cum at Rs. 158.20 per cum.	= Rs. 12.34
2.	Collection of 22.4 mm to 13.2 mm stone aggregate 25/100 x 2268/1440 = 0.39 cum at Rs. 229.00 per cum.	= Rs. 89.31
3.	Collection of 13.2 mm to 2.8 mm stone aggregate 30/100 x 2268/1440 = 0.47 cum at Rs. 231.50 per cum.	= Rs. 108.81
4.	Collection of stone dust 2.8 mm to 90 mixron 40/100 x 2268/1440 = 0.63 cum at Rs. 102.80 per cum.	= Rs. 64.76
5.	Bitumen 132 kg. at Rs. 6292.00 per tonne grade 60/70	= Rs. 830.54
6.	Add 5% lime 5/100 x 2268 = 113.4 kg at Rs. 1.50 per kg. (Market Rate)	= Rs. 170.10
7.	Mixing and laying 2.4 tonnes as per analysis attached	= Rs. 626.00
	Total	= Rs. 1901.86
	Say	= Rs. 1900 per cum.

Annexure 42.

Analysis of Rate

Applicable for NH-9

Item of Work : Providing Bituminous Concrete

Assume Density	=	2500 kg/cum.
Binder concrete at 6.5%	=	162.5 kg.
Weight of aggregate = 2500-162.5	=	2337.50 kg. say 2338 kg.

Unit : 1 cum.

1.	Collection of 22.4 mm to 11.2 mm stone aggregate 25/100 x 2338/1440 = 0.405 cum at Rs. 229.00 per cum.	= Rs. 92.75
2.	Collection of 11.2 mm to 2.8 mm stone aggregate 30/100 x 2338/1440 = 0.487 cum at Rs. 206.70 per cum.	= Rs. 100.66
3.	Collection of stone dust 2.8 mm to 90 mixron 40/100 x 2338/1440 = 0.649 cum at Rs. 102.80 per cum.	= Rs. 66.72
4.	Collection of Lime filler 90 mixron 5/100 x 2338 = 116.9 kg at Rs. 1.50 per cum.	= Rs. 175.35
5.	Bitumen 162.5 kg at Rs. 6292.00 per tonne	= Rs. 1022.50
6.	Mixing and laying completion 2.5 tonnes as per analysis attached	= Rs. 626.00
	Total	= Rs. 2083.98
	Say	= Rs. 2084 per cum.

Annexure 43.

Analysis of Rates

Applicable for NH-5 and NH-9

Mixing, laying and consolidation of WMM 6 hrs working/day.

Quantity = 189 cum.

1.	Hire charges of asphalt paver with electronic sensor etc. with operator	1 No.	= Rs.	6739.00
2.	Hire charges of vibratory tandem roller with operator	4 Nos.	= Rs.	9325.00
3.	Hire charges of transport dumpers with operator	- Nos.	= Rs.	13333.00
4.	Hire charges of water tank	2 Nos.	= Rs.	6133.00
5.	Cost of water 100 m^3 @ Rs.2.00		= Rs.	200.00
6.	Pugmill		= Rs.	3000.00
	Total		= Rs.	38730.00

$$\text{Cost per } m^3 \text{ of WMM} = \frac{38730}{189} = \text{Rs. } 205.00$$

Annexure 44.

NH-5.

Rate analysis for retaining wall

Length = 10 m.

Sl. No.	Item	Unit	Quantity	Rate	Cost
1.	Earth work	cum	3	25	75.00
2.	Cement concrete (M15)	cum	3	1500	4500.00
3.	Brick work (1:4)	cum	24.38	800	19500.00
4.	Filter media	cum	15	360	5400.00
		Total per 10 m length		= Rs.	29475.00

Cost per m length $= \dfrac{29475}{10} =$ Rs.2947.50

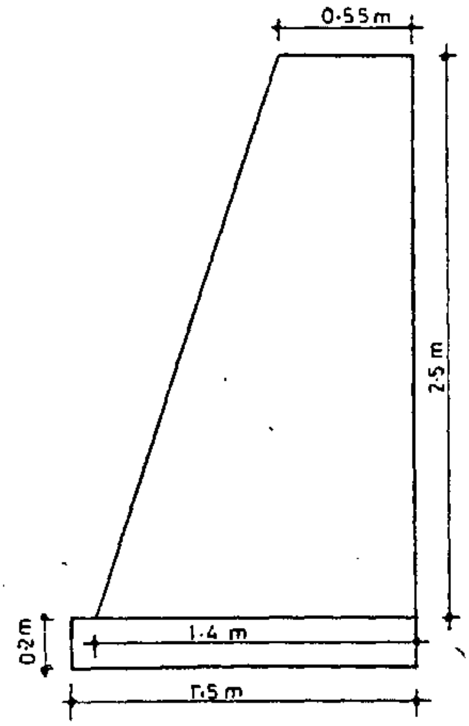
Say = Rs. 3000 per m length

Annexure 45.

NH-5

Details of Quantities

Retaining Wall



1 Earth work in Excavation
= 10 x 1.5 x 2
= 3 cum.

2 Cement concrete (M 15)
= 10 x 1.5 x 2
= 3 cum.

3 Brick masonary (1:4 cm)
= 10 x ((.55+1.4)/2) x 2.5
= 24.38 cum.

4 Providing filter media behind R/W
= 10 x 0.6 x 2.5
= 15 cum.

ANALYSIS OF RATE
FOR NH-5 AND NH-9

ITEM OF WORK: - MIXING LAYING AND COMPLETION OF DENSE BITUMINOUS CONCRET FOR 189 Cum OUTPUT PER DAY WITH 9 HOURS WORKING DAY.

S.NO	DESCRIPTION	AMOUNT (Rs.)
1.	Hire charges of storage tanks for bitumen - 1 No x 6673	6673
2.	3 storage tanks without heating = 3 x 1273	3819
3.	Hire charges of asphalt paver with electronic sensor etc. with operator. 1.No	10108
4.	Hire charges of vibratory tandem roller with operators -1 No.	3497
5.	Hire charges of Pneumatic rollers with operators - 2 Nos. x 2604	5208
6.	Hire charges of Hot mix plant with operators (9 Hrs.)	57078
7.	Hire charges of transport dumpers with operator 10 x 2600	26000
8.	Hire charges of water tank - 1 No	5481
9.	Cost of water - 10 m^3 at the rate of Rs. 3/-	30
10.	Foreman - 1 No: at the rate of Rs. 225/-	225
11.	Asphalt crew & helpers - 6 nos. at the rate of Rs. 32.40	194.40
12.	Helpers with water tank- 1 No. at the rate of Rs. 34.8	34.8
	Add 23% for LI & LA and MAH on Sl.No. 11 & 12 per SSR	52.72
	TOTAL	Rs.118401

Total production per day = 225 x 7 x 0.12 = 189 m^3.

$$\text{Cost per } m^3 \text{ of DBM} = \frac{118401}{189}$$

= Rs. 626.46

Say Rs. 626/m^3

ANNEXURE 47

NH-5 AND NH-9

CONSTRUCTING SURFACE DRAIN (LINED) TO LINES AND GRADES (OPEN DRAIN 1m WIDE)

UNIT L-M

TAKING LENGTH 1000 m.

		AMOUNT (Rs.)
1.	Earthwork in excavation 1000 x 1.5 x 1.7 = 2550	63750
2.	Plain cement concrete in M-10 in foundation and plinth 1000 x 1.5 x 0.1 = 150 Cum at the rate of Rs. 1197 Cum	179550
3.	Brick work 1:3 in cement sand mortar 2 x 1000 x 0.23 x 1.7 = 782 Cum at the rate of Rs. 797/ Cum	623254
4.	20 mm thick plaster (1:3) (15:4) 2 x 1000 x 1.7 = 34000 at the rate of Rs. 35/sq.m	119000
5.	P.C.C. M-15 1000 x 1.0 x 0.075 = 75 Cum at the rate of Rs. 1443/Cum	108225
6.	R.C.C. covering to be provided (M-15) 1000 x 1.5 x 0.100 = 150 Cum at the rate of Rs.1443/Cum	216450
		1310229

$$\text{Rate per m} = \frac{1310229}{1000} = \text{Rs. } 1310.229$$

Say Rs. 1310/m.

ANNEXURE 48

NH-9

RATE ANALYSIS FOR OPEN AREA TO BE PAVED

UNIT = Sqm.

S. NO.	DESCRIPTION ITEMS	QUANTITY (m^3)	RATE PER (m^3)	AMOUNT Rs.
1	B.C. (25 mm)	0.025	2084.0	52.10
2	WMM (250 mm)	0.025	473.0	118.25
3	G.S.B. I (150 mm)	0.15	368.0	55.0
4	G.S.B. III (150 mm)	0.15	334.0	50.10
5	Earthwork Excavation (375 mm)	0.375	16.0	6.00
6	Shifting of Earth (375 mm)	0.375	32.0	12.00
				293.65

Say Rs.294/-

DETAILS OF

(i) LAND ACQUISITION

(ii) SHIFTING OF UTILITIES

(iii) CULVERTS-RCC SLAB AND HUME PIPE

(iv) BRIDGES

(v) ROAD JUNCTIONS

(vi) LENGTHS TO BE RAISED

(vii) PAVING OF OPEN SPACES

SECTION WISE

NH-5

4 LANING

SHIFTING OF UTILITIES

	QUANTITY	RATE(Rs.)	AMOUNT
1. Electric poles (222 Nos.)	8720 m	200	1744000
2. Telephone poles(91 Nos.)	3750 m	50	187500
3. Transformers	3 Nos.	10000	30000
4. Trees	19 Nos.	L.S.	10000
5. High Tension Wire	4200 m	400	1680000
		Rs.	3651500

Say Rs. 3.652 million

NH5

FOUR LANING

CULVERTS

A. RCC SLAB - 4 LANE WIDTH

1.	6.400	1 x 2.00
2.	6.600	1 x 1.50
3.	7.700	1 x 1.50
4.	7.080	1 x 1.50
5.	7.410	1 x 1.50
6.	10.500	1 x 1.50
7.	1.800	1 x 1.50
8.	11.400	1 x 1.50
9.	12.500	1 x 2.00
		14.5 m

Say 15 m length - 4 lane wide.

B. RCC SLAB - 2 LANE WIDTH (FROM 2 LANE TO 4 LANE)

1.	11.700	3 x 0.90	2.70
2.	12.900	1 x 4.00	4.00
3.	New culverts on side drains	14 x 1.00	14.00
			20.70

Say 21 m length - 2 lane wide.

C. HUME PIPE CULVERT -RECONSTRUCTION

		Existing	Proposed
1.	6.255	1 x 0.7	1 x 1.0
2.	6.595	1 x 0.6	1 x 1.0
3.	6.700	1 x 0.7	1 x 1.0
4.	6.240	1 x 0.7	1 x 1.0
5.	7.880	1 x 0.5	1 x 1.0
6.	8.080	1 x 0.7	1 x 1.0
7.	8.500	1 x 0.7	1 x 1.0
8.	10.260	1 x 0.9	1 x 1.0
			8 x 1.0 m.

Total length of HP culvert = 8 x 24 = 192 m.

NH-5

FOUR LANING (CONCENTRIC WIDENING)

BRIDGES:-

1. KM. 5.170 LENGTH - 75 m. @ 1.75 lakhs/m = 131.25 Lacs.

Say 13.125 million

ROAD JUNCTIONS:-

S.NO.	LOCATION (KM)	TYPE	RATE (Rs. IN LAKHS)	AMOUNT (Rs. IN LAKHS)
MAJOR JUNCTIONS:-				
1.	3.350	Y	5	5
2.	5.900	+	4	4
3.	6.250	+	5	5
4.	9.900	Y	5	5
MINOR JUNCTIONS:-				
1.	7.400	T	2	2
2.	7.610	+	2	2
3.	8.510	+	2	2
				25

SAY Rs. 2.5 millions.

NH-5

IMPROVEMENT OF CURVE IN KM.36-37

A. Land to be acquired from km 35.925 to 36.140

B. Land area to be acquired.

Left Side :-

1.	1/2 x 60.0 x 9.0	=	270.0
2.	1/2 x 41.0 x (9.0+13.0)	=	451.0
3.	1/2 x 45.0 x (13.0+7.0)	=	450.0
4.	1/2 x 32.0 x (7.0+3.0)	=	160.0
5.	1/2 x 30.0 x 3.0	=	45.0

Right Side :-

6.	1/2 x 36.0 x 3.0	=	54.0
7.	1/2 x 24.0 x (3.0+2.0)	=	60.0
8.	1/2 x 25.0 x 2.0	=	25.0
	Total	=	1515.0 sqm
	Add 20% due to extra variations	=	303.0 sqm
	Total	=	1818 sqm
	Say		1800 sqm
	Cost @ Rs.5,00,000 per hectare	=	Rs.0.090 million

C. Buildings to be acquired :-

H.No. 1.	12.0 x 6.0	=	72.0
H.No. 2.	10.0 x 8.0	=	80.0
H.No. 3.	5.0 x 4.0	=	20.0
H.No. 4.	25.0 x 5.0	=	125.0
	Total	=	297.0 sqm
	Say		300.0 sqm
	Add 20% for extra variations	=	60.0 sqm
	Total	=	360.0 sqm
	Cost @ Rs.1000/- per sqm	=	Rs.0.360 million
	Total cost	=	Rs.0.450 million

NH-5
BOMMULERU VILLAGE

A. Land to be acquired from km 49.240 to km 49.540.

B. Building acquisition area :-

H.No. 1.	13.0 x 4.0	=	52.0
H.No. 2.	7.4 x 4.0	=	29.60
H.No. 3.	8.20 x 4.0	=	32.80
H.No. 4.	6.0 x 3.70	=	22.20
H.No. 5.	16.50 x 4.0	=	66.00
	Total	=	202.60 sqm
		Say	203.0 sqm
	Add 20% extra for variation		40.6
			243.6 sqm
		Say	244 sqm
	Cost @ Rs.1000/- per sqm	=	Rs.0.244 million

C. Land area to be acquired :-

1.	1/2 x 50 x 9	=	225.0
2.	1/2 x 43 x (9+23)	=	688.0
3.	1/2 x 33 x (23+28)	=	841.50
4.	1/2 x 40 x (28+24)	=	1040.0
5.	1/2 x 40 x (24+17)	=	820.0
6.	1/2 x 37 x (17+6.0)	=	425.5
7.	1/2 x 32 x 6.0	=	96.0
	Total	=	4136.0 sqm
	Say		4140.0 sqm
	Add 20% extra for variations	=	828.0 "
	Total	=	4968 sqm
	Say		5000 sqm
	Cost @ Rs.5,00,000 per hectare	=	Rs.0.250 Million
	Total cost	=	Rs.0.494 Million

NH-5

STRENGTHENING

SHIFTING OF UTILITIES

ITEM	QTY	RATE	AMOUNT (IN RS)
1. Electric Poles (93 Nos.)	3550 m	200	710000
2. Transformer	2 Nos.	10000	20000
3. Telephone Poles (49 Nos.)	1950	50	97500
4. Trees.	4	L.S.	2000
			Rs. 829500

Say Rs. 0.830 million.

NH-5

STRENGTHENING

CULVERTS

RCC CULVERTS:-

			ARRANGEMENT	
		LOCATION	EXISTING	PROPOSED
A.	1. 24/1	23.300	1 x 0.80	1 x 1.0
	2. 37/1	36.350	1 x 1.83	1 x 2.0
	3. 37/6	36.900	1 x 0.76	1 x 1.0

TOTAL SPAN LENGTH 4 m.
RECONSTRUCTION = 2 LANE WIDE.

B.	1. 40/7	39.950	1 x 2.44	2.44
	2. 47/1	46.150	2 x 1.750	3.50
	3. 47/2	46.450	3 x 0.91	2.73
	4. 47/3	46.910	1 x 0.80	0.80

9.47 x 2 m.

$$\text{TOTAL SPAN LENGTH} = \frac{9.47 \times 2}{12} = 1.6$$

TOTAL SPAN LENGTH (12 m WIDE) = 5.6 m/

SAY 6 m.

HUME PIPE CULVERTS

A.	1. 16/3	15.900	1 x 1.0	1 x 1.0
	2. 32/1	31.100	1 x 0.3	1 x 1.0
	3. 35/2	34.580	1 x 0.6	1 x 1.0
	4. 51/2	50.250	1 x 0.3	1 x 1.0

TOTAL Nos. 4 x 1.0 ; LENGTH = 48 m.

B. NEW CULVERTS PROPOSED IN RAISING STRETCHES
2 Nos./km = 4 x 2 = 8 Nos. x 12 = 96 m.

TOTAL LENGTH OF HP CULVERT = 48 + 96
= 144 m.

NH-5

STRENGTHENING

BIRDGES

SL. NO.	BRIDGE NO	LOCAITON	LENGTH (m)	RATE (RS IN LAKHS)	AMOUNT (IN LAKHS)
1.		71.220	21.08	1.25x2	52.70
2.		73.610	34.72	1.00x2	69.44
			55.80		122.14

Say Rs 12.214

ROAD JUNCTION

	TYPE	RATE (RS IN LAKHS)	AMOUNT (RS IN LAKHS)
MAJOR JUNCTION			
1. KM 46.400	+	5	5
MINOR JUNCTION (KM)			
1. km 14.200	Y	2	2
2. km 15.900	Y	2	2
3. km 17.900	+	2	2
4. km 21.300	T	2	2
5. km 22.700	T	2	2
6. km 24.700	T	2	2
7. km 29.400	T	2	2
8. km 35.150	T	2	2
9. km 35.200	T	2	2
10.km 39.010	T	2	2
11.km 41.200	T	2	2
12.km 49.800	T	2	2
13.km 50.100	T	2	2
14.km 52.250	Y	2	2
15.km 53.390	T	2	2
16.km 71.050	T	2	2
		37	Say Rs 3.7 million

NH-5

STRENGTHENING

LENGTHS	(i)	Tobe raised 15.800 to 19.100	= 3.30 km
	(ii)	Realignment 35.900 to 36.300	= 0.40 km
	(iii)	Realignment 49.150 to 49.650	= 0.50 km
		Total	= 4.20 km

NH-5

(OPEN SPACE AREA)

1. GANNAVARAM VILLAGE

a. Left side (From ch.23.980 to 25.300):-
1340 x 4.5 = 6030

b. Right side (From ch. 23.980 to 25.300):-

1340 x 4.5 = 6030

Total (both sides) 12060

2. HANUMAN JUNCTION :-

(CH. 45.00 TO 47.600)

a. Left side = 1600 x 6 = 9600
b. Right side = 1600 x 6 = 9600

Total (both sides) =19200

Grand Total = 12060 + 19200
= 31260 Sqm.

NH-5

ELURU BYPASS

DETAILS OF CULVERS

a) R.C.C. Slab Culverts	3 Nos.	4 m span	=	12 m
	15 Nos.	2 m span	=	30 m
	1 Nos.	1 m span	=	1 m
				43 m
b) H.P. - 1m dia culverts	35 Nos.	18m long	=	630 m

BRIDGES

BRIDGES ON ELURU BYPASS (EXCLUDING R.O.Bs)

1.	Bridge at chainage km 1.770 m	21.08	125000	2635000
2.	Bridge at chainage km 7.590 m	21.08	125000	2635000
3.	Bridge at chainage km 7.615 m	25.88	125000	3235000
4.	Bridge at chainage km 10.300 m	186.138	175000	32574000
5.	Bridge at chainage km 11.870 m	9.04	125000	1130000
6.	Bridge at chainage km 12.750 m	16.88	125000	2110000
7.	Bridge at chainage km 13.540 m	25.88	125000	3235000
8.	Bridge at chainage km 14.815 m	16.88	125000	2110000
9.	Bridge at chainage km 16.600 m	156.92	150000	23538000
		479.778 m	Rs.	73202000

R.O.Bs

1.	R.O.Bs at chainage 0.600 km m	15.6	175000x2	5460000
2.	R.O.Bs at chainage 16.950 km m	19.6	175000x2	6860000
			Rs.	12320000

NH5

ELURU BYPASS

ROAD JUNCTIONS

	QTY.	RATE	AMOUNT (Rs. in million)
1. Major Road Junctions.			
a. on NH at 0/0 (Y Type)			
b. on NH - 17/5 (Y Type)			
c. on SH -10/9 (+ Type)			
d. on SH - 14.300 (+ Type)	4	0.50	2.00
2. Medium			
a. on MDR at km 8.900 (+) type	1	0.30	0.30
3. Small			
a. VR at km 4.400 (+type)			
b. VR at km 6.600 (+type)			
c. VR at km 11.800 (+type)	3	0.20	0.60
Total			2.9 millions.

Say Rs.3 millions.

NH-9

4-LANING-SHIFTING OF UTILITIES

		Qty	Rate	Amount Rs.in million
1 Electric poles to be shifted (length in m)	:	178 Nos (5380)	200.00	1.076
2 Electric Transformers	:	5 Nos	10000.00	0.050
3 Telephone poles	:	97 Nos (3600)	50.00	0.180
4 Coaxial cable	:	12.6 km	100.00	1.260
5 Trees	:	90 Nos	L.S.	0.050
		TOTAL	Rs.	2.616
		Say	Rs. 3.00 million	

Applicable For NH-9

(KM 252 to KM 265)

Details Of Culvert
(for New Construction & Replacement.)

A. RCC slab culverts :-

Culvert Sl.No.	Location (KM.)	Existing Culvert No.	Existing		Proposed	
			Span arrangement	Span length	Span arrangement	Span length
1.	252.70	253/2	3x1.7	5.10	1x5.0	5.0
2.	252.850	253/3	2x1.75	3.50	1.3.5	3.5
3.	254.180	255/1	2x3.0	6.00	2x3.0	6.0
4.	256.240	257/1	3x1.2	3.60	1x3.5	3.5
5.	256.900	257/2	1x2.95	2.95	1x3.0	3.0
6.	259.880	260/2	1x1.20	1.20	1x2.5	2.5
7.	260.640	261/1	1x1.95	1.95	1x4.0	4.0
8.	261.130	262/1	1x1.80	1.80	1x3.5	3.5
9.	261.420	262/2	1x1.80	1.80	1x3.5	3.5
10.	261.985	262/3	1x0.90	0.90	1x1.0	1.0
11.	263.050	264/1	1x1.15	1.15	1x1.0	1.0
12.	263.560	265/1	1x1.22	1.22	1x1.5	1.5
13.	264.190	264/3	1x2.25	2.25	1x2.5	2.5
14.	262.170	263/1	HP1x0.75 Ø		1x1.5	1.5
15.	263.690	264/2	HP1x0.75 Ø		1x1.0	1.0
16.	255.340	256/1	1x1.2		1x1.0	1.0
17.	259.030	260/1	1x1.0 Ø		1x1.0	1.0

Equivalent length of 12m slab culvert = sum of span length of culvert 1 to 15 & 17 + span length of culvert 16 x 1.16
= 44 + 1/2 = 44.5 m

B. Hume pipe culvert : -

Sl.No.	Culvert No.	Location (km)	Existing Arrangement	Proposed Arrangement
1.	253/1	252.320	1 x 0.45 Ø	1 x 1.0 Ø
2.	255/2	254.500	1 x 1.00 Ø	1 x 1.0 Ø
3.	258/1	257.550	1 x 1.00 Ø	1 x 1.0 Ø

Total length of culvert (1m dia) = 3x24
= 72 m

Applicable For NH-9

ANNEXURE 64

DETAILS OF BRIDGES AND ROAD JUNCTIONS

BRIDGES:-

SL. NO.	CULVERT NO.	LOCATION	LENGTH	RATE	AMOUNT (IN RS)
1.	254/1	253.500	60.71	175000	10624250
2.	254/2	253.600	55.62	175000	9733500
3.	255/3	254.650	10.04	125000x2	2510000
4.	263/2	262.190	9.72	125000	1215000
			146.13		24082750
Say			146 m		Rs 24.083 million

ROAD JUNCTIONS:-

SL. NO.	LOCATION	TYPE	RATE	AMOUNT(IN RS)
1.	253.200	Cross Junction	500000	500000
2.	262.50	Y Junction	400000	400000
3.	259.60	T Junction	200000	200000
4.	264.20	T Junction	200000	200000
			Total	1300000

Say Rs 1.3 million

Annexure 65A

NH-9

COST OF LAND ACQUISITION

IMPROVEMENT OF GEOMETRICS IN PARITALA VILLAGE

A. Area of houses to be acquired :-

H.No. 1.	12 x 4 x 1/2 + 5.5 x 4 x 1/2	=	35 Sqm.
H.No. 2.	35 x (2+6) x 1/2	=	140 Sqm.
H.No. 3.	52 x 6	=	312 Sqm.
H.No. 4.	25 x 6	=	150 Sqm.
H.No. 5.	(14 + 22) x 6	=	216 Sqm.
	Total	=	853 Sqm
	Add 20% for variation		170
	Total	=	1023 Sqm.
	Say	=	1000 Sqm.
	Cost @ Rs.1000/- per sqm	=	Rs.1.000 million

B. Land to be acquired :-

As Above for houses	=	853 Sqm.
Add for open areas :-		
1 x 4 x 2	=	8
1 x 4 x 6	=	24
1 x 68 x 6	=	408
1 x 93 x 2	=	186
Total	=	1479 sqm
Add 20% for variation	=	296
Total	=	1775 sqm
Say	=	1800 sqm
Cost @ Rs.5,00,000 per hectre	=	Rs. 0.090 million
Total cost	=	Rs. 1.09 million

2. LAND ACQUISITION FOR OTHER CURVE IMPROVEMENTS

	Chainage From		To	Length	Width	Area (m^2)
km	258.300	-	258.700	400 m	7	2800
km	258.900	-	259.900	1000 m	7	7000
km	257.000	-	257.400	400 m	7	2800
km	255.000	-	255.400	400 m	10	4000
				Total	=	16600

Total land to be acquired = 16600 sqm.

= 1.66 Hectares

Cost of land to be acqired @ Rs. 5,00,000 per haectares

= 1.66 x 5,00,000

= 830000

Say Rs. 0.830 million

Cost of Boundary wall at km. 257.257.4 @ 600 per m

= 100 x 600

= 60,000

Say Rs. 0.06 million

Annexure 66

Applicable for NH-9

Shifting Of Utilities

Km 217 to Km 252

		Quantity	Rate	Amount
1.	Electric Poles to be shifted (length/m)	15 Nos. (600)	200.00	1,20,000.00
2.	Telephone Poles	7 Nos. (320)	50.00	16,000.00
3.	Trees	1		500.00
		Total		= Rs. 1,36,500.00
		Say		= Rs. 0.137 million

Annexure 67

NH-9

CULVERTS
(Km 217 to Km 252)

A. RCC Slab Culverts Reconstruction

Sl. No.	Culvert No.	Location (km)	Span Arrangement Excisting	Span Arrangement Proposed	Total Spar length
1.	218/2	217.180	1x1.20	1x1.5	1.5
2.	219/1	218.080	1x1.75	1x2.0	2.0
3.	219/2	218.350	1x1.20	1x1.5	1.5
4.	230/1	229.350	1x0.75 Ø	1x1.0	1.0
5.	236/1	235.185	1x2.40	1x2.5	2.5
6.	251/1	250.210	1x1.65	1x1.5	1.5
7.	251/2	250.245	1x1.00	1x1.0	1.0
8.	251/3	250.450	1x1.40	1x1.5	1.5
9.	251/4	250.480	1x1.50	1x1.5	1.5
		Effective span length (for 12m wide)			14m
		+ one culvert proposed at km 239/0			2m
			Total		16m

B. RCC Slab Culverts Widening.

1.	218/1	217.630	1x1.75	1.75
2.	245/2	244.420	1x4.60	4.60
3.	251/5	250.730	1x1.70	1.70
				8.05

Effective span length (for 12m wide) = 8.05x2/12
= 1.34

Total = 16+1.34 = 17.34 m

Say = 18 m

C. Hume Pipe Culvert Reconstruction

1.	249/1	248.110	2x0.90	2x1.0	24 m

D. Hume Pipe Culvert Widening

1.	252/1	251.395	1x0.60	2 m

Total length of 1m Ø HP culvert = 26 m

Annexure 6B

NH-9

Strengthening Portion

Bridges :-

Sl. No.	Bridge No.	Location	Span	Rate (Rs. in lakhs)	Amount (Rs.)
1.	231/1	230.365	11.54	1.25	1442500.00

Rs. 1.443 million

Road Junctions :-

Major Junctions - Nil

Minor Junctions -

Sl. No.	Location	Type	Rate	Amount (Rs.)
1.	217/2	T-type	2,00,000	2,00,000.00
2.	219/0	T-type	2,00,000	2,00,000.00
3.	219/4	Y-type	2,00,000	2,00,000.00
4.	235/0	T-type	2,00,000	2,00,000.00
5.	246/0	T-type	2,00,000	2,00,000.00
6.	253/1	T-type	2,00,000	2,00,000.00
				12,00,000.00

Rs. 1.2 million

CHAPTER 9

ECONOMIC ANALYSIS

9.01 INTRODUCTION

The economic analysis carried out for the present project is a comparision of the economic costs and the economic benefits over a period of 20 years after opening the road to traffic. The guidelines given in the T.O.R. and the subsequent directions indicated by the ADB Consultants have been followed.

9.02 SECTIONS

The project comprises of improvements to the following sections :

i) Strengthening and four laning km.3.4 to km.13.0 of NH-5

ii) Strengthening of existing two lanes in km.13.0 to km.75.0 of NH-5 excluding the portion through ELURU town.

iii) Construction of a two lane bypass to ELURU town on the Left side for 17.88 kms.

iv) Strengthening and four laning km. 252.0 to km. 265.0 of NH-9.

v) Strengthening of existing two lanes in km. 217.0 to km. 252.0 of NH-9.

All the five sections mentioned above are homogeneous with respect to traffic volumes, terrain, roughness, etc. Separate benefit cost analysis has been carried out for all the sections and Internal Rate of Return with and without passenger time costs have been worked out for each of the five sections. A combined sensitivity analysis has also been carried out for each National Highway separately.

9.03 ALTERNATIVES

The following two sets of alternatives have been considered for each of the five sections :

a) Do nothing i.e. maintain the existing carriageway with reasonable maintenance input commensurating with the very heavy volume of the traffic on the road.

b) Carry out improvements as detailed in para 9.02 above.

9.04 GROWTH FACTORS AND TRAFFIC FORECAST

The growth factors for forecasting the traffic for the project are based on analysis of past trends and elasticity method taking into consideration the growth of economic indicators. The traffic volume counts taken in Jan., 1993 have been projected using these growth rates. Traffic growth factors and traffic forecasts are discussed in detail in Chapter 5.

9.05 ASSUMPTIONS

1. The economic costs of construction and maintenance are 0.8 of the financial costs.

2. The cost of construction is spread over the construction period as under :-

   1993 - Detailed Engineering costs at 2% of the Economic Cost of Civil Works.

   1994 - 15% of the Economic Cost of Civil Works plus 15% of supervision cost.

   1995 - 20% of the Economic Cost of Civil Works plus 20% of supervision cost.

   1996 - 25% of the Economic Cost of Civil Works plus 25% of supervision cost.

   1997 - 25% of the Economic Cost of Civil Works plus 25% of supervision cost.

   1998 - 15% of the Economic Cost of Civil Works plus 15% of supervision cost.

3. The cost of routine maintenance of an existing road and the improved road are assumed to be same and hence they have not been reflected in the cost streams. However, when a road is widened to four lanes, the extra cost involved in maintenance have been considered as under :-

   Flexible pavement : Rs 30,000
   (1 km x 2 lane)

4. All costs and benefits are at 1993 prices.

5. The cost of VOC inputs 'as given by the ADB TA Consultants have been used. These are enclosed as App. III.

6. The factors for converting layers into Structural Number are as suggested by the ADB TA Consultants and are enclosed as App. IV.

7. The roughness values for a new flexible pavement have been assumed as under :-

   i) Opening year : 2000 mm/km

   ii) The roughness is assumed to deteriorate as per HDM relationship till a maximum value of 5000 mm/km is reached. Thereafter the value changes as per the overlay provided.

   iii) In the "without" case, the roughness is assumed to reach a maximum value of 5000 mm/km and is held constant thereafter.

8. The thickness of the overlay and the roughness after providing the overlay are calculated from the HDM deterioration model :

$$IRI_a = 146 + [(IRI_b - 1.46)/(1+0.602\ t_o)]$$

Where

IRI_a = roughness after overlaying

IRI_b = roughness prior to overlaying

t_o = overlay thickness in cm.

9. The cost of VOC components has been estimated by the relationships given in the Road User Cost Study Updating (1990), calculated at 1993 prices.

10. Congestion effect due to traffic has been considered in two parts :

    i) Distance - related

    ii) Time - related

    The congestion factors given by the relationships suggested in the TOR (Annexure9.3) have been used to calculate the effect of congestion on distance-related components. Speed/Flow relationships suggested in the TOR (Annexure II) have been used for calculating the speeds under congested conditions, and thus the VOC under congested conditions.

11. The benefits considered are only for the existing traffic and normal growth of traffic.

12. The traffic has been allowed to grow on the roads to their maximum capacities as under :

    Two-lane with paved shoulders : 30,000 PCUs per day

Two-lane without paved shoulders: 25,000 PCUs per day

Four-lane : 80,000 PCUs per day

13) The traffic has been converted to PCUs as per factors given in IRC : 64 : 1990.

9.6 CONSTRUCTION COSTS

The construction cost of the project is based on detailed cost estimates discussed in Chapter 8.

9.7 ANALYSIS AND RESULTS

The analysis has been done for the following conditions :

(1) Normal costs and normal benefits

(2) Base benefits minus 15 per cent

(3) Base costs plus 15 per cent

(4) Base benefits minus 15 per cent and base costs plus 15 per cent.

Annexures 1 to 12 present the details of input and output data for different alternatives.

The results are tabulated, as under :

EIRR in Percent

NH-5

SECTION 1 KM.3.4 TO KM.13.0	SECTION 2 KM.13.0 TO KM.75.0	ELURU BYPASS
Without Passenger Cost	Without Passenger Cost	Without Passenger Cost
30.7 %	31.8 %	15.3 %

EIRR in Percent

NH-9

SECTION 1 KM.217.0 TO 252.0	SECTION 2 KM.252.0 TO 265.0
Without Passenger Cost	Without Passenger Cost
32.3 %	49 %

The E.I.R.Rs. calculated from combined sensitivity analysis for the sections of NH-5 and NH-9 are as under :

Sensitivity Analysis

NH-5

Basic cost/ Benefits	Cost +15%	Benefits -15%	Cost +15% and Benefits -15%
25.3 %	23.1 %	22.8 %	20.7 %

Sensitivity Analysis

NH-9

Basic cost/ Benefits	Cost +15%	Benefits -15%	Cost +15% and Benefits -15%
41.7 %	38.8 %	38.3 %	35.5 %

Keeping in view the opportunity rates of 12% in the Indian economy, the above rates of return indicate that the project is a very sound investment and justifies its taking up on a high priority.

9.08 The above, economic analysis does not include the cost of the realignment portion on NH-9 in Paritala village in km 239.

Annexure 1

NH-5

STRENGTHENING OF NH-5 FROM VIJAYAWADA TO ELURU
(Km. 3.4 to Km. 75)

Section I : Strengthening & Four-laning from km.3.4 to km. 13

Year : 1993 ; Ec. Conv. Fact.: 0.80 ; Total Analysis Period : 26
Construction Period : 6 ; Overlay Thickness : 17.0 ; P.R.P.: 1.40

Vehicle	Cost	Tyre Price
N.T.Cars	102020	483
O.T.Cars	101990	820
Buses	456460	4065
Lt.Com.Veh.	301920	2125
2-Axled Trucks	350000	5306
M-Axled Trucks	528000	5306
Two Wheelers	15200	230

Petrol : 11.97 ; Diesel : 3.48
Engine oil : 36.26 ; Other Oil : 55.04 ; Grease : 31.81

Initial Traffic Volumes (veh/day)

New Tech. Cars :	289
Old Tech. Cars :	853
Buses:	766
L.C.V.s :	413
2-Axled Trucks :	3899
M-Axled Trucks :	135
Two Wheelers :	2077
Cycles/Rickshaws :	3774
Animal Drawn Vehicles :	63

Vehicle Damage Factor : 3.5

Road Characteristics

Old Road	Length : 9.600 ;	Roughness : 3550
	Terrain : P ;	Rise & Fall : 1
	Lanes : 4 ;	Width : 6.70
	Capacity : 2500 ;	Maint.Cost : 0
New Road	Length : 9.600 ;	Roughness : 2000
	Terrain : P ;	Rise & Fall : 1
	Lanes : 5 ;	Width : 7.00
	Capacity : 4200 ;	Maint.Cost : 30000

Annexure 2

ECONOMIC ANALYSIS (Without Passenger Cost)

YEAR	DO-NOTHING ALTERNATIVE Existing Road Maint.Cost	R.U.Cost	PROPOSED NEW ALTERNATIVE Proposed Road Cons/Maint.Cost	R.U.Cost	Cost	Benefit
1993	0	120447460	3688000	120447460	3688000	0
1994	0	134581922	27664000	134581922	27664000	0
1995	0	150889816	36880000	150889816	36880000	0
1996	0	169818184	46104000	169818184	46104000	0
1997	0	188794066	46104000	188794066	46104000	0
1998	0	204511322	27664000	204511322	27664000	0
1999	0	221696129	230400	142008855	230400	79687274
2000	0	240504709	230400	153864025	230400	86640684
2001	0	261112006	230400	166931258	230400	94180749
2002	0	283714129	230400	181328544	230400	102385585
2003	0	307723191	230400	197758475	230400	109964716
2004	0	334034642	230400	216886831	230400	117147811
2005	0	362899525	230400	238391609	230400	124507915
2006	0	394599266	230400	262662254	230400	131937011
2007	0	429449633	230400	290090258	230400	139359375
2008	0	466555828	230400	320296515	230400	146259313
2009	0	507312902	230400	354583906	230400	152728996
2010	0	548894216	28008023	354373363	28008023	194520853
2011	0	584855060	230400	373668672	230400	211186388
2012	0	623179837	230400	378730224	230400	244449614
2013	0	664024566	230400	384101908	230400	279922658
2014	0	707555611	230400	389804565	230400	317751045
2015	0	717885602	230400	395860470	230400	322025132
2016	0	717600610	230400	402293432	230400	315307178
2017	0	717310479	230400	409128898	230400	308181581
2018	0	717015148	230400	416404930	230400	300610218

E.I.R.R.= 30.7 %

STRENGTHENING OF NH-5 FROM VIJAYAWADA TO ELURU
(Km. 3.4 to Km. 75)

Section II : Strengthening of existing two-lane road from km. 13 to km. 54 and km. 69 to km. 75.

Year : 1993 ; Ec. Conv. Fact.: 0.80 ; Total Analysis Period : 26
Construction Period : 6 ; Overlay Thickness : 17.0 ; P.R.F.: 1.40

Vehicle	Cost	Tyre Price
N.T.Cars	102020	483
O.T.Cars	101990	820
Buses	456460	4065
Lt.Com.Veh.	301920	2125
2-Axled Trucks	350000	5306
M-Axled Trucks	528000	5306
Two Wheelers	15200	230

Petrol : 11.97 ; Diesel : 3.48
Engine oil : 36.26 ; Other Oil : 55.04 ; Grease : 31.81

Initial Traffic Volumes (veh/day)

New Tech. Cars :	357
Old Tech. Cars :	662
Buses:	852
L.C.V.s :	285
2-Axled Trucks :	4010
M-Axled Trucks :	125
Two Wheelers :	1971
Cycles/Rickshaws :	1686
Animal Drawn Vehicles :	41

Vehicle Damage Factor : 3.5

Road Characteristics

Old Road	Length : 46.600 ;	Roughness : 3930
	Terrain : P ;	Rise & Fall : 3
	Lanes : 4 ;	Width : 6.70
	Capacity : 2500 ;	Maint.Cost : 0
New Road	Length : 46.600 ;	Roughness : 2000
	Terrain : P ;	Rise & Fall : 3
	Lanes : 3 ;	Width : 7.00
	Capacity : 3000 ;	Maint.Cost : 0

Annexure 4

ECONOMIC ANALYSIS [Without Passenger Cost]

	DO-NOTHING ALTERNATIVE Existing Road		PROPOSED NEW ALTERNATIVE Proposed Road			
YEAR	Maint.Cost	R.U.Cost	Cons/Maint.Cost	R.U.Cost	Cost	Benefit
1993	0	582192277	6744000	582192277	6744000	0
1994	0	664238989	50568000	664238989	50568000	0
1995	0	734865429	67424000	734865429	67424000	0
1996	0	815038975	84280000	815038975	84280000	0
1997	0	906522134	84280000	906522134	84280000	0
1998	0	988740090	50568000	988740090	50568000	0
1999	0	1071156592	0	854075666	0	217080927
2000	0	1158057720	0	947857681	0	210200039
2001	0	1174120286	0	970543593	0	203576693
2002	0	1191309743	0	995894829	0	195414914
2003	0	1209122501	0	1023251373	0	185871128
2004	0	1228145036	0	1052462959	0	175682077
2005	0	1248459213	0	1083666369	0	164792844
2006	0	1270152439	134896562	1014452450	134896562	255699989
2007	0	1293318042	0	1032538570	0	260779472
2008	0	1317291231	0	1051297148	0	265994083
2009	0	1342838976	0	1071249082	0	271589894
2010	0	1370064394	0	1092474674	0	277589720
2011	0	1385263063	0	1115059716	0	270203348
2012	0	1384638549	0	1139095868	0	245542681
2013	0	1384003962	0	1164681061	0	219322900
2014	0	1383359183	0	1176333736	0	207025447
2015	0	1382704093	0	1178385028	0	204319065
2016	0	1382038574	0	1180499064	0	201539510
2017	0	1381362505	0	1182630751	0	198731754
2018	0	1380675765	0	1184780006	0	195895760

E.I.R.R.= 31.8 %

STRENGTHENING OF NH-5 FROM VIJAYAWADA TO ELURU
(Km. 3.4 to Km. 75)

Section III : Construction of Bypass for Eluru Town
Length 17.880

Year : 1993 ; Ec. Conv. Fact.: 0.80 ; Total Analysis Period : 26
Construction Period : 6 ; Overlay Thickness : 17.0 ; P.R.F.: 1.40

Vehicle	Cost	Tyre Price
N.T.Cars	102020	483
O.T.Cars	101990	820
Buses	456460	4065
Lt.Com.Veh.	301920	2125
2-Axled Trucks	350000	5306
M-Axled Trucks	528000	5306
Two Wheelers	15200	230

Petrol : 11.97 ; Diesel : 3.48
Engine oil : 36.26 ; Other Oil : 55.04 ; Grease : 31.81

Initial Traffic Volumes (veh/day)

New Tech. Cars :	268
Old Tech. Cars :	497
Buses:	639
L.C.V.s :	214
2-Axled Trucks :	3007
M-Axled Trucks :	97
Two Wheelers :	1478
Cycles/Rickshaws :	1264
Animal Drawn Vehicles :	30

Vehicle Damage Factor : 3.5

Road Characteristics

Old Road	Length : 15.400 ;	Roughness : 3930
	Terrain : P ;	Rise & Fall : 3
	Lanes : 4 ;	Width : 6.70
	Capacity : 2500 ;	Maint.Cost : 0
New Road	Length : 17.880 ;	Roughness : 2000
	Terrain : P ;	Rise & Fall : 3
	Lanes : 3 ;	Width : 7.00
	Capacity : 3000 ;	Maint.Cost : 30000

ECONOMIC ANALYSIS [Without Passenger Cost]

	DO-NOTHING ALTERNATIVE		PROPOSED NEW ALTERNATIVE					
	Existing Road		Existing Road		Proposed Road			
YEAR	Maint.Cost	R.U.Cost	Maint.Cost	R.U.Cost	C/M Cost	R.U.Cost	Cost	Benefit
1993	0	130181072	0	130181072	7216000	0	7216000	0
1994	0	145930790	0	145930790	54144000	0	54144000	0
1995	0	161135137	0	161135137	72192000	0	72192000	0
1996	0	177130728	0	177130728	90240000	0	90240000	0
1997	0	195070327	0	195070327	90240000	0	90240000	0
1998	0	214997218	0	214997218	54144000	0	54144000	0
1999	0	237468855	44579550	52923553	429120	143195174	45008670	41350128
2000	0	262916561	0	57160809	429120	155154376	429120	50601376
2001	0	291875512	0	61837635	429120	168269537	429120	61768340
2002	0	320386671	0	67054348	429120	182676236	429120	70656087
2003	0	346201304	0	72661337	429120	198182371	429120	75357595
2004	0	374347521	0	78869919	429120	215428154	429120	80049448
2005	0	405065329	0	85928826	429120	235379037	429120	83757465
2006	0	438622540	0	84766403	429120	258907396	429120	94948741
2007	0	475318288	44579550	91310218	429120	285370647	45008670	98637424
2008	0	514187591	0	98720642	429120	314341232	429120	101125717
2009	0	556656480	0	106841439	429120	347327550	429120	102487491
2010	0	603103934	0	116454068	429120	384730072	429120	101919794
2011	0	653953245	0	127150709	51758595	384447011	51758595	142355525
2012	0	709677577	0	139066700	429120	389200579	429120	181410297
2013	0	770806257	0	152384105	429120	394255686	429120	224166466
2014	0	837931892	0	167423492	429120	399755454	429120	270752946
2015	0	911718419	0	184488500	429120	405601838	429120	321628082
2016	0	913990251	0	203814839	429120	411818114	429120	298357298
2017	0	913542851	0	225814101	429120	418429143	429120	269299607
2018	0	913088394	0	251005605	429120	425461480	429120	236621309

E.I.R.R.= 15.3 %

Annexure 7

RESULTS OF SENSITIVITY ANALYSIS

Year	Cost	Benefits	Base Cost & Benefits	Benefits - 15%	Cost + 15%	Benefits - 15% Plus cost + 15%
1993	17648000	0	-17648000	-17648000	-20295200	-20295200
1994	132376000	0	-132376000	-132376000	-152232400	-152232400
1995	176496000	0	-176496000	-176496000	-202970400	-202970400
1996	220624000	0	-220624000	-220624000	-253717600	-253717600
1997	220624000	0	-220624000	-220624000	-253717600	-253717600
1998	132376000	0	-132376000	-132376000	-152232400	-152232400
1999	45239070	338118329	292879259	242161510	286093399	235375649
2000	659520	347442099	346782579	294666264	346683651	294567336
2001	659520	359525782	358866262	304937395	358767334	304838467
2002	659520	368456586	367797066	312528578	367698138	312429650
2003	659520	371193439	370533919	314854903	370434991	314755975
2004	659520	372879336	372219816	316287916	372120888	316188988
2005	659520	373058224	372398704	316439970	372299776	316341042
2006	135556082	482585741	347029659	274641798	326696247	254308386
2007	45239070	498776271	453537201	378720760	446751341	371934900
2008	659520	513379113	512719593	435712726	512620665	435613798
2009	659520	526806381	526146861	447125904	526047933	447026976
2010	28437143	574030367	545593224	459488669	541327653	455223098
2011	51988995	623745261	571756266	478194477	563957917	470396128
2012	659520	671402592	670743072	570032683	670644144	569933755
2013	659520	723412024	722752504	614240700	722653576	614141772
2014	659520	795529438	794869918	675540502	794770990	675441574
2015	659520	847972279	847312759	720116917	847213831	720017989
2016	659520	815203986	814544466	692263868	814445538	692164940
2017	659520	776212942	775553422	659121481	775454494	659022553
2018	659520	733127287	732467767	622498674	732368839	622399746
		EIRR %	25.3	22.8	23.1	20.7

STRENGTHENING OF NH-9 FROM NANDIGAMA TO VIJAYAWADA
(Km. 217 to Km. 265)

Section I : Strengthening of existing two-lane road from km. 217 to km. 252

Year : 1993 ; Ec. Conv. Fact.: 0.80 ; Total Analysis Period : 26
Construction Period : 6 ; Overlay Thickness : 17.0 ; P.R.F.: 1.40

Vehicle	Cost	Tyre Price
N.T.Cars	102020	483
O.T.Cars	101990	820
Buses	456460	4065
Lt.Com.Veh.	301920	2125
2-Axled Trucks	350000	5306
M-Axled Trucks	528000	5306
Two Wheelers	15200	230

Petrol : 11.97 ; Diesel : 3.48
Engine oil : 36.26 ; Other Oil : 55.04 ; Grease : 31.81

Initial Traffic Volumes (veh/day)

New Tech. Cars :	310
Old Tech. Cars :	627
Buses:	682
L.C.V.s :	378
2-Axled Trucks :	2693
M-Axled Trucks :	14
Two Wheelers :	799
Cycles/Rickshaws :	1798
Animal Drawn Vehicles :	38

Vehicle Damage Factor : 3.5

Road Characteristics

Old Road	Length : 35.000 ;	Roughness : 4094
	Terrain : P ;	Rise & Fall : 4
	Lanes : 4 ;	Width : 6.70
	Capacity : 2500 ;	Maint.Cost : 0
New Road	Length : 35.000 ;	Roughness : 2000
	Terrain : P ;	Rise & Fall : 4
	Lanes : 3 ;	Width : 7.00
	Capacity : 3000 ;	Maint.Cost : 0

Annexure 9

ECONOMIC ANALYSIS (Without Passenger Cost)

	DO-NOTHING ALTERNATIVE Existing Road		PROPOSED NEW ALTERNATIVE Proposed Road			
YEAR	Maint.Cost	R.U.Cost	Cons/Maint.Cost	R.U.Cost	Cost	Benefit
1993	0	279195939	4200000	279195939	4200000	0
1994	0	308841297	31520000	308841297	31520000	0
1995	0	341079291	42024000	341079291	42024000	0
1996	0	374031968	52528000	374031968	52528000	0
1997	0	411428086	52528000	411428086	52528000	0
1998	0	452936054	31520000	452936054	31520000	0
1999	0	499659680	0	401852577	0	97807103
2000	0	552463378	0	439896025	0	112567353
2001	0	612412849	0	482639127	0	129773722
2002	0	680843961	0	530439735	0	150404226
2003	0	744104592	0	582883697	0	161220895
2004	0	804036541	0	642391132	0	161645409
2005	0	869378142	0	709519189	0	159858953
2006	0	893550505	0	735031893	0	158518612
2007	0	906260392	0	748512336	0	157748056
2008	0	919400462	0	762970147	0	156430315
2009	0	933399461	0	778409938	0	154989523
2010	0	948313579	0	794761697	0	153551882
2011	0	964202684	0	812088028	0	152114656
2012	0	981130563	0	830456362	0	150674201
2013	0	999165181	0	849939318	0	149225863
2014	0	1018378952	0	870615094	0	147763858
2015	0	1038849035	96830160	807752461	96830160	231096574
2016	0	1060657642	0	823641218	0	237016424
2017	0	1062228966	0	840552547	0	221676419
2018	0	1061991529	0	858554604	0	203436924

E.I.R.R.= 32.3 %

STRENGTHENING OF NH-9 FROM NANDIGAMA TO VIJAYAWADA
(Km. 217 to 265)

Section II : Strengthening & four-laning from
km. 252 to 265

Year : 1993 ; Ec. Conv. Fact.: 0.80 ; Total Analysis Period : 26
Construction Period : 6 ; Overlay Thickness : 19.0 ; P.R.F.: 1.40

Vehicle	Cost	Tyre Price
N.T.Cars	102020	483
O.T.Cars	101990	820
Buses	456460	4065
Lt.Com.Veh.	301920	2125
2-Axled Trucks	350000	5306
M-Axled Trucks	528000	5306
Two Wheelers	15200	230

Petrol : 11.97 ; Diesel : 3.48
Engine oil : 36.26 ; Other Oil : 55.04 ; Grease : 31.81

Initial Traffic Volumes (veh/day)

New Tech. Cars	1085
Old Tech. Cars	2127
Buses	2288
L.C.V.s	303
2-Axled Trucks	6377
M-Axled Trucks	60
Two Wheelers	2802
Cycles/Rickshaws	2115
Animal Drawn Vehicles	28

Vehicle Damage Factor : 3.5

Road Characteristics

Old Road	Length : 13.000 ;	Roughness : 3954
	Terrain : P ;	Rise & Fall : 2
	Lanes : 4 ;	Width : 6.70
	Capacity : 2500 ;	Maint.Cost : 0
New Road	Length : 13.000 ;	Roughness : 2000
	Terrain : P ;	Rise & Fall : 2
	Lanes : 5 ;	Width : 7.00
	Capacity : 4200 ;	Maint.Cost : 30000

ECONOMIC ANALYSIS [Without Passenger Cost]

YEAR	DO-NOTHING ALTERNATIVE Existing Road		PROPOSED NEW ALTERNATIVE Proposed Road			
	Maint.Cost	R.U.Cost	Cons/Maint.Cost	R.U.Cost	Cost	Benefit
1993	0	350184261	4152000	350184261	4152000	0
1994	0	387867085	31144000	387867085	31144000	0
1995	0	429242918	41520000	429242918	41520000	0
1996	0	467542035	51904000	467542035	51904000	0
1997	0	509720681	51904000	509720681	51904000	0
1998	0	555742272	31144000	555742272	31144000	0
1999	0	606493071	312000	377155535	312000	229337536
2000	0	662523946	312000	417023255	312000	245500691
2001	0	724456452	312000	462318904	312000	262137548
2002	0	792055348	312000	514576068	312000	277479280
2003	0	845829498	312000	558570885	312000	287258613
2004	0	903265983	312000	573299499	312000	329966484
2005	0	964615142	312000	588936665	312000	375678477
2006	0	1030144505	312000	605545801	312000	424598703
2007	0	1050957739	312000	623197035	312000	427760704
2008	0	1050672657	38731888	570501606	38731888	480171051
2009	0	1050381806	312000	580168049	312000	470213757
2010	0	1050085110	312000	590445302	312000	459639808
2011	0	1049782492	312000	601374664	312000	448407827
2012	0	1049473873	312000	613000271	312000	436473602
2013	0	1049159177	312000	625369283	312000	423789894
2014	0	1048838324	312000	638532097	312000	410306228
2015	0	1048511236	312000	652542567	312000	395968669
2016	0	1048177833	312000	667458243	312000	380719589
2017	0	1047838034	312000	671792490	312000	376045543
2018	0	1047491759	312000	672851597	312000	374640162

E.I.R.R.= 49.0 %

Annexure 12

RESULTS OF SENSITIVITY ANALYSIS

Year	Cost	Benefits	Base Cost & Benefits	Benefits - 15%	Cost + 15%	Benefits - 15% Plus cost + 15%
1993	8352000	0	-8352000	-8352000	-9604800	-9604800
1994	62664000	0	-62664000	-62664000	-72063600	-72063600
1995	83544000	0	-83544000	-83544000	-96075600	-96075600
1996	104432000	0	-104432000	-104432000	-120096800	-120096800
1997	104432000	0	-104432000	-104432000	-120096800	-120096800
1998	62664000	0	-62664000	-62664000	-72063600	-72063600
1999	312000	327144639	326832639	277760943	326785839	277714143
2000	312000	357922307	357610307	303921961	357563507	303875161
2001	312000	391574383	391262383	332526226	391215583	332479426
2002	312000	427298100	426986100	362891385	426939300	362844585
2003	312000	447546329	447234329	380102380	447187529	380055580
2004	312000	490180658	489868658	416341559	489821858	416294759
2005	312000	533544186	533232186	453200558	533185386	453153758
2006	312000	580587398	580275398	493187288	580228598	493140488
2007	312000	582441319	582129319	494763121	582082519	494716321
2008	38731888	632964334	594232446	499287796	588422663	493478013
2009	312000	620960985	620648985	527504837	620602185	527458037
2010	312000	608306035	607994035	516748130	607947235	516701330
2011	312000	594952341	594640341	505397490	594593541	505350690
2012	312000	580848680	580536680	493409378	580489880	493362578
2013	312000	565939422	565627422	480736509	565580622	480689709
2014	97142160	634765933	537623773	442408883	523052449	427837559
2015	312000	625876212	625564212	531682780	625517412	531635980
2016	312000	616450112	616138112	523670595	616091312	523623795
2017	312000	596334120	596022120	506572002	595975320	506525202
2018	312000	576581810	576269810	489782539	576223010	489735739
		EIRR %	41.7	38.3	38.8	35.5

CHAPTER - 10

CONCLUSIONS AND RECOMMENDATIONS

10.1 It is observed that there is heavy traffic on the present 2-lane Nandigama (km 217) - Ibrahimpatnam (km 252) - Vijayawada (km 265) section on NH-9 and Vijayawada (km 3.4-13.0) - Eluru (km 75) section on NH-5.

10.2 These highways have already reached high level of congestion from Ibrahimpatnam to Vijayawada (km 252 to km 265) on NH-9 and from km. 3.4 to km 13 at Vijayawada on NH-5. Therefore, it is necessary to widen these 2-lane National Highway sections to 4-lane divided carriageway.

10.3 The existing road in the remaining stretches has an inadequate pavement thickness which cannot bear the present day heavy loading and will not be able to withstand the future repetitions of load and hence it is required to be strengthened. In view of poor soil conditions and heavy volume of traffic, it is considered necessary to provide 1.50m wide paved shoulders on both sides of the road.

10.4 The present road through Eluru town on NH-5 is extremely congested and there is an urgent need to construct a bypass.

10.5 There are several curves on both NH-5 and NH-9, which are sharp and need to be improved with greater radii. Attempt has, however, been made to accommodate the improvement within the land width, except at three locations, where some land and a few houses have to be acquired.

10.6 An alternative proposal to provide a realignment on NH-9 in Paritala village in km.239 has also been worked out in this report. The detailed project report shall however be prepared as per the proposal to be approved by the Ministry of Surface Transport.

10.7 BRIDGES

Based on the latest guidelines contained in the Ministry of Surface Transport (Roads Wing)'s Circular No.RW/33044/2/88-D.O.II dated 21.9.90 regarding "Width of bridges on National Highways" and the present condition of existing bridges judged during condition survey, the following programme for bridges is recommended in Chapter-5 of Vol. 2 of the Report.

NH-5 (Total = 22 nos. + 2 ROBs)

i) 2 lane existing major bridges proposed to be retained = 4 nos.

ii) 2 lane existing minor bridges proposed to be retained = 6 nos.

iii) 2 lane additional major bridge proposed on 4 lane section. = 1 no.

iv) New 2 lane major bridges proposed on Eluru Bypass = 2 nos.

v) New 2 lane minor bridges proposed on Eluru Bypass = 7 nos.

vi) 4 lane minor bridges proposed at existing locations = 2 nos.

vii) 2 lane minor bridge already under construction = 1 nos.

viii) ROBs, proposed on Eluru bypass = 2 nos.

NH-9 (Total = 10 nos).

i) 2 lane existing major bridges proposed to be retained = 2 nos.

ii) 2 lane existing minor bridges proposed to be retained = 6 nos.

iii) 2 lane additional major bridge proposed on 4 lane section = 1 no.

iv) 2 lane additional minor bridges proposed for 4 laning = 2 nos.

v) 4 lane minor bridge proposed at existing location = 1 no.

vi) Replacement of 2 lane minor bridge at the existing location = 1 no.

10.8 Environmental aspects of road projects have been studied. Detailed studies of these aspects shall be carried out at the stage of the Detailed Engineering.

10.9 The cost of execution of these works, comes out to Rs. 1625 million, including cost of Land Acquisition and shifting of utilities, but excluding the cost of realignment of NH-9 in Paritala village on km.239.

10.10 The EIRR for the work varies from 30.7% to 31.8% for NH-5 and 32.3% to 49.0% for NH-9 which shows that the project is economically viable. The cost of realignment of NH-9 in Paritala village in km 239 has not been included while working out EIRR.

10.11 The work is planned to be completed in a period of five years i.e. 1994-1998.

10.12 In the end, the consultants would like to mention that the Project Roads pass through rich agricultural and industrial areas. Therefore, improvement to these roads will greatly help in speedy movement of goods and vehicles, reduce number of accidents and operating costs. These will also help in accelerating the pace of industrialisation and boost up the economy of the area through which these roads pass and in turn improve the overall economy of the state.

G 02134

सत्यमेव जयते

GOVERNMENT OF ANDHRA PRADESH
PUBLIC WORKS (R&B) DEPARTMENT

TA 1678

FINAL

FEASIBILITY REPORT

FOR

(1) **STRENGTHENING OF NH - 5 FROM VIJAYAWADA TO ELURU** (Km 3.40 TO Km 75.00) INCLUDING FOUR LANING FROM Km 3.40 TO K.m 13.00 AND A BYPASS FOR ELURU TOWN

&

(2) **STRENGTHENING OF NH -9 FROM NANDIGAMA TO VIJAYAWADA** (Km 217.00 TO Km 265.00) INCLUDING FOUR LANING FROM Km 252.00 TO Km 265.00

VOL. - II

DESIGN REPORT

MAY, 1993

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11, GREEN PARK, NEW DELHI-110016, TEL.: 668846, 669418, 6855252
TELEX: 031-73236 CINT IN, FAX: (011) - 6855252, GRAM: ELEMICO (NEW DELHI)
DELHI, KOTPUTLI, BANGALORE, BHUBANESWAR, MADRAS, BOMBAY, MALAYSIA.

GOVERNMENT OF ANDHRA PRADESH

PUBLIC WORKS (R&B) DEPARTMENT

FINAL

FEASIBILITY REPORT

FOR

(1) STRENGTHENING OF NH-5 FROM VIJAYAWADA TO ELURU (Km 3.40 TO Km 75.00) INCLUDING FOUR LANING FROM Km 3.40 TO Km 13.00 AND BYPASS FOR ELURU TOWN

&

(2) STRENGTHENING OF NH-9 FROM NANDIGAMA TO VIJAYAWADA (Km 217.00 TO Km 265.00) INCLUDING FOUR LANING FROM Km 252.00 to Km 265.00

VOLUME -II

DESIGN REPORT

MAY, 1993

CONTENTS

CONTENTS

VOLUME II -DESIGN REPORT

CHAPTER 1

PROJECT ROAD INVENTORY

1.1 INTRODUCTION

1.1.1 GENERAL

The Feasibility Report Volume I - Main Report - gives the details of the general background of the project, the socio-economic conditions of the State of Andhra Pradesh, as well as the Project Influence Area, i.e., Vijayawada - Eluru section of NH-5 and Nandigama-Vijayawada section of NH-9, the field work done in respect of traffic surveys, their projections etc. and estimate and economic analysis. The present Volume II - Design Report, deals with the design aspects of the project. It includes the condition survey of roads, pavements, culverts, bridges, the status of power, telephone lines and other utility services. This volume also contains the statements of crust thickness, typical cross sections of pits, borelog, results of soil tests of the sub-grade, results of material tests, borrow area tests. The design standards and specifications being adopted are contained in Chapter 3 of this volume. The design of the pavements and design of bridges including the general arrangement drawings of the proposed bridges, both for two-lanes and four-lanes, are also contained in this volume in Chapters 4 & 5 respectively.

1.1.2 SCOPE

The design scope of the project as given in the terms of reference of the consultancy contract consists of collection of data and its analysis and framing proposals including designs, as follows:

a) Past traffic, present day road traffic and future projected traffic over the design period;

b) The alignment of the additional carriageway on the two-lane sections required to be converted to four-lane divided carriageway;

c) Realignments in some of the sections mostly in improvement of curves;

d) Alignment of bypass around Eluru town;

e) Strengthening of existing road pavement based on benkleman beam deflection data.

f) Design of new road pavement based on the repetition of standard axle load for 10 years.

g) Determination of the condition of the existing bridges, design for reconstruction of bridges, and the general arrangement drawings thereof;

h) The land width, houses to be acquired while making improvement, in the alignment of curves.

1.1.3 METHODOLOGY

The methodology has been discussed in detail in Vol.I of the feasibility report. However, the methodology proposed to be adopted in order to achieve the objectives spelt out under "Scope" is summarised as follows:

a) Inventorisation of the existing road pavement, culverts, bridges, utility services etc.

b) Inventorisation of the crust thickness, typical cross section of pits, and borelogs, results of soil tests, material tests and borrow area tests;

c) Condition Survey of Roads, culverts and bridges;

d) Topographical survey and geometric improvements;

e) Traffic Surveys;

f) The project proposals giving the design standards and specifications to be followed;

g) Widening to four-lane, divided carriageway as per stretches specified in the terms of reference;

h) Widening/reconstruction of the existing bridges and culverts;

i) Details of the typical cross section regarding shoulder width, shoulder treatment, median width, camber etc.

j) Identification of various road junctions, Road Over-bridges, road furniture etc.

k) Design of new pavement based on CBR and compared with the design based on Shell curves.

l) Cost Estimates;

m) Economic Analysis;

n) Environmental Impact;

In this chapter, the details of the road and bridge inventory are given and the details of engineering survey and investigation data are given in chapter 2, Design standards and specifications in chapter 3 and Design of Pavement and bridges in chapters 4 & 5 respectively.

1.2 CONDITION SURVEY OF ROAD INVENTORIZATION

1.2.1 An inventory data including the condition survey of the project road in respect of NH-5 and NH-9, has been compiled and given in Tables 1.1, 1.2, 1.4 and 1.5 respectively.

1.2.2 The inventory data consists of road land width, pavement type and width, type of shoulders and width, details of road junctions, condition of the pavement, drainage condition, geometric deficiencies, whether road is in embankment or cutting or ground level etc. It has been done km.wise.

1.3 INVENTORY OF CULVERTS AND CONDITION SURVEY

1.3.1 An inventory data in respect of all the culverts consisting of the span arrangement, type of foundations, sub-structure and superstructure, their condition, clear roadway etc. has been compiled. It also contains details of the protection works. It is tabulated in Tables 1.3 & 1.6. Mostly these are RCC slab culverts or Hume pipe culverts or masonry arch culverts.

1.3.2 Where 4-laning is required, these culverts have either been widened or replaced with new ones.

1.3.3 In case of culverts in 2-lane section, where the overall width is less than 12 m., the same are again either proposed to be widened or proposed for new construction depending on the condition of the culverts.

1.4 INVENTORY OF BRIDGES AND CONDITION SURVEY

1.4.1 Similarly, inventory data in respect of bridges consisting of the type of bridge, span arrangement, type and dimensions of the foundation, substructure, superstructure, clear water-way, High Flood Level/Full Supply Level, condition of the structure, details of the protection works etc. has been compiled.

1.4.2 Most of the bridges are of RCC T-Beam or RCC Slab Type.

1.4.3 As in case of culverts, for bridges upto 30 m. length, where the overall width is less than 12 m. all such bridges have been proposed for reconstruction.

1.4.4 For bridges between 30 and 60 m. length, where the carriageway width is less than 7.50 m. or marginally less, either they have been retained or provision made for their reconstruction, depending on their condition.

1.4.5 Bridges, more than 60 m. in length have been retained, as their condition is found satisfactory.

1.4.6 However, where 4-laning is proposed, new 2-lane bridges have been proposed, parallel to the existing bridges.

1.4.7 The bridge structures have been dealt with in detail under the chapter 5 - Bridges.

1.5 INVENTORY OF UTILITY SERVICES

1.5.1 An inventory has also been prepared in respect of the utility services, along the existing road, which need shifting. These are given in Tables 1.7 to 1.12.

1.5.2 Such utility services consists of electric lines, transformers, telephone lines, coaxial cables and cutting down of trees. Cutting of trees, has been kept to the minimum.

1.5.3 There are High Tension Lines in Km.6.25 to 10 on NH-5. Care has been taken to adjust the width of the service road on this side so that their shifting is avoided.

TABLE [illegible]1

ROAD INVENTORY

NH-9 (NANDIGAMA TO VIJAYWADA)

FROM KM 217.000 TO KM. 265.000

SL. NO.	EXISTING ROAD FROM (km)	EXISTING ROAD TO (km)	EXISTING ROAD ROAD LENGTH (km)	TERRAIN AND LAND USE	ROAD IN EMBANKMENT/ CUT OR AT G.L.	ROAD LAND WIDTH (m)	ROAD WAY WIDTH (m)	PAVEMENT TYPE	PAVEMENT WIDTH	SHOULDER TYPE	SHOULDER WIDTH LSW (m)	SHOULDER WIDTH RSW (m)	ROAD JUNCTION TYPE	ROAD JUNCTION LOCATION	GEOMETRIC DEFICIENCIES TYPE	GEOMETRIC DEFICIENCIES LOCATION FROM (km)	GEOMETRIC DEFICIENCIES LOCATION TO (km)	LENGTH MTR.	PAVEMENT CONDITION RIDING QUALITY G/F/P	PAVEMENT CONDITION CRACKS	PAVEMENT CONDITION DEFORMATION	REMARKS
1.	217.000	218.000	1.00	PLAIN/BD	E	27.00-33.00	10.70	BT	6.70	ES	2.50	1.50	T	217.200 TO GUDIMETLA					P	L	M	FROM 217.200 TO 219.400
2.	218.000	219.000	1.00	PLAIN/BD	E	22.00-27.00	11.30	BT	6.30	ES	2.50	2.50	T	219.000 TO JONNALAGADDA					P	Ex	M	PAVED SHOULDER
3.	219.000	220.000	1.00	PLAIN/BD	E	24.00-35.00	11.30	BT	6.30	ES	2.50	2.50	Y	219.400 INSIDE NANDIGAMA MARKET					P	M	M	CONSTRUCTION WORK IS IN PROGRESS
4.	220.000	221.000	1.00	PLAIN/AG	E	36.00-39.00	10.30	BT	6.30	ES	2.00	1.50							P	L	M	
5.	221.000	222.000	1.00	PLAIN/AG	E	27.00-37.00	9.70	BT	6.70	ES	1.50	1.50							F	M	M	
6.	222.000	223.600	1.60	PLAIN/BU	E	23.00-37.00	11.30	BT	5.30	ES	2.50	2.00							F	M	M	
7.	223.600	224.600	1.00	PLAIN/AG	E	30.00-34.00	9.60	BT	6.60	ES	1.50	1.50							P	Ex	Ex	
8.	224.600	225.400	0.80	PLAIN/AG	E	33.00-37.00	8.20	BT	6.70	ES	1.00	0.50							P	L	M	
9.	225.400	226.200	0.80	RIVER	E	27.00-32.00	6.80	BT	6.30	-	-	-							P	Ex	M	KESARA BRIDGE
10.	226.200	227.000	0.80	RIVER/BU	E	27.00-29.00	11.30	BT	6.30	ES	2.50	2.00							P	Ex	Ex	
11.	227.000	228.000	1.00	PLAIN/AG	E	27.00-30.00	11.30	BT	6.30	ES	2.50	2.00							P	L	M	
12.	228.000	229.000	1.00	PLAIN/AG	E	30.00-35.00	9.50	BT	6.30	ES	1.50	1.20							P	L	M	
13.	229.000	230.000	1.00	PLAIN/AG	E	28.00-32.00	10.30	BT	6.30	ES	2.00	1.50							F	M	L	
14.	230.000	231.000	1.00	PLAIN/AG	E	32.00-35.00	10.20	BT	6.70	ES	2.00	1.50							F	L	M	
15.	231.000	232.000	1.00	PLAIN/AG	E	31.00-35.00	10.80	BT	6.30	ES	2.00	2.00							F	L	M	
16.	232.000	233.000	1.00	PLAIN/AG	E	33.00-35.00	10.80	BT	6.80	ES	2.00	2.00							P	M	M	
17.	233.000	234.000	1.00	PLAIN/AG	E	24.00-30.00	11.30	BT	6.30	ES	2.00	2.50							P	Ex	Ex	
18.	234.000	235.300	1.30	PLAIN/BU	E	22.00-25.00	11.30	BT	6.30	ES	2.50	2.50	T	235.00 TO SVS COLLEGE					G	L	L	
19.	235.300	236.300	1.00	PLAIN/BU	E	23.00-32.00	10.70	BT	6.70	ES	2.00	2.00							F	M	M	FROM KM. 234.450 TO KM. PAVED SHOULDER UNDER CONSTRUCTION
20.	236.000	237.600	1.60	PLAIN/AG	E	32.00-36.00	10.30	BT	6.30	ES	2.00	1.50							P	M	M	
21.	237.600	238.800	1.20	PLAIN/BU	E	27.00-31.00	9.20	BT	6.70	ES	1.50	1.00							P	M	M	
22.	238.800	240.000	1.20	PLAIN/AG	E	38.00-43.00	10.80	BT	6.30	ES	2.50	1.50							P	Ex	Ex	
23.	240.000	241.600	1.60	PLAIN/AG	E	30.00-33.00	9.30	BT	6.30	ES	1.20	1.00							P	Ex	Ex	
24.	241.600	243.000	1.40	PLAIN/BD	E	29.00-35.00	9.30	BT	6.30	ES	1.00	1.50							P	Ex	Ex	FROM KM. 242.150 TO KM. PAVED SHOULDER UNDER CONSTRUCTION
25.	243.000	244.000	1.00	PLAIN/BD	E	32.00-35.00	9.30	BT	6.30	ES	1.00	1.50							P	Ex	M	
26.	244.000	245.400	1.40	PLAIN/BU	E	32.00-36.00	9.30	BT	6.60	ES	1.50	1.20							P	Ex	M	
27.	245.400	246.400	1.00	PLAIN/AG	E	29.00-36.00	9.60	BT	6.80	ES	1.50	1.50	T	246.200 TO MOLAPADO					F	M	M	

ABBRIVIATIONS

BT = BLACK TOP
ES = EARTHEN SHOULDER
PS = PAVED SHOULDER
HS = HARD SHOULDER
LSW= LEFT SIDE WIDTH
RSW= RIGHT SIDE WIDTH
Ag = AGRICULTURAL
BU = BUILT-UP
E = EMBANKMENT

PAVEMENT CONDITION
G = GOOD
F = FAIR
P = POOR
L = LOW
M = MEDIUM (5-15%)
Ex = EXCESSIVE (>15%)

NOTE:-
SHOULDER WIDTHS ARE SHOWN AS LSW AND RSW WITH RESPECT TO FORWARD MOVEMENT

SL. NO.	EXISTING ROAD FROM (km)	TO (km)	ROAD LENGTH (km)	TERRAIN AND LAND USE	ROAD IN EMBANKMENT/ CUT OR AT G.L.	ROAD LAND WIDTH (m)	ROAD WAY WIDTH (m)	PAVEMENT TYPE	PAVEMENT WIDTH	SHOULDER TYPE	SHOULDER WIDTH LSW (m)	SHOULDER WIDTH RSW (m)	ROAD JUNCTION TYPE	ROAD JUNCTION LOCATION	GEOMETRIC DEFICIENCIES TYPE	LOCATION FROM (km)	LOCATION TO (km)	LENGTH MTR.	PAVEMENT CONDITION RIDING QUALITY G/F/P	CRACKS	DEFORMATION	REMARKS	ABBRIVIATIONS
28.	246.400	247.000	0.60	PLAIN/BU	E	29.00-37.00	7.60	BT	6.60	ES	0.50	0.50							P	Ex	Ex		
29.	247.000	248.000	1.00	PLAIN/AG	E	34.00-37.00	9.20	BT	6.70	ES	1.00	1.50							F	M	M		
30.	248.000	249.000	1.00	PLAIN/BU	E	33.00-35.00	9.30	BT	6.80	ES	1.00	1.50							F	M	M		
31.	249.000	250.000	1.00	PLAIN/BU	E	32.00-38.00	9.20	BT	6.70	ES	1.00	1.50							P	Ex	Ex		
32.	250.000	250.600	0.60	PLAIN/AG	E	31.00-33.00	9.20	BT	6.70	ES	1.50	1.00	T	251.030 TO TV RELAY STN.					F	M	M		
33.	250.600	251.000	0.40	PLAIN/BU	E	30.00-35.00	8.70	BT	6.70	ES	1.00	1.00							F	Ex	Ex		
34.	251.000	252.000	1.00	PLAIN/BU	E	30.00-35.00	9.70	BT	6.70	ES	1.50	1.50							F	M	M		
35.	252.000	152.800	0.80	PLAIN/BU	E	32.00-47.00	7.60	BT	6.80	ES	0.50	0.50							G	L	L		
36.	252.800	253.000	0.20	PLAIN/AG	E	44.00-48.00	7.80	BT	6.80	ES	0.50	0.50							F	L	M		
37.	253.000	254.200	1.20	PLAIN/BU	E	38.00-44.00	9.00	BT	6.80	ES	1.00	1.20	+	253.200 TO VTPS (L/S) PHERI VILLAGE (R/S)					P	Ex	M		
38.	254.200	255.000	0.80	PLAIN/AG	E	33.00-44.00	9.60	BT	6.60	ES	1.50	1.50							F	L	M		
39.	255.000	256.000	1.00	PLAIN/AG	E	28.00-43.00	8.60	BT	6.60	ES	1.00	1.00			HORI-ZONTAL CURVE	255.000	255.00	500	G	M	L		
40.	256.000	256.600	0.60	PLAIN/AG	E	33.00-49.00	8.70	BT	6.70	ES	1.00	1.00							G	M	L		
41.	256.600	257.200	0.60	PLAIN/BU	E	33 - 47	9.70	BT	6.70	ES	2.00	1.00							F	M	M		
42.	257.200	258.000	0.80	PLAIN/BU	E	37.00-40.00	9.60	BT	6.60	ES	1.50	1.50	T	257.400 TO RLY WAGON WORK SHOP					G	L	M		
43.	258.000	258.800	0.80	PLAIN/AG	E	30.00-42.00	9.60	BT	6.60	ES	1.50	1.50							G	L	L		
44.	258.800	260.000	1.20	PLAIN/AG	E	35.00-42.00	9.60	BT	6.60	HARD SHOU-LDER	1.50	1.50	T	259.600 TO RLY WAGON WORK SHOP					G	L	M		
45.	260.000	261.000	1.00	PLAIN/AG	E	35.00-40.00	10.10	BT	6.60	HARD SHOU-LDER	1.50	2.00							F	M	L		
46.	261.000	262.000	1.00	PLAIN/BU	E	28.00-39.00	9.80	BT	6.80	HARD SHOU-LDER	1.50	1.50	T	261.600 TO GULAPUDDI VILLAGE									
47.	262.000	263.000	1.00	PLAIN/BU	E	27.00-28.00	8.70	BT	6.70	HARD SHOU-LDER	1.00	1.00							G	L	L		
48.	263.000	264.200	1.20	PLAIN/BU	E	21.00-29.00	8.70	BT	6.70	HARD SHOU-LDER	1.00	1.00	+	264.180 TO VIZ. CITY (BOTH SIDE)									
49.	264.200	265.000	0.80	PLAIN/BU	E	24.00-27.00	9.90	BT	6.70	PAVED SHOU-LDER	1.50	1.70							G	L	L		

Table 1.2

CONDITION SURVEY (VISUAL ASSESSMENT)
NH-9 FROM KM. 217.00 TO 265.00 (NANDIGAMA TO VIJAYAWADA)

KM.		RIDING QUALITY	CRACKS			DEFORMATION				EDGE BREAK-ING	IMPROPER CAMBER	DRAINAGE CONDITION		SHOULDER			REMARKS
FROM	TO	G/F/P	ALLIGA-TORS	LONG.	LATE-RAL	RUTT-ING	SETTLE-MENT/ UNDULA-TION	POT HOLES	PATCH-ING			SURFACE DRAINAGE	FLOODING	TYPE	DEFICIENCY: INSUFFI-CIENT WIDTH	DEFICIENCY: BELOW ROAD LEVEL	
217	0 - 0.2	F	M	L	M	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	P	Ex	Ex	Ex	M	Ex	Ex	M	-	_/	G	-	ES	-	-	
218	0 - 0.2	P	Ex	Ex	L	M	M	M	L	-	-	G	-	ES	-	-	
	0.2 - 0.4	F	M	L	L	L	M	L	L	-	-	G	-	ES	-	-	
	0.4 - 0.6	P	Ex	Ex	M	M	Ex	M	L	-	-	G	-	ES	-	-	
	0.6 - 0.8	F	L	M	L	L	M	L	L	-	-	G	-	ES	-	-	
	0.8 - 1.0	G	L	L	L	L	M	L	L	-	-	G	-	ES	-	-	
219	0 - 0.2	F	M	M	L	L	M	L	L	-	-	G	-	ES	-	-	
	0.2 - 0.4	F	M	M	L	L	M	L	L	-	-	G	-	ES	-	-	
	0.4 - 0.6	G	L	L	L	L	L	L	L	-	-	G	-	ES	-	-	
	0.6 - 0.8	F	Ex	M	M	M	M	L	L	-	-	G	-	ES	-	-	
	0.8 - 1.0	P	Ex	Ex	Ex	M	Ex	M	L	-	_/	G	-	ES	-	-	
220	0 - 0.2	P	M	M	M	M	Ex	M	L	-	_/	G	-	ES	-	-	
	0.2 - 0.4	F	M	L	L	M	Ex	L	L	-	-	G	-	ES	-	-	
	0.4 - 0.6	F	L	L	L	L	M	L	L	-	-	G	-	ES	-	-	
	0.6 - 0.8	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	M	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
221	0 - 0.2	F	M	M	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	P	Ex	M	L	M	M	M	M	-	_/	G	-	ES	_/	_/	
	0.4 - 0.6	F	M	L	L	L	M	M	L	-	_/	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	L	L	L	M	L	L	-	_/	G	-	ES	_/	_/	
	0.8 - 1.0	F	M	L	L	L	M	L	L	-	_/	G	-	ES	_/	_/	
222	0 - 0.2	F	M	M	L	L	M	L	L	-	_/	G	-	ES	_/	_/	
	0.2 - 0.4	F	M	M	L	L	M	L	L	-	_/	G	-	ES	_/	_/	
	0.4 - 0.6	F	Ex	M	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	P	M	L	L	M	M	M	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	M	L	L	M	L	M	L	-	-	G	-	ES	_/	_/	
223	0 - 0.2	F	M	M	L	L	M	L	L	-	-	P	-	ES	_/	_/	
	0.2 - 0.4	P	Ex	Ex	Ex	M	M	Ex	L	-	_/	P	-	ES	_/	_/	
	0.4 - 0.6	P	Ex	Ex	Ex	M	Ex	Ex	L	-	_/	P	-	ES	_/	_/	
	0.6 - 0.8	P	Ex	Ex	Ex	M	Ex	Ex	L	-	_/	P	-	ES	_/	_/	
	0.8 - 1.0	P	Ex	Ex	Ex	M	Ex	Ex	M	-	_/	P	-	ES	_/	_/	

ABBREVIATIONS

L = LOW (0-5%)
M = MEDIUM (5-15%)
Ex = EXCESSIVE (>15%)
HS = HARD SHOULDER
PS = PAVED SHOULDER
ES = EARTHERN SHOULDER
G = GOOD
F = FAIR
P = POOR
_/ = YES
\- = NO

Table 1.2 contd.

KM.	FROM - TO	RIDING QUALITY G/F/P	CRACKS: ALLIGATORS	CRACKS: LONG.	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLEMENT/ UNDULATION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	SHOULDER: TYPE	SHOULDER DEFICIENCY: INSUFFICIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	REMARKS
224	0 - 0.2	P	M	M	M	L	Ex	M	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	P	Ex	M	M	Ex	Ex	Ex	M	-	_/	G	-	ES	_/	_/	
	0.4 - 0.6	P	M	M	L	L	M	M	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	_/	_/	G	-	ES	_/	_/	
225	0 - 0.2	F	L	L	L	L	M	L	M	-	_/	G	-	ES	_/	_/	
	0.2 - 0.4	P	Ex	Ex	Ex	M	M	M	M	-	_/	G	-	ES	_/	_/	
	0.4 - 0.6	P	Ex	Ex	M	M	M	M	L	-	_/	G	-	ES			
	0.6 - 0.8	P	Ex	Ex	M	M	M	M	L	-	_/	G	-	-			KESARA BRIDGE APPROACH UNDER CONSTRUCTION
	0.8 - 1.0	P	M	M	M	L	M	L	L	-	_/	G	-	-			
226	0 - 0.2	F	L	L	L	L	M	L	M	-	-	P	-	ES			
	0.2 - 0.4	P	Ex	Ex	Ex	Ex	Ex	Ex	M	-	-	P	-	ES	_/	-	
	0.4 - 0.6	P	Ex	Ex	Ex	Ex	Ex	M	M	_/	-	P	-	ES	_/	-	
	0.6 - 0.8	P	Ex	Ex	M	Ex	Ex	M	M	_/	_/	P	-	ES	_/	_/	
	0.8 - 1.0	P	Ex	Ex	M	M	Ex	Ex	M	-	_/	P	-	ES	_/	_/	
227	0 - 0.2	F	M	M	L	L	M	L	M	_/	_/	P	-	ES	_/	_/	
	0.2 - 0.4	F	M	M	L	L	M	L	L	-	-	P	-	ES	_/	_/	
	0.4 - 0.6	F	L	L	L	L	M	L	L	-	_/	P	-	ES	_/	_/	
	0.6 - 0.8	F	L	L	L	L	M	L	L	-	_/	P	-	ES	_/	_/	
	0.8 - 1.0	F	L	L	L	M	Ex	L	L	-	_/	P	-	ES	_/	_/	
228	0 - 0.2	F	L	L	L	L	M	L	L	-	_/	G	-	ES	_/	_/	
	0.2 - 0.4	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
229	0 - 0.2	F	M	M	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	P	Ex	Ex	Ex	Ex	Ex	Ex	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	L	L	L	L	Ex	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	P	M	M	M	Ex	Ex	M	L	-	-	G	-	ES	_/	_/	
230	0 - 0.2	F	M	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	P	L	L	L	Ex	Ex	M	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	L	L	L	L	M	L	M	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	P	Ex	M	L	M	Ex	M	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	L	L	L	L	Ex	L	L	-	-	G	-	ES	_/	_/	
231	0 - 0.2	F	L	L	L	L	Ex	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	L	L	L	L	Ex	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	L	L	L	M	Ex	L	L	-	-	G	-	ES	_/	_/	

ABBREVIATIONS

L = LOW (0-5%)
M = MEDIUM (5-15%)
Ex = EXCESSIVE (>15%)
HS = HARD SHOULDER
PS = PAVED SHOULDER
ES = EARTHERN SHOULDER
G = GOOD
F = FAIR
P = POOR
_/ = YES
- = NO

KM.	FROM - TO	RIDING QUALITY G/F/P	CRACKS: ALLIGATORS	CRACKS: LONG.	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLEMENT/ UNDULATION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	SHOULDER: TYPE	SHOULDER: DEFICIENCY: INSUFFICIENT WIDTH	SHOULDER: DEFICIENCY: BELOW ROAD LEVEL	REMARKS
232	0 - 0.2	P	L	L	L	M	Ex	L	L	-	_/	G	-	ES	_/	_/	
	0.2 - 0.4	P	L	L	L	L	Ex	L	M	-	_/	G	-	ES	_/	_/	
	0.4 - 0.6	P	M	L	L	L	M	L	L	-	_/	G	-	ES	_/	_/	
	0.6 - 0.8	P	L	L	L	M	Ex	M	M	-	_/	G	-	ES	_/	_/	
	0.8 - 1.0	P	M	M	M	Ex	Ex	L	M	-	_/	G	-	ES	_/	_/	
233	0 - 0.2	P	Ex	Ex	Ex	M	Ex	Ex	M	-	_/	G	-	ES	_/	_/	
	0.2 - 0.4	P	Ex	Ex	Ex	Ex	Ex	Ex	M	-	_/	G	-	ES	_/	_/	
	0.4 - 0.6	P	Ex	Ex	M	M	Ex	Ex	M	-	_/	G	-	ES	-	_/	
	0.6 - 0.8	P	Ex	Ex	M	M	Ex	Ex	M	-	-	G	-	ES	-	_/	
	0.8 - 1.0	P	Ex	Ex	Ex	Ex	Ex	Ex	M	-	-	G	-	ES	_/	_/	
234	0 - 0.2	G	L	L	L	L	L	L	L	-	-	G	-	ES	_/	-	
	0.2 - 0.4	G	L	L	L	L	L	L	L	-	-	G	-	ES	_/	-	
	0.4 - 0.6	G	L	L	L	L	L	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	G	L	L	L	L	L	L	L	-	-	G	-	UC	-	-	
	0.8 - 1.0	G	L	L	L	L	L	L	L	-	-	G	-	UC	-	-	
235	0 - 0.2	G	L	L	L	L	L	L	L	-	-	G	-	UC	-	-	
	0.2 - 0.4	F	M	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	Ex	Ex	Ex	Ex	Ex	Ex	M	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	M	L	Ex	Ex	M	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	Ex	L	Ex	M	M	L	L	-	-	G	-	ES	_/	_/	
236	0 - 0.2	F	M	L	L	M	Ex	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	F	M	L	L	Ex	Ex	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	Ex	M	M	L	Ex	L	M	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	L	L	L	Ex	L	Ex	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	M	L	L	M	M	L	Ex	-	_/	G	-	ES	_/	_/	
237	0 - 0.2	F	M	L	L	M	M	L	M	-	_/	G	-	ES	_/	_/	
	0.2 - 0.4	F	M	L	L	Ex	Ex	L	M	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	M	L	L	Ex	M	L	Ex	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	L	L	Ex	M	L	M	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	P	Ex	M	M	Ex	Ex	L	L	-	_/	G	-	ES	_/	_/	
238	0 - 0.2	F	M	M	L	L	M	L	L	-	_/	G	-	ES	_/	_/	
	0.2 - 0.4	F	M	L	L	M	M	L	L	-	_/	G	-	ES	_/	_/	
	0.4 - 0.6	F	M	L	L	M	M	M	L	-	_/	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	L	L	L	L	M	L	-	_/	G	-	ES	_/	_/	
	0.8 - 1.0	F	M	M	L	L	L	M	M	-	_/	G	_/	ES	_/	_/	FROM KM. 238.000 TO KM. 239.200 WATER OVERTOPPING THE ROAD.

ABBREVIATIONS

L = LOW (0-5%)
M = MEDIUM (5-15%)
Ex = EXCESSIVE (>15%)
HS = HARD SHOULDER
PS = PAVED SHOULDER
ES = EARTHERN SHOULDER
G = GOOD
F = FAIR
P = POOR
_/ = YES
- = NO

Table 1.2 contd.

KM.			RIDING QUALITY	CRACKS			DEFORMATION				EDGE BREAK-ING	IMPROPER CAMBER	DRAINAGE CONDITION		SHOULDER			REMARKS	ABBREVIATIONS
	FROM	TO	G/F/P	ALLIGA-TORS	LONG.	LATE-RAL	RUTT-ING	SETTLE-MENT/ UNDULA-TION	POT HOLES	PATCH-ING			SURFACE DRAINAGE	FLOODING	TYPE	DEFICIENCY INSUFFI-CIENT WIDTH	DEFICIENCY BELOW ROAD LEVEL		
239	0	0.2	P	Ex	Ex	Ex	M	M	M	Ex	_/	_/	G	_/	ES	_/	_/		L = LOW (0-5%)
	0.2	0.4	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	_/	_/	G	_/	ES	_/	_/		M = MEDIUM (5-15%)
	0.4	0.6	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	_/	_/	G	-	ES	_/	_/		Ex = EXCESSIVE ( )15%)
	0.6	0.8	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	_/	_/	G	-	ES	_/	_/		HS = HARD SHOULDER
	0.8	1.0	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	-	_/	G	-	ES	_/	_/		PS = PAVED SHOULDER
																			ES = EARTHERN SHOULDER
240	0	0.2	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	-	_/	G	-	ES	_/	_/		G = GOOD
	0.2	0.4	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	_/	_/	G	-	ES	_/	-		F = FAIR
	0.4	0.6	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	_/	_/	G	-	ES	_/	-		P = POOR
	0.6	0.8	P	Ex	Ex	Ex	Ex	Ex	M	Ex	_/	_/	G	-	ES	_/	-		_/ = YES
	0.8	1.0	P	Ex	M	M	Ex	Ex	M	Ex	_/	_/	G	-	ES	_/	-		- = NO
241	0	0.2	P	Ex	M	M	Ex	Ex	M	Ex	_/	_/	G	-	ES	_/	-		
	0.2	0.4	F	Ex	L	L	L	M	L	M	-	-	G	-	ES	_/	-		
	0.4	0.6	F	Ex	L	L	L	M	L	M	-	-	G	-	ES	_/	-		
	0.6	0.8	F	Ex	Ex	M	M	Ex	M	M	-	_/	G	-	ES	_/	-		
	0.8	1.0	P	Ex	Ex	Ex	M	Ex	M	M	-	_/	G	-	ES	_/	-		
242	0	0.2	F	M	L	L	M	Ex	L	Ex	-	_/	G	-	ES	_/	-		
	0.2	0.4	P	Ex	Ex	M	M	Ex	M	M	_/	_/	G	-	ES	_/	-		
	0.4	0.6	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	_/	_/	G	-	ES	_/	-		
	0.6	0.8	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	_/	_/	G	-	ES	_/	-		
	0.8	1.0	P	Ex	M	M	M	Ex	L	L	-	-	G	-	ES	_/	-		
243	0	0.2	P	Ex	M	L	M	Ex	L	L	-	-	G	-	ES	_/	-		
	0.2	0.4	F	M	L	L	L	M	L	L	-	-	G	-	ES	_/	-		
	0.4	0.6	F	M	L	L	L	M	L	Ex	-	-	G	-	ES	_/	-		
	0.6	0.8	F	M	L	M	M	Ex	L	L	-	-	G	-	ES	_/	-		
	0.8	1.0	P	Ex	Ex	Ex	M	Ex	M	M	-	_/	G	-	ES	_/	-		
244	0	0.2	P	Ex	Ex	Ex	Ex	Ex	Ex	Ex	-	_/	G	-	ES	_/	-		
	0.2	0.4	F	Ex	M	M	Ex	Ex	Ex	M	-	_/	G	-	ES	_/	-		
	0.4	0.6	F	Ex	M	M	M	Ex	Ex	Ex	-	_/	G	-	ES	_/	_/		
	0.6	0.8	P	Ex	M	M	M	Ex	M	Ex	-	-	G	-	ES	_/	_/		
	0.8	1.0	P	Ex	M	M	M	Ex	M	Ex	-	-	G	-	ES	_/	_/		
245	0	0.2	P	Ex	L	M	M	Ex	L	Ex	-	-	G	-	ES	_/	_/		
	0.2	0.4	F	Ex	M	L	M	Ex	L	M	-	-	G	-	ES	_/	_/		
	0.4	0.6	F	Ex	L	L	L	Ex	L	M	-	-	G	-	ES	_/	-		
	0.6	0.8	F	Ex	M	M	L	L	L	L	-	-	G	-	ES	_/	-		
	0.8	1.0	P	Ex	M	M	M	M	L	M	-	-	G	-	ES	_/	-		
246	0	0.2	F	M	L	L	L	M	L	L	-	-	G	-	ES	_/	_/		
	0.2	0.4	P	Ex	Ex	Ex	Ex	Ex	Ex	M	-	_/	G	-	ES	_/	_/		
	0.4	0.6	P	Ex	Ex	Ex	Ex	Ex	Ex	M	-	_/	G	-	ES	_/	_/		
	0.6	0.8	F	Ex	L	L	M	L	L	L	-	_/	G	-	ES	_/	_/		
	0.8	1.0	F	Ex	L	L	M	L	L	L	-	_/	G	-	ES	_/	_/		

Table 1.2 contd.

KM.	FROM - TO	RIDING QUALITY G/F/P	CRACKS: ALLIGATORS	CRACKS: LONG.	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLEMENT/ UNDULATION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	SHOULDER: TYPE	SHOULDER DEFICIENCY: INSUFFICIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	REMARKS
247	0 - 0.2	F	Ex	M	L	M	Ex	L	L	-	_/	G	-	ES	_/	_/	
	0.2 - 0.4	F	M	M	L	M	Ex	L	L	-	_/	G	-	ES	_/	_/	
	0.4 - 0.6	F	Ex	M	M	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	M	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	G	M	M	L	L	M	L	L	-	-	G	-	ES	_/	_/	
248	0 - 0.2	F	M	L	L	M	L	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	F	M	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	Ex	Ex	Ex	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	Ex	M	M	M	Ex	M	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	Ex	Ex	M	M	M	M	L	-	-	G	-	ES	_/	-	
249	0 - 0.2	P	Ex	Ex	Ex	Ex	Ex	L	M	-	-	G	-	ES	_/	-	
	0.2 - 0.4	F	M	M	M	M	Ex	M	L	-	-	G	-	ES	_/	-	
	0.4 - 0.6	P	Ex	Ex	Ex	M	Ex	L	Ex	-	-	G	-	ES	_/	-	
	0.6 - 0.8	P	Ex	Ex	M	M	M	L	Ex	-	_/	G	-	ES	_/	-	
	0.8 - 1.0	P	Ex	Ex	Ex	M	Ex	L	Ex	-	_/	G	-	ES	_/	-	
250	0 - 0.2	F	Ex	Ex	Ex	M	Ex	L	M	-	-	G	-	ES	_/	-	
	0.2 - 0.4	F	Ex	L	L	M	M	L	Ex	-	-	G	-	ES	_/	-	
	0.4 - 0.6	F	Ex	M	M	L	M	L	L	-	-	G	-	ES	_/	-	
	0.6 - 0.8	P	Ex	Ex	M	Ex	Ex	M	L	-	-	G	-	ES	_/	-	
	0.8 - 1:0	P	Ex	Ex	Ex	Ex	Ex	M	M	-	-	G	-	ES	_/	-	
251	0 - 0.2	F	M	L	L	L	M	L	L	-	-	G	-	ES	_/	-	
	0.2 - 0.4	F	M	L	L	L	M	L	L	-	-	G	-	ES	_/	-	
	0.4 - 0.6	P	Ex	Ex	L	M	M	L	Ex	-	-	G	-	ES	_/	-	
	0.6 - 0.8	F	M	L	L	M	M	L	L	-	-	G	-	ES	_/	-	
	0.8 - 1.0	F	M	L	M	L	M	L	L	-	-	G	-	ES	_/	-	
252	0 - 0.2	G	L	L	L	M	M	L	L	-	_/	G	-	ES	_/	-	
	0.2 - 0.4	G	L	L	L	M	M	L	L	-	_/	G	-	ES	_/	-	
	0.4 - 0.6	G	L	L	L	L	M	M	L	-	-	G	-	ES	_/	-	
	0.6 - 0.8	F	L	M	L	L	Ex	M	L	-	_/	G	-	ES	_/	-	
	0.8 - 1.0	F	L	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
253	0 - 0.2	F	M	L	L	L	M	M	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	F	M	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	P	Ex	Ex	Ex	M	M	L	M	-	-	G	-	-	-	-	
	0.6 - 0.8	P	Ex	M	M	M	M	Ex	Ex	_/	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	L	L	L	M	M	L	L	-	-	G	-	ES	_/	-	
254	0 - 0.2	F	L	L	L	M	M	L	L	-	_/	P	-	ES	_/	-	
	0.2 - 0.4	F	L	L	L	M	M	L	L	-	_/	G	-	ES	_/	-	
	0.4 - 0.6	G	L	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	G	L	L	L	M	L	L	L	-	-	G	-	ES	_/	_/	

ABBREVIATIONS

L = LOW (0-5%)
M = MEDIUM (5-15%)
Ex = EXCESSIVE (>15%)
HS = HARD SHOULDER
PS = PAVED SHOULDER
ES = EARTHERN SHOULDER
G = GOOD
F = FAIR
P = POOR
_/ = YES
\- = NO

KM.	FROM - TO	RIDING QUALITY G/F/P	CRACKS: ALLIGA-TORS	CRACKS: LONG.	CRACKS: LATE-RAL	DEFORMATION: RUTT-ING	DEFORMATION: SETTLE-MENT/ UNDULA-TION	DEFORMATION: POT HOLES	DEFORMATION: PATCH-ING	EDGE BREAK-ING	IMPROPER CAMBER	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	SHOULDER: TYPE	SHOULDER DEFICIENCY: INSUFFI-CIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	REMARKS
255	0 - 0.2	G	M	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	F	M	M	L	M	L	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	F	M	M	L	M	L	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	G	M	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	G	L	L	L	M	L	L	L	-	-	G	-	ES	_/	_/	
256	0 - 0.2	G	L	L	L	L	L	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	G	L	L	M	L	L	L	L	-	-	G	-	ES	_/	-	
	0.4 - 0.6	F	M	M	L	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	F	M	L	M	M	M	L	L	_/	-	G	-	ES	_/	_/	
	0.8 - 1.0	F	M	M	L	M	M	L	L	_/	-	G	-	ES	_/	_/	
257	0 - 0.2	G	L	M	L	M	M	L	L	-	-	G	-	ES	_/	-	
	0.2 - 0.4	G	L	L	L	L	M	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	G	L	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	G	L	L	L	L	L	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	G	L	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
258	0 - 0.2	G	L	L	L	L	L	L	L	-	-	G	-	ES	_/	_/	
	0.2 - 0.4	G	L	L	L	M	M	L	L	-	-	G	-	ES	_/	_/	
	0.4 - 0.6	G	L	M	L	L	L	L	L	-	-	G	-	ES	_/	_/	
	0.6 - 0.8	G	L	L	L	L	L	L	L	-	-	G	-	ES	_/	_/	
	0.8 - 1.0	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/	
259	0 - 0.2	F	L	M	M	L	M	M	L	-	-	G	-	HS	_/	_/	
	0.2 - 0.4	F	M	M	M	L	M	L	L	-	-	G	-	HS	_/	_/	
	0.4 - 0.6	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/	
	0.6 - 0.8	G	L	L	L	M	M	L	L	-	-	G	-	HS	_/	_/	
	0.8 - 1.0	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/	
260	0 - 0.2	F	M	M	L	L	M	L	L	-	-	G	-	HS	_/	_/	
	0.2 - 0.4	F	M	M	L	L	L	L	L	-	-	G	-	HS	_/	_/	
	0.4 - 0.6	F	M	M	L	M	L	L	L	-	-	G	-	HS	_/	_/	
	0.6 - 0.8	G	L	L	L	L	M	L	L	-	-	G	-	HS	_/	_/	
	0.8 - 1.0	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/	
261	0 - 0.2	G	L	L	L	L	M	L	L	-	-	G	-	HS	_/	_/	
	0.2 - 0.4	G	L	L	L	M	M	L	L	-	-	G	-	HS	_/	_/	
	0.4 - 0.6	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/	
	0.6 - 0.8	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/	
	0.8 - 1.0	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/	
262	0 - 0.2	F	M	M	M	L	L	L	M	-	-	G	-	HS	_/	-	
	0.2 - 0.4	G	M	L	L	L	M	L	L	-	-	G	-	HS	_/	-	
	0.4 - 0.6	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	-	
	0.6 - 0.8	G	M	M	L	L	L	L	L	-	-	G	-	HS	_/	-	
	0.8 - 1.0	G	M	L	M	L	M	L	L	-	-	G	-	HS	_/	-	

ABBREVIATIONS

L = LOW (0-5%)
M = MEDIUM (5-15%)
Ex = EXCESSIVE (>15%)
HS = HARD SHOULDER
PS = PAVED SHOULDER
ES = EARTHERN SHOULDER
G = GOOD
F = FAIR
P = POOR
_/ = YES
- = NO

Table 1.2 contd.

KM.	FROM - TO	RIDING QUALITY G/F/P	CRACKS: ALLIGA-TORS	CRACKS: LONG.	CRACKS: LATE-RAL	DEFORMATION: RUTT-ING	DEFORMATION: SETTLE-MENT/ UNDULA-TION	DEFORMATION: POT HOLES	DEFORMATION: PATCH-ING	EDGE BREAK-ING	IMPROPER CAMBER	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	SHOULDER: TYPE	SHOULDER DEFICIENCY: INSUFFI-CIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	REMARKS	ABBREVIATIONS
263	0 - 0.2	G	-	-	-	L	L	L	L	-	-	G	-	HS	_/	-		L = LOW (0-5%)
	0.2 - 0.4	G	-	-	-	L	L	L	L	-	-	G	-	HS	_/	-		M = MEDIUM (5-15%)
	0.4 - 0.6	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	-		Ex = EXCESSIVE (>15%)
	0.6 - 0.8	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	-		HS = HARD SHOULDER
	0.8 - 1.0	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/		PS = PAVED SHOULDER
																		ES = EARTHERN SHOULDER
264	0 - 0.2	G	L	L	L	L	L	L	L	-	-	G	-	HS	_/	_/		G = GOOD
	0.2 - 0.4	G	L	L	L	L	L	L	L	-	-	G	-	HS/PS	-	-		F = FAIR
	0.4 - 0.6	G	L	L	L	L	L	L	M	-	-	G	-	PS	-	-		P = POOR
	0.6 - 0.8	G	L	L	L	L	L	L	L	-	-	G	-	PS	-	-		_/ = YES
	0.8 - 1.0	G	L	L	L	L	L	L	L	-	-	G	-	PS	-	-		- = NO

Table 1.3

INVENTORY OF CULVERTS
NH-9 (NANDIGAMA-VIJAYAWADA)
FROM KM. 217.00 TO KM. 265.00

SL. NO.	CULVERT NO. AS WRITTEN AT SITE	LOCATION AS PER SITE KM.	TYPE OF CULVERT	CLEAR ROADWAY (M)	NO. OF SPAN/PIPE X LENGTH/ DIA (IN M)	OTHER FEATURES			CONDITION OF STRUCTURE	REMARKS
						DECK RCC SLAB/ BRICK ARCH THICKNESS (CM)	TYPE OF SUB-STRUCTURE	PROTECTION WORK		
1.	218/1	217.040	SC	11.00	1x1.75	30	SM	NIL	GOOD	R
2.	218/2	217.180	SC	11.20	1x1.20	25	SM	NIL	BLOCKED	- RC*
3.	218/3	217.630	SC	10.70	1x1.20	25	SM	NIL	FAIR	W (RIGHT SIDE BY 2M)
4.	219/1	218.080	SC	16.70	1x1.75	25	SM	NIL	POOR	RC
5.	219/2	218.350	SC	10.30	1x1.20	20	SM	NIL	POOR	RC
6.	219/3	218.900	SC	11.00	2x1.37	25	SM	NIL	GOOD	R (P)
7.	220/1	219.790	SC	10.30	1x1.20	20	SM	NIL	FAIR	RD (P)
8.	220/2	219.950	SC	10.80	1x1.25	20	SM	NIL	GOOD	RD
9.	221/1	220.050	SC	10.60	1x1.20	20	SM	NIL	GOOD	RD (P)
10.	221/2	220.185	HP	13.70	1x0.900	-	SM	NIL	GOOD	RD
11.	221/3	220.425	SC	10.30	1x1.25	20	SM	NIL	GOOD	RD
12.	222/1	221.190	SC	10.30	1x3.80	40	SM	NIL	GOOD	R
13.	222/2	221.840	HP	13.80	1x0.75	-	SM	NIL	GOOD	RD
14.	223/1	222.180	SC	10.30	1x1.80	25	SM	NIL	GOOD	R
15.	223/2	222.700	SC	11.00	1x1.80	25	SM	NIL	GOOD	R
16.	223/3	222.810	SC	13.30	1x2.45	30	SM	NIL	GOOD	RD
17.	224/1	223.595	SC	10.60	1x1.50	20	SM	NIL	GOOD	R
18.	224/2	223.790	SC	10.00	1x1.80	25	SM	NIL	FAIR	R (P)
19.	224/3	223.820	SC	9.60	1x1.80	30	SM	NIL	GOOD	R
20.	224/4	223.930	SC	9.30	1x1.20	20	SM	NIL	GOOD	R (P)
21.	225/1	224.660	SYPHON	15.80	1x1.000	-	SM	NIL	GOOD	R
22.	228/1	227.220	SC	10.90	1x3.60	30	SM	NIL	GOOD	R
23.	228/2	227.975	SC	10.20	1x1.80	25	SM	NIL	GOOD	R
24.	229/1	228.070	SC	10.60	1x1.80	25	SM	NIL	GOOD	R
25.	229/2	228.265	SC	10.30	1x1.80	25	SM	BED STONE FLOORING	GOOD	R
26.	230/1	229.250	HP	10.10	1x0.750	-	SM	NIL	POOR	RC (AS SLAB CULVERT)
27.	233/1	232.405	SC	11.00	1x1.40	20	SM	NIL	FAIR	R (P) CRACKS AT WING WALL JUNCTIONS
28.	234/2	233.640	SC	25.30	1x0.50	20	SM	NIL	GOOD	R
29.	235/1	234.380	SC	11.30	1x1.90	25	SM	NIL	GOOD	R
30.	236/1	235.185	SC	11.20	1x2.40	25	SM	NIL	POOR	RC
31.	236/2	235.580	HP	10.80	1x0.750	-	SM	NIL	GOOD	R
32.	237/1	236.120	ARCH/SC	10.50	2x2.40	25	SM	BED STONE FLOORING	GOOD	R
33.	238/1	237.085	HP	10.70	1x1.00	-	SM	NIL	GOOD	RD
34.	239/1	238.205	SC	11.40	1x0.85	25	SM	NIL	FIAR	RD (P)
35.	239/2	238.730	SC	10.60	1x1.80	25	SM	NIL	GOOD	R
36.	239/3	238.840	SC	10.80	1x0.90	25	SM	NIL	GOOD	R
37.	240/1	239.220	HP	13.00	2x1.00	-	SM	NIL	GOOD	RD
38.	240/2	239.520	HP	13.80	1x1.00	-	SM	NIL	FAIR	R
39.	240/3	239.580	HP	13.30	1x1.00	-	SM	NIL	FAIR	R

ABBREVIATIONS

R = RETAINED
RC = RECONSTRUCTION
W = WIDENING
SM = STONE MASONRY
SC = SLAB CULVERT
HP = HUME PIPE
RD = RETAINED AND DESILTING
(P)= PARAPETS TO BE REPAIRED
CC = CEMENT CONCRETE

(contd.)

Table 1.3 contd.

SL. NO.	CULVERT NO. AS WRITTEN AT SITE	LOCATION AS PER SITE KM.	TYPE OF CULVERT	CLEAR ROADWAY (M)	NO. OF SPAN/PIPE X LENGTH/ DIA (IN M)	OTHER FEATURES			CONDITION OF STRUCTURE	REMARKS	ABBREVIATIONS
						DECK RCC SLAB/ BRICK ARCH THICKNESS (CM)	TYPE OF SUB-STRUCTURE	PROTECTION WORK			
40.	240/4	239.660	HP	13.20	1x1.00	-	SM	NIL	GOOD	R	
41.	240/5	239.800	HP	19.00	2x1.00	-	SM	NIL	GOOD	R	
42.	242/1	241.175	SC	11.10	3x0.90	30	SM	NIL	FAIR	R	
43.	242/2	241.595	HP	10.90	1x1.00	-	SM	NIL	GOOD	RD	
44.	242/3	241.610	SC	10.80	1x3.60	40	SM	NIL	GOOD	R	
45.	243/1	242.080	SC	11.40	1x2.25	25	SM	BED STONE FLOORING	GOOD	R (P)	
46.	243/2	242.750	SC	10.80	1x1.75	25	SM	BED STONE FLOORING	GOOD	R (P)	
47.	243/3	242.850	SC	11.00	1x3.00	30	SM	NIL	GOOD	R (P)	
48.	244/1	243.100	SC	11.10	1x3.00	30	SM	NIL	FAIR	R (P)	
49.	244/2	243.250	HP	13.50	1x0.30	-	SM	NIL	GOOD	RD (P)	
50.	244/3	243.500	SC	11.00	1x6.00	50	SM	NIL	GOOD	R	
51.	244/4	243.630	SC	11.20	1x1.15	20	SM	NIL	FAIR	R	
52.	244/5	243.700	SC	10.90	1x2.90	30	SM	NIL	FAIR	R	
53.	244/6	243.940	SC	10.80	1x1.15	25	SM	NIL	GOOD	R	
54.	245/1	244.020	SC	10.00	1x1.20	25	SM	NIL	GOOD	R (P)	
55.	245/2	244.420	SC	10.90	1x4.60	50	SM	STONE PITCHING	GOOD	W (RIGHT SIDE BY 2 M)	
56.	246/1	245.030	SC	10.80	1x1.20	20	SM	NIL	FAIR	R	
57.	246/2	245.110	SC	10.70	1x1.20	20	SM	NIL	FAIR	R	
58.	246/3	245.380	SC	10.80	1x1.20	20	SM	NIL	GOOD	R	
59.	246/4	245.610	SC	10.80	1x1.20	20	SM	NIL	GOOD	R (P)	
60.	246/5	245.760	SC	11.00	1x1.45	20	SM	NIL	FAIR	R	
61.	246/6	245.950	SC	10.50	1x1.15	20	SM	NIL	GOOD	R	
62.	248/2	247.600	SC	10.40	1x4.50	40	CC	STONE PICHING	GOOD	R	
63.	249/1	248.110	HP	12.30	2x0.900	-	SM	NIL	POOR	RC	
64.	250/1	249.250	SC	11.10	1x3.00	40	SM	NIL	GOOD	R	
65.	250/2	249.580	HP	13.20	3x1.370	-	SM	NIL	GOOD	R] DESILTING AND PARAPET EXIST	
66.	250/3	249.620	HP	12.30	2x0.900	-	SM	NIL	GOOD	R] DESILTING AND PARAPET EXIST	
67.	251/1	250.210	SC	10.70	1x1.65	25	SM	NIL	FAIR	RC	
68.	251/2	250.245	SC	10.50	1x1.00	20	SM	NIL	POOR	RC CRACKS IN ABUTMENT	
69.	251/3	250.450	SC	10.70	1x1.40	25	SM	NIL	POOR	RC	
70.	251/4	250.480	SC	10.50	1x1.50	25	SM	NIL	POOR	RC	
71.	251/5	250.730	SC	9.40	1x1.70	25	SM	NIL	FAIR	W (TO BE EXTENDED RIGHT SIDE BY 2 M)	
72.	252/1	251.395	HP	9.70	1x0.600	-	SM	NIL	FAIR	W (TO BE EXTENDED RIGHT SIDE BY 2 M)	
73.	253/1	252.320	HP	11.80	1x0.450	-	SM	NIL	POOR	RC	
74.	253/2	252.700	SC	10.30	3x1.70	30	SM	NIL	FAIR	RC	
75.	253/3	252.850	SC	10.50	2x1.75	30	SM	NIL	FAIR	RC	
76.	255/1	254.180	SC	10.60	2x3.00	40	SM	NIL	FAIR	RC	
77.	255/2	254.500	HP	20.70	1x1.000	-	SM	NIL	FAIR	RC	
78.	256/1	255.340	SC	10.10	1x1.20	25	SM	NIL	GOOD	W	

(contd.)

Table 1.3 contd.

SL. NO.	CULVERT NO. AS WRITTEN AT SITE	LOCATION AS PER SITE KM.	TYPE OF CULVERT	CLEAR ROADWAY (M)	NO. OF SPAN/PIPE X LENGTH/ DIA (IN M)	OTHER FEATURES: DECK RCC SLAB/ BRICK ARCH THICKNESS (CM)	OTHER FEATURES: TYPE OF SUB-STRUCTURE	OTHER FEATURES: PROTECTION WORK	CONDITION OF STRUCTURE	REMARKS	ABBREVIATIONS
79.	257/1	256.240	ARCH/SC	13.70	3x1.20	25	SM	NIL	POOR	RC (ARCH CULVERT EXTENDED BY SLAB CULVERT)	
80.	257/2	256.900	SC	10.80	1x2.95	40	SM	NIL	POOR	RC (ARCH CULVERT EXTENDED BY SLAB CULVERT)	
81.	258/1	257.550	HP	13.80	1x1.000	-	CC	NIL	FAIR	RC	
82.	260/1	259.030	HP	13.00	1x1.000	-	CC	NIL	FAIR	RC (TO BE REPLACED BY RCC CULVERT).	
83	260/2	259.880	SC	10.30	1x1.20	20	SM	NIL	POOR	RC.	
84.	261/1	260.640	ARCH/SC	10.70	1x1.95	25	SM	NIL	POOR	RC.	
85.	262/1	261.130	ARCH/SC	10.50	1x1.80	25	SM	NIL	POOR	RC	
86.	262/2	261.420	SC	10.60	1x1.80	25	SM	NIL	POOR	RC	
87.	262/3	261.985	SC	11.70	1x0.90	20	SM	NIL	POOR	RC	
88.	263/1	262.170	HP	11.00	1x0.750	-	SM	NIL	POOR	RC (FLOOD WATER DRAIN EXTENDING TO BYPASS	
89.	264/1	263.050	SC	11.20	1x1.15	20	SM	NIL	POOR	RC	
90.	264/2	263.250	HP	10.95	1x0.750	-	SM	NIL	POOR	RC	
91.	264/3	263.560	ARCH/SC	9.60	1x2.25	30	SM	NIL	FAIR	RC (ARCH TYPE CULVERT TO BE REPLACED).	
92.	265/1	264.190	SC	10.45	1x1.22	20	SM	CC FLOORING	FAIR	RC (ROAD WIDTH BETWEEN DRAIN 18.20 M)	

NOTE : (1) FOUR LANING FROM KM. 252.00 TO KM. 265.00
SIZE AND LOCATION TO BE CORELATED WITH EXISTING CULVERTS

(2) PARAPETS OF ALL CULVERTS TO BE RECONSTRUCTED TO UNIFORM LENGTH AND HEIGHT

(3) SLAB CULVERT REQUIRED AT Km. 263·900

Table 1.4

ROAD INVENTORY
NH - 5 (VIJAYWADA - ELURU)
FROM KM. 6.250 TO KM. 75.00

SL. NO.	EXISTING ROAD FROM KM.	EXISTING ROAD TO KM.	EXISTING ROAD ROAD LENGTH KM.	TERRAIN AND LAND USE	ROAD IN EMBANKMENT/ CUT OR AT GL	ROAD LAND WIDTH Mtr.	ROAD WAY WIDTH Mtr.	PAVEMENT TYPE	PAVEMENT WIDTH Mtr.	SHOULDER TYPE	SHOULDER WIDTH LSW Mtr.	SHOULDER WIDTH RSW Mtr.	ROAD JUNCTIONS TYPE	ROAD JUNCTIONS LOCATION	GEOMETRIC DEFICIENCIES TYPE	GEOMETRIC DEFICIENCIES LOCATION FROM KM.	GEOMETRIC DEFICIENCIES LOCATION TO KM.	LENGTH Mtr.	PAVEMENT CONDITION RIDING QUALITY G/F/P	PAVEMENT CONDITION CRACKS	PAVEMENT CONDITION DEFORMATION	REMARKS	ABBREVIATIONS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.	6.25	7.00	0.75	PLAIN/ CITY AREA	E	60.00	11.90	BT	6.90	ES	2.50	2.50	+	6.25 TO VIJAYWADA CITY AND SIDHARTHA ENGG. COLLEGE	-	-	-	-	P	EX	M		AG = AGRICULTURAL BU = BUILT-UP E = EMBANKMENT BT = BLACK TOP ES = EARTHEN SHOULDER LSW = LEFT SIDE WIDTH RSW = RIGHT SIDE WIDTH T = T JUNCTION Y = Y JUNCTION GEOMETRIC DEFICIENCIES H = HORIZONTAL V = VERTICAL RIDING QUALITY PAVEMENT CONDITION G = GOOD F = FAIR P = POOR L = LOW (0-5%) M = MEDIUM (5-15%) EX = EXCESSIVE (>15%) NOTE:- SHOULDER WIDTHS ARE SHOWN AS LSW AND RSW WITH RESPECT TO FORWARD MOVEMENT
2.	7.00	8.00	1.00	-DO-	E	60.00	10.90	BT	6.90	ES	2.00	2.00	T +	7.400 TO VIJAYWADA CITY 7.610 TO LOYOLA COLLEGE & COLONY	-	-	-	-	F	M	EX		
3.	8.00	9.00	1.00	-DO-	E	60.00	10.80	BT	6.80	ES	2.00	2.00	+	8.510 TO NTR COLONY JAWAHAR AUTONAGAR	-	-	-	-	P	M	EX		
4.	9.00	9.800	0.800	-DO-	E	60.00	10.80	BT	6.80	ES	2.00	2.00	-	-	-	-	-	-	G	L	L	NEWLY LAID MSS	
5.	9.80	11.00	1.20	-DO-	E	45.00	10.10	BT	6.80	ES	1.60	1.70	Y	9.900 TO VIJAYWADA BUS STAND	-	-	-	-	G	L	L	-DO-	
6.	11.00	12.00	1.00	-DO-	E	20-25	9.40	BT	6.70	ES	1.50	1.20	-	-	-	-	-	-	P	EX	M		
7.	12.00	13.00	1.00	PLAIN AG/BU	E	21-26	10.70	BT	6.70	ES	2.50	1.50	-	-	-	-	-	-	F	M	L		
8.	13.00	14.00	1.00	PLAIN AG/BU	E	21-28	9.70	BT	6.70	ES	1.50	1.50	-	-	-	-	-	-	F	M	L		
9.	14.00	15.00	1.00	PLAIN/AG	E	45.00	11.30	BT	6.80	ES	2.50	2.00	Y	14.200 OLD NH-5	-	-	-	-	G	L	L	NEWLY LAID MSS	
10.	15.00	16.00	1.00	PLAIN/AG	E	45.00	11.80	BT	6.80	ES	2.50	2.50	Y	15.900 OLD NH-5	-	-	-	-	G	L	L	-DO-	
11.	16.00	17.00	1.00	PLAIN AG/BU	GL	29-33	11.40	BT	6.80	ES	2.50	2.50	-	-	-	-	-	-	P	EX	EX		

Table 1.4 contd.

ROAD INVENTORY
NH - 5 (VIJAYAWADA - ELURU)
FROM KM. 6.250 TO KM. 35.00

SL. NO.	EXISTING ROAD FROM KM.	TO KM.	ROAD LENGTH KM.	TERRAIN AND LAND USE	ROAD IN EMBANKMENT/ CUT OR AT GL	ROAD LAND WIDTH Mtr.	ROAD WAY WIDTH Mtr.	PAVEMENT TYPE	PAVEMENT WIDTH Mtr.	SHOULDER TYPE	SHOULDER WIDTH LSW Mtr.	SHOULDER WIDTH RSW Mtr.	ROAD JUNCTIONS TYPE	ROAD JUNCTIONS LOCATION	GEOMETRIC DEFICIENCIES TYPE	LOCATION FROM KM.	LOCATION TO KM.	LENGTH Mtr.	PAVEMENT CONDITION RIDING QUALITY G/F/P	CRACKS	DEFORMATION	REMARKS	ABBREVIATIONS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
12.	17.00	18.00	1.00	PLAIN/BU	F	27-33	12.00	BT	7.00	ES	2.50	2.50	+	17.900 TO UPPLURE VILLAGE & NECCALEM VILLAGE	-	-	-	-	P	M	L		
13.	18.00	19.00	1.00	PLAIN/BU	F	31-33	11.00	BT	7.00	ES	2.00	2.00	-	-	-	-	-	-	F	M	M		
14.	19.00	20.00	1.00	PLAIN/AG	F	31-32	10.00	BT	7.00	ES	2.00	2.00	-	-	-	-	-	-	G	L	L	NEWLY LAID MSS	
15.	20.00	21.00	1.00	PLAIN/AG	F	45.00	10.50	BT	7.00	ES	2.00	1.50	-	-	-	-	-	-	F	L	M		
16.	21.00	22.00	1.00	PLAIN/AG	F	45.00	10.60	BT	6.90	ES	2.20	2.50	T	21.300 TO KESARPALLI VILLAGE	-	-	-	-	G	L	L		
17.	22.00	23.00	1.00	PLAIN/BU	F	29-33	10.80	BT	6.80	ES	2.00	2.00	T	22.050 TO KESARPALLI VILLAGE	-	-	-	-	F	L	M		
18.	23.00	24.00	1.00	PLAIN/ FOREST	F	30-32	9.10	BT	6.70	ES	1.20	1.20	-	-	-	-	-	-	G	L	L	NEWLY LAID MSS	
19.	24.00	25.00	1.00	PLAIN/CITY AREA	F	29-31	11.00	BT	6.70	ES	1.90	2.40	T	24.700 TO GANNAVARAM RAILWAY STATION	-	-	-	-	F	EX	EX		
20.	25.00	26.00	1.00	PLAIN/BU	F	25-30	9.80	BT	6.80	ES	1.50	1.50	+		-	-	-	-	P	EX	EX		
21.	26.00	27.00	1.00	PLAIN/AG	F	26-32	9.00	BT	6.80	ES	1.20	1.00	-	-	-	-	-	-	P	EX	M		
22.	27.00	28.00	1.00	PLAIN/AG	F	25-30	9.80	BT	6.80	ES	1.50	1.50	-	-	-	-	-	-	P	M	M		
23.	28.00	29.00	1.00	PLAIN/AG	F	24-37	9.40	BT	6.80	ES	1.40	1.20	-	-	-	-	-	-	P	M	L		
24.	29.00	30.00	1.00	PLAIN AG/BU	F	24-32	10.60	BT	7.00	ES	1.60	2.00	T	29.400 TO PEDAVUTAPALLI VILLAGE	-	-	-	-	F	M	L		
25.	30.00	31.00	1.00	PLAIN/BU	F	23-38	9.80	BT	6.80	ES	1.50	1.50	-	-	-	-	-	-	G	L	L		
26.	31.00	32.00	1.00	PLAIN/BU	F	24-30	9.60	BT	6.80	ES	1.30	1.50	-	-	-	-	-	-	P	EX	EX		
27.	32.00	33.00	1.00	PLAIN/BU	F	27-30.30	9.30	BT	6.80	ES	1.50	1.00	-	-	-	-	-	-	P	EX	EX		

ROAD INVENTORY
NH - 5 (VIJAYWADA - ELURU)
FROM KM. 6.250 TO KM. 75.00

SL. NO.	EXISTING ROAD FROM KM.	TO KM.	ROAD LENGTH KM.	TERRAIN AND LAND USE	ROAD IN EMBANKMENT/ CUT OR AT GL	ROAD LAND WIDTH Mtr.	ROAD WAY WIDTH Mtr.	PAVEMENT TYPE	PAVEMENT WIDTH Mtr.	SHOULDER TYPE	SHOULDER WIDTH LSW Mtr.	SHOULDER WIDTH RSW Mtr.	ROAD JUNCTIONS TYPE	ROAD JUNCTIONS LOCATION	GEOMETRIC DEFICIENCIES TYPE	LOCATION FROM KM.	LOCATION TO KM.	LENGTH Mtr.	PAVEMENT CONDITION RIDING QUALITY G/F/P	CRACKS	DEFORMATION	REMARKS	ABBREVIATIONS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
28.	33.00	34.00	1.00	PLAIN/BD	E	21-26	9.20	BT	6.70	ES	1.50	1.00	-	-	-	-	-	-	P	M	L		
29.	34.00	35.00	1.00	PLAIN/AG	E	26-35	8.50	BT	6.80	ES	0.90	0.80	-	-	-	-	-	-	P	M	L		
													T	35.150 TO AITHAR									
30.	35.00	36.00	1.00	-DO-	E	24-40	11.30	BT	6.70	ES	2.50	2.10	T	35.250 TO TELAPROLU VILLAGE	-	-	-	-	P	L	M		
31.	36.00	37.00	1.00	-DO-	E	20-30.5	10.10	BT	6.80	ES	1.50	1.80	-	-	S-CURVE (BLIND)	36.200	36.800	600	P	M	M		
32.	37.00	38.00	1.00	-DO-	E	30.5-37	9.40	BT	6.70	ES	1.60	1.10	-	-	-	-	-	-	G	L	L	NEWLY LAID MSS	
33.	38.00	39.00	1.00	PLAIN/BD	E	27-32	9.80	BT	6.70	ES	2.00	1.10	-	-	-	-	-	-	P	EX	EX		
34.	39.00	40.00	1.00	PLAIN/AG	E	45.00	10.35	BT	6.70	ES	2.00	1.65	T	39.010 TO MUTAM VERVALLI	-	-	-	-	G	L	L	-DO-	
35.	40.00	41.00	1.00	-DO-	E	45.00	10.30	BT	6.70	ES	2.00	1.60	-	-	-	-	-	-	G	L	L	-DO-	
36.	41.00	42.00	1.00	-DO-	E	25-37	9.90	BT	6.80	ES	1.60	1.50	T	41.200 TO VIRAPALLI VILLAGE	-	-	-	-	P	M	M		
37.	42.00	43.00	1.00	-DO-	E	30-34	9.90	BT	6.80	ES	1.60	1.50	-	-	-	-	-	-	P	L	M		
38.	43.00	44.00	1.00	-DO-	E	30-35	10.60	BT	6.80	ES	2.00	1.80	-	-	-	-	-	-	P	EX	EX		
39.	44.00	45.00	1.00	-DO-	E	30-34	10.35	BT	7.00	ES	1.75	1.60	-	-	-	-	-	-	P	L	M		
40.	45.00	46.00	1.00	PLAIN/BD	E	34-36	11.50	BT	7.00	ES	2.00	2.50	-	-	-	-	-	-	P	EX	EX		
41.	46.00	47.00	1.00	PLAIN/BD	E	36-38	13.50	BT	7.00	ES	3.50	3.00	+	46.400 TO NUZVID & MACHILIPATNAM	-	-	-	-	F	M	L		
42.	47.00	48.00	1.00	PLAIN AG/BD	E	38-47	12.00	BT	7.00	ES	2.50	2.50	-	-	-	-	-	-	P	M	L		
43.	48.00	49.00	1.00	PLAIN/AG	E	30-51	10.30	BT	6.80	ES	2.00	1.50	-	-	-	-	-	-	P	EX	EX		
44.	49.00	50.40	1.40	PLAIN/BD	E	38-51	11.30	BT	6.80	ES	2.50	2.00	T	49.880 TO BOMMULURU VILLAGE	+	49.150	49.600	-	G	L	L	NEWLY LAID MSS	
													T	50.100 TO BOMMULURU VILLAGE									

Table 1.4 contd

ROAD INVENTORY
NH - 5 (VIJAYWADA - ELURU)
FROM KM. 6.250 TO KM. 75.00

SL. NO.	EXISTING ROAD FROM KM.	TO KM.	ROAD LENGTH KM.	TERRAIN AND LAND USE	ROAD IN EMBANKMENT/ CUT OR AT GL	ROAD LAND WIDTH Mtr.	ROAD WAY WIDTH Mtr.	PAVEMENT TYPE	PAVEMENT WIDTH Mtr.	SHOULDER TYPE	SHOULDER WIDTH LSW Mtr.	SHOULDER WIDTH RSW Mtr.	ROAD JUNCTIONS TYPE	ROAD JUNCTIONS LOCATION	GEOMETRIC DEFICIENCIES TYPE	GEOMETRIC DEFICIENCIES LOCATION FROM KM.	GEOMETRIC DEFICIENCIES LOCATION TO KM.	LENGTH Mtr.	PAVEMENT CONDITION RIDING QUALITY G/F/P	PAVEMENT CONDITION CRACKS	PAVEMENT CONDITION DEFORMATION	REMARKS	ABBREVIATIONS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
45.	50.40	51.80	1.40	PLAIN/AG	E	51-65	10.60	BT	6.80	ES	2.00	1.80	-	-	-	-	-	-	G	L	L	-DO-	
46.	51.80	52.40	0.60	PLAIN/BU	E	40-54	10.30	BT	6.80	ES	2.00	1.50	Y	52.250 TO KALPARU VILLAGE	-	-	-	-	G	L	L	-DO-	
47.	52.40	53.00	0.60	PLAIN/AG	E	35-40	10.40	BT	6.80	ES	2.00	1.60	-	-	-	-	-	-	G	L	L	-DO-	
48.	53.00	54.00	1.00	PLAIN AG/BU	E	22-35	11.70	BT	6.70	ES	2.50	2.50	T	53.390 TO KUKARPADA VILLAGE	-	-	-	-	F	L	M	FROM KM.54.00 TO KM.69.00 ROAD IS BEING BYPASSED	
49.	69.00	70.00	1.00	PLAIN/AG	E	32-42	10.50	BT	7.00	ES	2.50	1.00	-	-	-	-	-	-	F	L	M		
50.	70.00	71.00	1.00	-DO-	E	36-44	9.70	BT	7.00	ES	1.50	1.20	-	-	-	-	-	-	P	M	EX		
51.	71.00	72.00	1.00	-DO-	E	37-100	10.20	BT	6.70	ES	1.50	2.00	T	71.050 TO DENDULURU VILLAGE	-	-	-	-	P	EX	EX		
52.	72.00	73.00	1.00	-DO-	E	44-100	9.80	BT	7.00	ES	1.50	1.30	-	-	-	-	-	-	G	L	L		
53.	73.00	74.00	1.00	-DO-	E	41-44	9.30	BT	6.80	ES	1.50	1.00	-	-	-	-	-	-	F	M	M		
54.	74.00	75.00	1.00	-DO-	E	44-115	10.00	BT	7.00	ES	1.50	1.50	-	-	-	-	-	-	P	EX	EX		

Table 4.5

CONDI[...] SUR[...]ISON[...]ESS[...]
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS: ALLIGATOR	CRACKS: LONG	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLEMENT / UNDULATION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	SHOULDER: TYPE	SHOULDER DEFICIENCY: INSUFFICIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	REMARKS
6																	
.2-.4	E	P	EX	EX	EX	L	M	M	M	-	Y	ES	-	-	P	-	There is no proper drainage system for the road stretch passing through the city areas, waste water from the residences and rain water remains stagnant in pools all along the road. A deep nallah has been constructed by the Local Authorities from Km. 6 to 7. This carries partial discharge/overflow water but most of it remains stagnant on the road from Km. 6 to 10.
.4-.6	E	P	EX	EX	EX	L	M	EX	EX	-	Y	ES	-	-	P	-	
.6-.8	E	P	EX	EX	EX	M	M	EX	M	-	Y	ES	-	-	P	-	
.8-.1	E	P	EX	EX	EX	M	M	EX	M	-	Y	ES	-	-	P	-	
7																	
0-.2	E	P	M	M	M	L	L	M	M	-	Y	ES	Y	Y	P	-	
.2-.4	E	P	L	L	L	L	L	M	M	-	Y	ES	Y	Y	P	-	
.4-.6	E	P	L	L	L	M	M	M	L	-	Y	ES	Y	Y	P	-	
.6-.8	E	P	L	L	L	M	M	L	L	-	Y	ES	Y	Y	P	-	
.8-.1	E	P	EX	EX	EX	EX	EX	M	M	-	Y	ES	Y	Y	P	-	
8																	
0-.2	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	Y	P	-	
.2-.4	E	P	M	M	M	M	EX	M	M	-	-	ES	Y	Y	P	-	
.4-.6	E	P	M	M	M	M	M	M	M	-	-	ES	Y	Y	P	-	
.6-.8	E	P	EX	EX	EX	M	M	EX	EX	-	-	ES	Y	Y	P	-	
.8-.1	E	P	EX	EX	EX	EX	EX	EX	EX	-	-	ES	Y	Y	P	-	
9																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	P	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	P	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	P	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	P	-	NEWLY LAID MSS
.8-.1	E	F	L	L	L	L	M	M	L	-	-	ES	Y	Y	P	-	NEWLY LAID MSS
10																	
0-.2	E	G	L	L	L	L	L	L	L	-	Y	ES	Y	Y	P	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	Y	ES	Y	Y	P	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	Y	ES	Y	Y	P	-	NEWLY LAID MSS
.6-.8	E	F	L	L	L	L	M	L	L	-	Y	ES	Y	Y	P	-	NEWLY LAID MSS
.8-.1	E	F	M	M	M	M	L	M	M	-	Y	ES	Y	Y	P	-	

ABBREVIATIONS

E = EMBANKMENT
ES = EARTHEN SHOULDER
G = GOOD
F = FAIR
P = POOR
L = LOW (0-5%)
M = MEDIUM (5-15%)
EX = EXCESSIVE (>15%)
Y = YES
- = NO

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS			DEFORMATION				EDGE BREAKING	IMPROPER CAMBER	SHOULDER			DRAINAGE CONDITION		REMARKS
			ALLIGATOR	LONG	LATERAL	RUTTING	SETTLEMENT UNDULATION	POT HOLES	PATCHING			TYPE	DEFICIENCY INSUFFICIENT WIDTH	BELOW ROAD LEVEL	SURFACE DRAINAGE	FLOODING	
11																	
0-.2	E	P	EX	EX	EX	M	L	EX	EX	-	Y	ES	Y	Y	P	-	
.2-.4	E	P	EX	EX	EX	M	M	EX	EX	-	Y	ES	Y	Y	P	-	
.4-.6	E	P	EX	EX	EX	M	M	EX	EX	-	Y	ES	Y	Y	P	-	
.6-.8	E	F	L	M	M	M	M	M	M	-	Y	ES	Y	Y	P	-	
.8-.1	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	Y	P	-	
12																	
0-.2	E	F	M	L	L	L	M	M	M	-	-	ES	Y	Y	P	-	
.2-.4	E	F	M	EX	-	-	-	L	L	-	-	ES	Y	Y	P	-	
.4-.6	E	F	M	EX	-	-	-	L	L	-	-	ES	Y	Y	P	-	
.6-.8	E	F	M	M	L	L	L	L	L	-	-	ES	Y	Y	P	-	
.8-.1	E	G	L	L	L	L	M	L	L	-	-	ES	Y	Y	P	-	
13																	
0-.2	E	F	L	L	-	-	M	L	L	-	-	ES	Y	Y	P	-	
.2-.4	E	P	M	M	-	-	M	M	M	-	-	ES	Y	Y	P	-	
.4-.6	E	F	EX	M	M	-	L	M	M	-	-	ES	Y	Y	P	-	
.6-.8	E	G	L	L	L	L	L	L	L	-	Y	ES	Y	Y	P	-	
.8-.1	E	P	EX	EX	-	EX	EX	EX	EX	-	Y	ES	Y	Y	P	-	
14																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
15																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS

ABBREVIATIONS

E = EMBANKMENT
ES = EARTHEN SHOULDER
G = GOOD
F = FAIR
P = POOR
L = LOW (0-5%)
M = MEDIUM (5-15%)
EX = EXCESSIVE (>15%)
Y = YES
- = NO

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS			DEFORMATION				EDGE BREAKING	IMPROPER CAMBER	SHOULDER			DRAINAGE CONDITION		REMARKS
			ALLIGATOR	LONG	LATERAL	RUTTING	SETTLEMENT UNDULATION	POT HOLES	PATCHING			TYPE	DEFICIENCY INSUFFICIENT WIDTH	DEFICIENCY BELOW ROAD LEVEL	SURFACE DRAINAGE	FLOODING	
16																	
0-.2	L	P	EX	EX	M	M	M	M	M	-	Y	ES	-	Y	P		
.2-.4	L	P	EX	EX	M	M	M	M	M	-	Y	ES	-	Y	P		
.4-.6	L	P	EX	EX	M	M	EX	EX	EX	-	Y	ES	-	Y	P		
.6-.8	L	P	EX	EX	M	M	EX	EX	EX	-	Y	ES	-	Y	P		
.8-.1	L	P	EX	EX	L	L	EX	EX	EX	-	Y	ES	-	Y	P		
17																	
0-.2	L	F	M	M	L	L	L	L	L	-	Y	ES	-	-	P		
.2-.4	L	P	M	M	L	L	M	M	M	-	Y	ES	-	-	P		
.4-.6	L	P	M	M	L	L	M	M	M	-	Y	ES	-	-	P		
.6-.8	L	P	M	M	L	L	M	M	M	-	Y	ES	-	-	P		
.8-.1	L	P	M	M	L	L	M	M	M	-	Y	ES	-	-	P		
18																	
0-.2	L	F	L	L	L	L	L	L	L	-	Y	ES	Y	Y	P	-	WATER OVER
.2-.4	L	F	M	M	M	M	M	M	M	-	Y	ES	Y	Y	P	-	LAPPING THE ROAD
.4-.6	L	F	M	M	M	M	M	M	M	-	Y	ES	Y	Y	P	-	
.6-.8	L	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	P	-	NEWLY LAID MSS
.8-.1	L	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	P	-	NEWLY LAID MSS
19																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
20																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS

ABBREVIATIONS

E = EMBANKMENT
ES = EARTHEN SHOULDER
G = GOOD
F = FAIR
P = POOR
L = LOW (0-5%)
M = MEDIUM (5-15%)
EX = EXCESSIVE (>15%)
Y = YES
- = NO

CONDITION SURVEY VISUAL ASSESSMENT
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS: ALLIGATOR	CRACKS: LONG	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLEMENT UNDULATION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	SHOULDER TYPE	SHOULDER DEFICIENCY: INSUFFICIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	REMARKS
21																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
22																	
0-.2	E	F	L	L	L	-	-	L	M	-	Y	ES	Y	Y	P	-	
.2-.4	E	F	L	L	L	-	-	L	M	-	Y	ES	Y	Y	P	-	
.4-.6	E	F	L	L	L	-	-	L	M	-	Y	ES	Y	Y	P	-	
.6-.8	E	F	L	L	L	-	-	M	L	-	Y	ES	Y	Y	P	-	
.8-.1	E	F	M	M	L	L	-	M	L	-	Y	ES	Y	Y	P	-	
23																	
0-.2	E	F	L	M	L	-	L	L	L	-	Y	ES	Y	Y	G	-	
.2-.4	E	F	M	M	L	-	-	L	L	-	Y	ES	Y	Y	G	-	
.4-.6	E	F	M	L	L	-	-	L	L	-	Y	ES	Y	Y	G	-	
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	-	-	-	-	-	ES	Y	-	G	-	NEWLY LAID MSS
24																	
0-.2	E	G	L	L	L	-	-	-	-	-	-	ES	Y	-	P	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	-	-	-	-	-	-	ES	Y	-	P	-	NEWLY LAID MSS
.4-.6	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	-	P	-	
.6-.8	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	-	P	-	
.8-.1	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	-	P	-	
25																	
0-.2	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	-	P	-	
.2-.4	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	-	P	-	
.4-.6	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	-	P	-	
.6-.8	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	-	P	-	
.8-.1	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	-	P	-	

ABBREVIATIONS

- E = EMBANKMENT
- ES = EARTHEN SHOULDER
- G = GOOD
- F = FAIR
- P = POOR
- L = LOW (0-5%)
- M = MEDIUM (5-15%)
- EX = EXCESSIVE (>15%)
- Y = YES
- \- = NO

CONDITION SURVEY VISUAL ASSESSMENT
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS			DEFORMATION				EDGE BREAKING	IMPROPER CAMBER	SHOULDER			DRAINAGE CONDITION		REMARKS
			ALLIGATOR	LONG	LATERAL	RUTTING	SETTLEMENT UNDULATION	POT HOLES	PATCHING			TYPE	DEFICIENCY INSUFFICIENT WIDTH	DEFICIENCY BELOW ROAD LEVEL	SURFACE DRAINAGE	FLOODING	
26																	
0-.2	E	P	EX	EX	EX	EX	EX	M	M	-	-	ES	Y	Y	G	-	
.2-.4	E	P	EX	EX	EX	EX	EX	M	M	-	-	ES	Y	Y	G	-	
.4-.6	E	P	EX	EX	EX	EX	EX	M	M	-	-	ES	Y	Y	G	-	
.6-.8	E	P	EX	EX	EX	EX	EX	M	M	-	-	ES	Y	Y	G	-	
.8-.1	E	P	EX	EX	EX	EX	EX	M	M	-	-	ES	Y	-	G	-	
27																	
0-.2	E	F	M	M	M	M	EX	M	M	-	-	ES	Y	-	G	-	
.2-.4	E	P	M	M	M	M	EX	M	M	-	-	ES	Y	-	G	-	
.4-.6	E	F	M	L	L	L	M	L	L	-	-	ES	Y	-	G	-	
.6-.8	E	F	M	L	L	L	M	L	L	-	-	ES	Y	-	G	-	
.8-.1	E	F	M	L	L	L	M	L	L	-	-	ES	Y	Y	G	-	
28																	
0-.2	E	F	M	L	L	L	M	L	L	-	-	ES	Y	Y	G	-	
.2-.4	E	F	M	L	L	L	M	L	L	-	-	ES	Y	Y	G	-	
.4-.6	E	F	M	L	L	L	M	L	L	-	-	ES	Y	Y	G	-	
.6-.8	E	F	M	L	L	L	M	L	L	-	-	ES	Y	Y	G	-	
.8-.1	E	F	M	L	L	L	M	L	L	-	-	ES	Y	Y	G	-	
29																	
0-.2	E	P	EX	EX	EX	EX	EX	EX	EX	-	-	ES	Y	Y	G	-	
.2-.4	E	F	M	L	L	-	-	L	-	-	-	ES	Y	Y	G	-	
.4-.6	E	F	M	L	L	-	-	L	EX	-	-	ES	Y	Y	G	-	
.6-.8	E	F	M	L	L	-	-	L	-	-	-	ES	Y	Y	G	-	
.8-.1	E	P	M	M	M	M	M	M	M	-	-	ES	Y	Y	G	-	
30																	
0-.2	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.6-.8	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS

ABBREVIATIONS

E = EMBANKMENT
ES = EARTHEN SHOULDER
G = GOOD
F = FAIR
P = POOR
L = LOW (0-5%)
M = MEDIUM (5-15%)
EX = EXCESSIVE (>15%)
Y = YES
- = NO

CONDITION SURVEY VISUAL ASSESSMENT
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.80

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS			DEFORMATION				EDGE BREAKING	IMPROPER CAMBER	SHOULDER			DRAINAGE CONDITION		REMARKS
			ALLIGATOR	LONG	LATERAL	RUTTING	SETTLEMENT UNDULATION	POT HOLES	PATCHING			TYPE	DEFICIENCY INSUFFICIENT WIDTH	DEFICIENCY BELOW ROAD LEVEL	SURFACE DRAINAGE	FLOODING	
31																	
0-.2	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	P	EX	EX	EX	EX	EX	EX	EX	-	-	ES	Y	Y	G	-	
.6-.8	E	P	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	
.8-.1	E	P	EX	EX	EX	M	M	EX	EX	-	-	ES	Y	-	G	-	
32																	
0-.2	E	F	L	L	L	L	M	L	L	-	-	ES	Y	-	P	-	
.2-.4	E	F	L	L	L	L	M	-	-	-	-	ES	Y	-	P	-	
.4-.6	E	F	L	L	L	L	M	-	-	-	-	ES	Y	Y	P	-	
.6-.8	E	P	L	L	L	L	-	-	-	-	-	ES	Y	Y	P	-	
.8-.1	E	P	EX	EX	EX	EX	EX	EX	EX	-	-	ES	Y	Y	P	-	
33																	
0-.2	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	Y	P	-	
.2-.4	E	P	EX	EX	EX	EX	EX	EX	EX	-	Y	ES	Y	Y	P	-	
.4-.6	E	F	M	L	L	-	-	-	-	-	Y	ES	Y	Y	P	-	
.6-.8	E	F	M	L	L	-	-	-	-	-	Y	ES	Y	Y	P	-	
.8-.1	E	F	M	L	L	-	-	-	-	-	Y	ES	Y	Y	P	-	
34																	
0-.2	E	F	M	L	L	-	-	-	-	-	-	ES	Y	Y	P	-	
.2-.4	E	F	M	L	L	-	-	-	-	-	-	ES	Y	Y	P	-	
.4-.6	E	F	M	L	L	-	-	-	-	-	-	ES	Y	Y	P	-	
.6-.8	E	F	M	L	L	-	-	-	-	-	-	ES	Y	Y	P	-	
.8-.1	E	F	M	L	L	-	-	-	-	-	-	ES	Y	Y	P	-	
35																	
0-.2	E	P	M	M	M	-	-	L	-	-	-	ES	Y	Y	P	-	
.2-.4	E	F	L	L	L	-	-	L	-	-	-	ES	Y	Y	P	-	
.4-.6	E	F	L	L	L	-	-	L	L	-	-	ES	Y	-	P	-	
.6-.8	E	F	L	L	L	-	-	-	M	-	-	ES	Y	-	P	-	
.8-.1	E	F	L	L	L	-	-	L	M	-	-	ES	Y	-	F	-	

ABBREVIATIONS

E = EMBANKMENT
ES = EARTHEN SHOULDER
G = GOOD
F = FAIR
P = POOR
L = LOW (0-5%)
M = MEDIUM (5-15%)
EX = EXCESSIVE (>15%)
Y = YES
- = NO

Table 1.5 contd.

CONDITION SURVEY VISUAL ASSESSMENT
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS: ALLIGATOR	CRACKS: LONG	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLEMENT UNDULATION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	SHOULDER: TYPE	SHOULDER DEFICIENCY: INSUFFICIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	REMARKS
36																	
0-.2	E	F	M	M	M	-	-	L	L	-	-	ES	Y	Y	P	-	
.2-.4	E	F	L	L	L	L	L	M	L	-	-	ES	Y	Y	P	-	
.4-.6	E	F	M	M	M	M	M	L	M	-		ES	Y	Y	P	-	
.6-.8	E	G	M	M	M	-	-	M	-			ES	Y	Y	P	-	
.8-.1	E	P	M	M	M	-	-	-	L			ES	Y	Y	P	-	
37																	
0-.2	E	P	L	M	M	-	-	M	L	-	-	ES	Y	Y	G	-	
.2-.4	E	F	L	L	L	L	-	M	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	F	L	L	L	L	-	L	L	-	-	ES	Y	-	G	-	
.6-.8	E	F	L	L	L	L	-	L	L	-	-	ES	Y	-	G	-	
.8-.1	E	F	L	L	L	L	-	L	L	-	-	ES	Y	-	G	-	
38																	
0-.2	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	P	EX	EX	EX	EX	-	-	EX	-	Y	ES	Y	Y	G	-	
.4-.6	E	F	L	L	L	L	-	M	M	-	Y	ES	Y	Y	G	-	
.6-.8	E	F	L	L	L	L	-	M	M	-	Y	ES	Y	Y	G	-	
.8-.1	E	F	L	L	L	L	-	M	M	-	Y	ES	Y	-	G	-	
39																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
40																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS

ABBREVIATIONS

E = EMBANKMENT
ES = EARTHEN SHOULDER
G = GOOD
F = FAIR
P = POOR
L = LOW (0-5%)
M = MEDIUM (5-15%)
EX = EXCESSIVE (>15%)
Y = YES
- = NO

CONDITION SURVEY VISUAL ASSESSMENT
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS: ALLIGATOR	CRACKS: LONG	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLEMENT UNDULATION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	SHOULDER: TYPE	SHOULDER: DEFICIENCY: INSUFFICIENT WIDTH	SHOULDER: DEFICIENCY: BELOW ROAD LEVEL	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	REMARKS
41																	
0-.2	E	P	M	M	M	M	-	M	M	-	Y	ES	Y	Y	G	-	
.2-.4	E	P	M	M	M	M	M	M	M	-	Y	ES	Y	Y	G	-	
.4-.6	E	P	M	M	M	M	M	M	M	-	Y	ES	Y	Y	G	-	
.6-.8	E	P	M	M	M	M	M	M	M	-	-	ES	Y	Y	G	-	
.8-.1	E	P	M	M	M	M	M	M	M	-	-	ES	Y	Y	G	-	
42																	
0-.2	E	F	L	L	L	L	L	L	L	-	Y	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	F	L	L	L	L	L	L	L	-	Y	ES	Y	Y	G	-	NEWLY LAID MSS
.4-.6	E	F	L	L	L	L	L	L	L	-	Y	ES	Y	Y	G	-	NEWLY LAID MSS
.6-.8	E	P	M	EX	EX	-	L	EX	EX	-	Y	ES	Y	Y	G	-	
.8-.1	E	P	M	EX	EX	-	L	EX	EX	-	-	ES	Y	Y	G	-	
43																	
0-.2	E	P	M	EX	EX	-	L	EX	EX	-	-	ES	Y	Y	G	-	
.2-.4	E	P	M	EX	EX	-	L	EX	EX	-	-	ES	Y	Y	G	-	
.4-.6	E	P	M	EX	EX	-	L	EX	EX	-	-	ES	Y	Y	G	-	
.6-.8	E	P	M	EX	EX	-	L	EX	EX	-	-	ES	Y	Y	G	-	
.8-.1	E	P	M	M	M	L	L	L	M	-	-	ES	Y	Y	G	-	
44																	
0-.2	E	P	M	M	M	L	L	L	M	-	-	ES	Y	-	G	-	
.2-.4	E	P	M	M	M	L	L	L	M	-	-	ES	Y	-	G	-	
.4-.6	E	P	M	M	M	L	L	L	M	-	-	ES	Y	-	G	-	
.6-.8	E	P	M	M	M	L	L	L	M	-	-	ES	Y	Y	G	-	
.8-.1	E	P	EX	EX	EX	EX	-	-	EX	-	-	ES	Y	Y	G	-	
45																	
0-.2	E	P	EX	EX	EX	EX	-	-	EX	-	-	ES	Y	Y	G	-	
.2-.4	E	P	EX	EX	EX	EX	-	-	EX	-	-	ES	-	Y	G	-	
.4-.6	E	P	EX	EX	EX	EX	-	-	EX	-	-	ES	-	Y	G	-	
.6-.8	E	P	EX	EX	EX	EX	-	-	EX	-	-	ES	-	-	G	-	
.8-.1	E	P	EX	EX	EX	EX	-	-	EX	-	-	ES	-	-	G	-	

ABBREVIATIONS

- E = EMBANKMENT
- ES = EARTHEN SHOULDER
- G = GOOD
- F = FAIR
- P = POOR
- L = LOW (0-5%)
- M = MEDIUM (5-15%)
- EX = EXCESSIVE (>15%)
- Y = YES
- \- = NO

CONDITION SURVEY VISUAL ASSESSMENT
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS: ALLIGATOR	CRACKS: LONG	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLE-MENT UNDULA-TION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	SHOULDER: TYPE	SHOULDER DEFICIENCY: INSUFFI-CIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	REMARKS
46																	
0-.2	E	F	M	M	L	-	-	M	-	-	-	ES	Y	Y	P	-	
.2-.4	E	P	M	M	L	M	M	M	M	-	-	ES	Y	Y	P	-	
.4-.6	E	P	L	L	M	M	M	EX	EX	-	-	ES	-	-	P	-	
.6-.8	E	F	L	L	L	L	M	M	M	-	Y	ES	-	-	P	-	
.8-.1	E	F	M	L	L	L	L	M	M	-	Y	ES	-	-	P	-	
47																	
0-.2	E	F	M	L	M	L	L	M	M	-	Y	ES	Y	Y	P	-	
.2-.4	E	P	EX	EX	M	EX	EX	EX	M	-	Y	ES	Y	Y	P	-	
.4-.6	E	P	M	M	M	M	M	EX	EX	-	-	ES	Y	Y	P	-	
.6-.8	E	F	L	L	-	-	-	L	M	-	-	ES	Y	Y	P	-	
.8-.1	E	F	L	L	-	-	-	M	M	-	-	ES	Y	-	P	-	
48																	
0-.2	E	G	L	L	L	L	L	L	L	-	Y	ES	Y	-	P	-	NEWLY LAID MSS
.2-.4	E	F	L	L	L	L	L	L	L	-	Y	ES	Y	-	P	-	NEWLY LAID MSS
.4-.6	E	F	L	L	L	L	L	L	L	-	Y	ES	Y	Y	P	-	NEWLY LAID MSS
.6-.8	E	P	EX	EX	EX	EX	EX	EX	EX	-	-	ES	Y	Y	P	-	
.8-.1	E	P	EX	EX	-	M	L	EX	EX	-	-	ES	Y	-	P	-	
49																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	-	-	P	-	NEWLY LAID MSS
.2-.4	E	F	L	L	L	L	L	L	L	-	-	ES	-	-	P	-	NEWLY LAID MSS
.4-.6	E	F	L	L	L	L	L	L	L	-	-	ES	-	-	P	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	-	-	P	-	NEWLY LAID MSS
.8-.1	E	F	L	L	L	L	L	L	L	-	-	ES	-	-	P	-	NEWLY LAID MSS
50																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.6-.8	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.8-.1	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS

ABBREVIATIONS

- E = EMBANKMENT
- ES = EARTHEN SHOULDER
- G = GOOD
- F = FAIR
- P = POOR
- L = LOW (0-5%)
- M = MEDIUM (5-15%)
- EX = EXCESSIVE (>15%)
- Y = YES
- \- = NO

Table 1.5 Contd

CONDITION SURVEY VISUAL ASSESSMENT
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS: ALLIGATOR	CRACKS: LONG	CRACKS: LATERAL	DEFORMATION: RUTTING	DEFORMATION: SETTLEMENT UNDULATION	DEFORMATION: POT HOLES	DEFORMATION: PATCHING	EDGE BREAKING	IMPROPER CAMBER	SHOULDER: TYPE	SHOULDER DEFICIENCY: INSUFFICIENT WIDTH	SHOULDER DEFICIENCY: BELOW ROAD LEVEL	DRAINAGE CONDITION: SURFACE DRAINAGE	DRAINAGE CONDITION: FLOODING	REMARKS
51																	
0-.2	E	F	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
52																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.2-.4	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.4-.6	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.6-.8	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
.8-.1	E	G	L	L	L	L	L	L	L	-	-	ES	Y	-	G	-	NEWLY LAID MSS
53																	
0-.2	E	F	L	L	-	-	L	M	L	-	-	ES	Y	Y	G	-	
.2-.4	E	F	L	L	-	-	M	L	L	-	-	ES	Y	Y	G	-	
.4-.6	E	F	L	L	-	-	M	L	L	-	-	ES	-	-	G	-	
.6-.8	E	F	L	L	L	M	L	-	L	-	Y	ES	-	-	G	-	
.8-.1	E	P	EX	EX	EX	EX	EX	M	EX	-	Y	ES	-	-	G	-	
69																	
0-.2	E	F	M	M	L	L	L	L	L	-	Y	ES	Y	Y	G	-	
.2-.4	E	F	L	L	M	M	L	L	L	-	-	ES	Y	Y	G	-	
.4-.6	E	F	L	M	L	L	L	L	M	-	-	ES	Y	Y	G	-	
.6-.8	E	P	M	M	L	EX	EX	L	M	-	-	ES	Y	Y	G	-	
.8-.1	E	P	L	L	L	M	M	M	M	-	-	ES	Y	Y	G	-	
70																	
0-.2	E	F	L	L	L	M	EX	M	M	-	-	ES	-	-	G	-	
.2-.4	E	P	L	M	M	M	EX	M	EX	-	Y	ES	-	-	G	-	
.4-.6	E	P	L	M	M	L	L	L	EX	-	Y	ES	-	-	G	-	
.6-.8	E	P	EX	EX	EX	M	EX	M	M	-	Y	ES	-	-	G	-	
.8-.1	E	P	M	EX	EX	M	M	EX	M	-	Y	ES	-	-	G	-	

ABBREVIATIONS

E = EMBANKMENT
ES = EARTHEN SHOULDER
G = GOOD
F = FAIR
P = POOR
L = LOW (0-5%)
M = MEDIUM (5-15%)
EX = EXCESSIVE (>15%)
Y = YES
- = NO

Table [illegible] contd.

CONDITION SURVEY VISUAL ASSESSMENT
NH - 5 (VIJAYWADA - ELURU)

NH-5 FROM KM. 6.250 TO KM. 75.00

KM.	ROAD IN CUTTING OR FILLING	RIDING QUALITY G/F/P	CRACKS			DEFORMATION				EDGE BREAKING	IMPROPER CAMBER	SHOULDER			DRAINAGE CONDITION		REMARKS
			ALLIGATOR	LONG	LATERAL	RUTTING	SETTLEMENT UNDULATION	POT HOLES	PATCHING			TYPE	DEFICIENCY INSUFFICIENT WIDTH	DEFICIENCY BELOW ROAD LEVEL	SURFACE DRAINAGE	FLOODING	
71																	
0-.2	E	P	EX	EX	M	M	EX	M	M	-	Y	ES	Y	-	G	-	
.2-.4	E	P	EX	EX	EX	M	EX	M	M	-	-	ES	Y	Y	G	-	
.4-.6	E	P	EX	EX	EX	M	M	M	M	-	-	ES	Y	Y	G	-	
.6-.8	E	P	M	M	M	M	M	M	L	-	-	ES	-	-	G	-	
.8-.1	E	P	L	M	L	L	L	L	L	-	Y	ES	-	-	G	-	
72																	
0-.2	E	G	L	L	L	L	L	L	L	-	-	ES	Y	Y	G	-	
.2-.4	E	G	L	M	L	M	L	L	L	-	-	ES	-	-	G	-	
.4-.6	E	G	L	L	M	M	L	L	L	-	-	ES	-	-	G	-	
.6-.8	E	F	M	L	M	L	L	L	L	-	-	ES	-	-	G	-	
.8-.1	E	F	L	L	L	M	M	L	M	-	-	ES	-	-	G	-	
73																	
0-.2	E	F	M	M	L	M	M	M	M	-	Y	ES	Y	Y	G	-	
.2-.4	E	P	M	M	L	M	M	M	M	-	Y	ES	Y	Y	G	-	
.4-.6	E	F	M	M	M	L	EX	M	EX	-	Y	ES	Y	Y	G	-	
.6-.8	E	F	M	M	M	M	EX	L	EX	-	Y	ES	Y	Y	G	-	
.8-.1	E	P	M	M	EX	L	M	M	M	-	-	ES	-	-	G	-	
74																	
0-.2	E	P	M	EX	EX	M	M	EX	EX	-	-	ES	-	-	G	-	
.2-.4	E	P	L	L	EX	M	M	M	EX	-	-	ES	Y	Y	G	-	
.4-.6	E	P	EX	EX	EX	M	EX	M	EX	-	-	ES	Y	Y	G	-	
.6-.8	E	P	M	L	L	L	L	EX	EX	-	-	ES	Y	Y	G	-	
.8-.1	E	P	M	M	EX	EX	EX	M	EX	-	-	ES	Y	Y	G	-	

ABBREVIATIONS

E = EMBANKMENT
ES = EARTHEN SHOULDER
G = GOOD
F = FAIR
P = POOR
L = LOW (0-5%)
M = MEDIUM (5-15%)
EX = EXCESSIVE (>15%)
Y = YES
- = NO

TABLE 1.6
INVENTORY OF CULVERTS
KM. 3.40 TO 75.00 - NH-5 (VIJAYWADA - ELURU)

SL. NO.	CULVERT NO. AS WRITTEN AT SITE	LOCATION AS PER SITE KM.	TYPE OF CULVERT	CLEAR ROADWAY (m)	NO. OF SPAN /PIPE X LENGTH/DIA (IN m)	OTHER DECK RCC SLAB/BRICK ARCH THICKNESS (m)	FEATURES TYPE OF SUB-STRUCTURE	PROTECTION WORK	CONDITION OF STRUCTURE	REMARKS	ABBREVIATIONS
1.	7/1	6.240	SC	10.10	1x0.70	-	SM	NIL	FAIR	RC	
2.	7/2	6.255	HP	10.10	1x0.70	-	SM	NIL	FAIR	RC	SC - SLAB CULVERT
3.	7/3	6.595	HP	10.00	1x0.60	-	PCC	NIL	FAIR	NEW CULVERT	HP = HOME PIPE
										PROPOSED AT	SM STONE MASONR
										KM.6.40 & 6/60	R RETAINED
4.	7/4	6.700	HP	9.20	1x0.70	-	SM	NIL	POOR	RC	RC = RECONSTRUCT
5.	8/1	7.060	HP	14.00	1x0.70	-	PCC	NIL	FAIR	NEW CULVERT	RD RETAINED AN
										PROPOSED	DESILTING
											W TO BE WIDEN
6.	8/2	7.065	HP	14.00	1x0.70	-	SM	NIL	BLOCKED	RC AT 7.080	PCC = PLAIN CEMENT
										AS SC 1x1.50m	
7.	8/3	7.410	HP	10.00	1x0.70	-	SM	NIL	POOR	RC WITH 1x1.5 SC	
8.	8/4	7.880	HP	11.00	1x0.50	-	SM	NIL	POOR	RC	
9.	9/1	8.080	HP	11.00	1x0.70	-	SM	NIL	POOR	RC	
10.	9/2	8.500	HP	11.20	1x0.70	-	SM	NIL	POOR	RC	
11.	9/3	8.900	HP	12.00	1x0.70	-	SM	NIL	POOR	RC	
12.	10/1	9.590	HP	10.50	1x0.70	-	SM	NIL	BLOCKED	NEW CULVERT	
										PROPOSED AT	
										KM.10.800	
13.	11/1	10.260	HP	12.50	1x0.90	-	SM	NIL	FAIR	RC	
14.	11/2	10.900	SC	14.00	1x0.90	20 cm	SM	NIL	BLOCKED	RC A NEW	
										CULVERT PROPOSED	
										AT 11.40 (1x1.5)	
15.	12/1	11.700	SC	10.00	1x0.90	20 cm	SM	NIL	FAIR	W	
16.	13/1	12.300	HP	11.50	1x0.30	-	SM	NIL	BLOCKED	NEW CULVERT	
										PROPOSED AT	
										KM.12.500 (1x2)	
17.	13/2	12.900	SC	11.00	1x4.0	30 cm	SM	CC FLOORING	GOOD	W	
18.	14/1	13.700	SC	11.00	1x2.20	30 cm	SM	NIL	GOOD	R	
19.	15/1	14.310	HP	12.00	1x1	-	SM	NIL	GOOD	RD	
20.	15/2	14.470	HP	12.80	1x1	-	SM	NIL	GOOD	R	
21.	15/3	14.610	HP	12.90	1x1	-	SM	NIL	GOOD	R	
22.	15/5	14.930	HP	12.80	1x1	-	SM	NIL	GOOD	R	
23.	16/1	15.300	HP	15.00	1x1	-	SM	NIL	GOOD	R	
24.	16/2	15.650	HP	13.00	1x1	-	SM	NIL	GOOD	R	
25.	16/3	15.900	HP	16.00	1x1	-	SM	NIL	GOOD	RC	
26.	18/1	17.015	HP	10.80	1x0.30	-	SM	NIL	GOOD	R	

SL. NO.	CULVERT NO. AS WRITTEN AT SITE	LOCATION AS PER SITE KM.	TYPE OF CULVERT	CLEAR ROADWAY (m)	NO.OF SPAN /PIPE X LENGTH/DIA (IN m)	OTHER DECK RCC SLAB/BRICK ARCH THICKNESS (m)	FEATURES TYPE OF SUB-STRUCTURE	PROTECTION WORK	CONDITION OF STRUCTURE	REMARKS	ABBREVIATIONS
27.	18/2	17.490	HP	11.60	1x0.30	-	SM	NIL	FAIR	R	
28.	18/3	17.960	SC	11.50	4x0.90	25 cm	SM	NIL	GOOD	R	
29.	20/2	19.940	SC	11.15	1x6.0	40 cm	SM	NIL	GOOD	R	
30.	21/2	20.950	HP	13.20	1x0.90	-	SM	NIL	GOOD	R	
31.	22/1	21.100	HP	16.50	1x0.90	-	PCC	PROVIDED	GOOD	R	
32.	22/2	21.410	HP	15.15	1x0.90	-	SM	NIL	FAIR	R	
33.	24/1	23.300	SC	11.85	1x0.80	20 cm	SM	NIL	POOR	RC	
34.	26/1	25.810	SC	10.75	2x1.82	30 cm	SM	NIL	GOOD	R	
35.	27/1	26.010	SC	10.70	1x2.43	30 cm	SM	NIL	FAIR	R	
36.	27/2	26.130	HP	11.20	1x0.30	-	SM	NIL	GOOD	RD	
37.	27/3	26.415	SC	10.80	1x1.22	25 cm	SM	NIL	FAIR	R	
38.	29/1	28.080	SC	10.80	1x2.44	25 cm	SM	NIL	GOOD	R (P)	
39.	29/2	28.350	SC	10.75	1x2.44	25 cm	SM	STONE PITCHING	GOOD	R	
40.	30/1	29.300	SC	11.10	1x2.0	25 cm	SM	STONE PITCHING	FAIR	R (P)	
41.	30/2	29.880	SC	10.40	1x1.22	20 cm	SM	STONE PITCHING	FAIR	R (P)	
42.	31/1	30.700	SC	10.70	1x1.20	20 cm	SM	NIL	GOOD	RD	
43.	31/2	30.950	HP	11.20	1x0.30	-	SM	NIL	BLOCKED	RC NOT REQUIRED	
44.	32/1	31.100	HP	11.20	1x0.30	-	SM	NIL	BLOCKED	RC	
45.	32/2	31.300	SC	10.70	1x1.22	20 cm	SM	NIL	FAIR	R (P)	
46.	32/4	31.900	SC	11.00	1x1.22	20 cm	SM	NIL	GOOD	R (P)	
47.	33/1	32.300	SC	10.40	1x1.80	25 cm	SM	NIL	FAIR	R (P)	
48.	33/2	32.700	SC	10.65	1x2.40	30 cm	SM	STONE	FAIR	R (P)	
49.	34/1	33.210	SC	10.85	2x1.80	25 cm	SM	NIL	FAIR	R (P)	
50.	34/2	33.825	SC	10.60	1x1.20	25 cm	SM	NIL	FAIR	R (P)	
51.	35/1	34.410	SC	10.75	1x1.83	25 cm	SM	NIL	GOOD	R (P)	
52.	35/2	34.580	HP	11.70	1x0.60	-	SM	NIL	BLOCKED	RC	
53.	35/3	34.990	SC	10.40	1x2.44	30 cm	SM	NIL	FAIR	R (P)	
54.	37/1	36.070	SC	11.70	1x3.44	30 cm	SM	NIL	GOOD	R	
55.	37/2	36.350	SC	10.60	1x1.83	25 cm	SM	NIL	POOR	RC	
56.	37/3	26.410	HP	11.20	1x0.46	-	SM	NIL	FAIR	R (P)	
57.	37/4	36.590	HP	11.80	1x0.75	-	SM	NIL	GOOD	R (P)	
58.	37/5	36.660	SC	11.30	1x1.22	25 cm	SM	NIL	FAIR	R (P)	
59.	37/6	36.900	SC	11.75	1x0.76	20 cm	SM	NIL	POOR	RC	
60.	39/1	38.190	HP	11.80	1x0.76	-	SM	NIL	GOOD	R (P)	
61.	39/2	38.415	HP	11.50	1x0.76	-	SM	NIL	GOOD	R	
62.	39/3	38.440	HP	12.30	1x0.90	-	SM	NIL	FAIR	RD	
63.	40/1	39.010	HP	18.30	1x0.76	-	SM	NIL	GOOD	RD	
64.	40/2	39.250	HP	18.25	1x0.76	-	SM	NIL	GOOD	R	
65.	40/3	39.220	HP	18.30	1x0.76	-	SM	NIL	GOOD	R	
66.	40/4	39.450	HP	18.20	1x0.76	-	SM	NIL	GOOD	R	
67.	40/5	39.605	HP	18.20	1x0.76	-	SM	NIL	GOOD	R	
68.	40/6	39.850	HP	18.00	1x0.76	-	SM	NIL	GOOD	R	

SL. NO.	CULVERT NO. AS WRITTEN AT SITE	LOCATION AS PER SITE KM.	TYPE OF CULVERT	CLEAR ROADWAY (m)	NO.OF SPAN /PIPE X LENGTH/DIA (IN m)	OTHER DECK RCC SLAB/BRICK ARCH THICKNESS (m)	FEATURES TYPE OF SUB-STRUCTURE	PROTECTION WORK	CONDITION OF STRUCTURE	REMARKS	ABBREVIATIONS
69.	40/7	39.950	SC	9.50	1x2.44	25 cm	SM	NIL	GOOD	W TO BE EXTENDED RIGHT SIDE BY 2m	
70.	40/8	39.990	HP	14.50	1x0.76	-	SM	NIL	GOOD	R	
71.	41/1	40.210	HP	18.30	1x0.76	-	SM	NIL	FAIR	R (P)	
72.	41/2	40.300	HP	18.30	1x0.76	-	SM	NIL	GOOD	R	
73.	41/3	40.360	HP	18.20	1x0.76	-	SM	NIL	GOOD	R	
74.	41/4	40.380	HP	18.35	1x0.76	-	SM	NIL	GOOD	R	
75.	41/5	40.400	HP	18.20	1x0.76	-	SM	NIL	GOOD	R	
76.	41/6	40.420	HP	18.30	1x0.76	-	SM	NIL	GOOD	R	
77.	41/7	40.500	HP	18.40	1x0.76	-	SM	NIL	GOOD	R	
78.	41/8	40.600	HP	18.30	1x0.76	-	SM	NIL	GOOD	R	
79.	41/9	40.700	HP	18.30	1x0.76	-	SM	NIL	GOOD	R	
80.	41/10	40.790	HP	22.50	1x0.76	-	SM	NIL	GOOD	R	
81.	41/11	40.920	SC	10.80	2x1.80	25 cm	SM	STONE PITCHING	FAIR	R (P)	
82.	41/12	40.990	SC	13.40	2x2.0	25 cm	SM	STONE PITCHING	FAIR	R (P)	
83.	42/1	41.350	SC	10.70	2x1.83	25 cm	SM	STONE PITCHING	FAIR	R (P)	
84.	43/1	42.500	SC	10.75	1x4.27	30 cm	SM	STONE PITCHING	FAIR	R (P)	
85.	43/2	42.860	SC	10.67	1x2.44	30 cm	SM	STONE PITCHING	GOOD	R (P)	
86.	44/1	43.120	SC	10.65	2x2.44	30 cm	SM	STONE PITCHING	FAIR	R (P)	
87.	44/2	43.460	SC	10.70	3x1.80	25 cm	SM	NIL	GOOD	R	
88.	44/3	43.950	SC	10.75	1x4.20	30 cm	SM	STONE PITCHING	GOOD	R	
89.	45/1	44.700	SC	10.63	1x4.12	30 cm	SM	STONE PITCHING	GOOD	R (P)	
90.	46/1	45.300	SC	10.75	2x1.75	30 cm	SM	NIL	GOOD	R (P)	
91.	47/1	46.150	SC	10.20	2x1.75	25 cm	SM	NIL	FAIR	W TO BE EXTENDED (RIGHT SIDE BY 1.5m)	
92.	47/2	46.415	SC	9.00	3x0.91	25 cm	SM	NIL	GOOD	W TO BE EXTENDED BOTH SIDE BY 2m	
93.	47/3	46.910	SC	9.20	1x1.80	25 cm	SM	NIL	GOOD	W TO BE EXTENDED RIGHT SIDE BY 2m	
94.	48/1	47.100	SC	10.10	2x1.80	25 cm	SM	STONE PITCHING	FAIR	R (P)	
95.	48/2	47.300	SC	10.60	2x0.90	20 cm	SM	NIL	BLOCKED	NOT REQUIRED	
96.	48/3	47.510	HP	13.20	1x1	-	SM	NIL	GOOD	R	

SL. NO.	CULVERT NO. AS WRITTEN AT SITE	LOCATION AS PER SITE KM.	TYPE OF CULVERT	CLEAR ROADWAY (m)	NO. OF SPAN PIPE X LENGTH/DIA (IN m)	OTHER DECK RCC SLAB/BRICK ARCH THICKNESS (m)	FEATURES TYPE OF SUB-STRUCTURE	PROTECTION WORK	CONDITION OF STRUCTURE	REMARKS	ABBREVIATION
97.	48/4	47.780	HP	15.20	1x1	-	SM	NIL	GOOD	R	
98.	48/5	47.860	HP	14.70	1x1	-	SM	NIL	GOOD	R	
99.	49/1	48.020	SC	10.70	2x1.85	25 cm	SM	NIL	GOOD	R (P)	
100.	49/2	48.095	SC	10.50	2x1.90	25 cm	SM	NIL	GOOD	R (P)	
101.	50/1	49.010	HP	13.70	1x1	-	SM	NIL	GOOD	R	
102.	50/2	49.210	HP	13.60	1x1	-	SM	NIL	GOOD	R	
103.	50/3	49.410	SC	10.00	1x1.20	-	SM	NIL	GOOD	R (P)	
104.	50/4	49.500	HP	13.50	1x1	-	SM	NIL	GOOD	R	
105.	50/5	49.540	HP	13.50	1x1		SM	NIL	GOOD	R	
106.	50/6	49.640	HP	13.50	1x1		SM	NIL	GOOD	P	
107.	50/7	49.700	HP	13.60	1x1	-	SM	NIL	GOOD	[illegible]	
108.	50/8	49.920	HP	10.70	1x0.40	-	SM	NIL	GOOD	R (P)	
109.	51/1	50.160	SC	10.70	3x1.83	30 cm	SM	NIL	FAIR	R (P)	
110.	51/2	50.290	HP	10.80	1x0.30	-	SM	NIL	BLOCKED	LC	
111.	51/3	50.650	HP	11.50	1x1	-	SM	NIL	GOOD	R	
112.	51/4	50.900	SC	10.60	1x1.20	25 cm	SM	NIL	FAIR	R (P)	
113.	52/1	51.190	SC	10.50	1x6.0	45 cm	SM	NIL	GOOD	R	
114.	52/2	51.580	HP	13.80	1x1	-	PCC	NIL	GOOD	R	
115.	52/3	51.720	HP	12.10	1x1	-	PCC	NIL	GOOD	R	
116.	52/4	51.940	HP	13.80	1x1	-	PCC	NIL	GOOD	R	
117.	53/1	52.050	HP	11.10	1x0.90	-	SM	NIL	GOOD	R (P)	
118.	53/2	52.120	HP	13.50	1x1	-	PCC	NIL	GOOD	R	
119.	53/3	52.420	SC	11.00	1x1.10	20 cm	SM	NIL	FAIR	R (P)	
120.	53/4	52.550	HP	13.00	1x1	-	PCC	NIL	GOOD	R	
121.	53/5	52.850	HP	14.00	1x1	-	PCC	NIL	GOOD	R	
122.	54/1	53.100	SC	10.70	2x1.83	25 cm	SM	NIL	FAIR	R (P)	
123.	54/2	53.500	HP	12.00	1x1	-	PCC	NIL	GOOD	R	
124.	73/1	73.195	HP	11.00	2x0.90	-	SM	STONE PITCHING	GOOD	R (P)	
125.	74/1	73.405	HP	12.70	5x1	-	SM	NIL	GOOD	R	
126.	75/1	74.205	HP	13.80	11x1	-	SM	PROVIDED	GOOD	R	

NOTE :-

1. The exact requirement, location & Size of culverts will be decided along with drainage plan.
2. Parapet of most of the culverts are damaged, some of the parapets are of varying length & heights. All the parapets will be reconstructed to standard length and size.

Table 1.7

SHIFTING OF ELECTRIC POLES, TRANSFORMERS AND ELECTRIC LINES

PROJECT : NH.5 VIJAYAWADA TO ELURU
(FROM KM 3.4 TO KM 75.000)

SL. NO.	KM FROM	KM TO	LEFT SIDE NO. OF POLES	LEFT SIDE EFFECTIVE LENGTH (M)	RIGHT SIDE NO.OF POLES	RIGHT SIDE EFFECTIVE LENGTH (M)
1.	3.400	4.000	-	-	8	400.0
2.	4.000	5.000	-	-	15	850.0
3.	5.000	6.000	2	200.0	2	
4.	6.000	7.000	12	550.0	29+1*	1000.0
5.	7.000	8.000	2	-	28	1000.0
6.	8.000	9.000	-	-	29	1000.0
7.	9.000	10.000	1	-	31	900.0
8.	10.000	11.000	17	600.0	14	300.0
9.	11.000	12.000	-	-	22+1*	950.0
10.	12.000	13.000	3	120.0	17+1*	850.0
11.	13.000	14.000	9	500.0	25+2*	550.0
12.	14.000	15.000	-	-	1	-
13.	15.000	16.000	-	-	-	-
14.	16.000	17.000	-	-	1	-
15.	17.000	18.000	-	-	-	-
16.	18.000	19.000	-	-	-	-
17.	19.000	20.000	-	-	-	-
18.	20.000	21.000	-	-	-	-
19.	21.000	22.000	-	-	-	-
20.	22.000	23.000	-	-	-	-
21.	23.000	24.000	-	-	2	100.0
22.	24.000	25.000	-	-	2	100.0
23.	25.000	26.000	-	-	-	-
24.	26.000	27.000	-	-	-	-
25.	27.000	28.000	-	-	-	-
26.	28.000	29.000	-	-	-	-
27.	29.000	30.000	1	-	-	-
28.	30.000	31.000	-	-	7	450.0
29.	31.000	32.000	-	-	-	-
30.	32.000	33.000	1	100.0	-	-
31.	33.000	34.000	-	-	-	-
32.	34.000	35.000	-	-	-	-
33.	35.000	36.000	1	-	2	-

Table 1.7 contd.

SL. NO.	KM FROM	KM TO	LEFT SIDE NO.OF POLES	LEFT SIDE EFFECTIVE LENGTH (M)	RIGHT SIDE NO.OF POLES	RIGHT SIDE EFFECTIVE LENGTH (M)
34.	36.000	37.000	1	-	-	
35.	37.000	38.000	-	-	-	-
36.	38.000	39.000	-	-	-	-
37.	39.000	40.000	1	-	1	-
38.	40.000	41.000	-	-	1	-
39.	41.000	42.000	-	-	-	-
40.	42.000	43.000	-	-		
41.	43.000	44.000	-	-	-	-
42.	44.000	45.000	-	-	-	-
43.	45.000	46.000	11	350.0	-	-
44.	46.000	47.000	19	1000.0	-	-
45.	47.000	48.000	-	-	7	400.0
46.	48.000	49.000	-	-	-	-
47.	49.000	50.000	-	-	-	-
48.	50.000	51.000	-	-	-	-
49.	51.000	52.000	-	-	-	-
50.	52.000	53.000	-	-	-	-
51.	53.000	54.000	-	-	-	-
52.	68.000	69.000	-	-	-	-
53.	69.000	70.000	-	-	-	-
54.	70.000	71.000	-	-	-	-
55.	71.000	72.000	-	-	-	-
56.	72.000	73.000	-	-	-	-
57.	73.000	74.000	-	-	-	-
58.	74.000	75.000	-	-	-	-

* TRANSFORMERS

Table 1.8

SHIFTING OF TELEPHONE POLES AND TELEPHONE LINES

PROJECT : NH.5 (VIJAYAWADA TO ELURU
FROM KM 3.400 TO KM 75.000)

SL. NO.	KM FROM	KM TO	LEFT SIDE NO.OF POLES	LEFT SIDE EFFECTIVE LENGTH (M)	RIGHT SIDE NO.OF POLES	RIGHT SIDE EFFECTIVE LENGTH (M)
1.	3.400	4.000	3	150.0	8	400.0
2.	4.000	5.000	1	-	15	850.0
3.	5.000	6.000	11	650.0	2	-
4.	6.000	7.000	1	-	2	150.0
5.	7.000	8.000	1	100.0	-	-
6.	8.000	9.000	-	-	-	-
7.	9.000	10.000	8	250.0	6	200.0
8.	10.000	11.000	9	250.0	-	-
9.	11.000	12.000	10	300.0	7	250.0
10.	12.000	13.000	6	150.0	1	50.0
11.	13.000	14.000	-	-	3	100.0
12.	14.000	15.000	10	400.0	-	-
13.	15.000	16.000	1	-	2	-
14.	16.000	17.000	-	-	-	-
15.	17.000	18.000	-	-	1	-
16.	18.000	19.000	-	-	-	-
17.	19.000	20.000	-	-	-	-
18.	20.000	21.000	-	-	-	-
19.	21.000	22.000	-	-	-	-
20.	22.000	23.000	-	-	-	-
21.	23.000	24.000	-	-	2	100.0
22.	24.000	25.000	6	200.0	2	100.0
23.	25.000	26.000	-	-	-	-
24.	26.000	27.000	-	-	-	-
25.	27.000	28.000	-	-	-	-
26.	28.000	29.000	-	-	-	-
27.	29.000	30.000	-	-	-	-
28.	30.000	31.000	-	-	7	450.0
29.	31.000	32.000	1	-	-	-
30.	32.000	33.000	-	-	1	100.0
31.	33.000	34.000	-	-	-	-
32.	34.000	35.000	-	-	-	-

Table 1.8 contd.

SL. NO.	KM FROM	KM TO	LEFT SIDE NO.OF POLES	LEFT SIDE EFFEC-TIVE LENGTH (M)	RIGHT SIDE NO.OF POLES	RIGHT SIDE EFFEC-TIVE LENGTH (M)
33.	35.000	36.000	1	-	-	-
34.	36.000	37.000	1	-	-	-
35.	37.000	38.000	-	-	-	-
36.	38.000	39.000	-	-	-	-
37.	39.000	40.000	-	-	-	-
38.	40.000	41.000	-	-	-	-
39.	41.000	42.000	-	-	-	-
40.	42.000	43.000	-	-	-	-
41.	43.000	44.000	-	-	-	-
42.	44.000	45.000	-	-	-	-
43.	45.000	46.000	5	250.0	-	-
44.	46.000	47.000	-	-	-	-
45.	47.000	48.000	4	200.0	2	50.0
46.	48.000	49.000	-	-	-	-
47.	49.000	50.000	-	-	-	-
48.	50.000	51.000	-	-	-	-
49.	51.000	52.000	-	-	-	-
50.	52.000	53.000	-	-	-	-
51.	53.000	54.000	-	-	-	-
52.	68.000	69.000	-	-	-	-
53.	69.000	70.000	-	-	-	-
54.	70.000	71.000	-	-	-	-
55.	71.000	72.000	-	-	-	-
56.	72.000	73.000	-	-	-	-
57.	73.000	74.000	-	-	-	-
58.	74.000	75.000	-	-	-	-

COAXIAL CABLE IS TO BE SHIFTED FROM KM 5.500 TO KM 13.000.

<u>Table 1.9</u>

DETAILS OF TREES TO BE CUT

PROJECT: NH.5 (VIJAYAWADA TO ELURU

FROM KM 3.400 TO KM 75.000)

SL. NO.	KM FROM	TO	NO. OF TREES LEFT SIDE	RIGHT SIDE
1.	3.400	4.000	3	3
2.	4.000	5.000	4	2
3.	5.000	6.000	7	-
4.	6.000	7.000	-	-
5.	7.000	8.000	-	-
6.	8.000	9.000	-	-
7.	9.000	10.000	-	-
8.	10.000	11.000	-	-
9.	11.000	12.000	-	-
10.	12.000	13.000	-	-
11.	13.000	14.000	-	-
12.	14.000	15.000	-	-
13.	15.000	16.000	-	-
14.	16.000	17.000	-	-
15.	17.000	18.000	-	-
16.	18.000	19.000	-	-
17.	19.000	20.000	-	-
18.	20.000	21.000	-	-
19.	21.000	22.000	-	-
20.	22.000	23.000	-	-
21.	23.000	24.000	-	-
22.	24.000	25.000	-	-
23.	25.000	26.000	-	-
24.	26.000	27.000	-	-
25.	27.000	28.000	-	-
26.	28.000	29.000	-	-
27.	29.000	30.000	-	-
28.	30.000	31.000	-	-
29.	31.000	32.000	-	-

Table 1.9 contd.

SL. NO.	KM FROM	TO	NO. OF TREES LEFT SIDE	RIGHT SIDE
30.	32.000	33.000	-	-
31.	33.000	34.000	-	-
32.	34.000	35.000	-	-
33.	35.000	36.000	-	-
34.	36.000	37.000	2	-
35.	37.000	38.000	-	-
36.	38.000	39.000	-	-
37.	39.000	40.000	-	-
38.	40.000	41.000	-	-
39.	41.000	42.000	-	-
40.	42.000	43.000	-	-
41.	43.000	44.000	-	-
42.	44.000	45.000	-	-
43.	45.000	46.000	-	-
44.	46.000	47.000	-	-
45.	47.000	48.000	-	-
46.	48.000	49.000	-	-
47.	49.000	50.000	2	-
48.	50.000	51.000	-	-
49.	51.000	52.000	-	-
50.	52.000	53.000	-	-
51.	53.000	54.000	-	-
52.	68.000	69.000	-	-
53.	69.000	70.000	-	-
54.	70.000	71.000	-	-
55.	71.000	72.000	-	-
56.	72.000	73.000	-	-
57.	73.000	74.000	-	-
58.	74.000	75.000	-	-

Table 1.9 contd.

DETAILS OF TREE TO BE CUT NH-5 (VIJAYAWADA TO ELURU)

ELURU BYPASS

SL. NO.	KM FROM	TO	NAME OF TREES	NO.OF TREES TO BE CUT
1.	0.000	1.000	-	-
2.	1.000	2.000	EUCALYPTUS	200
			PALM	2
3.	2.000	3.000	COCONUT	10
4.	3.000	4.000	-	-
5.	4.000	5.000	COCONUT	20
6.	5.000	6.000	COCONUT	5
7.	6.000	7.000	-	-
8.	7.000	8.000	-	-
9.	8.000	9.000	-	-
10.	9.000	10.000	COCONUT	30
			GUAVA	70
11.	10.000	11.000	COCONUT	5
			MANGO	15
12.	11.000	12.000	COCONUT	5
13.	12.000	13.000	-	-
14.	13.000	14.000	-	-
15.	14.000	15.000	-	-
16.	15.000	16.000	COCONUT	10
17.	16.000	17.000	PALM	10
18.	17.000	17.517	-	-
			TOTAL =	382 NOS.

TABLE-1.10

SHIFTING OF ELECTRIC POLES, TRANSFORMERS AND ELECTRIC LINES

PROJECT :- NH.9 (NANDIGAMA TO VIJAYAWADA)
FROM (KM 217.000 TO KM 265.000)

SL. NO.	KM		LEFT SIDE		RIGHT SIDE		REMARKS
	FROM	TO	NO.OF POLES	EFFEC-TIVE LENGTH (M)	NO.OF POLES	EFFEC-CTIVE LENGTH (M)	
1.	217.000	218.000	-	-	-	-	
2.	218.000	219.000	9	300.0	4	200.0	
3.	219.000	220.000	-	-	2	100.0	
4.	220.000	221.000	-	-	-	-	
5.	221.000	222.000	-	-	-	-	
6.	222.000	223.000	-	-	-	-	
7.	223.000	224.000	-	-	-	-	
8.	224.000	225.000	-	-	-	-	
9.	225.000	226.000	-	-	-	-	
10.	226.000	227.000	-	-	-	-	
11.	227.000	228.000	-	-	-	-	
12.	228.000	229.000	-	-	-	-	
13.	229.000	230.000	-	-	-	-	
14.	230.000	231.000	-	-	-	-	
15.	231.000	232.000	-	-	-	-	
16.	232.000	233.000	-	-	-	-	
17.	233.000	234.000	-	-	-	-	
18.	234.000	235.000	-	-	-	-	
19.	235.000	236.000	-	-	-	-	
20.	236.000	237.000	-	-	-	-	
21.	237.000	238.000	-	-	-	-	
22.	238.000	239.000	-	-	-	-	

TABLE-1.10(Contd.)

SL. NO.	KM		LEFT SIDE		RIGHT SIDE		REMARKS
	FROM	TO	NO.OF POLES	EFFEC-TIVE LENGTH (M)	NO.OF POLES	EFFEC-CTIVE LENGTH (M)	
23.	239.000	240.000	-	-	-	-	
24.	240.000	241.000	-	-	-	-	
25.	241.000	242.000	-	-	-	-	
26.	242.000	243.000	-	-	-	-	
27.	243.000	244.000	-	-	-	-	
28.	244.000	245.000	-	-	-	-	
29.	245.000	246.000	-	-	-	-	
30.	246.000	247.000	-	-	-	-	
31.	247.000	248.000	-	-	-	-	
32.	248.000	249.000	-	-	-	-	
33.	249.000	250.000	-	-	-	-	
34.	250.000	251.000	-	-	-	-	
35.	251.000	252.000	-	-	-	-	
36.	252.000	253.000	18	550.0	3	100.0	
37.	253.00	254.00	7	300.0	-	-	
38.	254.000	255.000	5	300.0	-	-	
39.	255.000	256.000	1	-	-	-	
40.	256.000	257.000	-	-	3	-	
41.	257.000	258.000	4	100.0	-	-	
42.	258.000	259.000	-	-	1	-	
43.	259.000	260.000	-	-	-	-	
44.	260.000	261.000	-	-	8+1*	350.0	
45.	261.000	262.000	2	50	24	700.0	
46.	262.000	263.000	2	80	25+1*	800.0	
47.	263.000	264.000	12+1*	350.0	28+2*	1000.0	
48.	264.000	265.000	3	100.0	34+2*	600.0	

* TRANSFORMER

TABLE-1.11

SHIFTING OF TELEPHONE POLES AND TELEPHONE LINES

PROJECT : - NH.9 (NANDAGAMA TO VIJAYAWADA)
FROM KM 217.000 TO KM 265.000

SL. NO.	KM FROM	KM TO	LEFT SIDE NO.OF POLES	LEFT SIDE EFFECTIVE LENGTH (M)	RIGHT SIDE NO.OF POLES	RIGHT SIDE EFFECTIVE LENGTH (M)	REMARKS
1.	217.000	218.000	-	-	-	-	
2.	218.000	219.000	-	-	4	200.0	
3.	219.000	220.000	-	-	2	100.0	
4.	220.000	221.000	-	-	-	-	
5.	221.000	222.000	-	-	-	-	
6.	222.000	223.000	-	-	-	-	
7.	223.000	224.000	-	-	-	-	
8.	224.000	225.000	-	-	-	-	
9.	225.000	226.000	-	-	-	-	
10.	226.000	227.000	-	-	-	-	
11.	227.000	228.000	-	-	-	-	
12.	228.000	229.000	-	-	-	-	
13.	229.000	230.000	-	-	-	-	
14.	230.000	231.000	-	-	-	-	
15.	231.000	232.000	-	-	-	-	
16.	232.000	233.000	-	-	-	-	
17.	233.000	234.000	-	-	-	-	
18.	234.000	235.000	-	-	-	-	
19.	235.000	236.000	-	-	-	-	
20.	236.000	237.000	-	-	-	-	
21.	237.000	238.000	-	-	-	-	
22.	238.000	239.000	-	-	-	-	
23.	239.000	240.000	-	-	-	-	
24.	240.000	241.000	-	-	-	-	
25.	241.000	242.000	-	-	-	-	
26.	242.000	243.000	1	20.0	-	-	
27.	243.000	244.000	-	-	-	-	
28.	244.000	245.000	-	-	-	-	
29.	245.000	246.000	-	-	-	-	
30.	246.000	247.000	-	-	-	-	

TABLE-1.11(Contd.)

SL. NO.	KM FROM	KM TO	LEFT SIDE NO.OF POLES	LEFT SIDE EFFEC-TIVE LENGTH (M)	RIGHT SIDE NO.OF POLES	RIGHT SIDE EFFEC-TIVE LENGTH (M)	REMARKS
31.	247.000	248.000	-	-	-	-	
32.	248.000	249.000	-	-	-	-	
33.	249.000	250.000	-	-	-	-	
34.	250.000	251.000	-	-	-	-	
35.	251.000	252.000	-	-	-	-	
36.	252.000	253.000	3	50.0	1	-	
37.	253.000	254.000	-	-	-	-	
38.	254.000	255.000	-	-	1	50.0	
39.	255.000	256.000	-	-	-	-	
40.	256.000	257.000	-	-	-	-	
41.	257.000	258.000	-	-	9	400.0	
42.	258.000	259.000	5	350.0	-	-	
43.	259.000	260.000	-	-	1	-	
44.	260.000	261.000	20	950.0	-	-	
45	261.000	262.000	12	400.0	-	-	
46.	262.000	263.000	9	400.0	5	100.0	
47.	263.000	264.000	4	100.0	6	200.0	
48.	264.000	265.000	17	500.0	4	100.0	

COAXIAL CABLE IS TO BE SHIFTED FROM KM 252.000 TO 264.600.

TABLE-1.12

DETAILS OF TREES TO BE CUT

PROJECT : NH.9 NANDIGAMA TO VIJAYAWADA

(FROM KM 217.000 TO KM 265.000)

SL. NO.	KM FROM	KM TO	NO. OF TREES LEFT SIDE	NO. OF TREES RIGHT SIDE
1.	217.000	218.000	-	1
2.	218.000	219.000	-	-
3.	219.000	220.000	-	-
4.	220.000	221.000	-	-
5.	221.000	222.000	-	-
6.	222.000	223.000	-	-
7.	223.000	224.000	-	-
8.	224.000	225.000	-	-
9.	225.000	226.000	-	-
10.	226.000	227.000	-	-
11.	227.000	228.000	-	-
12.	228.000	229.000	-	-
13.	229.000	230.000	-	-
14.	230.000	231.000	-	-
15.	231.000	232.000	-	-
16.	232.000	233.000	-	-
17.	233.000	234.000	-	-
18.	234.000	235.000	-	-
19.	235.000	236.000	-	-
20.	236.000	237.000	-	-
21.	237.000	238.000	-	-
22.	238.000	239.000	-	-
23.	239.000	240.000	-	-
24.	240.000	241.000	-	-
25.	241.000	242.000	-	-
26.	242.000	243.000	-	-
27.	243.000	244.000	-	-
28.	244.000	245.000	-	-
29.	245.000	246.000	-	-
30.	246.000	247.000	-	-

TABLE-1.12(Contd.)

SL. NO.	KM		NO. OF TREES	
	FROM	TO	LEFT SIDE	RIGHT SIDE
31.	247.000	248.000	-	-
32.	248.000	249.000	-	-
33.	249.000	250.000	-	-
34.	250.000	251.000	-	-
35.	251.000	252.000	-	-
36.	252.000	253.000	-	-
37.	253.000	254.000	-	-
38.	254.000	255.000	-	3
39.	255.000	256.000	2	1
40.	256.000	257.000	-	-
41.	257.000	258.000	-	6
42.	258.000	259.000	2	35
43.	259.000	260.000	-	25
44.	260.000	261.000	-	-
45.	261.000	262.000	-	1
46.	262.000	263.000	3	3
47.	263.000	264.000	6	-
48.	264.000	265.000	-	3

CHAPTER 2

2.0 ENGINEERING SURVEY AND INVESTIGATION DATA

2.1 TOPOGRAPHICAL SURVEY

2.1.1 The Topographical Survey was conducted in the entire reach of the project road for both NH-5 and NH-9. It consisted of the following:

(a) Chaining

(b) Fixing of Temporary Bench Marks

(c) Theodolite Survey

(d) Plane Tabling in certain locations, especially in urban area;

(e) L-Sections and cross sections at every 50 m. intervals.

(f) Cross-sections for bridges.

2.1.2 Based on the above, Strip Plans have been prepared, showing the proposals for 4-laning, where required as per Terms of Reference, road realignments, relocation of utility services and land required to be acquired. These are given in Vol.III.

2.1.3 Typical survey plans, L-sections and Cross sections are also given in Vol.III.

2.2 TRAFFIC SURVEYS

2.2.1 The following traffic surveys were carried out in field:

(a) Traffic volume count at km.13/2, 45/6 and 50/8 in respect of NH-5 and 219/6, 253/4 on NH-9 for 7 days, continuously for 24 hours.

(b) Axle load survey was conducted on permanent weigh bridges at km.50/8 on NH-5 and 253/4 on NH-9 for 24 hours, weighing loaded as well as empty commercial vehicles, both for full truck load and for rear axle, on random basis.

(c) Origin-Destination survey was conducted for 24 hours at above locations, by road side interviewing all four or more wheeled vehicles.

(d) Junction Survey was also conducted at important Junctions on NH-5 and NH-9 respectively.

(e) Roughness measurements were taken by running Fifth wheel Bump Integrator in both directions, on both the National Highways.

2.2.2 Benkelman Beam Deflection measurements and Dynamic Cone Penetrometer measurements were also recorded.

2.2.3 The data regarding Traffic Survey is given in Chapter 4 are the Design of Pavement.

2.3 CRUST THICKNESS OF THE PAVEMENT

2.3.1 The existing crust of the pavement was measured in every 5th kilometer and details are presented in Table 4.3 in respect of NH-5 and in Table 4.4 in respect of NH-9 and are given in Chapter 4 on Design of Pavement. The improvements/renewals carried out by the department in the existing pavement from 1987-88 to 1992-93 and the proposals for the year 1993-94 are placed at pages 2-7 to 2-33 (Fig. Nos. 2.1 to 2.33).

2.4 CROSS SECTION OF PITS AND BORELOGS

2.4.1 Pits were excavated along the paved edge of the carriageway in 60 cm. width and 80 cm. length, about 80 cm. deep, in order to find out the cross section of the road pavement. Samples of sub-grade material were also taken to find out moisture content and its CBR. Typical cross sections of such pits are given in Figs. 4.1A to 4.20 (page 4-59 to 4-78).

2.5 SOIL TESTS OF SUBGRADE

2.5.1 100 mm dia., 1.00 m deep bores were also taken in such pits and the properties of the soil analysed. These are given in Tables 4.3 and 4.4, in Chapter 4 - Design of Pavement.

2.6 RESULTS OF BORROW AREA TESTS

2.6.1 Borrow areas were identified for embankment filling work, both for NH-5 and NH-9.

2.6.2 As per site investigations of the quarries, enough quantities of the borrow area soil is available to feed the requirements.

2.6.3 The soil from the borrow areas was tested in the laboratory for its physical properties. The same are presented in Tables 2.1 and 2.2 for NH-5 and NH-9 respectively.

TABLE 2.1

PHYSICAL CHARACTERISTICS OF BORROW AREA SOIL

PROJECT : NH 5 VIJAYAWADA-ELURU

Sl. No.	Sample No.	Location (Kms)	Sieve Analysis % by wt. passing IS Sieve				Atterberg Limits			Sand Content (%)	Soil Classification ISI	Laboratory Max. Density modified AASHTO gm/cc	Optimum Moisture content (%)	Soaked CBR Value (%)	Remakrs
			4.75 mm	2.36 mm	425 microns	75 microns	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)						
1.	1	Km. 4.0 on NH-5	99	98	55	12	NP	NP	NP	87	SW	1.86	9.8	10.2	Krishna river bed
2.	2	Km. 21 Left Side 7 km.	72	61	44	36	NP	NP	NP	36	SG	1.92	10.6	11.5	Quarry (Sawar Gudam quarry)
3.	3	Km. 22.7 Left Side	80	57	31	26	NP	NP	NP	54	SG	1.89	11.7	10.8	Quarry (Kesarapalli)
4.	4	Km. 24.60 Right Side	94	76	36	27	NP	NP	NP	67	SW	1.85	9.8	9.3	Sand quarry (Gannawaram quarry)
5.	5	Km. 25.0 Left Side 6 km.	77	65	49	43	NP	NP	NP	34	SG	1.93	12.2	11.2	Quarry (Purushotam patnam quarry)
6.	6	Km. 30, Left Side 6 km.	67	58	44	32	NP	NP	NP	35	SG	1.88	10.7	11.8	Quarry (Veerapanneni gudam quarry)
7.	7	Km. 45 Left side 13 km.	99	99	88	53	NP	NP	NP	46	SM	1.87	13.4	6.5	Red earth quarry
8.	8	Km. 45 Left side 9 km.	67	55	41	34	NP	NP	NP	33	SG	1.90	9.8	13.5	Quarry (Kottapalli quarry)
9.	9	Km. 45 Left side 1 km.	98	97	88	63	39.8	22.8	17.0	35	SC	1.94	15.9	4.6	Hanuman Junction (Sandy clay quarry)
10.	10	Km. 48.300 Left Side	100	100	93	86	35.4	21.2	14.2	14	SC	1.89	13.9	2.2	Barren land
11.	11	Km. 48.700 Left Side	100	100	97	76	34.6	22.3	12.3	24	SC	1.86	14.7	3.5	Barren land
12.	12	Km. 55.50 Right Side	100	99	94	83	45.3	21.1	24.2	17	SC	1.92	15.6	2.5	Barren land
13.	13	Km. 2.50 on Eluru bypass	98	95	81	62	35.3	21.2	14.1	36	SC	1.93	14.4	4.4	Barren land
14.	14	Km. 11.0 on Eluru bypass	99	98	41	10	NP	NP	NP	89	SW	1.86	9.7	11.2	Tamileru River bed
15.	15	Km. 11 Eluru bypass Left side 6.6 km.	75	62	39	31	NP	NP	NP	44	SG	1.90	12.1	13.8	Janampeta quarry
16.	16	Km. 83 Left side 6.6 km.	85	62	39	28	NP	NP	NP	57	SG	1.88	11.3	13.5	Quarry

PHYSICAL CHARACTERISTICS OF SUBGRADE SOIL

PROJECT : NH-5 VIJAYAWADA-ELURU

Sl. No.	Name of the Road	Location (Kms)	Sieve Analysis % by wt. passing IS Sieve 4.75 mm	2.36 mm	425 microns	75 microns	Atterberg Limits Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Sand Content (%)	Soil Classification ISI	Laboratory Max. Density modified AASHTO gm/cc	Optimum Moisture content (%)	Soaked CBR Value (%)	Remakrs
1.	NH-5	7.800	100	100	100	96	48.9	25.1	23.8	4	CI	1.73	18.6	1.9	
2.	NH-5	12.300	100	100	100	94	43.7	24.3	19.4	6	CI	1.75	17.4	2.0	
3.	NH-5	18.200	98	95	84	69	42.4	26.7	15.7	29	CI	1.71	18.2	3.7	
4.	NH-5	23.100	95	92	65	42	35.9	20.7	15.2	53	SC	1.81	15.2	7.5	
5.	NH-5	28.700	100	100	55	35	37.8	24.7	13.1	65	SC	1.80	17.6	9.8	
6.	NH-5	33.500	98	90	65	40	36.2	20.4	15.8	58	SC	1.77	17.8	7.6	
7.	NH-5	42.300	96	91	72	45	40.2	23.9	16.3	51	SC	1.72	18.6	6.0	
8.	NH-5	48.200	93	90	82	42	37.4	23.2	14.2	51	SC	1.76	16.8	5.2	
9.	NH-5	53.500	97	93	50	32	32.5	24.5	8.0	65	SC-SW	1.74	18.2	10.5	
10.	NH-5	69.500	93	85	70	41	33.7	22.7	11.0	52	SC-SW	1.71	15.4	7.2	
11.	NH-5	73.700	90	84	63	46	30.7	23.6	15.1	44	SC	1.79	16.4	6.8	

TABLE 2.2
PHYSICAL CHARACTERISTICS OF BORROW AREA SOIL

PROJECT : NH-9 NANDIGAMA-VIJAYAWADA

Sl. No.	Sample No.	Location (Kms)	General Description of the quarry	Sieve Analysis % by wt. passing IS Sieve 4.75 mm	2.38 mm	425 microns	75 microns	Atterberg Limits Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Sand Content (%)	Soil Classification I.S.I.	Laboratory Max. Density modified AASHTO gm/cc	Optimum Moisture content (%)	Soaked CBR Value (%)
1.	1	Km. 201.200 Right side	Quarry rubbish	94	76	36	27	NP	NP	NP	50	SC	1.91	9.6	11.9
2.	2	Km. 212.[illegible] Right side	Tibba (clay with and Kankar)	90	80	55	35	36.6	25.5	11.1	43	SC	1.85	11.9	7.7
3.	3	Km. 214.000 Right side	Tibba	98	95	80	70	39.8	22.5	17.3	27	SC	1.90	14.7	4.0
4.	4	Km. 217.200 Right side	Barren land Tibba	80	75	57	44	40.5	21.3	19.2	31	SC	1.89	13.5	6.3
5.	[illegible]	Km. 219.000 Left side 1 Km. (River bed)	Munjeru river bed	100	100	64	6	NP	NP	NP	94	SW	1.83	12.6	[illegible]
6.	6	Km. 21[illegible] Left side 2km. [illegible]	quarry rubbish	80	51	8	6	NP	NP	NP	47	SC	1.88	9.7	[illegible]
7.	[illegible]	Km. 226 Munjeru River bed	Munjeru river bed	100	94	66	5	NP	NP	NP	90	SW	1.84	12.2	[illegible]
8.	8	Km. 238.700 (Left side DRV Pond)	Dry pond clayey soil	100	100	100	98	45.9	20.1	25.8	5	SC	1.94	15.8	1.9
9.	[illegible]	Km. 240.500 Right side	Clayey soil barren land	96	91	67	54	38.5	24.7	13.8	40	SC	1.91	15.1	5.8
10.	10	Km. 234.400 Left side & Right side	Silty clay	100	100	98	74	33.8	22.4	11.4	31	SC	1.83	13.9	4.3
11.	11	Km. 254.000 Right side	Clayey barren land	94	92	67	47	35.6	21.3	14.3	48	SC	1.89	14.6	6.2
12.	[illegible]	Km. 4.0 on NH-5	Krishna River bed	99	98	55	12	NP	NP	NP	87	SW	[illegible]	[illegible]	

PHYSICAL CHARACTERISTICS OF SUBGRADE SOIL

PROJECT : NH-9 NANDIGAMA-VIJAYAWADA

Sl. No.	Name of the Road	Location (Kms)	Sieve Analysis % by wt. passing IS Sieve				Atterberg Limits			Sand Content (%)	Soil Classification ISI	Laboratory Max. Density modified AASHTO gm/cc	Optimum Moisture content (%)	Soaked CBR Value (%)	Remakrs
			4.75 mm	2.36 mm	425 microns	75 microns	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)						
1.	NH-9 (Nandigama-Vijayawada)	217.500	90	85	69	43	41.6	23.7	17.9	47	SG-SC	1.75	14.80	6.7	
2.	-do-	222.000	94	87	64	49	39.2	24.2	15.2	45	SG-SC	1.77	14.20	6.6	
3.	-do-	229.000	94	89	59	34	33.5	21.7	11.8	60	SG-SC	1.81	13.9	8.5	
4.	-do-	235.000	99	95	71	47	37.5	24.7	12.8	52	SC	1.72	13.7	5.8	
5.	-do-	240.600	100	99	72	50	35.4	22.4	13.0	50	SC	1.88	12.6	5.6	
6.	-do-	245.700	99	97	70	33	31.7	20.3	11.4	66	SC	1.86	11.9	7.5	
7.	-do-	251.000	100	100	81	64	38.2	22.4	15.8	36	CI	1.71	13.8	4.0	
8.	-do-	254.600	98	95	84	68	40.7	20.5	20.3	30	CI	1.73	15.9	3.5	
9.	-do-	262.700	86	79	64	46	38.5	19.3	19.2	40	SG-SC	1.72	18.2	6.4	

BAR CHART

D IS N : VI Y AD   EA 19 - 9   H. RC : VI YA AD

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 6·250   TO Km 9·000   NH-No 5   SEC

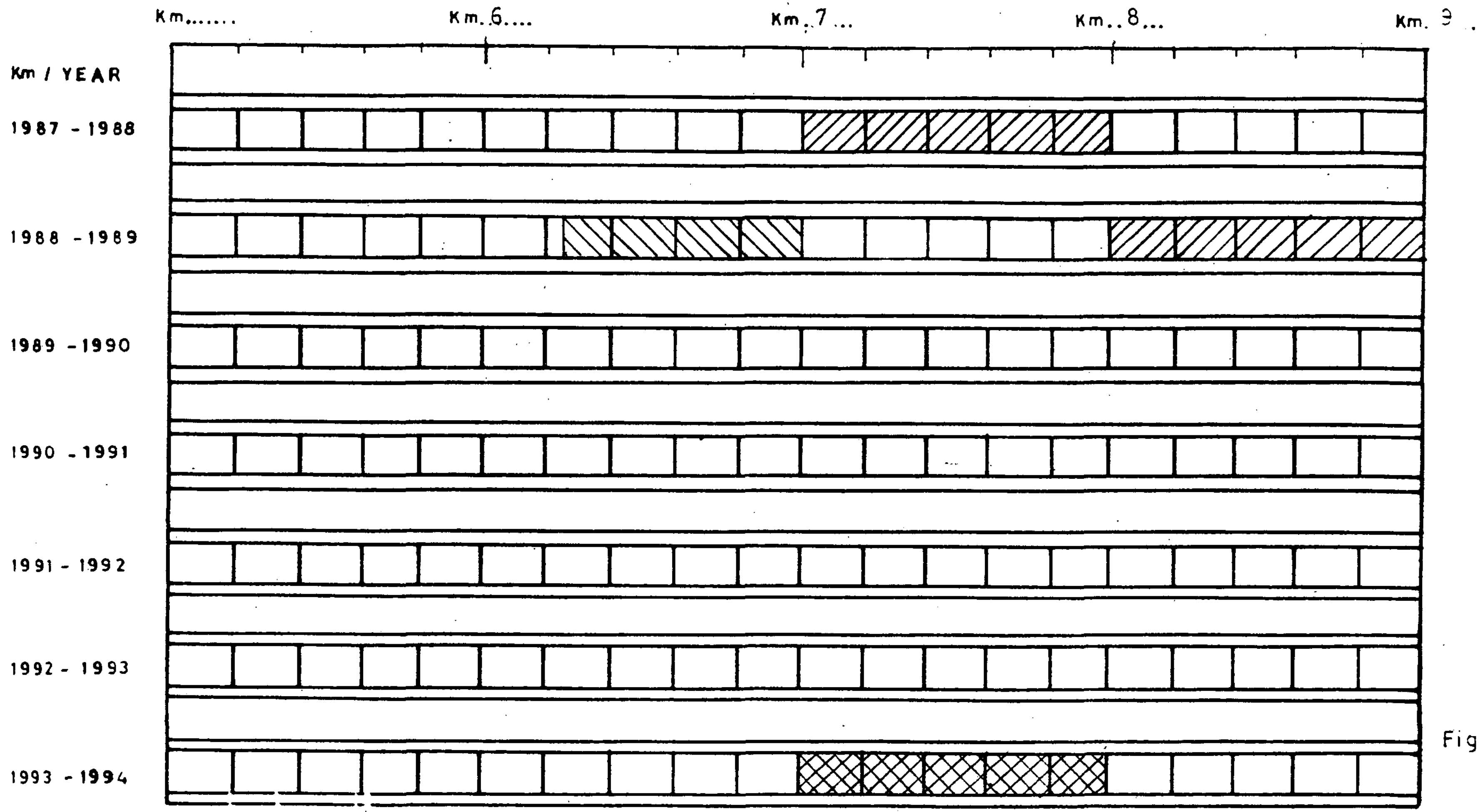


Fig. 2·1

LEGEND

1 WIDENING AND STRENGTHENING ....
2 WIDENING ....
3 STRENGTHENING ....
4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....
6 MIX SEAL SURFACE ....
7 FDR / SR ....
8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 9.000 TO Km 13.000 NH-No 5 SEC S

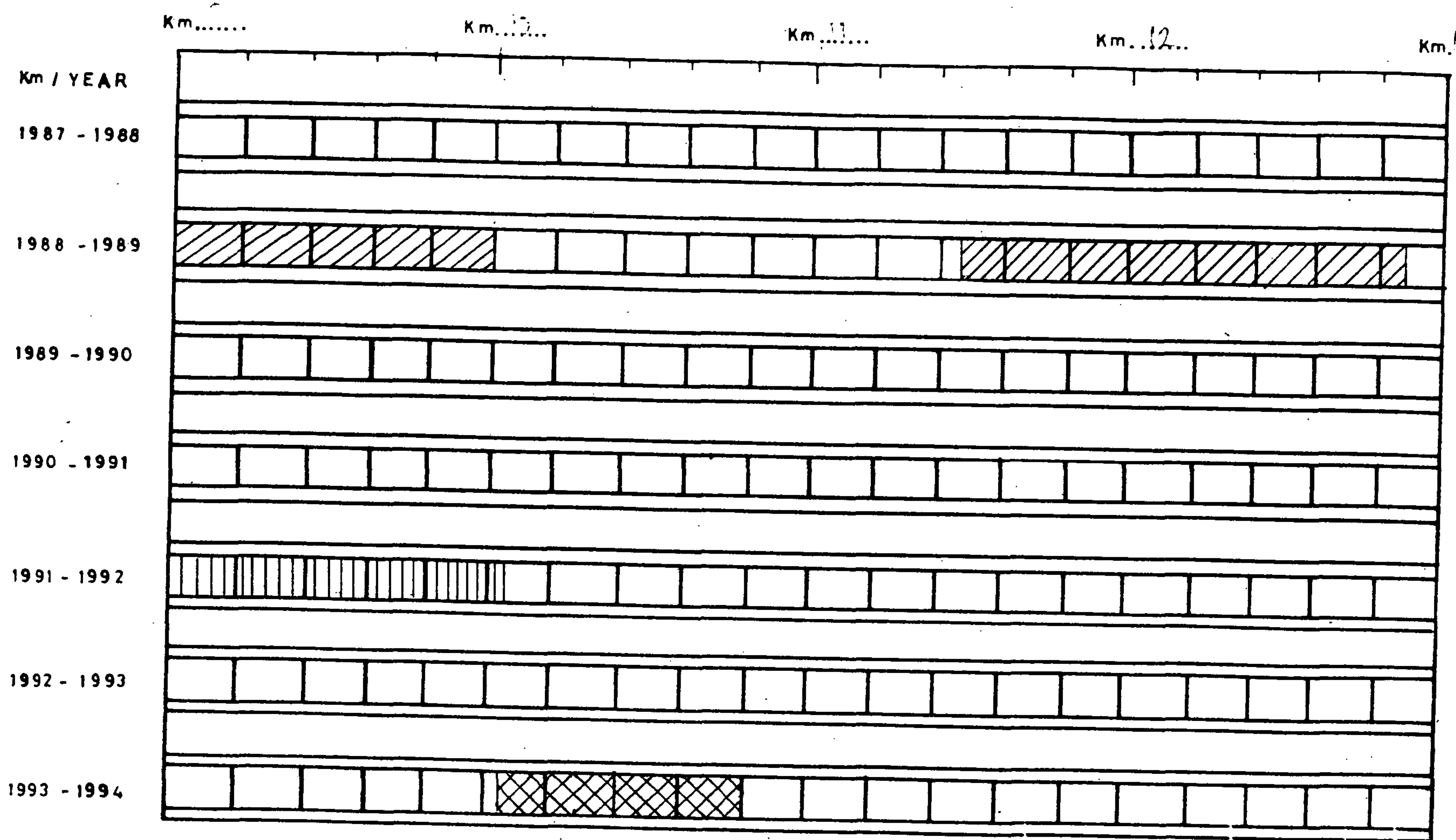


Fig. 2·2

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

2-8

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 13.000 TO Km 17.000 NH-No 5 SEC S

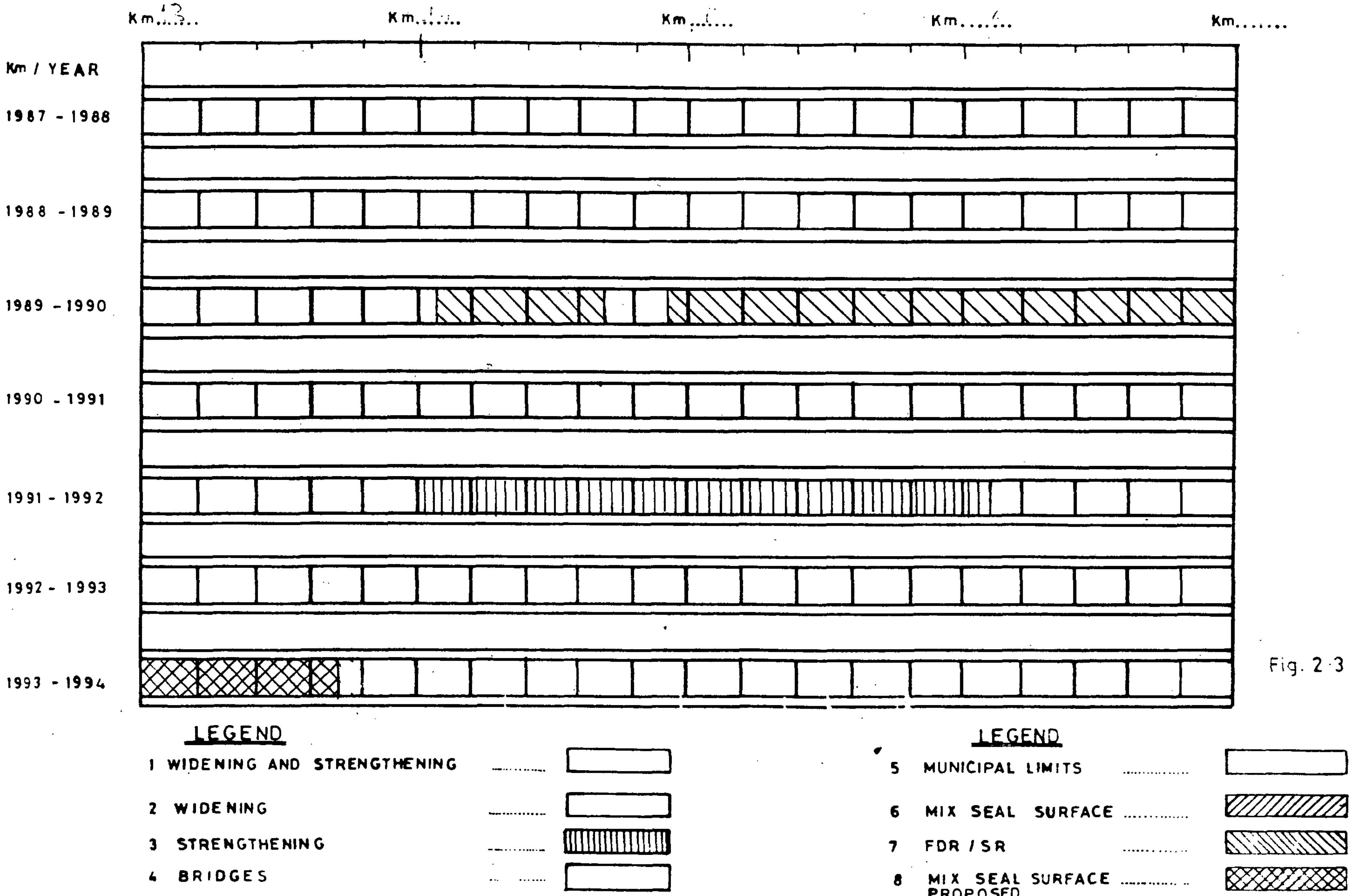


Fig. 2·3

2-9

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993-94 NH. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 17.000 TO Km 21.000 NH-No 5 SEC S

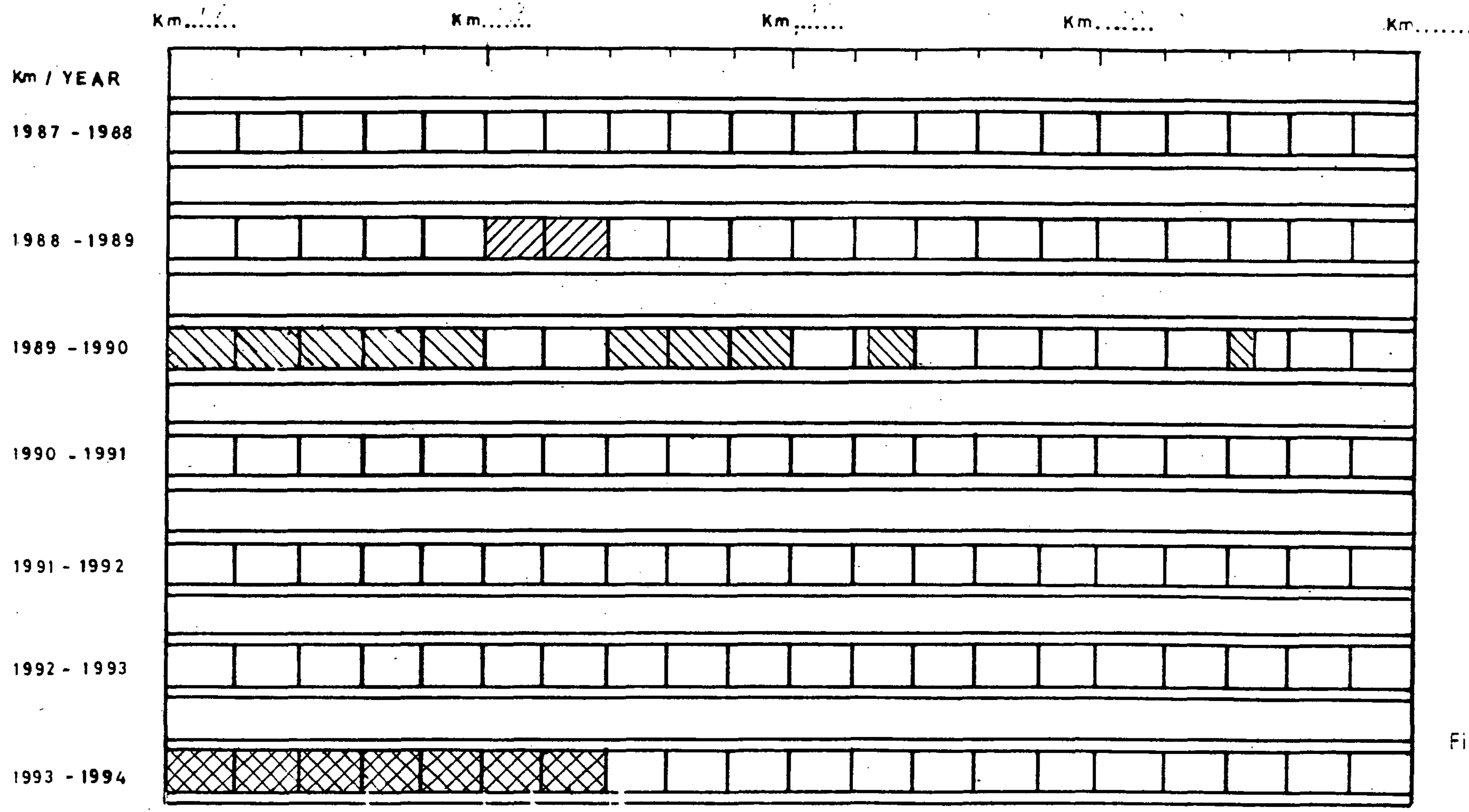


Fig. 2.4

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 21.000 TO Km 25.000 NH No 5 SEC S

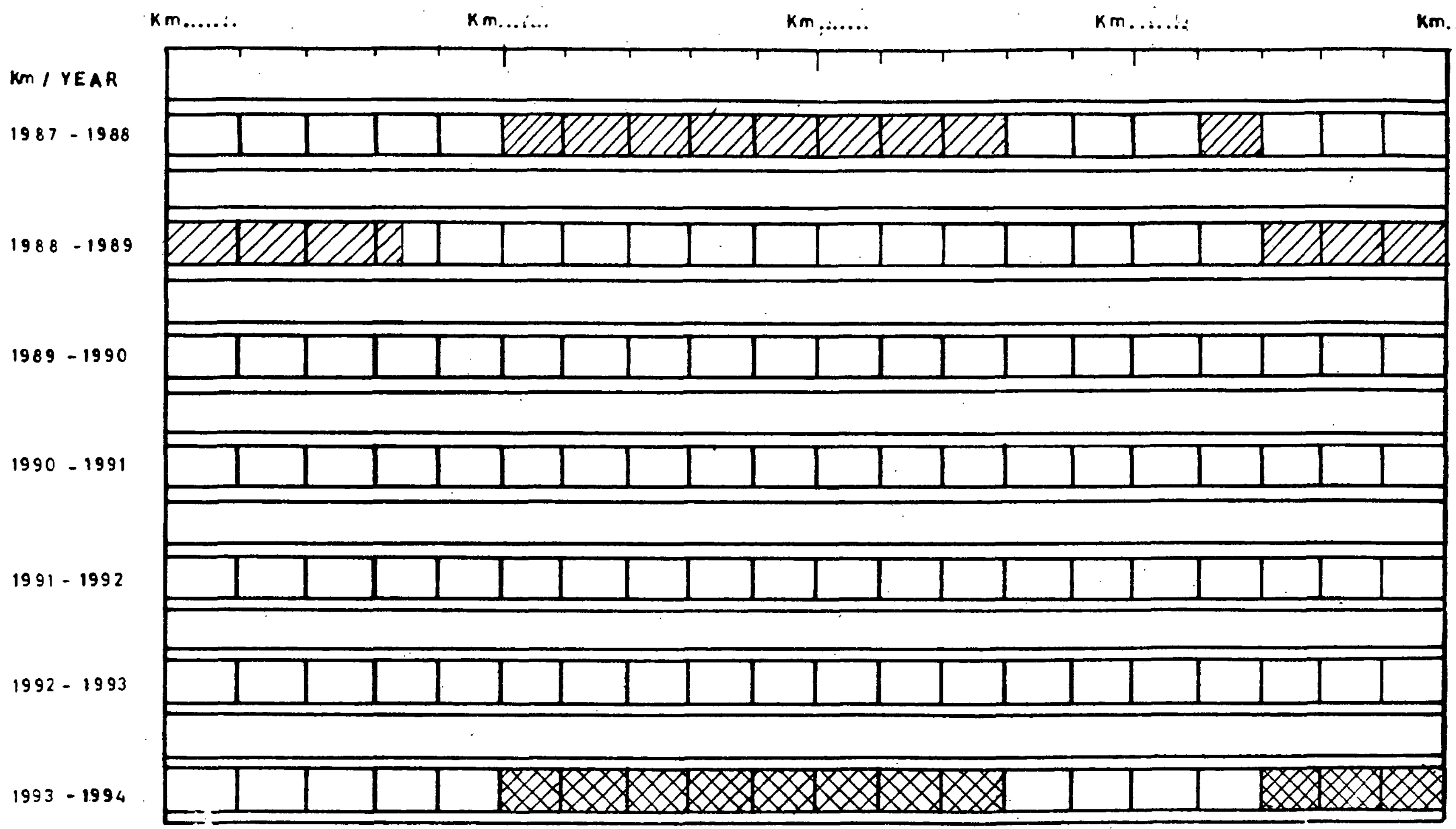


Fig. 2·5

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 25.000 TO Km 29.000 NH-No 5 SEC S

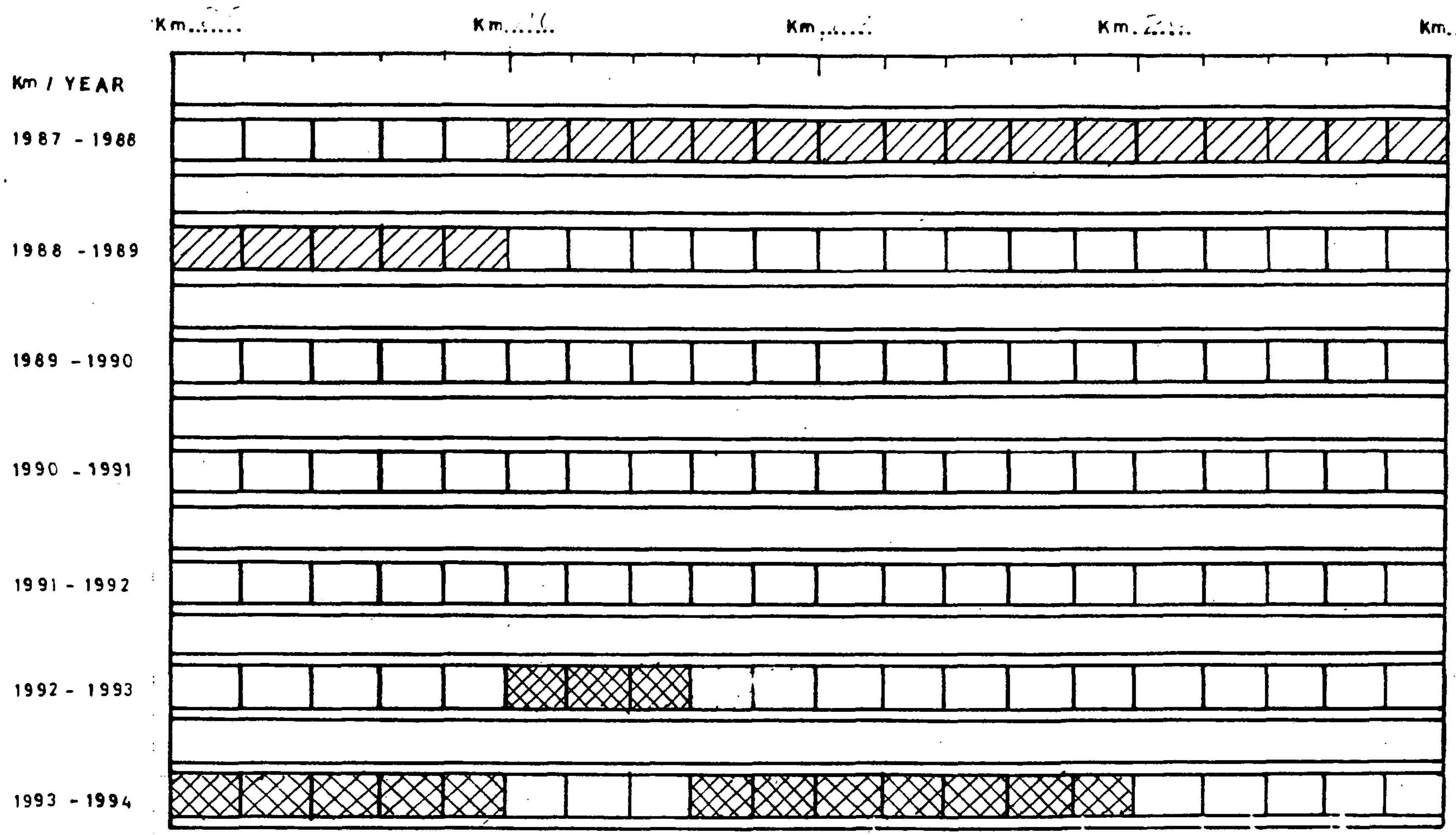


Fig. 2.6

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 29·000 TO Km 32·000 NH-No 5 SEC S

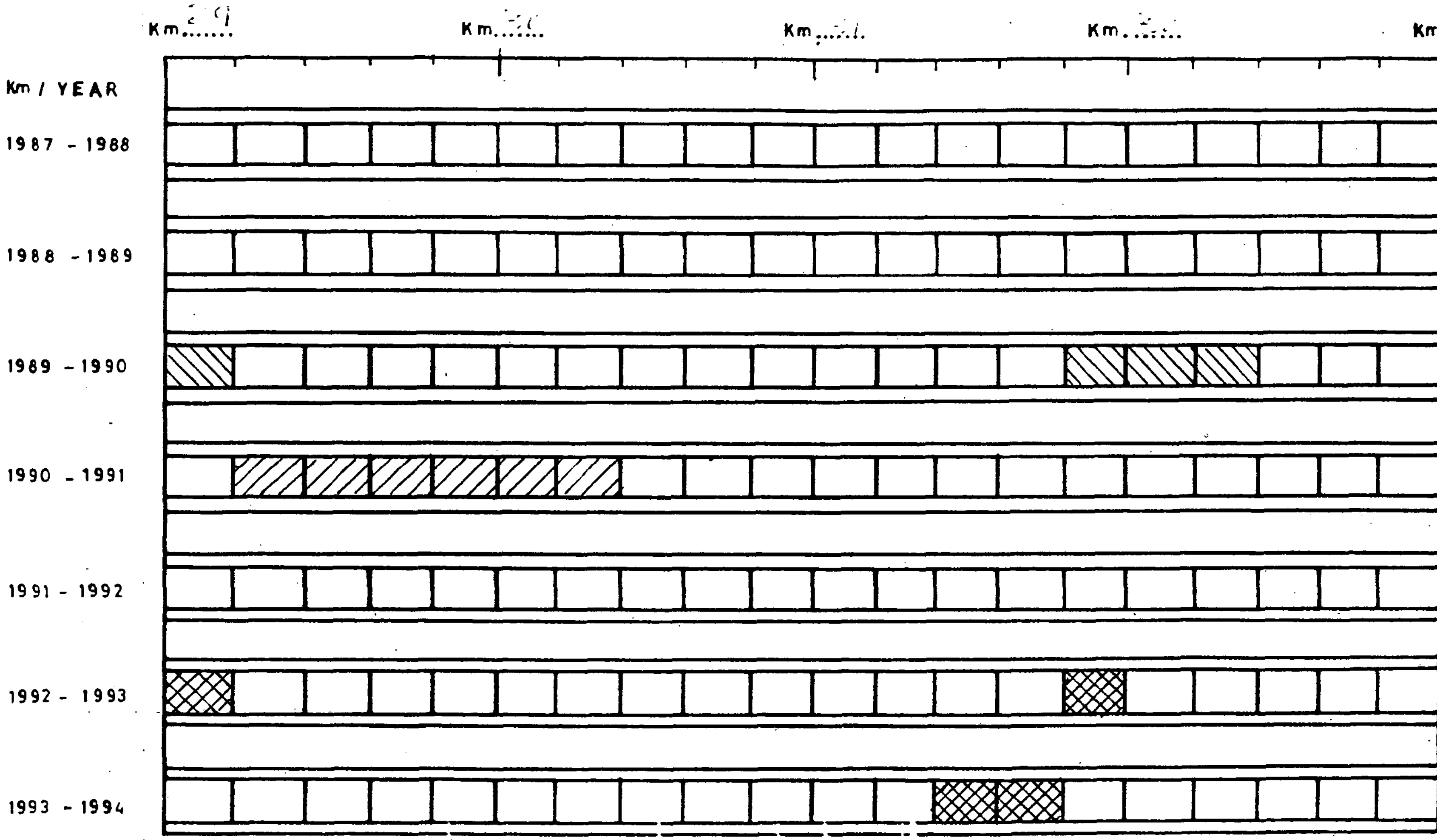


Fig. 2·7

LEGEND

1 WIDENING AND STRENGTHENING ....
2 WIDENING ....
3 STRENGTHENING ....
4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....
6 MIX SEAL SURFACE ....
7 FDR / SR ....
8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 33000 TO Km 37000 NH-No 5 SEC S

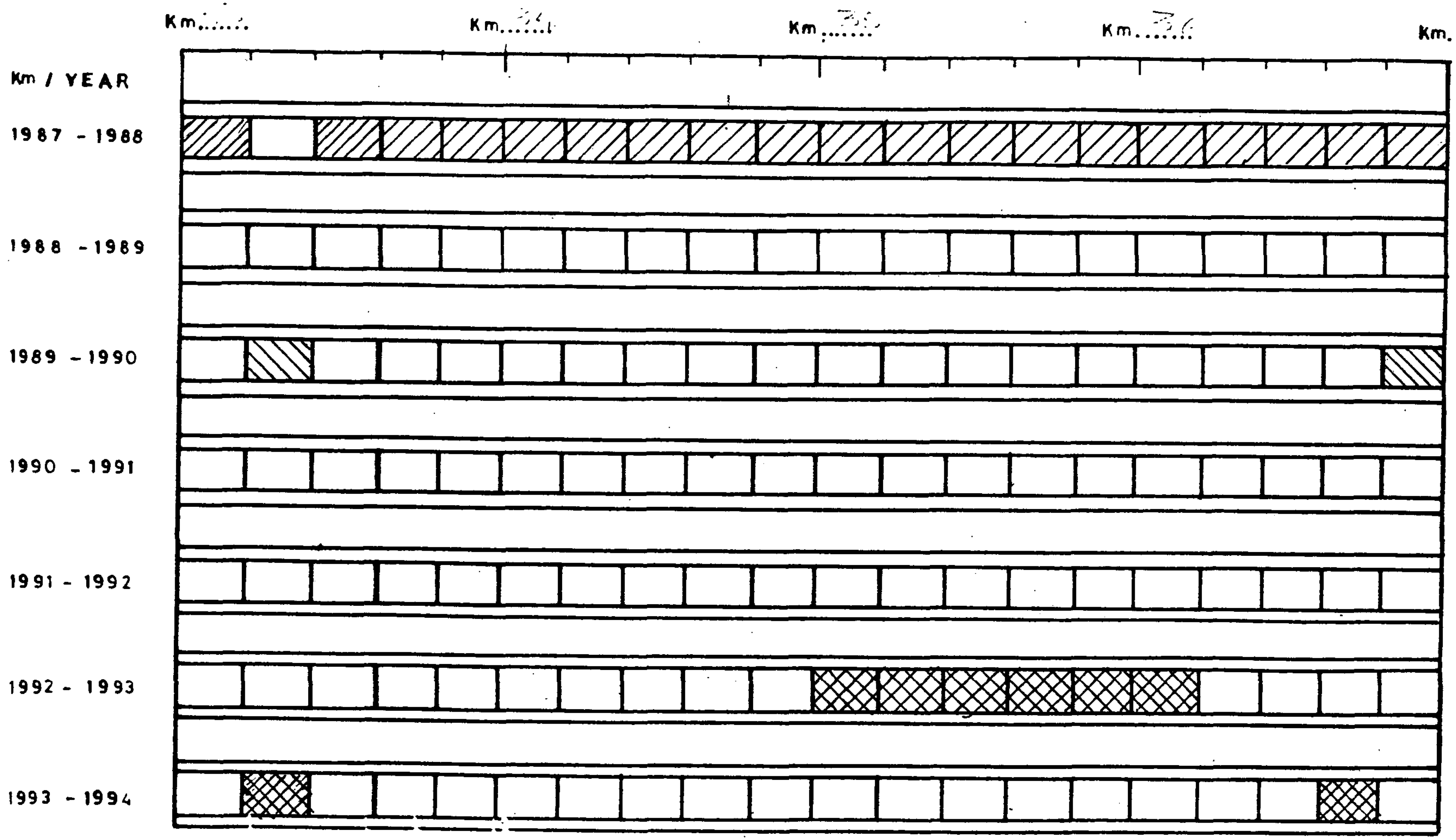


Fig. 2·8

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA   YEAR 1993 - 94   N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 37.000   TO Km 41.000   NH-No 5   SEC ____ S

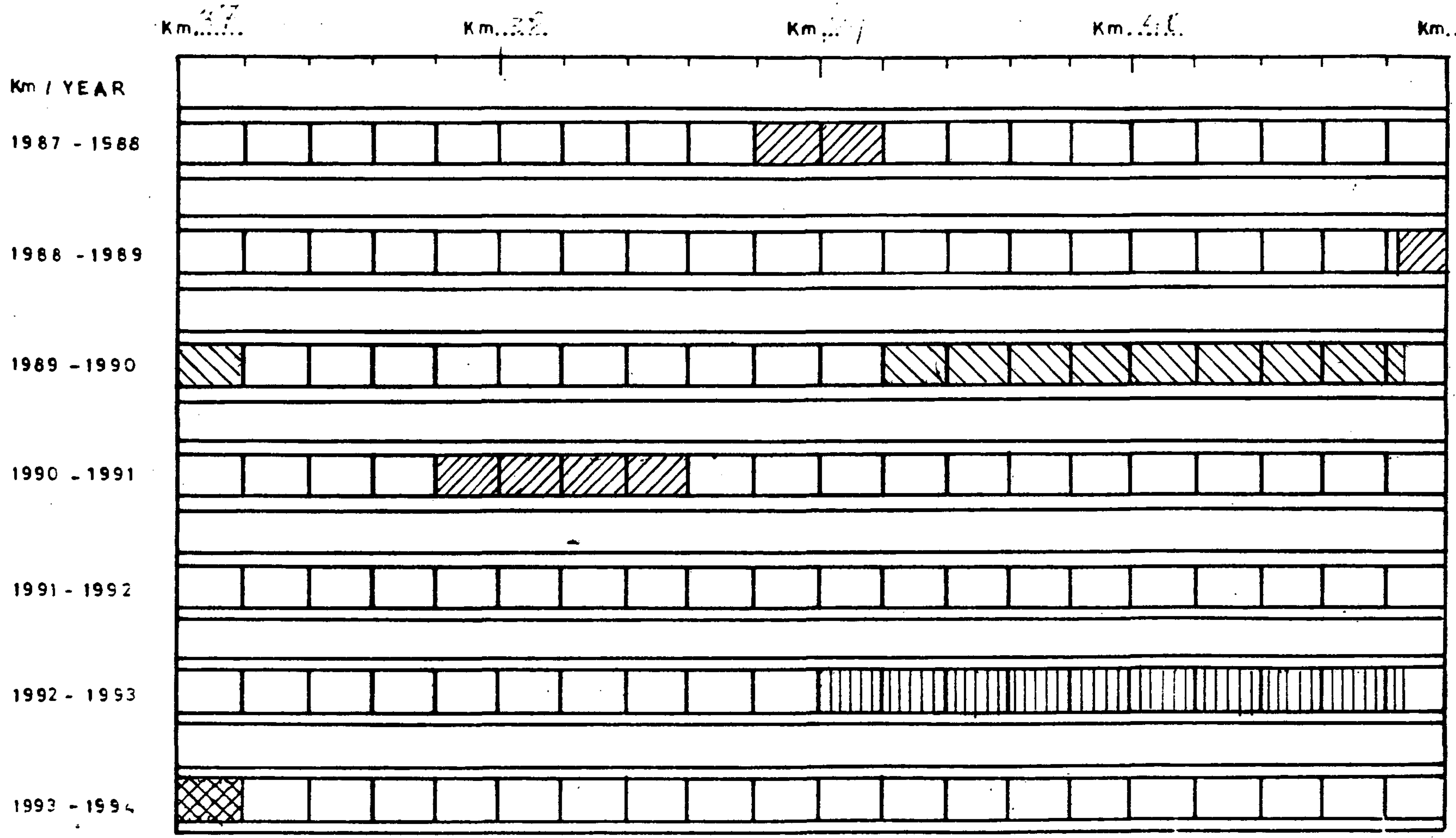


Fig 2·9

LEGEND		LEGEND	
1 WIDENING AND STRENGTHENING	....	5 MUNICIPAL LIMITS	....
2 WIDENING	....	6 MIX SEAL SURFACE	....
3 STRENGTHENING	....	7 FDR / SR	....
4 BRIDGES	....	8 MIX SEAL SURFACE PROPOSED	....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 41.000 TO Km 45.000 NH-No 5 SEC S

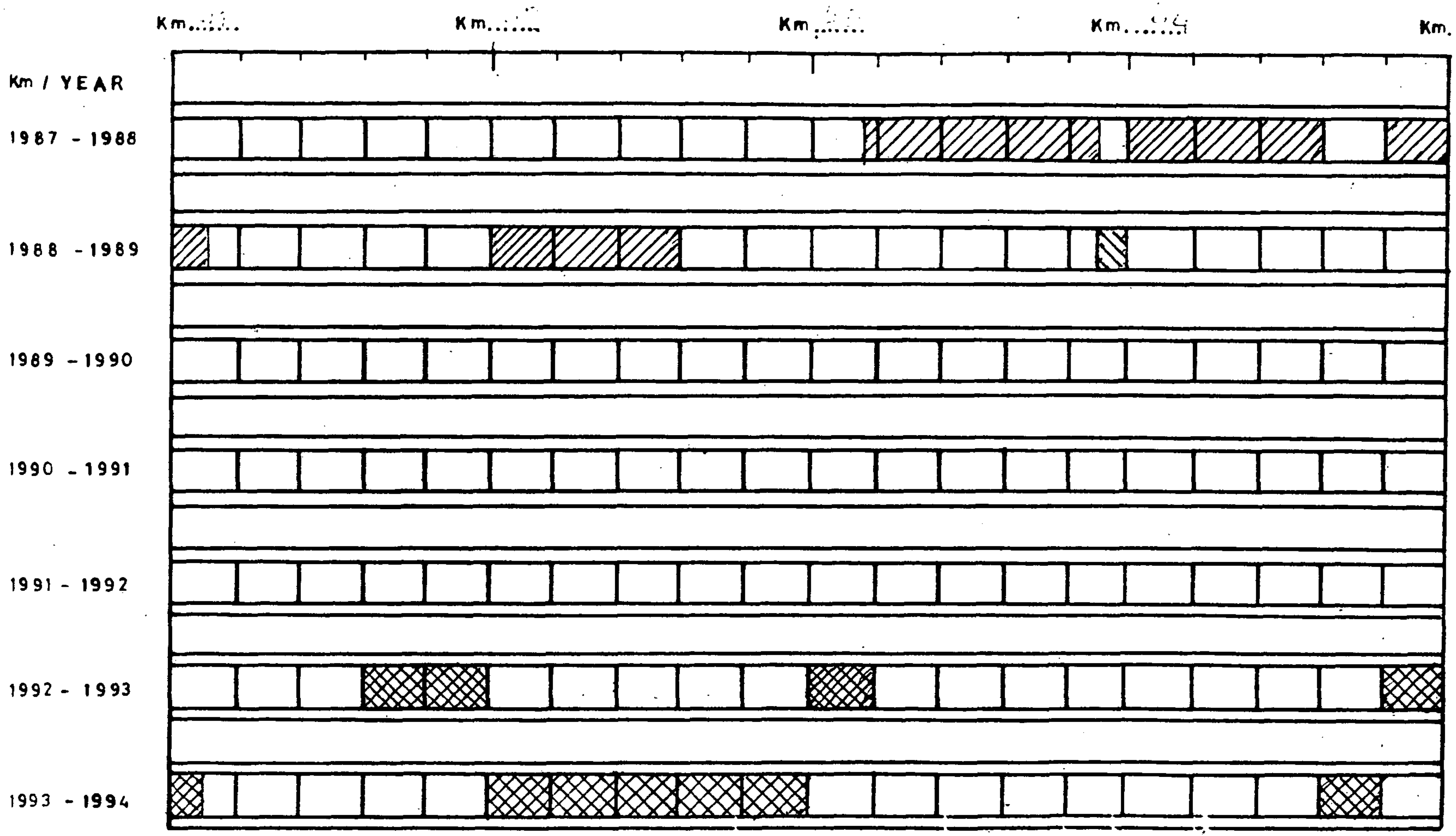


Fig. 2.10

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km [illegible] TO Km [illegible] NH-No [illegible] SEC S

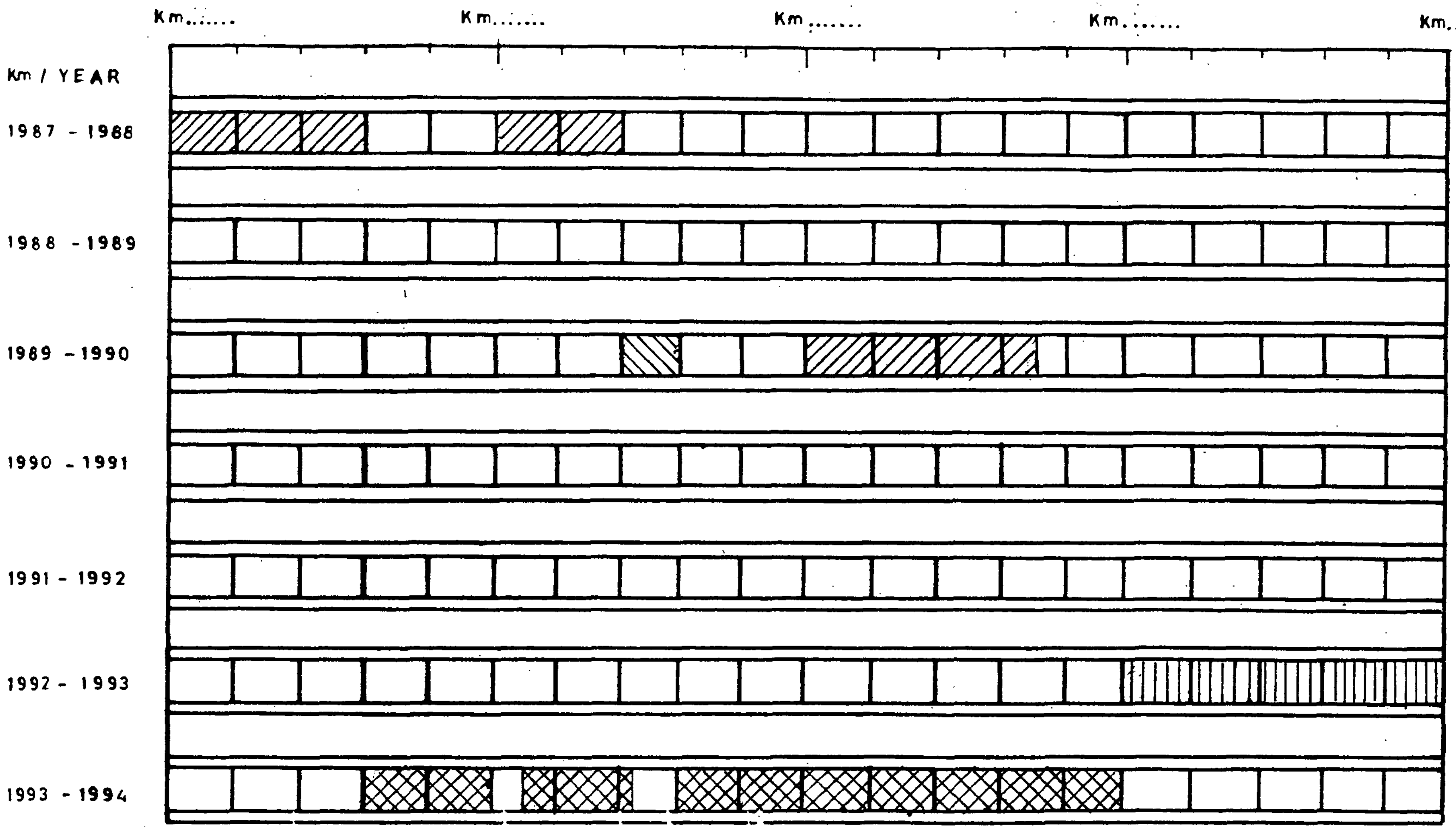


Fig 2·11

LEGEND		LEGEND	
1 WIDENING AND STRENGTHENING	....	5 MUNICIPAL LIMITS	....
2 WIDENING	....	6 MIX SEAL SURFACE	....
3 STRENGTHENING	....	7 FDR / SR	....
4 BRIDGES	....	8 MIX SEAL SURFACE PROPOSED	....

BAR CHART

DIVISION : VIJAYAWADA   YEAR 1993 - 94   N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km ……   TO Km ……   NH-No ……   SEC ……   S

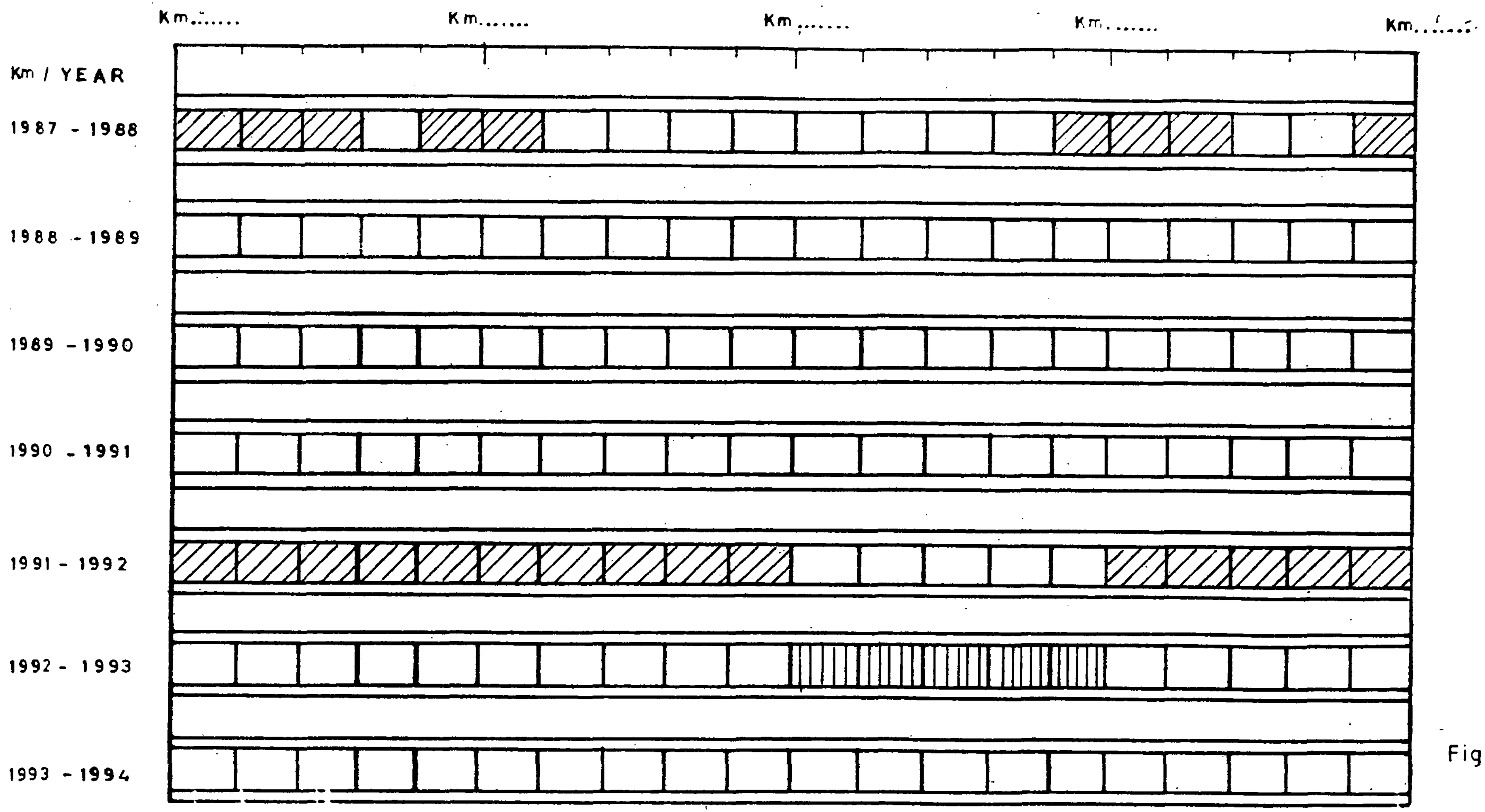


Fig. 2.12

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km ______ TO Km ______ NH-No ______ SEC ______ S

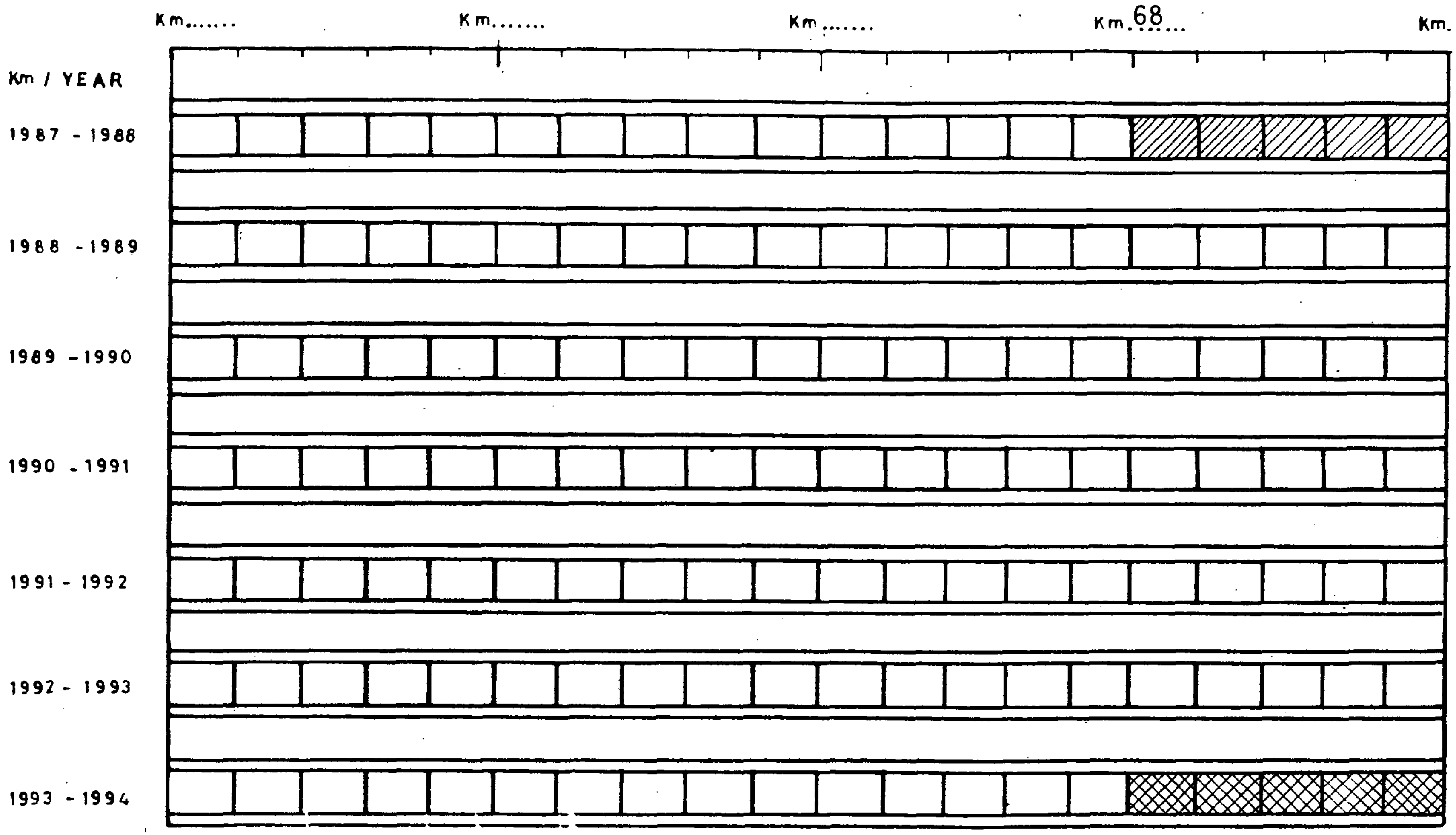


Fig. 2.13

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA   YEAR 1993 - 94   N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km [illegible]   TO Km [illegible]   NH-No [illegible]   SEC   S

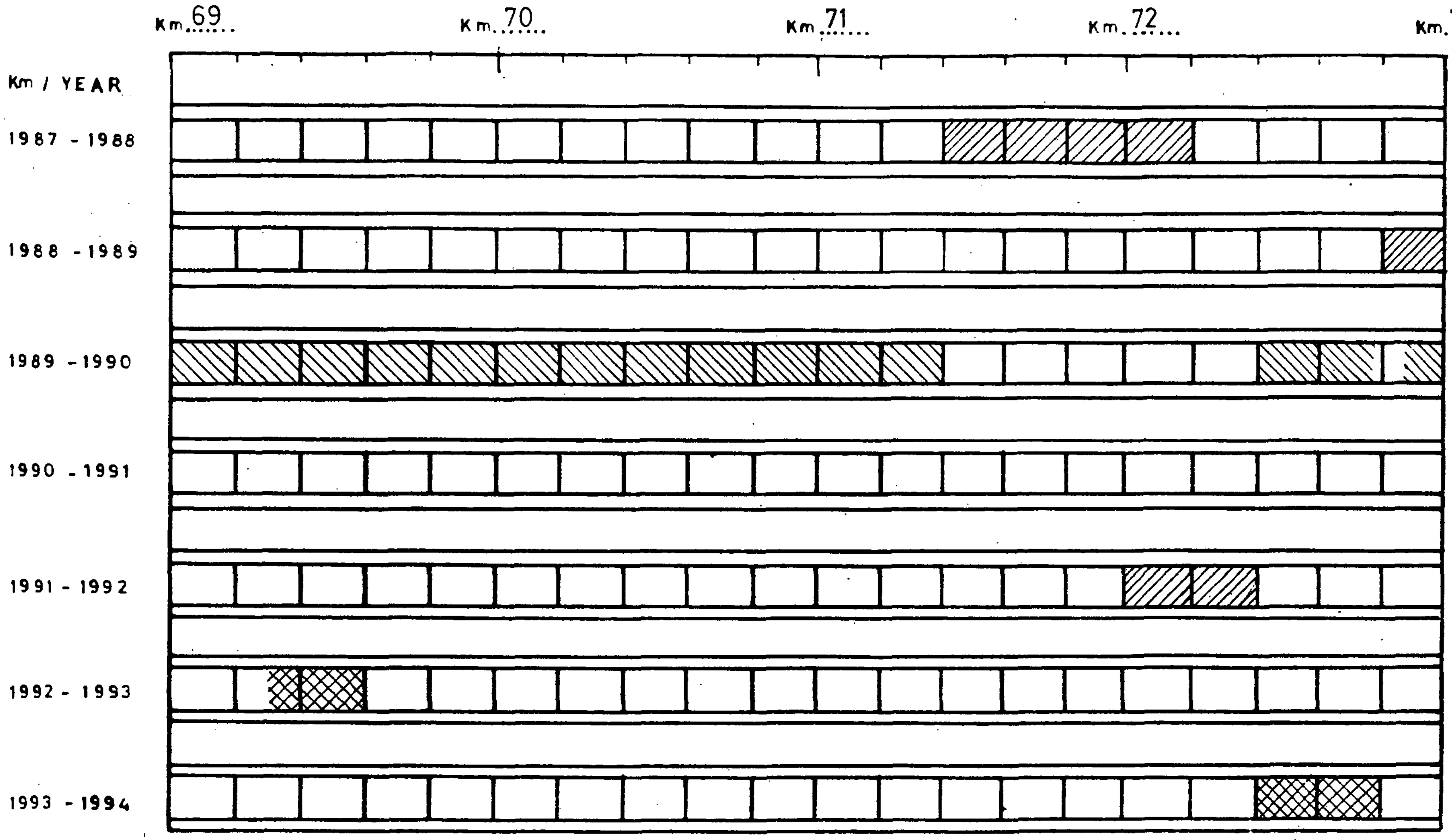


Fig. 2·14

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 73·000 TO Km 77·000 NH-No 5 SEC S

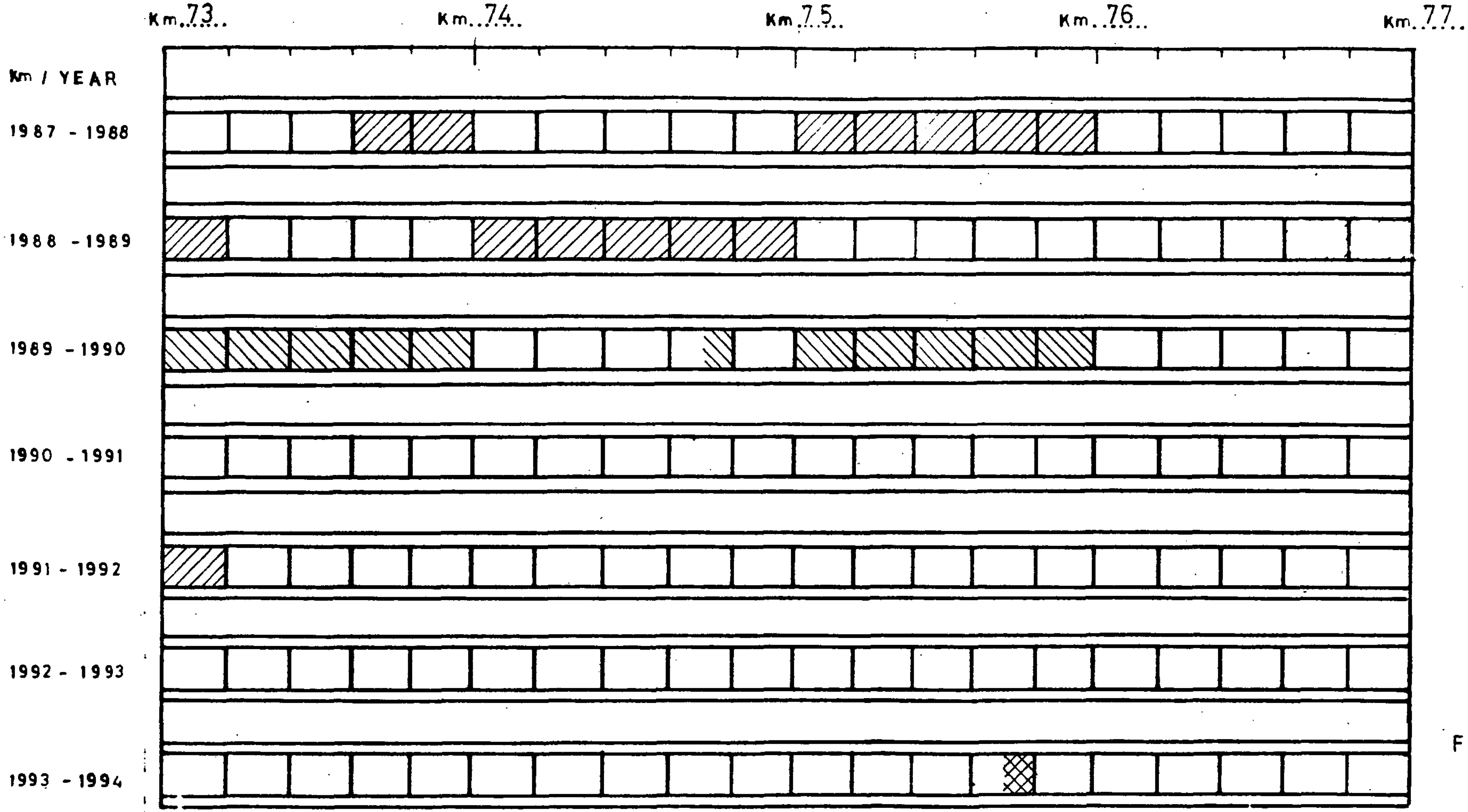


Fig. 2·15&2·16

LEGEND

1 WIDENING AND STRENGTHENING ....
2 WIDENING ....
3 STRENGTHENING ....
4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....
6 MIX SEAL SURFACE ....
7 FDR / SR ....
8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 217.000 TO Km 221.000 NH-No 9 SEC S

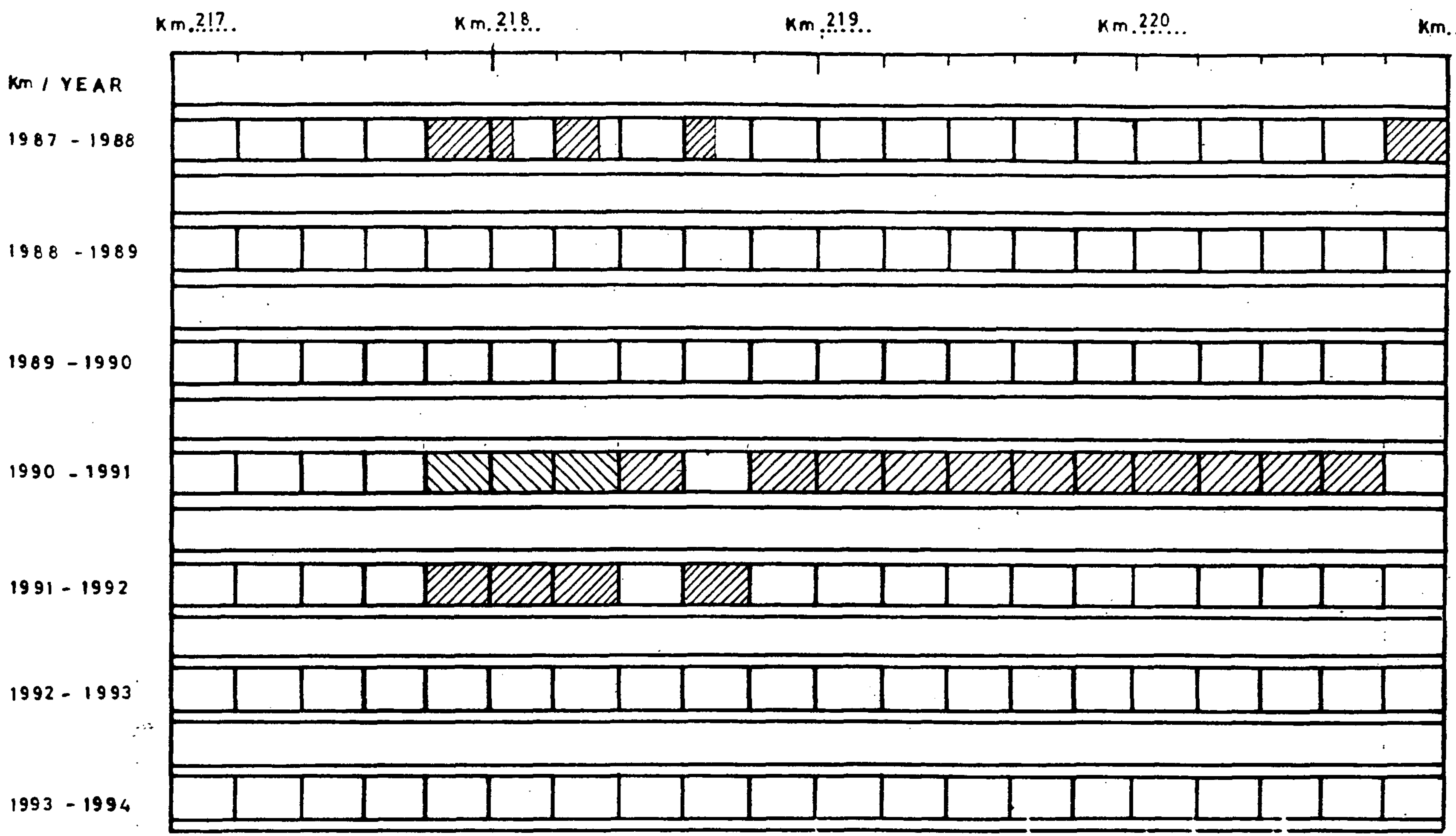


Fig. 2·17

LEGEND

1 WIDENING AND STRENGTHENING ....
2 WIDENING ....
3 STRENGTHENING ....
4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....
6 MIX SEAL SURFACE ....
7 FDR / SR ....
8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION : VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km TO Km NH-No SEC 5

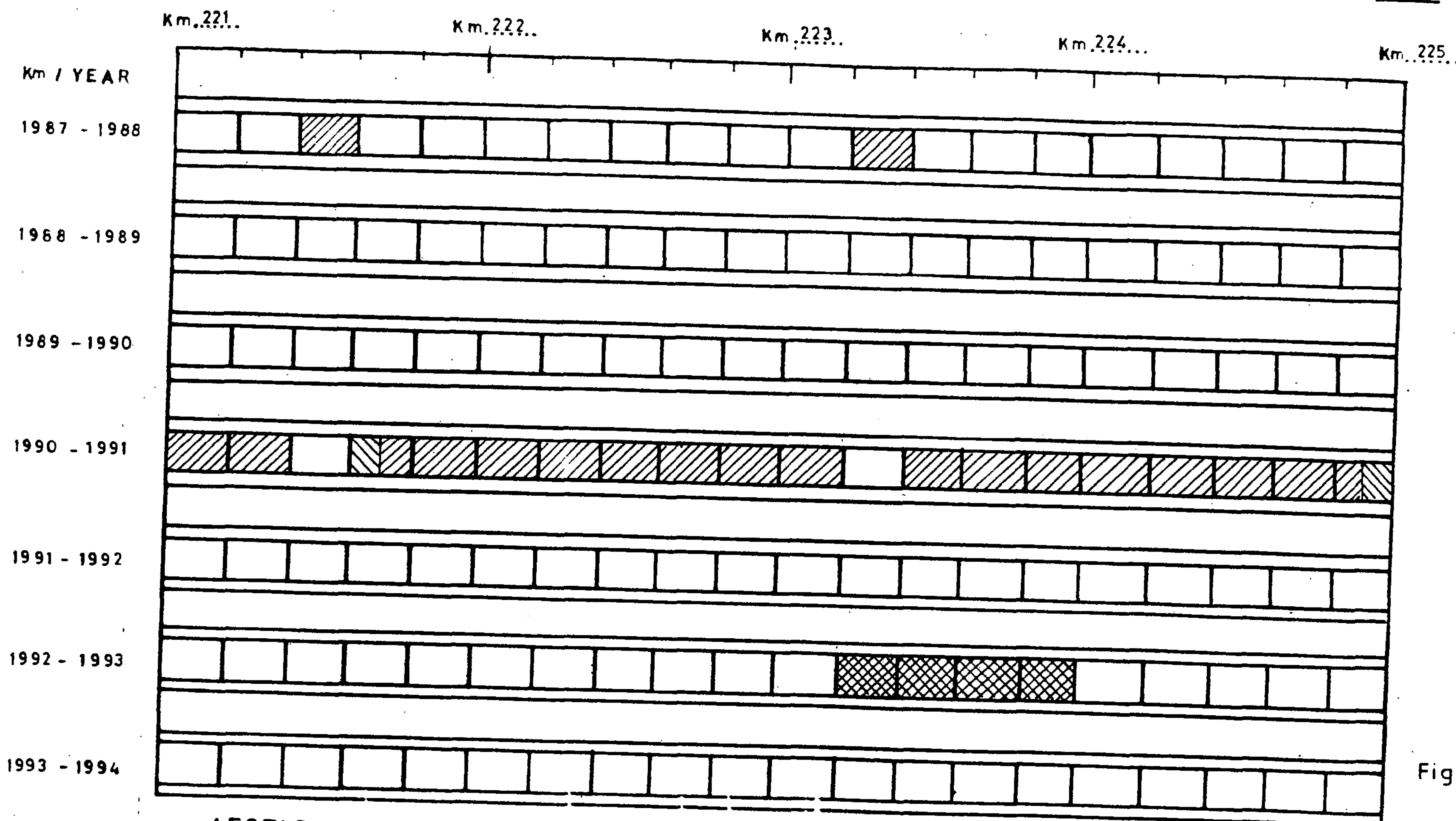


Fig 2.18

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km [illegible] TO Km [illegible] NH-No SEC S

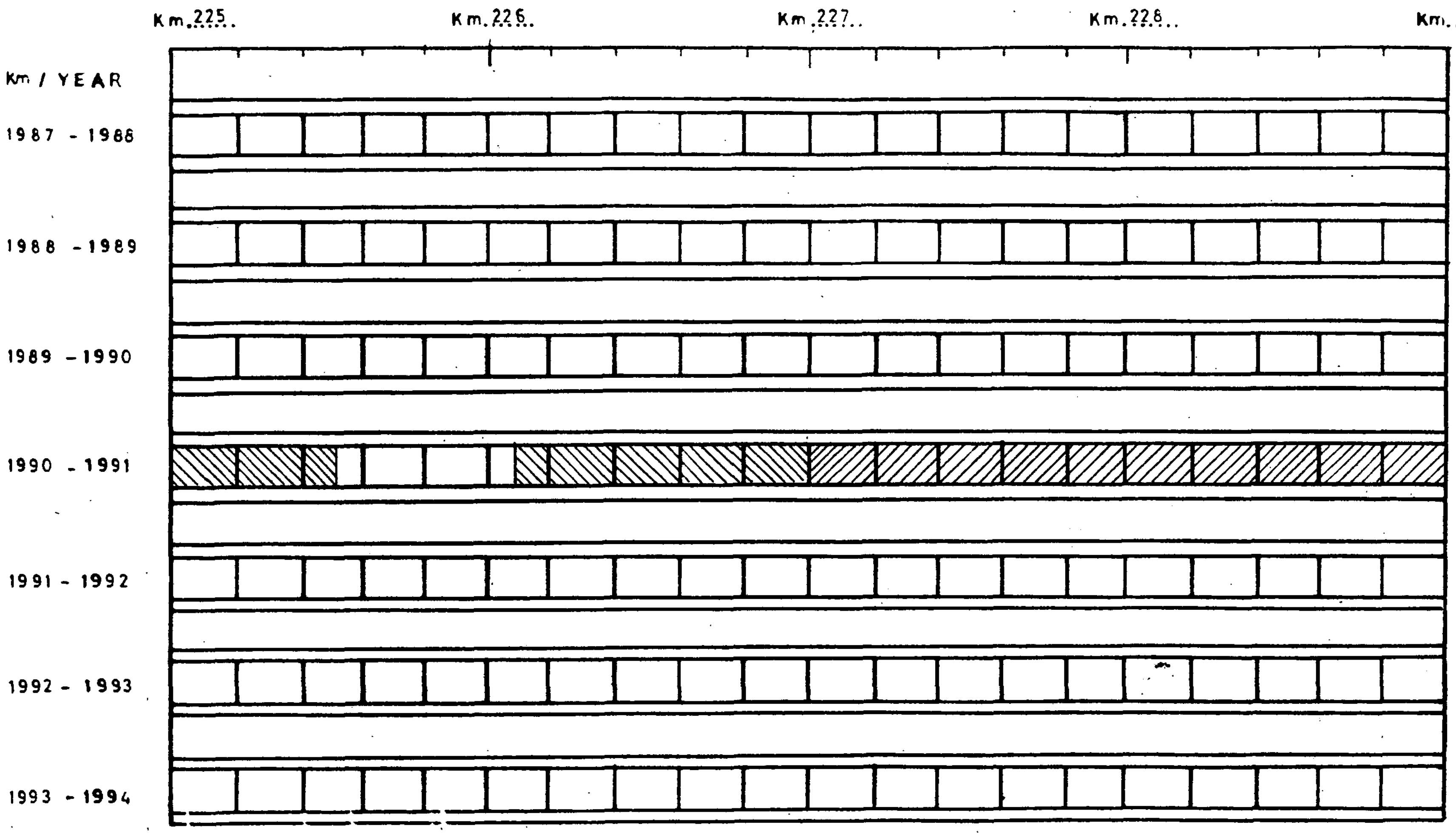


Fig. 2.19

LEGEND		LEGEND	
1	WIDENING AND STRENGTHENING	5	MUNICIPAL LIMITS
2	WIDENING	6	MIX SEAL SURFACE
3	STRENGTHENING	7	FDR / SR
4	BRIDGES	8	MIX SEAL SURFACE PROPOSED

BAR CHART

DIVISION : VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE : VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km TO Km NH-No 9 SEC S

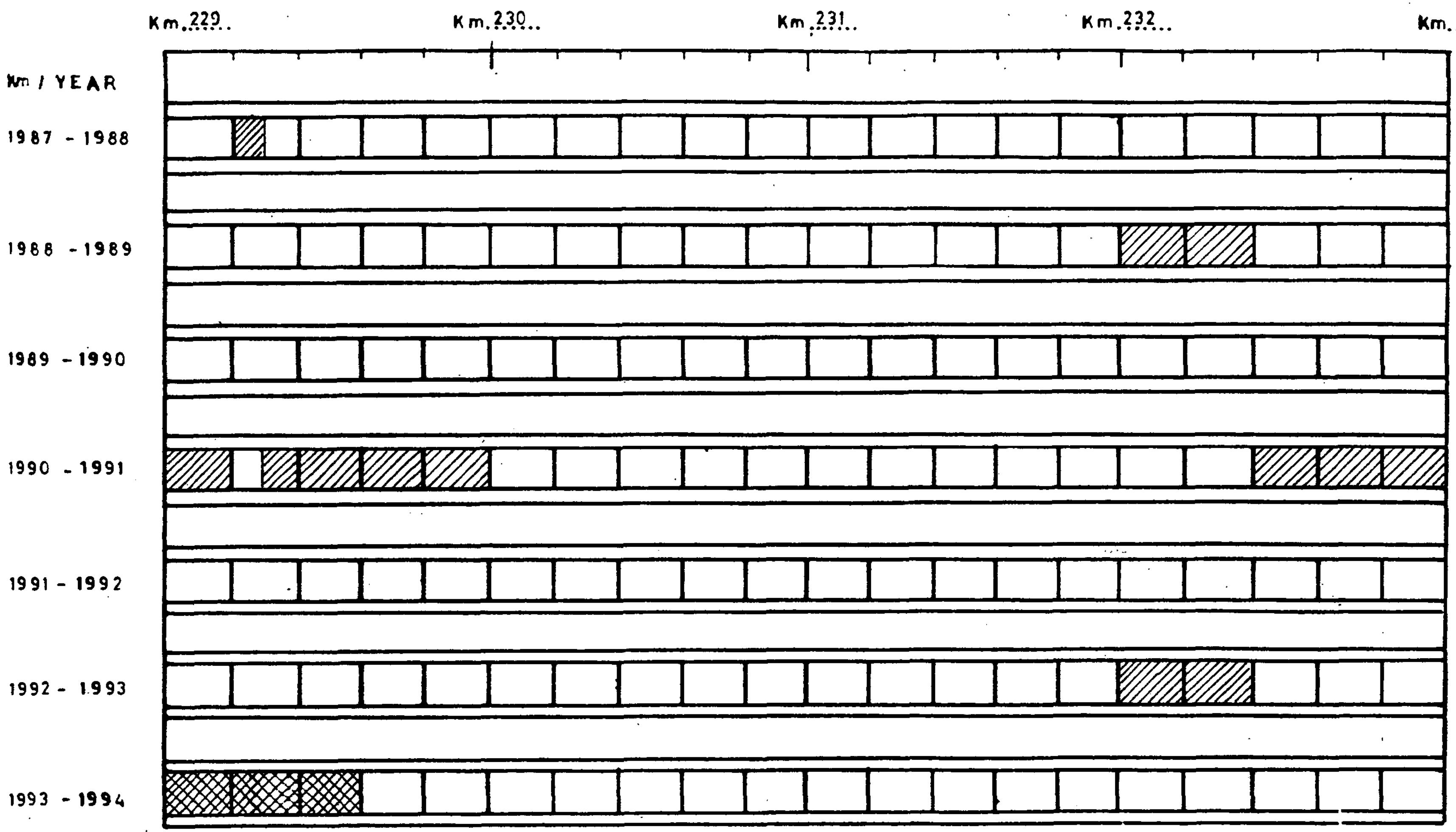


Fig. 2·20

LEGEND

1 WIDENING AND STRENGTHENING ....
2 WIDENING ....
3 STRENGTHENING ....
4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....
6 MIX SEAL SURFACE ....
7 FDR / SR ....
8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km [illegible] TO Km [illegible] NH-No [illegible] SEC S

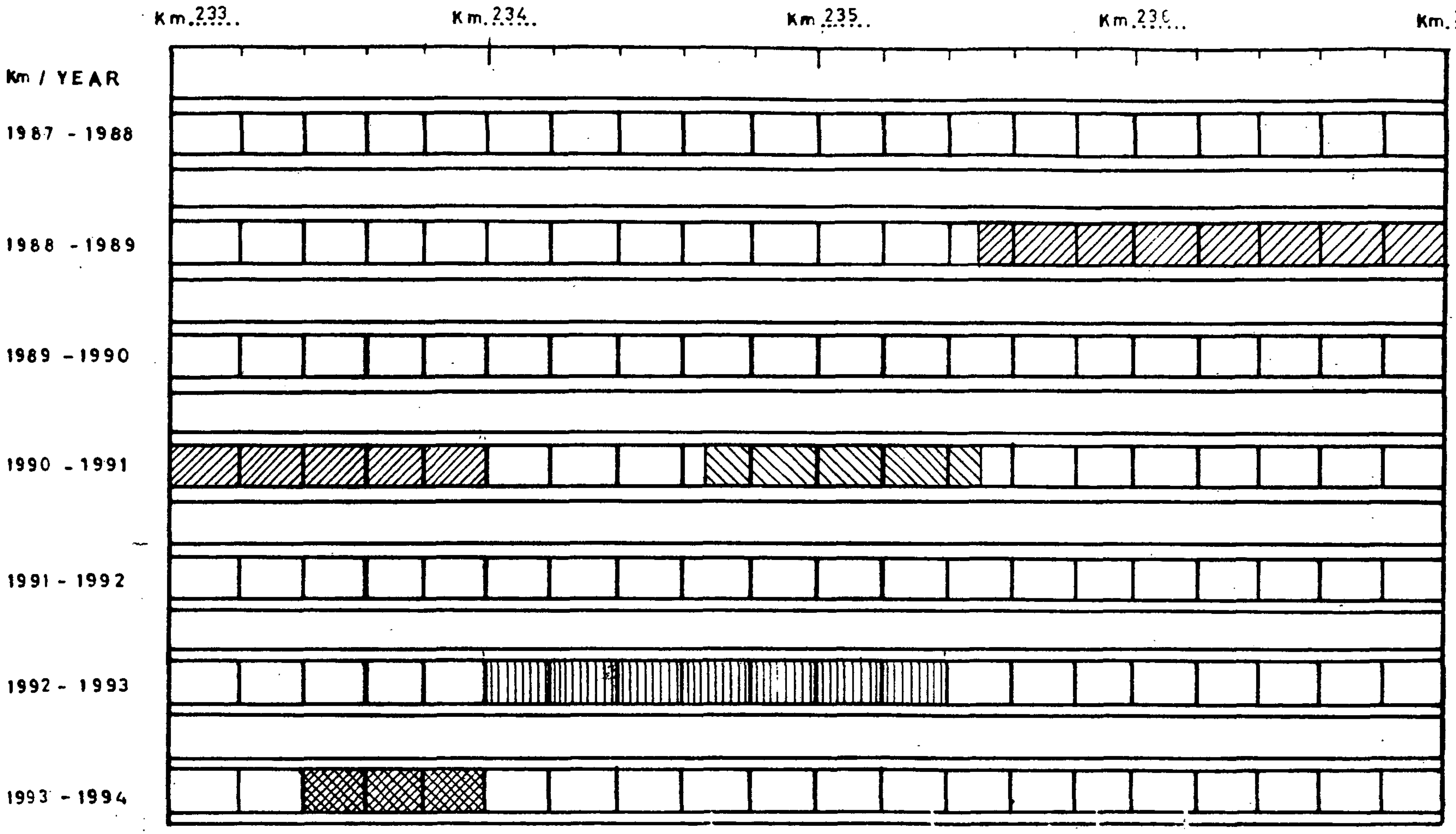


Fig. 2.21

LEGEND

1 WIDENING AND STRENGTHENING ....
2 WIDENING ....
3 STRENGTHENING ....
4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....
6 MIX SEAL SURFACE ....
7 FDR / SR ....
8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 237.050 TO Km 241.000 NH-No 9 SEC S

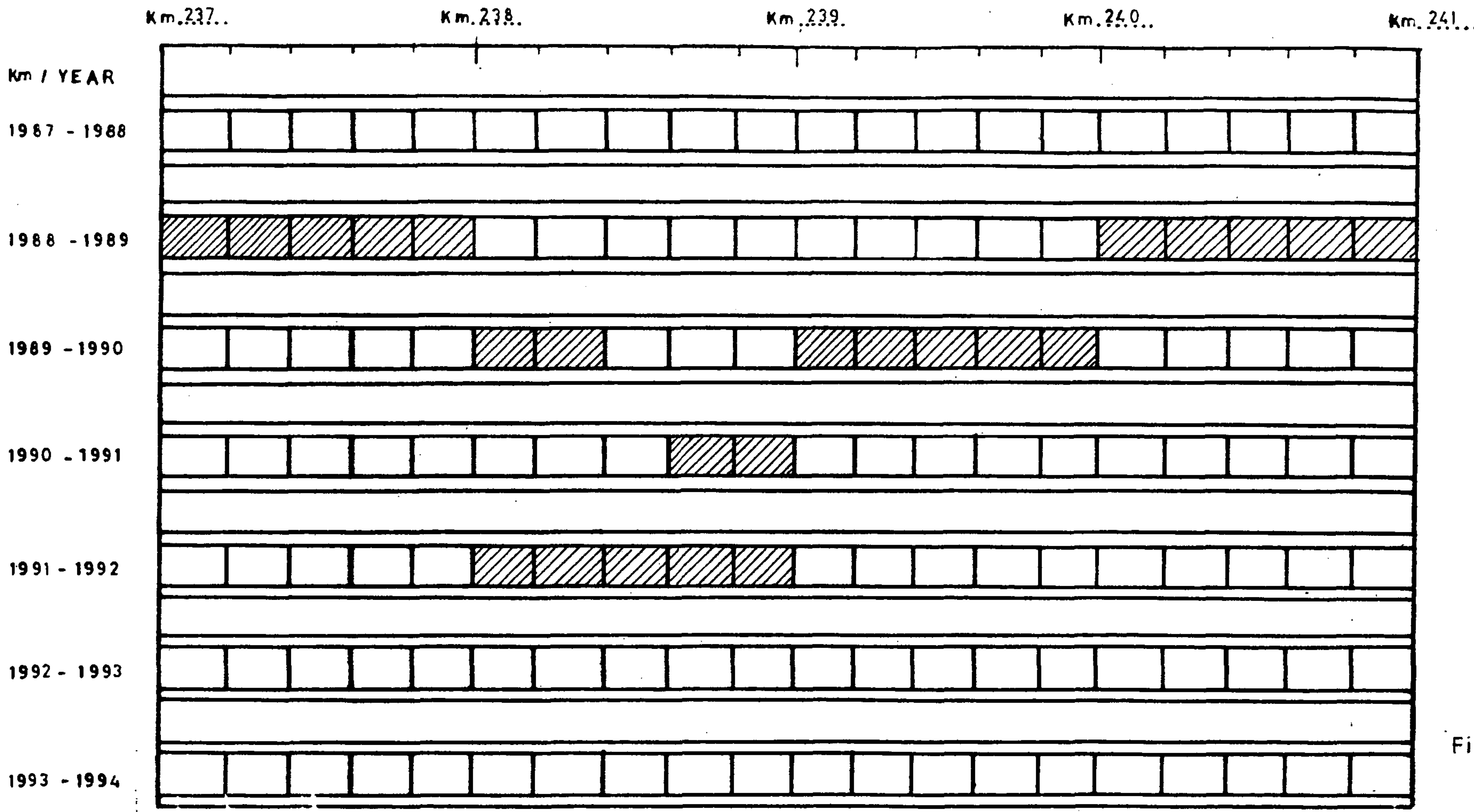


Fig. 2·22

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

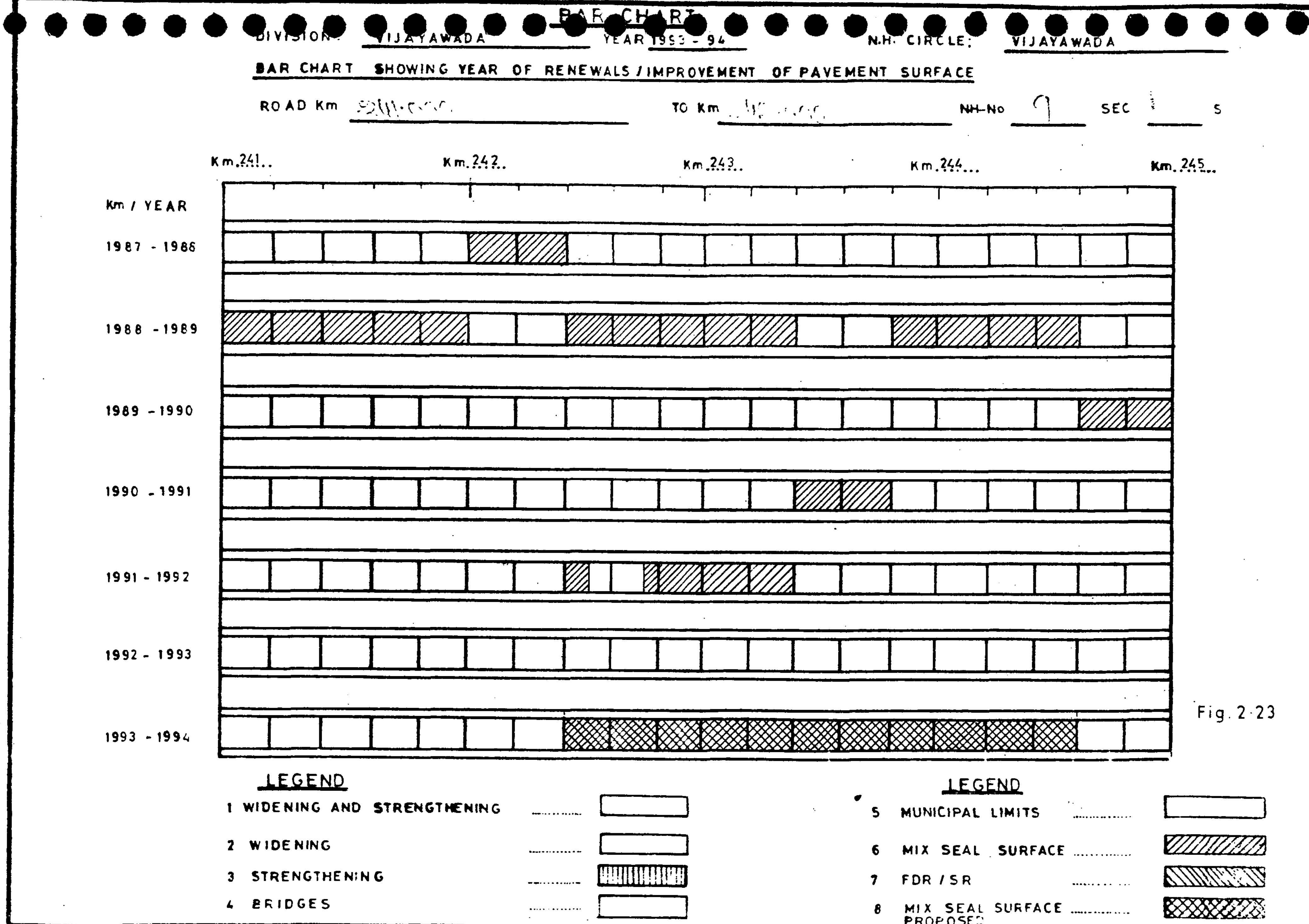

BAR CHART
DIVISION: VIJAYAWADA
YEAR 1993 - 94
N.H. CIRCLE: VIJAYAWADA
BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE
ROAD Km
TO Km
NH-No 9
SEC
Km.241..
Km.242..
Km.243..
Km.244...
Km.245..
Km / YEAR
1987 - 1988
1988 - 1989
1989 - 1990
1990 - 1991
1991 - 1992
1992 - 1993
1993 - 1994
LEGEND
1 WIDENING AND STRENGTHENING
2 WIDENING
3 STRENGTHENING
4 BRIDGES
LEGEND
5 MUNICIPAL LIMITS
6 MIX SEAL SURFACE
7 FDR / SR
8 MIX SEAL SURFACE PROPOSED

Fig. 2.23

DIVISION : VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE; VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km [illegible] TO Km [illegible] NH-No 9 SEC S

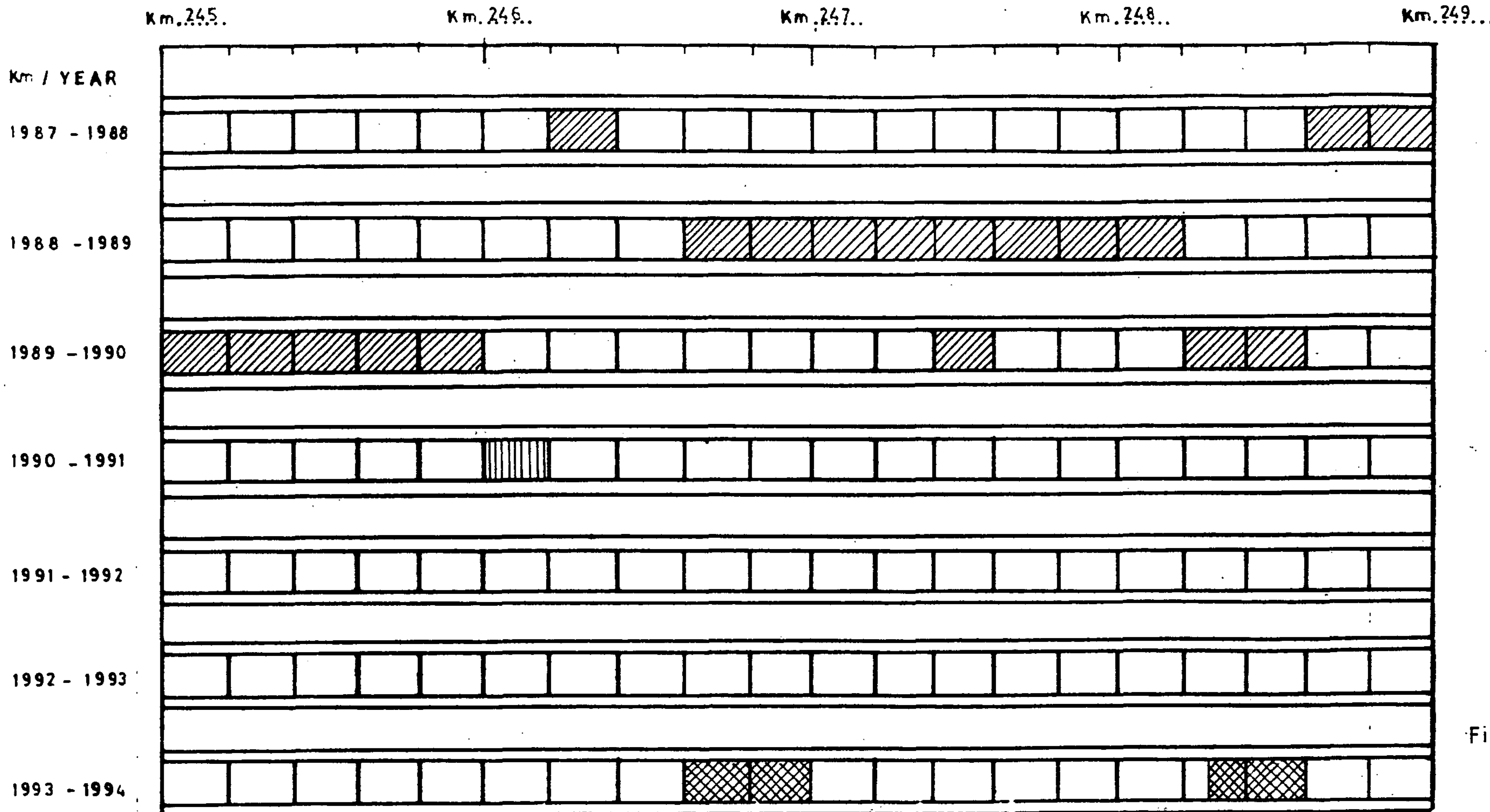


Fig. 2.24

LEGEND

1 WIDENING AND STRENGTHENING

2 WIDENING

3 STRENGTHENING

4 BRIDGES

LEGEND

5 MUNICIPAL LIMITS

6 MIX SEAL SURFACE

7 FDR / SR

8 MIX SEAL SURFACE PROPOSED

BAR CHART

IV ON J AW A ... AR 93 94 ... N.H CI LE, J A WA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 249.000 TO Km 253.000 NH-No 9 SEC S

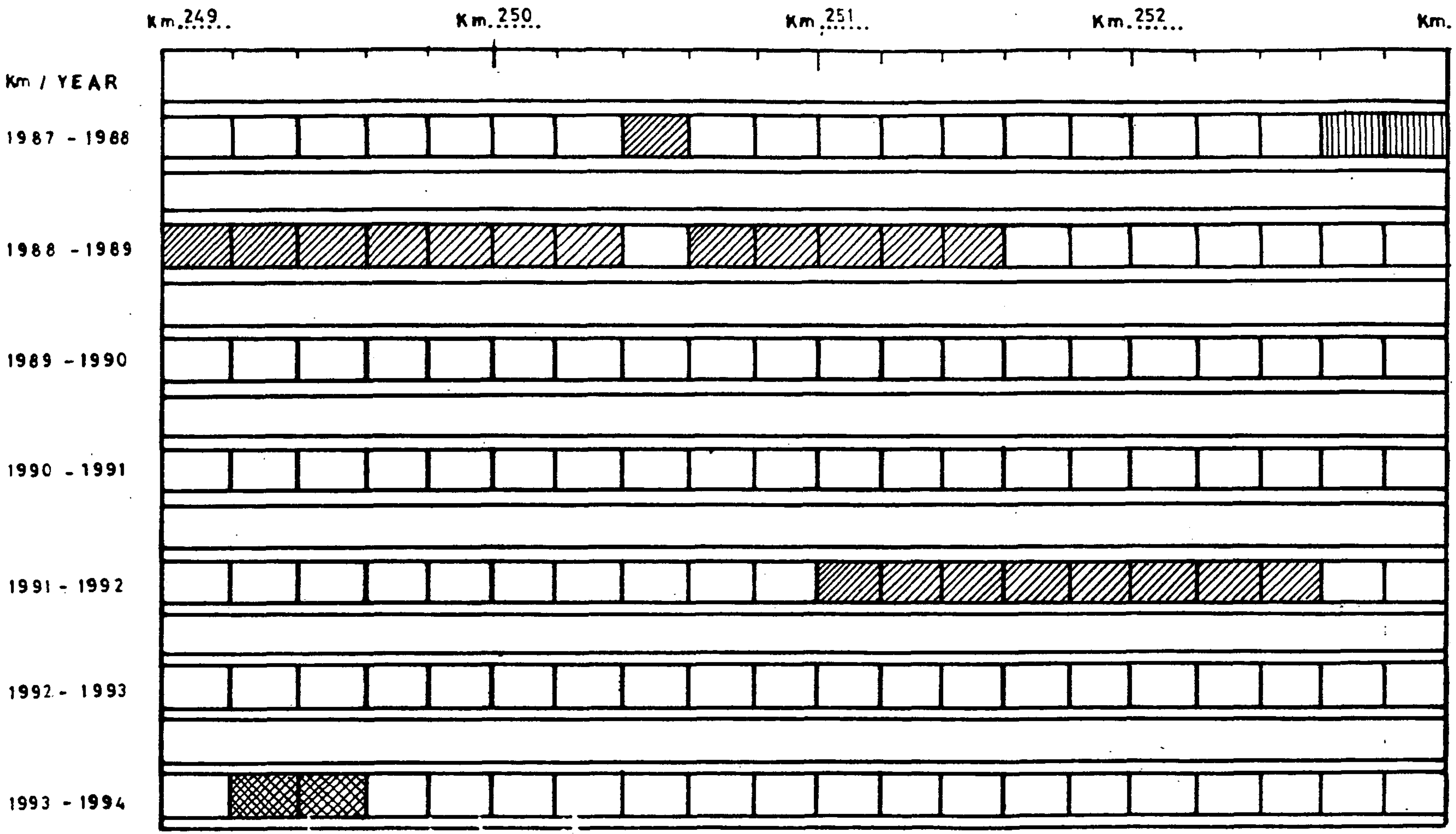


Fig. 2.25

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 253.000 TO Km 257.000 NH-No 9 SEC S

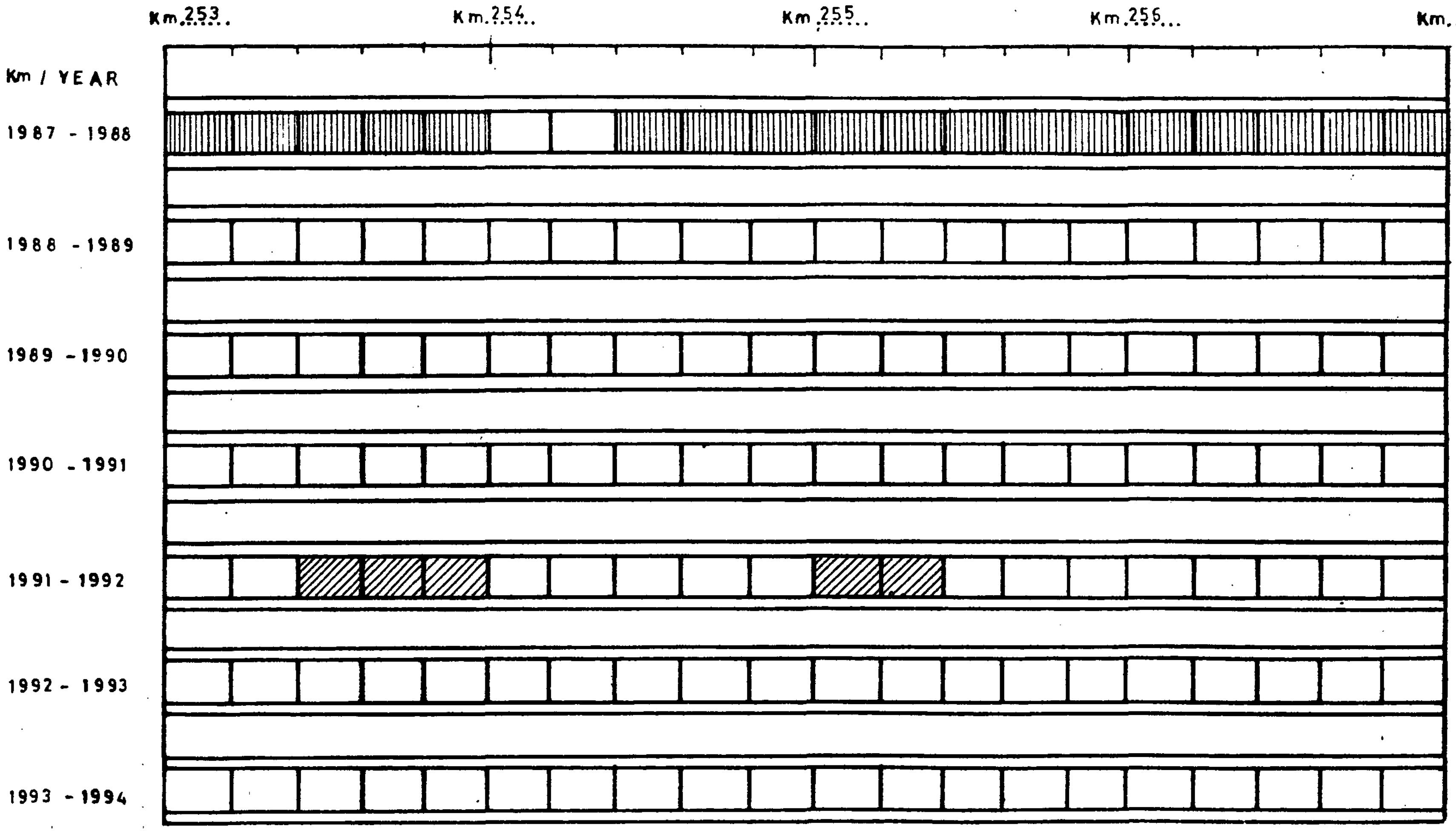


Fig. 2.26

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE: VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 257.000 TO Km 261.000 NH-No 9 SEC S

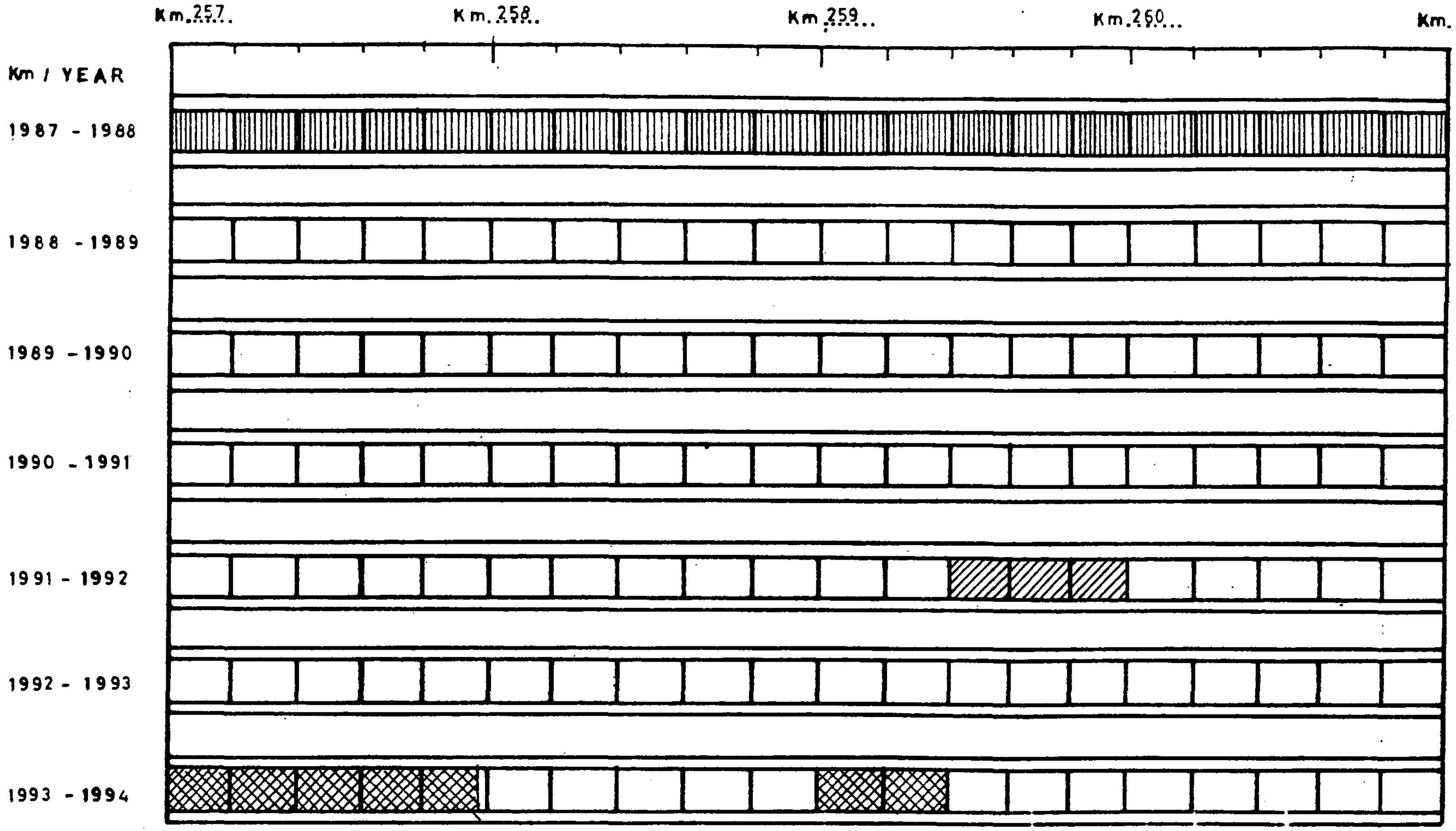


Fig. 2.27

LEGEND

1 WIDENING AND STRENGTHENING ....

2 WIDENING ....

3 STRENGTHENING ....

4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....

6 MIX SEAL SURFACE ....

7 FDR / SR ....

8 MIX SEAL SURFACE PROPOSED ....

BAR CHART

DIVISION: VIJAYAWADA YEAR 1993 - 94 N.H. CIRCLE; VIJAYAWADA

BAR CHART SHOWING YEAR OF RENEWALS / IMPROVEMENT OF PAVEMENT SURFACE

ROAD Km 261.000 TO Km 264.700 NH-No 1 SEC S

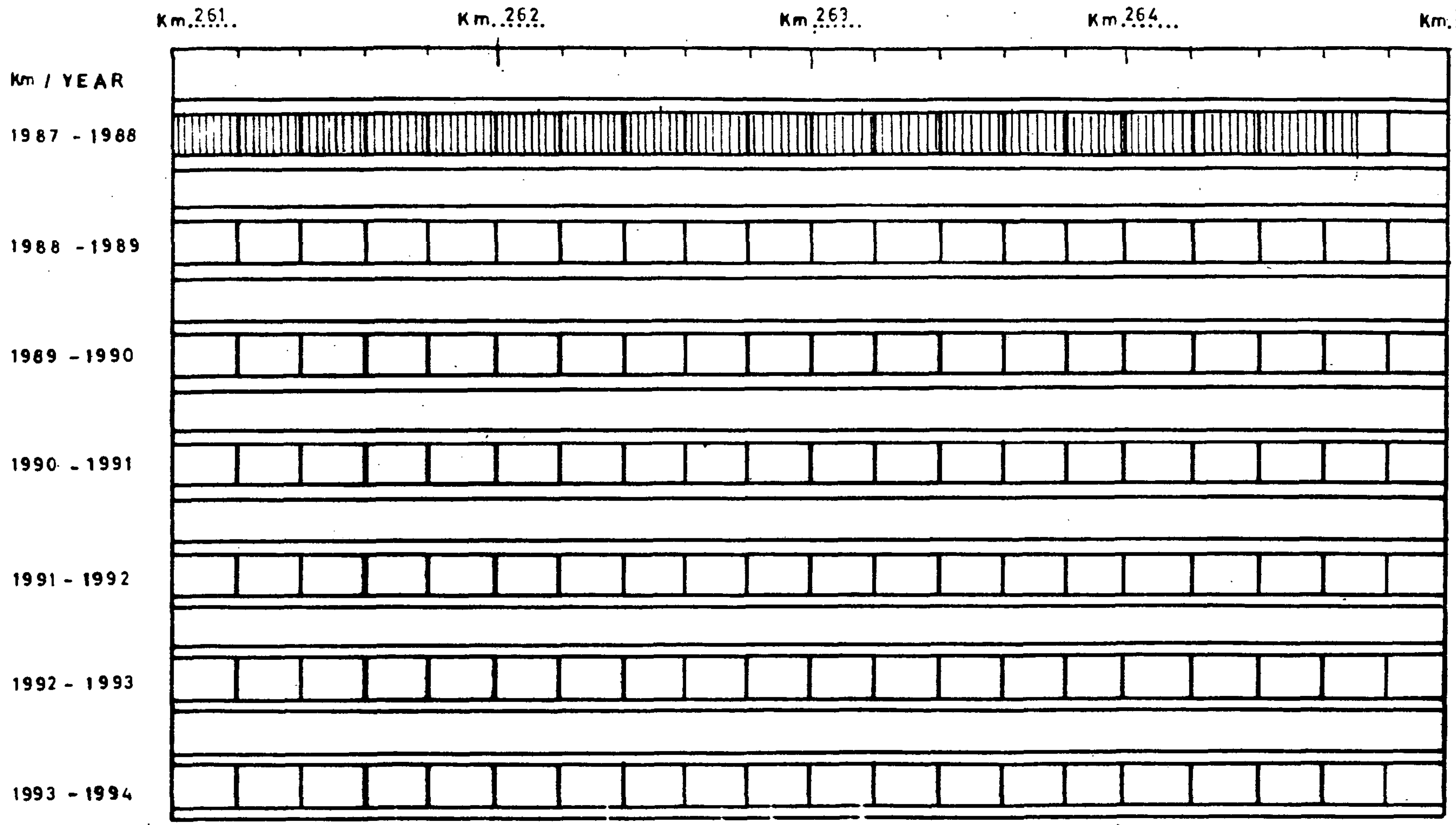


Fig. 2.28

LEGEND

1 WIDENING AND STRENGTHENING ....
2 WIDENING ....
3 STRENGTHENING ....
4 BRIDGES ....

LEGEND

5 MUNICIPAL LIMITS ....
6 MIX SEAL SURFACE ....
7 FDR / SR ....
8 MIX SEAL SURFACE PROPOSED ....

CHAPTER 3

SPECIFICATION OF WORKS

3.1 DESIGN STANDARD AND SPECIFICATION ELEMENTS

The geometric standards for the project have been adopted as per current standards for National Highways in plain terrain. These have been summarised in Table 3.1.

The standards adopted permit a ruling speed of 100 km/hr, but in urban portions and at one or two more locations, a minimum speed of 80 km/hr. has been kept and thus provide for a fast movement of uninterrupted traffic. The vertical profile is gentle, as the terrain in flat. However on approaches to road overbridges and on major bridges, a gradient of 1:50 has been adopted.

In this project 4-laning of NH-5 and NH-9 has been proposed in mostly urban area of Vijaywada town, where 60 m land width in entire reach is not available, nor it is possible to acquire additional land. The present land width varies from 22 m to 60 m. Hence the width of the median has been kept 1.2 m minimum and 2.5 m where sufficient land width is available. Similarly, in most of the length, concentric widening to 4-lane is being done, due to land width restrictions.

On NH-5, between km 5.4 to km 9.60, 5.5 m wide service road has been provided on both sides.

The Street lights have been proposed in the central median.

3.2 ROAD WORKS

Specification for Road and Bridge works of the Ministry of Surface Transport (Roads Wing), Govt. of India (2nd revision) Feb., 1988 shall be followed for execution of the works, unless otherwise specified. The relevant IS codes for various types of tests and testing procedure specified in AASHTO specifications shall be followed for collection of soil and material samples from the quarries and for testing to be done in field and laboratory. Detailed specifications on the basis of the above will be given in the tender documents at the detailed engineering stage.

3.3 BRIEF SPECIFICATIONS FOR BRIDGE WORKS

Brief specifications for bridge works are stated in this chapter, whereas, detailed technical specifications are given in the tender documents.

3.3.1 General

The work shall be executed in accordance with MOST Specifications for Road and Bridge Works (2nd revision, 1988) except wherever otherwise mentioned in the technical specifications forming part of the tender documents.

3.3.2 Materials and Workmanship

3.3.2.1 Reinforced concrete

A. Materials

I. Concrete

i) Concrete shall be design mix and shall have a minimum 28 days characteristic strength on 150 mm cubes as shown on respective drawings.

ii) High strength ordinary Portland cement conforming to IS:8112 or ordinary Portland cement conforming to IS:269 capable of achieving the required design concrete strength shall only be used.

iii) Cement content in concrete shall not be less than 310 kg/cum. of concrete and nor more than 540 kg/cum. of concrete.

iv) Maximum water cement ratio shall be 0.45.

II. Reinforcement

All reinforcing steel shall be of High Yield Strength Deformed Bars (Grade designation S:415) conforming to IS:1786.

III. Water

Water to be used in concreting and curing shall conform to Clause 302.4 of IRC:21-1987.

IV. Expansion Joints

i) For slab type superstructures upto 10m, the expansion joint will consist of 20 mm thick joint filler conforming to IS:1838 as per MOST Standards.

ii) For other span arrangements, the expansion joints must be robust, durable, water tight and replaceable. Expansion joints shall be obtained only from approved manufacturers and be of proven type. Details of expansion joints may be got approved before commencement of

construction. Site fabricated expansion joints shall be prohibited.

a) It shall be either from elastomer or shall have a cushion of elastomer to enable absorption of shock transmitted by vehicles.

b) Fabricated steel parts in the nosing of expansion joints shall be positioned accurately before the concreting of that portion of the deck slab.

c) Presence of manufacturer's representative at the time of concreting of nosing and installation of expansion joints is mandatory.

V. Bearings

For slab type superstructures tar paper bearing on pier/abutment cap rubbed smooth shall be provided as per MOST standards. For other span arrangements, elastomeric bearings shall conform to IRC:83-1987 (Part-II).

B. Workmanship

i) For ensuring proper cover of concrete to reinforcement, specially made polymer cover blocks shall only be used.

ii) Construction joints shall be provided only at locations shown on the drawings or otherwise as approved by the Engineer-in-charge. Concreting operation shall be carried out continuously upto the construction joints.

iii) Proper compaction of concrete shall be ensured by use of form and/or needle vibrators. Use of full width screed vibrators for compaction of concrete in deck slab shall be ensured.

iv) Shuttering plates shall suitably be stiffened to enable the compaction by form vibrators.

v) Welding of reinforcement bars shall not be permitted.

vi) Supporting chairs of 12 mm dia meter shall be provided at suitable intervals as per IS:2502.

3.3.2.2 Prestressed concrete

A. Materials

I. Concrete

i) Concrete shall be design mix and shall have a minimum 28 days characteristic strength as shown on respective drawings.

ii) Ordinary Portland cement conforming to IS:269 or High strength Ordinary Portland cement conforming to IS:8112 capable of achieving the required design concrete strength shall only be used.

iii) To improve workability of concrete and cement grout, admixtures conforming to IS:6925 and IS:9103 could be permitted subject to satisfactory proven use. Admixtures generating hydrogen, nitrogen, chlorides etc. should not be used.

iv) Cement content in concrete shall neither be less than 400 kg/cum. and nor more than 540 kg/cum. of concrete.

v) Maximum water cement ratio shall be 0.40.

II. Reinforcement

Reinforcing steel shall be of High Yield Strength Deformed Bars (Grade designation S:415) conforming to IS:1786.

III. Prestressing Steel and Accessories

i) Cable consisting of 12.7 mm dia. 7 ply Class 2 Strand as per IS:6006-1983 shall be used for main prestressing.

ii) The prestressing steel and accessories shall be subjected to an acceptance test prior to their actual use on the works (Guidance may be taken from BS:4447).

IV. Sheathing

Sheathing shall be of "Drossbach" type manufactured from 0.4 mm thick bright metal strip and tested as per IRC:18-1985, Appendix:1.

V. Water

Water to be used in concreting, grouting and curing shall conform to Clause 5.1 (ii) of IRC:SP:33-1989.

VI. Expansion Joints

i) The expansion joints must be robust, durable, water tight and replaceable. Expansion joints shall be obtained only from approved manufacturers and be of proven type. Details of expansion joints may be got approved before commencement of construction. Site fabricated expansion joints shall be prohibited.

ii) It shall be provided with a water proof memberane to ensure against leakage below the joint.

iii) It shall have a cushion of elastomer to enable absorption of shock transmitted by vehicles.

iv) Fabricated steel parts of expansion joints shall be positioned accurately before the concreting of that portion of the deck slab.

v) Presence of manufacturer's representative at the time of positioning of embedded parts and installation of expansion joints is mandatory.

VII. Bearings

Depending upon the type of bearings the following codes/standards shall be applicable or as decided by the Engineer-in-charge.

i) IRC:83-1987 (Part II)

ii) BS:5400

B. Workmanship

i) For ensuring proper cover of concrete to reinforcement, specially made polymer cover blocks shall only be used.

ii) Construction joints shall be provided only at locations shown on the drawings or otherwise as approved by the Engineer-in-charge.

iii) Supporting chairs of 12 mm dia shall be provided at suitable intervals, as per IS:2502.

iv) Shuttering plates shall suitably be stiffened to enable the compaction by form and/or needle vibrators.

v) Full width screed vibrator shall be used for compaction of concrete in deck slab.

vi) Welding of reinforcement bars shall not be permitted.

3.3.3 Wearing Course

Wearing course shall consist of a coat of mastic asphalt, 6 mm thick over the top of deck and covered by 50 mm thick asphaltic concrete.

3.3.4 Foundations

Open and pile foundations shall conform to IRC:78-1983.

Table 3.1

DESIGN STANDARDS

NH-5 AND NH-9

1.	Design Speed	
	- Ruling	100 km/hr.
	- Minimum	80 km/hr.
2.	Road Land Width	
	- Urban	22 m to 60 m as available
	- Rural	25 m to 45 m as available
	- Bypass	60 m
3.	Carriageway Width	
	- 2-lane section	7.0 m
	- 4-lane section	7.0 m each
	- Major bridges	7.5 m
	- Minor bridges and culverts	Same as for road widths
	- Service Roads on NH-5	5.5 m
4.	Shoulder width	
	- paved	1.5 m either side
	- earthen	1.0 m either side
5.	Median widths	1.2 / 2.5 / 4.5 m
6.	Camber	
	- Carriageway	2.5 per cent
	- Shoulders (paved)	2.5 per cent
	- Shoulders (earthen)	3.0 per cent
7.	Minimum radius of horizontal curves	360 m

CHAPTER - 4

PAVEMENT DESIGN

4.1 GENERAL

The project comprises the following essential items pertaining to pavement works:

i) Strengthening of the existing 2-lane pavement.

ii) Construction of a new pavement on the second carriageway (4 laning) or where concentric 4 laning is proposed, widening the existing carriageway and then strengthening.

iii) Construction of a new pavement for Eluru bypass on NH-5.

For strengthening, the thickness of the overlay courses is based on deflection data arrived at from Benkelman beam deflection tests on the existing pavement. These are categorized as (i) Strengthening of the existing road pavement for 2-lane carriageway sections; (ii) Strengthening of the existing road pavement in the proposed 4 lane sections. The thickness of new pavement and strengthening overlay is designed as per `Guidelines for Pavement Design of ADB-III Road Project' issued by M.O.S.T. (Roads Wing).

Almost all the existing pavement structural sections are boxed type flanked with earthen shoulders. These are proposed to be converted to freely draining pavements as far as practical by providing one granular layer in full width of shoulders and also provide 1.5m wide paved shoulders on either side of the carriageway.

New pavements will be freely draining pavements. The granular sub-base will be provided over the entire subgrade width.

While suggesting overlay courses for strengthening, draining requirements at various interfaces are kept in view.

The design period for the new pavement and strengthening has been taken as 10 years.

The pavement will have unidirectional crosss-slope in case of 4-lane divided carriageway sections and cambered profile in case of 2-lane cariageway sections.

4.2 EXISTING PAVEMENT DETAILS

The broad details of the existing pavement thickness have been collected by digging pits at the edge of the pavement and taking a 1 m deep bore hole below that and shown in

Tables 4.1 and 4.2 for NH5 and 9 respectively. Details of the cross sections of the pits are given in Chapters 2 of this Volume.

The existing pavements mostly composed of gravel, mooram, water bound macadam, Built up spray grout (BUSG) and/or bituminous macadam course. The bituminous wearing course consists mostly of premix carpet/MSS.

4.3 SUB-GRADE SOIL CHARACTERISTICS

The samples from the existing sub-grade at every 5 km have been taken and tested in the laboratory for the following:

i) Sieve Analysis and gradation

ii) Atterberg Limits

iii) Field Moisture Content

iv) Optimum Moisture Content

v) Field Density

vi) Proctor Density

vii) CBR for 4 days soaked condition.

The details of the sub-grade soil characteristics for each section are given in Tables 4.3 & 4.4.

In order to have the sub-grade soil for the new pavement for 4 laning as well as for bypass, borrow areas have been identified. It has been found that it is possible to get suitable soils having laboratory soaked CBR value of 10%.

Considering the general condition of the pavement and also the requirement for strengthening of the existing pavement, Benkelman beam deflection studies have been conducted.

The Benkelman Beam deflections were determined by using the standard procedures outlined in the IRC guidelines. The values of deflections so obtained have been suitably corrected to account for seasonal variations and temperature variations as per IRC-81-1981 with modification recommended vide MOST's letter No. RW/NH/33013/5/88-DO II dated 11.3.92 (copy enclosed).

The characteristic deflections have been taken as the mean deflection plus two standard deviation as recommended in the above referred letter. The permissible deflection has been taken as 0.60 mm where the total number of cumulative standard axles over the design period of 10 years is 30 to 50 million and 0.55 mm where it is 50 to 75 million. Tables 4.5 and 4.6 give the deflection data and the overlay required.

The thickness obtained is in terms of granular material. Since the strengthening shall be done by bituminous courses such as dense bituminous macadam and bituminous concrete, in suitable combinations as per actual requirements or the minimum bituminous surfacing, equivalency factors as indicated below have been applied.

Dense Bituminous Macadam	2 times of the granular course
Bituminous Concrete	2 times of the granular course

4.4 STRENGTHENING OF THE EXISTING PAVEMENT

The strengthening proposals have the following combinations of bituminous courses :

(a) Strengthening of existing two lane carriageway :

The requirement of overlay on NH5 varies from 225 to 510 and on NH-9 from 235 mm to 435 mm of granular thickness, average being 327 mm and 335 mm respectively for NH-5 and NH-9. The following specifications for strengthening of the existing 2-lane sections are recommended on NH-5 and NH-9.

i)	Dense bituminous macadam	:	130mm
ii)	Bituminous concrete	:	40mm

(b) Proposed 4 lane sections; strengthening of the existing two lane pavement after widening.

Keeping in view the overlay requirement as per Tables 4.5, 4.6, the following specifications are recommended.

			NH-5	NH-9
i)	Dense bituminous macadam	:	130mm	150mm
ii)	Bituminous concrete	:	40mm	40mm

In additon, the existing cross profile of pavement (i.e. camber) is required to be corrected to 2.5% in case of the pavement for 2-lane road. This will be achieved by using dense bituminous macadam for which an average thickness of 75 mm has been taken. After camber correction, the strengthening layers shall be provided. In case of 4-lane sections, the existing carriageway will be provided unidirectional crossfall of 2.5% with DBM. The strengthening courses will be uniformally laid on 7m carriageway.

4.5 DESIGN OF NEW PAVEMENT

The new pavement is designed for the following cases:

i) 2 lane carriageway in case of the proposed Eluru bypass

ii) Additional 2 lane carriageway of 4 lane divided carriageway.

The design of pavement has been done as per IRC-37-1984 and guidelines for pavement design of ADB III road projects issued by MOST. The traffic projections have been done for a period of 10 years from the stipulated year of completion, i.e. 1998. The traffic growth has been calculated, by taking an average of regression analysis of NH-5 and NH-9 and the elasticity method depending upon the socio-economic growth factors of the region. The details of traffic growth have already been dealt with in Volume-I, Main Report (Part-I, Chapter-5). Based on the traffic projections, the design of pavement is done for 10 years projection.

In case of 4 lane sections, the distribution of commercial vehicles per day on each carriageway has been taken as 75% of the number of commercial vehicles in each direction. Since for the traffic in either direction, the variation is less than 10%, half of the total traffic has been considered as the traffic on each lane.

The vehicle damage factor is 3.35 for NH-5 and 3.10 for NH-9 from the actual analysis of the axle load survey carried out. However, the minimum factor of 3.5 as per MOST Standards has been adopted. The details of the axle load surveys have already been dealt with in Volume-I, Main Report (Part-I - Chapter 5).

The pavement design has been done based on a soaked CBR value of 7% of the subgrade. The thickness of the road pavement has been arrived at as per the design chart of the guidelines for pavement design of ADB III road projects.

The pavement of new carriageway is also designed based on SHELL design curves. The thickness by this method is given in Tables 4.7 to 4.9.

Where concentric widening to 4 lane is suggested by providing median on the existing carriageway, the additional width will be made up by widening, providing 300 mm granular sub-base and 300 mm wet mix macadam base course which is approximately equal to the existing crust. After providing a camber correction layer of DBM on full carriageway width, strengthening layers of DBM and BC will be laid.

4.6 COMPOSITION OF THE NEW ROAD PAVEMENT

The details of the new pavement composition are given below :

New pavement for two lane carriageway :

The broad provisions are (over 500 mm sub-grade of 7% CBR):

			NH-5	NH-9	Eluru bypass
i)	Granular Subbase	-	300 mm	300 mm	300 mm
ii)	Base course of Wet mix macadam	-	300 mm	300 mm	300 mm
iii)	Dense bituminous macadam	-	130 mm	150 mm	150 mm
iv)	Bituminous concrete	-	40 mm	40 mm	40 mm

Table 4.10 gives the abstract of thickness and composition of pavement layers both for overlay on the existing pavements and for new pavement in 4-laning, Eluru bypass. The design calculations are given in Annexures I and II for NH-5 and NH-9 respectively.

4.7 PAVED SHOULDERS

In view of very high traffic density, it is recommended to provide 1.5 m wide paved shoulders on either side of carriageway in two lane sections and outer ends of the 4-lane sections. The composition of paved shoulders will be as under :

For NH-5 and NH-9

i)	Granular sub-base	-	300 mm
ii)	Wet Mix Macadam	-	450 mm
iii)	Mix Seal Surfacing	-	

For Eluru bypass

i)	Granular sub-base	-	300 mm
ii)	Wet Mix Macadam	-	425 mm
iii)	Mix Seal Surfacing	-	

4.8 SERVICE ROAD

5.5 m wide service roads have been provided in the urban area of Vijayawada on NH-5. The following specifications for pavement of service road are provided

i)	Granular sub-base	-	300 mm
ii)	Wet Mix Macadam	-	300 mm
iii)	Mix Seal Surfacing	-	

TABLE 4.1

DETAILS OF EXISTING PAVEMENT

Section : Vijayawada to Eluru - National Highway No. 5

Km.	Total Thickness of Crust in mm	Computation of Crust		
		Gravel in mm	WBM in mm	Bituminous in mm
7.800	510	100	100	310
12.300	490	120	100	270
18.200	560	300	200	60
23.100	515	300	175	25
28.700	590	300	100	130
33.500	480	250	100	130
42.300	610	300	150	160
48.200	585	240	220	130
53.500	575	150	375	50
69.500	640	410	140	90
73.700	550	350	150	50

TABLE 4.2

DETAILS OF EXISTING PAVEMENT

Section : Nandigama to Vijayawada - National Highway No. 9

Km.	Total Thickness of Crust in mm	Computation of Crust			
		Kankar with clay in mm	Stone soling in mm	WBM in mm	Bituminous in mm
217.500	725	300	150	150	125
222.000	675	300	150	100	125
229.000	440	-	150	100	190
235.000	515	140	150	100	125
240.600	690	480	-	180	30
245.700	475	150	100	100	125
251.000	615	250	110	120	135
254.600	720	-	300	250	170
262.700	770	300	150	200	120

TABLE 4.3

NH-5 - TEST DETAILS OF SUB GRADE SOIL (EXISTING)

SL. NO.	LOCATION CH. KM.	SIEVE ANALYSIS % BY WEIGHT PASSING IS SIEVE 4.75 MM	2.36 MM	425 MM MIC RONS	75 MM MIC RONS	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTI-CITY INDEX (%)	SAND CONTENT (%)	LABO-RATORY DEN-SITY (MODI-FIELD ASSHTO (gm/cc)	OPTIMUM MOISTURE CONTENT (%)	SOAKED CBR VALUE (%)	FIELD MOISTURE CONTENT (%) (gm/cc)	FIELD DRY DENSITY (gm/cc
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	7.800	100	100	100	100	48.9	25.1	23.8	00	1.73	18.6	2.1	26.4	1.65
	12.300	100	100	100	100	43.7	24.3	19.4	00	1.75	17.4	2.3	15.1	1.86
	18.200	98	95	84	69	42.4	26.7	15.7	29	1.71	18.2	2.7	22.4	1.59
	23.100	95	92	65	42	35.9	20.7	15.2	53	1.81	15.2	4.2	15.9	1.60
	28.700	100	100	55	35	37.8	24.7	13.1	65	1.80	17.6	4.8	14.5	1.82
	33.500	98	90	65	40	36.2	20.4	15.8	58	1.77	17.8	4.5	16.2	1.63
	42.300	96	91	72	45	40.2	23.9	16.3	51	1.72	18.6	4.1	21.6	1.59
	48.200	93	90	82	42	37.4	23.2	14.2	51	1.76	16.8	3.8	13.2	1.69
	53.500	97	93	50	32	39.9	24.5	15.4	65	1.74	18.2	3.1	23.9	1.66
10	69.500	93	85	70	41	41.7	22.7	190	52	1.71	15.4	3.6	14.1	1.68
11	73.700	90	84	63	46	38.7	23.6	15.1	44	1.79	16.4	3.4	15.2	1.80

TABLE 4.4

NH-9 - TEST DETAILS OF SUB GRADE SOIL (EXISTING)

SL. NO.	LOCATION CH. KM.	SIEVE ANALYSIS % BY WEIGHT PASSING IS SIEVE 4.75 MM	2.36 MM	425 MM MIC RONS	75 MM MIC RONS	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTI-CITY INDEX (%)	SAND CONTENT (%)	LABO-RATORY DEN-SITY (MODI-FIELD ASSHTO (gm/cc)	OPTIMUM MOISTURE CONTENT (%)	SOAKED CBR VALUE (%)	FIELD MOISTURE CONTENT (%) (gm/cc)	FIELD DRY DENSITY (gm/cc
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	217.500	90	85	69	43	41.6	23.7	17.9	47	1.75	14.8	3.6	7.2	1.74
2	222.000	94	87	64	49	39.2	24.2	15.2	45	1.77	14.2	3.7	8.9	1.67
3	229.000	94	89	59	34	33.5	21.7	11.8	60	1.81	13.9	4.6	7.4	1.66
4	235.000	99	95	71	47	37.5	24.7	12.8	52	1.72	13.7	3.8	9.1	1.74
5	240.600	100	99	72	50	35.4	22.4	13.0	50	1.88	12.6	4.2	10.8	1.89
6	245.700	99	97	70	33	31.7	20.3	11.4	66	1.86	11.9	4.5	6.3	1.85
7	251.000	100	100	81	64	38.2	22.4	15.8	36	1.71	13.8	3.1	8.1	1.71
8	254.600	98	95	84	68	40.7	20.5	20.3	30	1.73	15.9	2.6	14.3	1.64
9	262.700	86	79	64	46	38.5	19.3	19.3	40	1.72	18.2	3.4	22.5	1.66

TABLE NO. 4.5

ANALYSIS OF BENKELMAN BEAM DEFLECTION DATA NH-5

NAME OF ROAD : NH-5 METHOD OF MEASUREMENT : CGRA RAINFALL: (1300 mm PI :) 15 PERMISSIBLE DEFLECTION : Km 3.4-13 0.6 mm DATE : JAN. 93
SECTION : BZA-ELURU LANES : TWO SUBGRADE: CLAYEY MOISTURE CONTENT ; 18 % Km 13-75 = 0.55 mm

S.NO	CARRIAGEWAY	LOCATION OF TEST POINT AND IDENTIFICATION OF LANE	PAVEMENT TEMPERATURE (IN C)	DIAL GAUGE READING INITIAL	DIAL GAUGE READING INTERMEDIATE	DIAL GAUGE READING FINAL	DEFLECTION INTERMEDIATE MM	DEFLECTION FINAL MM	CORRECTIONS (mm) TEMPERATURE	CORRECTIONS (mm) SEASONAL	CORRECTED DEFLECTIONS (mm) Di (MM)	CORRECTED DEFLECTIONS (mm) Df (MM)	Df-Di	TRUE PAVE. DEFLECTION mm D	MEAN D	STANDARD DEVIATION	CHARACTERISTIC DEFLECTION (mm)	OVERLAY MM
1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	L.C KM 4	0.0	27	0.0	-	-												
		0.2		0.0	-	-												
		0.4		0.0	75	73	0.25	0.27	0.04	1.05	0.3045	0.3255	0.021	0.651				
		0.6		0.0	65	62	0.35	0.38	0.04	1.05	0.4095	0.441	0.0315	0.973665				
		0.8		0.0	71	69	0.29	0.31	0.04	1.05	0.3465	0.3675	0.021	0.735				
	R.C	0.9		0.0	81	79	0.19	0.21	0.04	1.05	0.2415	0.2625	0.021	0.525				
		0.7		0.0	79	77	0.21	0.23	0.04	1.05	0.2625	0.2835	0.021	0.567				
		0.5		0.0	66	64	0.34	0.36	0.04	1.05	0.399	0.42	0.021	0.84				
		0.3		0.0	-	-												
		0.1		0.0	-	-									0.715277	0.155473	1.026224	260.00
	L.C KM 5.	0.0		0.0	30	29	0.7	0.71	0.04	1.05	0.777	0.7875	0.0105	1.575				
		0.2		0.0	68	65	0.32	0.35	0.04	1.05	0.378	0.4095	0.0315	0.910665				
		0.4		0.0	74	71	0.26	0.29	0.04	1.05	0.315	0.3465	0.0315	0.784665				
		0.6		0.0	68	67	0.32	0.33	0.04	1.05	0.378	0.3885	0.0105	0.777				
		0.8		0.0	49	48	0.51	0.52	0.04	1.05	0.5775	0.588	0.0105	1.176				
	R.C	0.9		0.0	58	57	0.42	0.43	0.04	1.05	0.483	0.4935	0.0105	0.987				
		0.7		0.0	56	52	0.44	0.48	0.04	1.05	0.504	0.546	0.042	1.21422				
		0.5		0.0	49	47	0.51	0.53	0.04	1.05	0.5775	0.5985	0.021	1.197				
		0.3		0.0	68	64	0.32	0.36	0.04	1.05	0.378	0.42	0.042	0.96222				
		0.1		0.0	59	56	0.41	0.44	0.04	1.05	0.4725	0.504	0.0315	1.099665	1.068343	0.226980	1.522303	390.00
	L.C KM 6	0.0		0.0	62	61	0.38	0.39	0.04	1.05	0.441	0.4515	0.0105	0.903				
		0.2		0.0	64	63	0.36	0.37	0.04	1.05	0.42	0.4305	0.0105	0.861				
		0.4		0.0	58	52	0.42	0.48	0.04	1.05	0.483	0.546	0.063	1.27533				
		0.6		0.0	75	72	0.25	0.28	0.04	1.05	0.3045	0.336	0.0315	0.763665				
		0.8		0.0	81	80	0.19	0.2	0.04	1.05	0.2415	0.252	0.0105	0.504				
	R.C	0.9		0.0	69	68	0.31	0.32	0.04	1.05	0.3675	0.378	0.0105	0.756				
		0.7		0.0	56	57	0.44	0.43	0.04	1.05	0.504	0.4935	-0.0105	0.987				
		0.5		0.0	79	77	0.21	0.23	0.04	1.05	0.2625	0.2835	0.021	0.567				
		0.3		0.0	68	65	0.32	0.35	0.04	1.05	0.378	0.4095	0.0315	0.910665				
		0.1		0.0	82	81	0.18	0.19	0.04	1.05	0.231	0.2415	0.0105	0.483	0.801066	0.230894	1.262855	290.00

4-10

L.C KM 7	0.0	28.00	0.0	70	70	0.3	0.3	0.035	1.05	0.35175	0.35175	0	0.7035				
	0.2		0.0	70	70	0.3	0.3	0.035	1.05	0.35175	0.35175	0	0.7035				
	0.4		0.0	61	58	0.39	0.42	0.035	1.05	0.44625	0.47775	0.0315	1.047165				
	0.6		0.0	71	71	0.29	0.29	0.035	1.05	0.34125	0.34125	0	0.6825				
	0.8		0.0	70	66	0.3	0.34	0.035	1.05	0.35175	0.39375	0.042	0.99972				
R.C	0.9		0.0	70	70	0.3	0.3	0.035	1.05	0.35175	0.35175	0	0.7035				
	0.7		0.0	70	68	0.3	0.32	0.035	1.05	0.35175	0.37275	0.021	0.7455				
	0.5		0.0	58	55	0.42	0.45	0.035	1.05	0.47775	0.50925	0.0315	1.110165				
	0.3		0.0	74	73	0.26	0.27	0.035	1.05	0.30975	0.32025	0.0105	0.6405				
	0.1		0.0	71	70	0.29	0.3	0.035	1.05	0.34125	0.35175	0.0105	0.7035	0.794955	0.157652	1.110259	280.00
L.C KM 8	0.0		0.0	74	71	0.26	0.29	0.035	1.05	0.30975	0.34125	0.0315	0.774165				
	0.2		0.0	75	75	0.25	0.25	0.035	1.05	0.29925	0.29925	0	0.5985				
	0.4		0.0	52	50	0.48	0.5	0.035	1.05	0.54075	0.56175	0.021	1.1235				
	0.6		0.0	52	51	0.48	0.49	0.035	1.05	0.54075	0.55125	0.0105	1.1025				
	0.8		0.0	65	64	0.35	0.36	0.035	1.05	0.40425	0.41475	0.0105	0.8295				
R.C	0.9		0.0	45	42	0.55	0.58	0.035	1.05	0.61425	0.64575	0.0315	1.383165				
	0.7		0.0	42	40	0.58	0.6	0.035	1.05	0.64575	0.66675	0.021	1.3335				
	0.5		0.0	50	50	0.5	0.5	0.035	1.05	0.55175	0.56175	0	1.1235				
	0.3		0.0	62	60	0.38	0.4	0.035	1.05	0.43575	0.45675	0.021	0.9135				
	0.1		0.0	72	71	0.28	0.29	0.035	1.05	0.33075	0.34125	0.0105	0.6825	0.986433	0.254316	1.495066	390.00
L.C KM 9	0.0	31	0.0	30	25	0.7	0.75	0.02	1.05	0.756	0.8085	0.0525	1.769775				
	0.2		0.0	69	68	0.31	0.32	0.02	1.05	0.3465	0.357	0.0105	0.714				
	0.4		0.0	71	69	0.29	0.31	0.02	1.05	0.3255	0.3465	0.021	0.693				
	0.6		0.0	66	66	0.34	0.34	0.02	1.05	0.378	0.378	0	0.756				
	0.8		0.0	70	70	0.3	0.3	0.02	1.05	0.336	0.336	0	0.672				
R.C	0.9		0.0	72	70	0.28	0.3	0.02	1.05	0.315	0.336	0.021	0.672				
	0.7		0.0	71	70	0.29	0.3	0.02	1.05	0.3255	0.336	0.0105	0.672				
	0.5		0.0	68	66	0.32	0.34	0.02	1.05	0.357	0.378	0.021	0.756				
	0.3		0.0	70	70	0.3	0.3	0.02	1.05	0.336	0.336	0	0.672				
	0.1		0.0	69	69	0.31	0.31	0.02	1.05	0.3465	0.3465	0	0.693	0.733615	0.385143	1.503902	390.00
KM 10	0.0		0.0	74	70	0.26	0.3	0.02	1.05	0.294	0.336	0.042	0.79422				
	0.2		0.0	75	71	0.25	0.29	0.02	1.05	0.2835	0.3255	0.042	0.77322				
	0.4		0.0	84	84	0.16	0.16	0.02	1.05	0.189	0.189	0	0.378				
	0.6		0.0	84	80	0.16	0.2	0.02	1.05	0.189	0.231	0.042	0.58422				
	0.8		0.0	74	70	0.26	0.3	0.02	1.05	0.294	0.336	0.042	0.79422				
R.C	0.9		0.0	64	62	0.36	0.38	0.02	1.05	0.399	0.42	0.021	0.84				
	0.7		0.0	81	80	0.19	0.2	0.02	1.05	0.2205	0.231	0.0105	0.462				
	0.5		0.0	82	82	0.18	0.18	0.02	1.05	0.21	0.21	0	0.42				
	0.3		0.0	81	80	0.19	0.2	0.02	1.05	0.2205	0.231	0.0105	0.462				
	0.1		0.0	72	71	0.28	0.29	0.02	1.05	0.315	0.3255	0.0105	0.651	0.615888	0.168269	0.952426	230.00
L.C KM 11	0.0	34	0.0	45	45	0.55	0.55	0.005	1.05	0.58275	0.58275	0	1.1655				
	0.2		0.0	40	40	0.6	0.6	0.005	1.05	0.63525	0.63525	0	1.2705				
	0.4		0.0	48	44	0.52	0.56	0.005	1.05	0.55125	0.59325	0.042	1.39872				
	0.6		0.0	54	54	0.46	0.46	0.005	1.05	0.48825	0.48825	0	0.9765				
	0.8		0.0	72	70	0.3	0.3	0.005	1.05	0.32025	0.32025	0	0.6405				

R.C	0.9		0.0	76	74	0.24	0.26	0.005	1.05	0.25725	0.27825	0.021	0.5565				
	0.7		0.0	64	64	0.36	0.36	0.005	1.05	0.38325	0.38325	0	0.7665				
	0.5		0.0	50	49	0.5	0.51	0.005	1.05	0.53025	0.54075	0.0105	1.0815				
	0.3		0.0	49	48	0.51	0.52	0.005	1.05	0.54075	0.55125	0.0105	1.1025				
	0.1		0.0	51	50	0.49	0.5	0.005	1.05	0.51975	0.53025	0.0105	1.0605	0.902656	0.363467	1.639591	405.00
L.C																	
KM 12	0.0		0.0	60	58	0.4	0.42	0.005	1.05	0.42525	0.44625	0.021	0.8925				
	0.2		0.0	33	29	0.67	0.71	0.005	1.05	0.70875	0.75075	0.042	1.62372				
	0.4		0.0	44	40	0.56	0.6	0.005	1.05	0.59325	0.63525	0.042	1.39272				
	0.6		0.0	70	70	0.3	0.3	0.005	1.05	0.32025	0.32025	0	0.6405				
	0.8		0.0	65	64	0.35	0.36	0.005	1.05	0.37275	0.38325	0.0105	0.7665				
R.C	0.9		0.0	67	66	0.33	0.34	0.005	1.05	0.35175	0.36225	0.0105	0.7245				
	0.7		0.0	62	62	0.38	0.38	0.005	1.05	0.40425	0.40425	0	0.8085				
	0.5		0.0	61	60	0.39	0.4	0.005	1.05	0.41475	0.42525	0.0105	0.8505				
	0.3		0.0	40	40	0.6	0.6	0.005	1.05	0.63525	0.63525	0	1.2705				
	0.1		0.0	54	52	0.46	0.48	0.005	1.05	0.48825	0.50925	0.021	1.0185	0.90804	0.410541	1.729122	425.00
L.C																	
KM 13	0.0	40	0.0	65	65	0.35	0.35	-0.025	1.05	0.34125	0.34125	0	0.6825				
	0.2		0.0	70	69	0.3	0.31	-0.025	1.05	0.28875	0.29925	0.0105	0.5985				
	0.4		0.0	40	36	0.6	0.64	-0.025	1.05	0.60375	0.64575	0.042	1.41372				
	0.6		0.0	78	73	0.22	0.27	-0.025	1.05	0.20475	0.25725	0.0525	0.667275				
	0.8		0.0	70	66	0.3	0.34	-0.025	1.05	0.28875	0.33075	0.042	0.78372				
R.C	0.9		0.0	70	68	0.3	0.32	-0.025	1.05	0.28875	0.30975	0.021	0.6195				
	0.7		0.0	74	70	0.26	0.3	-0.025	1.05	0.24675	0.28875	0.042	0.69972				
	0.5		0.0	55	52	0.45	0.48	-0.025	1.05	0.44625	0.47775	0.0315	1.047165				
	0.3		0.0	64	60	0.36	0.4	-0.025	1.05	0.35175	0.39375	0.042	0.90972				
	0.1		0.0	70	70	0.3	0.3	-0.025	1.05	0.28875	0.28875	0	0.5775	0.799932	0.247833	1.295598	335.00
L.C																	
KM 14	0.0		0.0	70	66	0.3	0.34	-0.025	1.05	0.28875	0.33075	0.042	0.78372				
	0.2		0.0	69	69	0.31	0.31	-0.025	1.05	0.29925	0.29925	0	0.5985			AVERAGE FOR Km.3.4 TO Km.13 =	339.50
	0.4		0.0	66	64	0.34	0.36	-0.025	1.05	0.33075	0.35175	0.021	0.7035				
	0.6		0.0	63	63	0.37	0.37	-0.025	1.05	0.36225	0.36225	0	0.7245				
	0.8		0.0	55	52	0.45	0.48	-0.025	1.05	0.44625	0.47775	0.0315	1.047165				
R.C	0.9		0.0	59	58	0.41	0.42	-0.025	1.05	0.40425	0.41475	0.0105	0.8295				
	0.7		0.0	59	58	0.41	0.42	-0.025	1.05	0.40425	0.41475	0.0105	0.8295				
	0.5		0.0	64	63	0.36	0.37	-0.025	1.05	0.35175	0.36225	0.0105	0.7245				
	0.3		0.0	64	64	0.36	0.36	-0.025	1.05	0.35175	0.35175	0	0.7035				
	0.1		0.0	69	69	0.31	0.31	-0.025	1.05	0.29925	0.29925	0	0.5985	0.754238	0.123366	1.002022	320.00
L.C																	
KM 15	0.0		0.0	71	70	0.29	0.3	-0.025	1.05	0.27825	0.28875	0.0105	0.5775				
	0.2		0.0	74	70	0.26	0.3	-0.025	1.05	0.24675	0.28875	0.042	0.69972				
	0.4		0.0	70	70	0.3	0.3	-0.025	1.05	0.28875	0.28875	0	0.5775				
	0.6		0.0	66	66	0.34	0.34	-0.025	1.05	0.33075	0.33075	0	0.6615				
	0.8		0.0	61	60	0.39	0.4	-0.025	1.05	0.38325	0.39375	0.0105	0.7875				
R.C	0.9		0.0	62	62	0.38	0.38	-0.025	1.05	0.37275	0.37275	0	0.7455				
	0.7		0.0	68	66	0.32	0.34	-0.025	1.05	0.30975	0.33075	0.021	0.6615				
	0.5		0.0	71	71	0.29	0.29	-0.025	1.05	0.27825	0.27825	0	0.5565				
	0.3		0.0	70	70	0.3	0.3	-0.025	1.05	0.28875	0.28875	0	0.5775				
	0.1		0.0	72	72	0.28	0.28	-0.025	1.05	0.26775	0.26775	0	0.5355	0.638022	0.081822	0.801667	225.00
L.C																	
KM 16	0.0	32	0.0	62	60	0.38	0.4	0.015	1.05	0.41475	0.43575	0.021	0.8715				
	0.2		0.0	48	45	0.52	0.55	0.015	1.05	0.56175	0.59325	0.0315	1.273165				
	0.4		0.0	60	59	0.4	0.41	0.015	1.05	0.43575	0.44625	0.0105	0.8925				
	0.6		0.0	50	50	0.5	0.5	0.015	1.05	0.54075	0.54075	0	1.0815				
	0.8		0.0	52	50	0.48	0.5	0.015	1.05	0.51975	0.54075	0.021	1.0815				

R.C	0.9		0.0	40	40	0.6	0.6	0.015	1.05	0.64575	0.64575	0	1.2915				
	0.7		0.0	48	42	0.52	0.58	0.015	1.05	0.56175	0.62475	0.063	1.43283				
	0.5		0.0	50	42	0.5	0.58	0.015	1.05	0.54075	0.62475	0.084	1.49394				
	0.3		0.0	54	50	0.46	0.5	0.015	1.05	0.49875	0.54075	0.042	1.20372				
	0.1		0.0	52	50	0.48	0.5	0.015	1.05	0.51975	0.54075	0.021	1.0815	1.064423	0.335829	1.836082	510.00
L.C																	
KM 17	0.0		0.0	40	31	0.6	0.69	0.015	1.05	0.64575	0.74025	0.0945	1.755495				
	0.2		0.0	65	58	0.35	0.42	0.015	1.05	0.38325	0.45675	0.0735	1.127385				
	0.4		0.0	54	52	0.46	0.48	0.015	1.05	0.49875	0.51975	0.021	1.0395				
	0.6		0.0	64	60	0.36	0.4	0.015	1.05	0.39375	0.43575	0.042	0.99372				
	0.8		0.0	44	36	0.56	0.64	0.015	1.05	0.60375	0.68775	0.084	1.61994				
R.C	0.9		0.0	44	44	0.56	0.56	0.015	1.05	0.60375	0.60375	0	1.2075				
	0.7		0.0	61	60	0.39	0.4	0.015	1.05	0.42525	0.43575	0.0105	0.8715				
	0.5		0.0	64	64	0.36	0.36	0.015	1.05	0.39375	0.39375	0	0.7875				
	0.3		0.0	65	60	0.35	0.4	0.015	1.05	0.38325	0.43575	0.0525	1.024275				
	0.1		0.0	54	52	0.46	0.48	0.015	1.05	0.49875	0.51975	0.021	1.0395	1.146631	0.234073	1.734778	490.00
L.C																	
KM 18	0.0	35	0.0	45	39	0.55	0.61	0.00	1.05	0.5775	0.6405	0.063	1.46433				
	0.2		0.0	45	42	0.55	0.58	0.00	1.05	0.5775	0.609	0.0315	1.309665				
	0.4		0.0	57	53	0.43	0.47	0.00	1.05	0.4515	0.4935	0.042	1.10922				
	0.6		0.0	60	58	0.4	0.42	0.00	1.05	0.42	0.441	0.021	0.882				
	0.8		0.0	65	62	0.35	0.38	0.00	1.05	0.3675	0.399	0.0315	0.889665				
R.C	0.9		0.0	74	70	0.26	0.3	0.00	1.05	0.273	0.315	0.042	0.75222				
	0.7		0.0	61	60	0.39	0.4	0.00	1.05	0.4095	0.42	0.0105	0.84				
	0.5		0.0	60	58	0.4	0.42	0.00	1.05	0.42	0.441	0.021	0.882				
	0.3		0.0	51	50	0.49	0.5	0.00	1.05	0.5145	0.525	0.0105	1.05				
	0.1		0.0	45	40	0.55	0.6	0.00	1.05	0.5775	0.63	0.0525	1.412775	1.059187	0.242547	1.544282	460.00
L.C																	
KM 19	0.0		0.0	89	80	0.11	0.2	0.00	1.05	0.1155	0.21	0.0945	0.694995				
	0.2		0.0	55	53	0.45	0.47	0.00	1.05	0.4725	0.4935	0.021	0.987				
	0.4		0.0	50	50	0.5	0.5	0.00	1.05	0.525	0.525	0	1.05				
	0.6		0.0	77	77	0.23	0.23	0.00	1.05	0.2415	0.2415	0	0.483				
	0.8		0.0	88	86	0.12	0.14	0.00	1.05	0.126	0.147	0.021	0.294				
R.C	0.9		0.0	74	70	0.26	0.3	0.00	1.05	0.273	0.315	0.042	0.75222				
	0.7		0.0	72	70	0.28	0.3	0.00	1.05	0.294	0.315	0.021	0.63				
	0.5		0.0	64	60	0.36	0.4	0.00	1.05	0.378	0.42	0.042	0.96222				
	0.3		0.0	53	50	0.47	0.5	0.00	1.05	0.4935	0.525	0.0315	1.141665				
	0.1		0.0	81	80	0.19	0.2	0.00	1.05	0.1995	0.21	0.0105	0.42	0.74151	0.273759	1.289028	400.00
L.C																	
KM 20	0.0		0.0	68	63	0.32	0.37	0.00	1.05	0.336	0.3885	0.0525	0.929775				
	0.2		0.0	80	76	0.2	0.24	0.00	1.05	0.21	0.252	0.042	0.62622				
	0.4		0.0	76	70	0.24	0.3	0.00	1.05	0.252	0.315	0.063	0.81333				
	0.6		0.0	88	85	0.12	0.15	0.00	1.05	0.126	0.1575	0.0315	0.406665				
	0.8		0.0	81	78	0.19	0.22	0.00	1.05	0.1995	0.231	0.0315	0.553665				
R.C	0.9		0.0	81	78	0.19	0.22	0.00	1.05	0.1995	0.231	0.0315	0.553665				
	0.7		0.0	81	80	0.19	0.2	0.00	1.05	0.1995	0.21	0.0105	0.42				
	0.5		0.0	80	76	0.2	0.24	0.00	1.05	0.21	0.252	0.042	0.62622				
	0.3		0.0	80	78	0.2	0.22	0.00	1.05	0.21	0.231	0.021	0.462				
	0.1		0.0	80	77	0.2	0.23	0.00	1.05	0.21	0.2415	0.0315	0.574665	0.596620	0.157886	0.912392	280.00
L.C																	
KM 21	0.0		0.0	78	72	0.22	0.28	0.00	1.05	0.231	0.294	0.063	0.77133				
	0.2		0.0	62	58	0.38	0.42	0.00	1.05	0.399	0.441	0.042	1.00422				
	0.4		0.0	51	48	0.49	0.52	0.00	1.05	0.5145	0.546	0.0315	1.183665				
	0.6		0.0	50	49	0.5	0.51	0.00	1.05	0.525	0.5355	0.0105	1.071				
	0.8		0.0	55	50	0.45	0.5	0.00	1.05	0.4725	0.525	0.0525	1.202775				

R.C	0.9		0.0	61	60	0.39	0.4	0.00	1.05	0.4095	0.42	0.0105	0.84				
	~~0.7~~		~~0.0~~	~~50~~	~~48~~	~~0.5~~	~~0.52~~	~~0.00~~	~~1.05~~	~~0.525~~	~~0.546~~	~~0.021~~	~~1.092~~				
	0.5		0.0	50	50	0.5	0.5	0.00	1.05	0.525	0.525	0	1.05				
	0.3		0.0	60	59	0.4	0.41	0.00	1.05	0.42	0.4305	0.0105	0.861				
	0.1		0.0	72	70	0.28	0.3	0.00	1.05	0.294	0.315	0.021	0.63	0.970599	0.177859	1.326318	410.00
L.C																	
KM 22	0.0		0.0	52	52	0.48	0.48	0.00	1.05	0.504	0.504	0	1.008				
	0.2		0.0	79	77	0.21	0.23	0.00	1.05	0.2205	0.2415	0.021	0.483				
	0.4		0.0	75	70	0.25	0.3	0.00	1.05	0.2625	0.315	0.0525	0.782775				
	0.6		0.0	72	72	0.28	0.28	0.00	1.05	0.294	0.294	0	0.588				
	0.8		0.0	71	71	0.29	0.29	0.00	1.05	0.3045	0.3045	0	0.609				
R.C	0.9		0.0	66	66	0.34	0.34	0.00	1.05	0.357	0.357	0	0.714				
	0.7		0.0	71	68	0.29	0.32	0.00	1.05	0.3045	0.336	0.0315	0.763665				
	0.5		0.0	72	70	0.28	0.3	0.00	1.05	0.294	0.315	0.021	0.63				
	0.3		0.0	79	79	0.21	0.21	0.00	1.05	0.2205	0.2205	0	0.441				
	0.1		0.0	69	67	0.31	0.33	0.00	1.05	0.3255	0.3465	0.021	0.693	0.671244	0.154155	0.979555	300.00
L.C																	
KM 23	0.0	41	0.0	66	66	0.34	0.34	-0.03	1.05	0.3255	0.3255	0	0.651				
	0.2		0.0	71	70	0.29	0.3	-0.03	1.05	0.273	0.2835	0.0105	0.567				
	0.4		0.0	72	72	0.28	0.28	-0.03	1.05	0.2625	0.2625	0	0.525				
	0.6		0.0	62	58	0.38	0.42	-0.03	1.05	0.3675	0.4095	0.042	0.94122				
	0.8		0.0	66	66	0.34	0.34	-0.03	1.05	0.3255	0.3255	0	0.651				
R.C	0.9		0.0	62	62	0.38	0.38	-0.03	1.05	0.3675	0.3675	0	0.735				
	0.7		0.0	62	58	0.38	0.42	-0.03	1.05	0.3675	0.4095	0.042	0.94122				
	0.5		0.0	66	62	0.34	0.38	-0.03	1.05	0.3255	0.3675	0.042	0.85722				
	0.3		0.0	69	64	0.31	0.36	-0.03	1.05	0.294	0.3465	0.0525	0.845775				
	0.1		0.0	66	62	0.34	0.38	-0.03	1.05	0.3255	0.3675	0.042	0.85722	0.757165	0.144472	1.046110	340.00
L.C																	
KM 24	0.0		0.0	62	60	0.38	0.4	-0.03	1.05	0.3675	0.3885	0.021	0.777				
	0.2		0.0	67	66	0.33	0.34	-0.03	1.05	0.315	0.3255	0.0105	0.651				
	0.4		0.0	71	70	0.29	0.3	-0.03	1.05	0.273	0.2835	0.0105	0.567				
	0.6		0.0	70	68	0.3	0.32	-0.03	1.05	0.2835	0.3045	0.021	0.609				
	0.8		0.0	68	64	0.32	0.36	-0.03	1.05	0.3045	0.3465	0.042	0.81522				
R.C	0.9		0.0	71	68	0.29	0.32	-0.03	1.05	0.273	0.3045	0.0315	0.700665				
	0.7		0.0	70	68	0.3	0.32	-0.03	1.05	0.2835	0.3045	0.021	0.609				
	0.5		0.0	72	72	0.28	0.28	-0.03	1.05	0.2625	0.2625	0	0.525				
	0.3		0.0	64	62	0.36	0.38	-0.03	1.05	0.3465	0.3675	0.021	0.735				
	0.1		0.0	72	70	0.28	0.3	-0.03	1.05	0.2625	0.2835	0.021	0.567	0.655588	0.092559	0.840707	250.00
L.C																	
KM 25	0.0	31	0.0	72	71	0.28	0.29	0.02	1.05	0.315	0.3255	0.0105	0.651				
	0.2		0.0	76	74	0.24	0.26	0.02	1.05	0.273	0.294	0.021	0.588				
	0.4		0.0	80	78	0.2	0.22	0.02	1.05	0.231	0.252	0.021	0.504				
	0.6		0.0	75	72	0.25	0.28	0.02	1.05	0.2835	0.315	0.0315	0.721665				
	0.8		0.0	86	84	0.14	0.16	0.02	1.05	0.168	0.189	0.021	0.378				
R.C	0.9		0.0	64	60	0.36	0.4	0.02	1.05	0.399	0.441	0.042	1.00422				
	0.7		0.0	83	81	0.17	0.19	0.02	1.05	0.1995	0.2205	0.021	0.441				
	0.5		0.0	79	77	0.21	0.23	0.02	1.05	0.2415	0.2625	0.021	0.525				
	0.3		0.0	72	72	0.28	0.28	0.02	1.05	0.315	0.315	0	0.63				
	0.1		0.0	80	80	0.2	0.2	0.02	1.05	0.231	0.231	0	0.462	0.590488	0.170113	0.930715	285.00
L.C																	
KM 26	0.0		0.0	54	48	0.46	0.52	0.02	1.05	0.504	0.567	0.063	1.31733				
	0.2		0.0	82	82	0.18	0.18	0.02	1.05	0.21	0.21	0	0.42				
	0.4		0.0	55	55	0.45	0.45	0.02	1.05	0.4935	0.4935	0	0.987				
	0.6		0.0	60	60	0.4	0.4	0.02	1.05	0.441	0.441	0	0.882				
	0.8		0.0	88	86	0.12	0.14	0.02	1.05	0.147	0.168	0.021	0.336				

R.C	0.9		0.0	84	84	0.16	0.16	0.02	1.05	0.189	0.189	0	0.378				
	0.7		0.0	62	62	0.38	0.38	0.02	1.05	0.42	0.42	0	0.84				
	0.5		0.0	72	70	0.28	0.3	0.02	1.05	0.315	0.336	0.021	0.672				
	0.3		0.0	62	60	0.38	0.4	0.02	1.05	0.42	0.441	0.021	0.882				
	0.1		0.0	81	80	0.19	0.2	0.02	1.05	0.2205	0.231	0.0105	0.462	0.717633	0.303020	1.323673	410.00
L.C																	
KM 27	0.0		0.0	68	67	0.32	0.33	0.02	1.05	0.357	0.3675	0.0105	0.735				
	0.2		0.0	59	55	0.41	0.45	0.02	1.05	0.4515	0.4935	0.042	1.10922				
	0.4		0.0	84	84	0.16	0.16	0.02	1.05	0.189	0.189	0	0.378				
	0.6		0.0	63	62	0.37	0.38	0.02	1.05	0.4095	0.42	0.0105	0.84				
	0.8		0.0	59	57	0.41	0.43	0.02	1.05	0.4515	0.4725	0.021	0.945				
R.C	0.9		0.0	58	53	0.42	0.47	0.02	1.05	0.462	0.5145	0.0525	1.181775				
	0.7		0.0	65	60	0.35	0.4	0.02	1.05	0.3885	0.441	0.0525	1.034775				
	0.5		0.0	68	65	0.32	0.35	0.02	1.05	0.357	0.3885	0.0315	0.868665				
	0.3		0.0	62	59	0.38	0.41	0.02	1.05	0.42	0.4515	0.0315	0.994665				
	0.1		0.0	59	58	0.41	0.42	0.02	1.05	0.4515	0.462	0.0105	0.924	0.90111	0.213816	1.328743	290.00
L.C																	
KM 28	0.0	36	0.0	75	70	0.25	0.3	-0.005	1.05	0.25725	0.30975	0.0525	0.772275				
	0.2		0.0	54	54	0.46	0.46	-0.005	1.05	0.47775	0.47775	0	0.9555				
	0.4		0.0	82	82	0.18	0.18	-0.005	1.05	0.18375	0.18375	0	0.3675				
	0.6		0.0	75	72	0.25	0.28	-0.005	1.05	0.25725	0.28875	0.0315	0.669165				
	0.8		0.0	64	60	0.36	0.4	-0.005	1.05	0.37275	0.41475	0.042	0.95172				
R.C	0.9		0.0	84	80	0.16	0.2	-0.005	1.05	0.16275	0.20475	0.042	0.53172				
	0.7		0.0	64	64	0.36	0.36	-0.005	1.05	0.37275	0.37275	0	0.7455				
	0.5		0.0	80	78	0.2	0.22	-0.005	1.05	0.20475	0.22575	0.021	0.4515				
	0.3		0.0	76	74	0.24	0.26	-0.005	1.05	0.24675	0.26775	0.021	0.5355				
	0.1		0.0	75	70	0.25	0.3	-0.005	1.05	0.25725	0.30975	0.0525	0.772275	0.675265	0.190704	1.056673	340.00
L.C																	
KM 29	0.0		0.0	84	80	0.16	0.2	-0.005	1.05	0.16275	0.20475	0.042	0.53172				
	0.2		0.0	85	82	0.15	0.18	-0.005	1.05	0.15225	0.18375	0.0315	0.459165				
	0.4		0.0	87	85	0.13	0.15	-0.005	1.05	0.13125	0.15225	0.021	0.3045				
	0.6		0.0	70	66	0.3	0.34	-0.005	1.05	0.30975	0.35175	0.042	0.82572				
	0.8		0.0	67	65	0.33	0.35	-0.005	1.05	0.34125	0.36225	0.021	0.7245				
R.C	0.9		0.0	72	70	0.28	0.3	-0.005	1.05	0.28875	0.30975	0.021	0.6195				
	0.7		0.0	70	65	0.3	0.35	-0.005	1.05	0.30975	0.36225	0.0525	0.877275				
	0.5		0.0	81	80	0.19	0.2	-0.005	1.05	0.19425	0.20475	0.0105	0.4095				
	0.3		0.0	85	83	0.15	0.17	-0.005	1.05	0.15225	0.17325	0.021	0.3465				
	0.1		0.0	82	80	0.18	0.2	-0.005	1.05	0.18375	0.20475	0.021	0.4095	0.550788	0.191873	0.934534	285.00
L.C																	
KM 30	0.0	38	0.0	75	70	0.25	0.3	-0.015	1.05	0.24675	0.29925	0.0525	0.751275				
	0.2		0.0	90	86	0.1	0.14	-0.015	1.05	0.08925	0.13125	0.042	0.38472				
	0.4		0.0	90	88	0.1	0.12	-0.015	1.05	0.08925	0.11025	0.021	0.2205				
	0.6		0.0	86	82	0.14	0.18	-0.015	1.05	0.13125	0.17325	0.042	0.46872				
	0.8		0.0	60	58	0.4	0.42	-0.015	1.05	0.40425	0.42525	0.021	0.8505				
R.C	0.9		0.0	72	70	0.28	0.3	-0.015	1.05	0.27825	0.29925	0.021	0.5985				
	0.7		0.0	71	70	0.29	0.3	-0.015	1.05	0.28875	0.29925	0.0105	0.5985				
	0.5		0.0	84	84	0.16	0.16	-0.015	1.05	0.15225	0.15225	0	0.3045				
	0.3		0.0	90	88	0.1	0.12	-0.015	1.05	0.08925	0.11025	0.021	0.2205				
	0.1		0.0	86	84	0.14	0.16	-0.015	1.05	0.13125	0.15225	0.021	0.3045	0.470221	0.210588	0.891398	270.00
L.C																	
KM 31	0.0		0.0	76	70	0.24	0.3	-0.015	1.05	0.23625	0.29925	0.063	0.78183				
	0.2		0.0	64	62	0.36	0.38	-0.015	1.05	0.36225	0.38325	0.021	0.7665				
	0.4		0.0	74	72	0.26	0.28	-0.015	1.05	0.25725	0.27825	0.021	0.5565				
	0.6		0.0	61	60	0.39	0.4	-0.015	1.05	0.39375	0.40425	0.0105	0.8085				
	0.8		0.0	52	52	0.48	0.48	-0.015	1.05	0.48825	0.48825	0	0.9765				

R.C	0.9		0.0	50	46	0.5	0.54	-0.015	1.05	0.50925	0.55125	0.042	1.22472				
	0.7		0.0	52	52	0.48	0.48	-0.015	1.05	0.48825	0.48825	0	0.9765				
	0.5		0.0	65	65	0.35	0.35	-0.015	1.05	0.35175	0.35175	0	0.7035				
	0.3		0.0	80	76	0.2	0.24	-0.015	1.05	0.19425	0.23625	0.042	0.59472				
	0.1		0.0	50	47	0.5	0.53	-0.015	1.05	0.50925	0.54075	0.0315	1.173165	0.856243	0.215976	1.286396	400.00
L.C																	
KM 32	0.0	31.5	0.0	50	46	0.5	0.54	0.0175	1.05	0.543375	0.585375	0.042	1.29297				
	0.2		0.0	74	72	0.26	0.28	0.0175	1.05	0.291375	0.312375	0.021	0.62475				
	0.4		0.0	77	75	0.23	0.25	0.0175	1.05	0.259875	0.280875	0.021	0.56175				
	0.6		0.0	84	82	0.16	0.18	0.0175	1.05	0.186375	0.207375	0.021	0.41475				
	0.8		0.0	71	69	0.29	0.31	0.0175	1.05	0.322875	0.343875	0.021	0.68775				
R.C	0.9		0.0	70	70	0.3	0.3	0.0175	1.05	0.333375	0.333375	0	0.66675				
	0.7		0.0	80	80	0.2	0.2	0.0175	1.05	0.228375	0.228375	0	0.45675				
	0.5		0.0	81	80	0.19	0.2	0.0175	1.05	0.217875	0.228375	0.0105	0.45675				
	0.3		0.0	71	70	0.29	0.3	0.0175	1.05	0.322875	0.333375	0.0105	0.66675				
	0.1		0.0	72	70	0.28	0.3	0.0175	1.05	0.312375	0.333375	0.021	0.66675	0.649572	0.235400	1.120373	360.00
L.C																	
KM 33	0.0		0.0	76	74	0.24	0.26	0.0175	1.05	0.270375	0.291375	0.021	0.58275				
	0.2		0.0	71	70	0.29	0.3	0.0175	1.05	0.322875	0.333375	0.0105	0.66675				
	0.4		0.0	74	72	0.26	0.28	0.0175	1.05	0.291375	0.312375	0.021	0.62475				
	0.6		0.0	66	60	0.34	0.4	0.0175	1.05	0.375375	0.438375	0.063	1.06008				
	0.8		0.0	72	70	0.28	0.3	0.0175	1.05	0.312375	0.333375	0.021	0.66675				
R.C	0.9		0.0	72	72	0.28	0.28	0.0175	1.05	0.312375	0.312375	0	0.62475				
	0.7		0.0	64	60	0.36	0.4	0.0175	1.05	0.396375	0.438375	0.042	0.99897				
	0.3		0.0	69	66	0.31	0.34	0.0175	1.05	0.343875	0.375375	0.0315	0.842415				
	0.1		0.0	72	70	0.28	0.3	0.0175	1.05	0.312375	0.333375	0.021	0.66675	0.748218	0.165592	1.079402	350.00
L.C																	
KM 34	0.0	32	0.0	76	75	0.24	0.25	0.015	1.05	0.26775	0.27825	0.0105	0.5565				
	0.2		0.0	79	77	0.21	0.23	0.015	1.05	0.23625	0.25725	0.021	0.5145				
	0.4		0.0	62	56	0.38	0.44	0.015	1.05	0.41475	0.47775	0.063	1.13883				
	0.6		0.0	55	49	0.45	0.51	0.015	1.05	0.48825	0.55125	0.063	1.28583				
	0.8		0.0	80	80	0.2	0.2	0.015	1.05	0.22575	0.22575	0	0.4515				
R.C	0.9		0.0	74	72	0.26	0.28	0.015	1.05	0.28875	0.30975	0.021	0.6195				
	0.7		0.0	64	62	0.36	0.38	0.015	1.05	0.39375	0.41475	0.021	0.8295				
	0.5		0.0	62	58	0.38	0.42	0.015	1.05	0.41475	0.45675	0.042	1.03572				
	0.3		0.0	71	70	0.29	0.3	0.015	1.05	0.32025	0.33075	0.0105	0.6615				
	0.1		0.0	79	77	0.21	0.23	0.015	1.05	0.23625	0.25725	0.021	0.5145	0.760788	0.280619	1.322008	410.00
L.C																	
KM 35	0.0		0.0	65	65	0.35	0.35	0.015	1.05	0.38325	0.38325	0	0.7665				
	0.2		0.0	90	86	0.1	0.14	0.015	1.05	0.12075	0.16275	0.042	0.44772				
	0.4		0.0	71	66	0.29	0.34	0.015	1.05	0.32025	0.37275	0.0525	0.898275				
	0.6		0.0	72	72	0.28	0.28	0.015	1.05	0.30975	0.30975	0	0.6195				
	0.8		0.0	55	52	0.45	0.48	0.015	1.05	0.48825	0.51975	0.0315	1.131165				
R.C	0.9		0.0	72	70	0.28	0.3	0.015	1.05	0.30975	0.33075	0.021	0.6615				
	0.7		0.0	64	62	0.36	0.38	0.015	1.05	0.39375	0.41475	0.021	0.8295				
	0.5		0.0	72	71	0.28	0.29	0.015	1.05	0.30975	0.32025	0.0105	0.6405				
	0.3		0.0	81	81	0.19	0.19	0.015	1.05	0.21525	0.21525	0	0.4305				
	0.1		0.0	84	82	0.16	0.18	0.015	1.05	0.18375	0.20475	0.021	0.4095	0.683466	0.218138	1.119742	350.00
L.C																	
KM 36	0.0	36	0.0	82	76	0.18	0.24	-0.005	1.05	0.18375	0.24675	0.063	0.67683				
	0.2		0.0	76	72	0.24	0.28	-0.005	1.05	0.24675	0.28875	0.042	0.69972				
	0.4		0.0	64	56	0.36	0.44	-0.005	1.05	0.37275	0.45675	0.084	1.15794				
	0.6		0.0	82	82	0.18	0.18	-0.005	1.05	0.18375	0.18375	0	0.3675				
	0.8		0.0	75	75	0.25	0.25	-0.005	1.05	0.25725	0.25725	0	0.5145				

R.C	0.9		0.0	72	70	0.28	0.3	-0.005	1.05	0.28875	0.30975	0.021	0.6195				
	0.7		0.0	80	78	0.2	0.22	-0.005	1.05	0.20475	0.22575	0.021	0.4515				
	0.5		0.0	66	64	0.34	0.36	-0.005	1.05	0.35175	0.37275	0.021	0.7455				
	0.3		0.0	76	72	0.24	0.28	-0.005	1.05	0.24675	0.28875	0.042	0.69972				
	0.1		0.0	80	78	0.2	0.22	-0.005	1.05	0.20475	0.22575	0.021	0.4515	0.638421	0.211978	1.062377	340.00
L.C																	
KM 37	0.2		0.0	70	70	0.3	0.3	-0.005	1.05	0.30975	0.30975	0	0.6195				
	0.4		0.0	71	65	0.29	0.35	-0.005	1.05	0.29925	0.36225	0.063	0.90783				
	0.6		0.0	70	66	0.3	0.34	-0.005	1.05	0.30975	0.35175	0.042	0.82572				
	0.8		0.0	74	70	0.26	0.3	-0.005	1.05	0.26775	0.30975	0.042	0.74172				
R.C	0.9		0.0	74	72	0.26	0.28	-0.005	1.05	0.26775	0.28875	0.021	0.5775				
	0.7		0.0	72	71	0.28	0.29	-0.005	1.05	0.28875	0.29925	0.0105	0.5985				
	0.5		0.0	70	68	0.3	0.32	-0.005	1.05	0.30975	0.33075	0.021	0.6615				
	0.3		0.0	70	68	0.3	0.32	-0.005	1.05	0.30975	0.33075	0.021	0.6615				
	0.1		0.0	70	69	0.3	0.31	-0.005	1.05	0.30975	0.32025	0.0105	0.6405	0.592696	0.104643	0.901984	285.00
L.C																	
KM 38	0.0	40	0.0	74	70	0.26	0.3	-0.025	1.05	0.24675	0.28875	0.042	0.69972				
	0.2		0.0	65	60	0.35	0.4	-0.025	1.05	0.34125	0.39375	0.0525	0.940275				
	0.4		0.0	70	68	0.3	0.32	-0.025	1.05	0.28875	0.30975	0.021	0.6195				
	0.6		0.0	87	85	0.13	0.15	-0.025	1.05	0.11025	0.13125	0.021	0.2625				
	0.8		0.0	80	80	0.2	0.2	-0.025	1.05	0.18375	0.18375	0	0.3675				
R.C	0.9		0.0	72	70	0.28	0.3	-0.025	1.05	0.26775	0.28875	0.021	0.5775				
	0.7		0.0	84	82	0.16	0.18	-0.025	1.05	0.14175	0.16275	0.021	0.3255				
	0.5		0.0	82	78	0.18	0.22	-0.025	1.05	0.16275	0.20475	0.042	0.53172				
	0.3		0.0	70	68	0.3	0.32	-0.025	1.05	0.28875	0.30975	0.021	0.6195				
	0.1		0.0	74	72	0.26	0.28	-0.025	1.05	0.24675	0.26775	0.021	0.5355	0.547921	0.187619	0.923160	290.00
L.C																	
KM 39	0.0		0.0	75	73	0.25	0.27	-0.025	1.05	0.23625	0.25725	0.021	0.5145				
	0.2		0.0	70	66	0.3	0.34	-0.025	1.05	0.28875	0.33075	0.042	0.78372				
	0.4		0.0	66	56	0.34	0.44	-0.025	1.05	0.33075	0.43575	0.105	1.17705				
	0.6		0.0	68	64	0.32	0.36	-0.025	1.05	0.30975	0.35175	0.042	0.82572				
	0.8		0.0	72	68	0.28	0.32	-0.025	1.05	0.26775	0.30975	0.042	0.74172				
R.C	0.9		0.0	70	67	0.3	0.33	-0.025	1.05	0.28875	0.32025	0.0315	0.732165				
	0.7		0.0	68	64	0.32	0.36	-0.025	1.05	0.30975	0.35175	0.042	0.82572				
	0.5		0.0	66	64	0.34	0.36	-0.025	1.05	0.33075	0.35175	0.021	0.7035				
	0.3		0.0	72	70	0.28	0.3	-0.025	1.05	0.26775	0.28875	0.021	0.5775				
	0.1		0.0	74	72	0.26	0.28	-0.025	1.05	0.24675	0.26775	0.021	0.5355	0.741709	0.181125	1.103960	350.00
L.C																	
KM 40	0.0		0.0	65	65	0.35	0.35	-0.025	1.05	0.34125	0.34125	0	0.6825				
	0.2		0.0	67	65	0.33	0.35	-0.025	1.05	0.32025	0.34125	0.021	0.6825				
	0.4		0.0	64	62	0.36	0.38	-0.025	1.05	0.35175	0.37275	0.021	0.7455				
	0.6		0.0	71	68	0.29	0.32	-0.025	1.05	0.27825	0.30975	0.0315	0.711165				
	0.8		0.0	64	62	0.36	0.38	-0.025	1.05	0.35175	0.37275	0.021	0.7455				
R.C	0.9		0.0	62	62	0.38	0.38	-0.025	1.05	0.37275	0.37275	0	0.7455				
	0.7		0.0	62	62	0.38	0.38	-0.025	1.05	0.37275	0.37275	0	0.7455				
	0.5		0.0	66	60	0.34	0.4	-0.025	1.05	0.33075	0.39375	0.063	0.97083				
	0.3		0.0	71	70	0.29	0.3	-0.025	1.05	0.27825	0.28875	0.0105	0.5775				
	0.1		0.0	72	70	0.28	0.3	-0.025	1.05	0.26775	0.28875	0.021	0.5775	0.718399	0.104400	0.927200	285.00
L.C																	
KM 41	0.0		0.0	71	70	0.29	0.3	-0.025	1.05	0.27825	0.28875	0.0105	0.5775				
	0.2		0.0	65	64	0.35	0.36	-0.025	1.05	0.34125	0.35175	0.0105	0.7035				
	0.4		0.0	64	62	0.36	0.38	-0.025	1.05	0.35175	0.37275	0.021	0.7455				
	0.6		0.0	72	68	0.28	0.32	-0.025	1.05	0.26775	0.30975	0.042	0.74172				
	0.8		0.0	66	64	0.34	0.36	-0.025	1.05	0.33075	0.35175	0.021	0.7035				

R.C	0.9		0.0	62	60	0.38	0.4	-0.025	1.05	0.37275	0.39375	0.021	0.7375				
	0.7		0.0	72	72	0.28	0.28	-0.025	1.05	0.26775	0.26775	0	0.5355				
	0.5		0.0	66	64	0.34	0.36	-0.025	1.05	0.33075	0.35175	0.021	0.7035				
	0.3		0.0	68	66	0.32	0.34	-0.025	1.05	0.30975	0.33075	0.021	0.6615				
	0.1		0.0	71	70	0.29	0.3	-0.025	1.05	0.27825	0.28875	0.0105	0.5775	0.673722	0.079469	0.832650	240.00
L.C																	
KM 42	0.0	36	0.0	75	70	0.25	0.3	-0.005	1.05	0.25725	0.30975	0.0525	0.772275				
	0.2		0.0	76	76	0.24	0.24	-0.005	1.05	0.24675	0.24675	0	0.4935				
	0.4		0.0	88	88	0.12	0.12	-0.005	1.05	0.12075	0.12075	0	0.2415				
	0.6		0.0	70	68	0.3	0.32	-0.005	1.05	0.30975	0.33075	0.021	0.6615				
	0.8		0.0	75	75	0.25	0.25	-0.005	1.05	0.25725	0.25725	0	0.5145				
R.C	0.9		0.0	81	80	0.19	0.2	-0.005	1.05	0.19425	0.20475	0.0105	0.4095				
	0.7		0.0	72	72	0.28	0.29	-0.005	1.05	0.28875	0.28875	0	0.5775				
	0.5		0.0	74	72	0.26	0.28	-0.005	1.05	0.26775	0.28875	0.021	0.5775				
	0.3		0.0	84	82	0.16	0.18	-0.005	1.05	0.16275	0.18375	0.021	0.3675				
	0.1		0.0	72	70	0.28	0.3	-0.005	1.05	0.28875	0.30975	0.021	0.6195	0.523477	0.146225	0.815927	230.00
L.C																	
KM 43	0.0		0.0	82	80	0.18	0.2	-0.005	1.05	0.18375	0.20475	0.021	0.4095				
	0.2		0.0	74	70	0.26	0.3	-0.005	1.05	0.26775	0.30975	0.042	0.74172				
	0.4		0.0	60	56	0.4	0.44	-0.005	1.05	0.41475	0.45675	0.042	1.03572				
	0.6		0.0	72	68	0.28	0.32	-0.005	1.05	0.28875	0.33075	0.042	0.78372				
	0.8		0.0	70	63	0.3	0.37	-0.005	1.05	0.30975	0.38325	0.0735	0.980385				
R.C	0.9		0.0	61	61	0.39	0.39	-0.005	1.05	0.40425	0.40425	0	0.8085				
	0.7		0.0	72	69	0.28	0.31	-0.005	1.05	0.28875	0.32025	0.0315	0.732165				
	0.5		0.0	66	64	0.34	0.36	-0.005	1.05	0.35175	0.37275	0.021	0.7455				
	0.3		0.0	71	70	0.29	0.3	-0.005	1.05	0.29925	0.30975	0.0105	0.6195				
	0.1		0.0	76	74	0.24	0.26	-0.005	1.05	0.24675	0.26775	0.021	0.5355	0.739221	0.178184	1.095599	350.00
L.C																	
KM 44	0.0	36	0.0	63	63	0.37	0.37	-0.005	1.05	0.38325	0.38325	0	0.7665				
	0.2		0.0	65	61	0.35	0.39	-0.005	1.05	0.36225	0.40425	0.042	0.93072				
	0.4		0.0	61	56	0.39	0.44	-0.005	1.05	0.40425	0.45675	0.0525	1.066275				
	0.6		0.0	60	58	0.4	0.42	-0.005	1.05	0.41475	0.43575	0.021	0.8715				
	0.8		0.0	70	64	0.3	0.36	-0.005	1.05	0.30975	0.37275	0.063	0.92883				
R.C	0.9		0.0	81	80	0.19	0.2	-0.005	1.05	0.19425	0.20475	0.0105	0.4095				
	0.7		0.0	70	66	0.3	0.34	-0.005	1.05	0.30975	0.35175	0.042	0.82572				
	0.5		0.0	61	60	0.39	0.4	-0.005	1.05	0.40425	0.41475	0.0105	0.8295				
	0.3		0.0	65	62	0.35	0.38	-0.005	1.05	0.36225	0.39375	0.0315	0.879165				
	0.1		0.0	65	65	0.35	0.35	-0.005	1.05	0.36225	0.36225	0	0.7245	0.823221	0.164747	1.152716	360.00
L.C																	
KM 45	0.0		0.0	85	85	0.15	0.15	-0.005	1.05	0.15225	0.15225	0	0.3045				
	0.2		0.0	88	85	0.12	0.15	-0.005	1.05	0.12075	0.15225	0.0315	0.396165				
	0.4		0.0	62	62	0.38	0.38	-0.005	1.05	0.39375	0.39375	0	0.7875				
	0.6		0.0	70	68	0.3	0.32	-0.005	1.05	0.30975	0.33075	0.021	0.6615				
	0.8		0.0	90	90	0.1	0.1	-0.005	1.05	0.09975	0.09975	0	0.1995				
R.C	0.9		0.0	90	90	0.1	0.1	-0.005	1.05	0.09975	0.09975	0	0.1995				
	0.7		0.0	84	84	0.16	0.16	-0.005	1.05	0.16275	0.16275	0	0.3255				
	0.5		0.0	70	70	0.3	0.3	-0.005	1.05	0.30975	0.30975	0	0.6195				
	0.3		0.0	71	70	0.29	0.3	-0.005	1.05	0.29925	0.30975	0.0105	0.6195				
	0.1		0.0	85	85	0.15	0.15	-0.005	1.05	0.15225	0.15225	0	0.3045	0.441766	0.200414	0.842595	250.00

L.C KM 46	0.0	37	0.0	84	84	0.16	0.16	-0.01	1.05	0.1575	0.1575	0	0.315				
	0.2		0.0	82	80	0.18	0.2	-0.01	1.05	0.1785	0.1995	0.021	0.399				
	0.4		0.0	72	70	0.28	0.3	-0.01	1.05	0.2835	0.3045	0.021	0.609				
	0.6		0.0	76	70	0.24	0.3	-0.01	1.05	0.2415	0.3045	0.063	0.79233				
	0.8		0.0	68	68	0.32	0.32	-0.01	1.05	0.3255	0.3255	0	0.651				
R.C	0.9		0.0	72	70	0.28	0.3	-0.01	1.05	0.2835	0.3045	0.021	0.609				
	0.7		0.0	71	68	0.29	0.32	-0.01	1.05	0.294	0.3255	0.0315	0.742665				
	0.5		0.0	76	74	0.24	0.26	-0.01	1.05	0.2415	0.2625	0.021	0.525				
	0.3		0.0	77	76	0.23	0.24	-0.01	1.05	0.231	0.2415	0.0105	0.483				
	0.1		0.0	82	81	0.18	0.19	-0.01	1.05	0.1785	0.189	0.0105	0.378	0.550399	0.150242	0.850885	255.00
L.C KM 47	0.0		0.0	74	74	0.26	0.26	-0.01	1.05	0.2625	0.2625	0	0.525				
	0.2		0.0	66	66	0.34	0.34	-0.01	1.05	0.3465	0.3465	0	0.693				
	0.4		0.0	52	52	0.48	0.48	-0.01	1.05	0.4935	0.4935	0	0.987				
	0.6		0.0	55	54	0.45	0.46	-0.01	1.05	0.462	0.4725	0.0105	0.945				
	0.8		0.0	55	55	0.45	0.45	-0.01	1.05	0.462	0.462	0	0.924				
									1.05								
R.C	0.9		0.0	70	68	0.3	0.32	-0.01	1.05	0.3045	0.3255	0.021	0.651				
	0.7		0.0	55	50	0.45	0.5	-0.01	1.05	0.462	0.5145	0.0525	1.181775				
	0.5		0.0	52	50	0.48	0.5	-0.01	1.05	0.4935	0.5145	0.021	1.029				
	0.3		0.0	50	50	0.5	0.5	-0.01	1.05	0.5145	0.5145	0	1.029				
	0.1		0.0	66	66	0.34	0.34	-0.01	1.05	0.3465	0.3465	0	0.693	0.965777	0.199865	1.265508	400.00
L.C KM 48	0.0	29	0.0	75	75	0.25	0.25	0.03	1.05	0.294	0.294	0	0.588				
	0.2		0.0	55	50	0.45	0.5	0.03	1.05	0.504	0.5565	0.0525	1.265775				
	0.4		0.0	72	70	0.28	0.3	0.03	1.05	0.3255	0.3465	0.021	0.693				
	0.6		0.0	66	66	0.34	0.34	0.03	1.05	0.3885	0.3885	0	0.777				
	0.8		0.0	67	67	0.33	0.33	0.03	1.05	0.378	0.378	0	0.756				
R.C	0.9		0.0	69	68	0.31	0.32	0.03	1.05	0.357	0.3675	0.0105	0.735				
	0.7		0.0	69	67	0.31	0.33	0.03	1.05	0.357	0.378	0.021	0.756				
	0.5		0.0	74	70	0.26	0.3	0.03	1.05	0.3045	0.3465	0.042	0.81522				
	0.3		0.0	71	70	0.29	0.3	0.03	1.05	0.336	0.3465	0.0105	0.693				
	0.1		0.0	54	52	0.46	0.48	0.03	1.05	0.5145	0.5355	0.021	1.071	0.814999	0.191007	1.197013	380.00
L.C KM 49	0.0		0.0	71	69	0.29	0.31	0.03	1.05	0.336	0.357	0.021	0.714				
	0.2		0.0	72	70	0.28	0.3	0.03	1.05	0.3255	0.3465	0.021	0.693				
	0.4		0.0	72	70	0.28	0.3	0.03	1.05	0.3255	0.3465	0.021	0.693				
	0.6		0.0	71	70	0.29	0.3	0.03	1.05	0.336	0.3465	0.0105	0.693				
	0.8		0.0	79	74	0.21	0.26	0.03	1.05	0.252	0.3045	0.0525	0.761775				
R.C	0.9		0.0	78	72	0.22	0.28	0.03	1.05	0.2625	0.3255	0.063	0.83433				
	0.7		0.0	74	74	0.26	0.26	0.03	1.05	0.3045	0.3045	0	0.609				
	0.5		0.0	78	72	0.22	0.28	0.03	1.05	0.2625	0.3255	0.063	0.83433				
	0.3		0.0	71	68	0.29	0.32	0.03	1.05	0.336	0.3675	0.0315	0.826665				
	0.1		0.0	74	72	0.26	0.28	0.03	1.05	0.3045	0.3255	0.021	0.651	0.73101	0.075735	0.882480	260.00
L.C KM 50	0.0	29	0.0	78	72	0.22	0.28	0.03	1.05	0.2625	0.3255	0.063	0.83433				
	0.2		0.0	77	75	0.23	0.25	0.03	1.05	0.273	0.294	0.021	0.588				
	0.4		0.0	90	88	0.1	0.12	0.03	1.05	0.1365	0.1575	0.021	0.315				
	0.6		0.0	82	80	0.18	0.2	0.03	1.05	0.2205	0.2415	0.021	0.483				
	0.8		0.0	71	68	0.29	0.32	0.03	1.05	0.336	0.3675	0.0315	0.826665				
R.C	0.9		0.0	71	70	0.29	0.3	0.03	1.05	0.336	0.3465	0.0105	0.693				
	0.7		0.0	71	70	0.29	0.3	0.03	1.05	0.336	0.3465	0.0105	0.693				
	0.5		0.0	82	80	0.18	0.2	0.03	1.05	0.2205	0.2415	0.021	0.483				
	0.3		0.0	84	80	0.16	0.2	0.03	1.05	0.1995	0.2415	0.042	0.59522				
	0.1		0.0	81	81	0.19	0.2	0.03	1.05	0.231	0.2415	0.0105	0.483	0.622421	0.156353	0.914139	225.00

L.C																	
KM 51	~~0.0~~		~~0.0~~	~~82~~	~~80~~	~~0.18~~	~~0.2~~	~~0.03~~	~~1.05~~	~~0.2205~~	~~0.2415~~	~~0.021~~	~~0.483~~				
	0.2		0.0	82	82	0.18	0.18	0.03	1.05	0.2205	0.2205	0	0.441				
	0.4		0.0	76	72	0.24	0.28	0.03	1.05	0.2835	0.3255	0.042	0.77322				
	0.6		0.0	77	74	0.23	0.26	0.03	1.05	0.273	0.3045	0.0315	0.700665				
	0.8		0.0	71	69	0.29	0.31	0.03	1.05	0.336	0.357	0.021	0.714				
R.C	0.9		0.0	71	70	0.29	0.3	0.03	1.05	0.336	0.3465	0.0105	0.693				
	0.7		0.0	74	70	0.26	0.3	0.03	1.05	0.3045	0.3465	0.042	0.81522				
	0.5		0.0	76	74	0.24	0.26	0.03	1.05	0.2835	0.3045	0.021	0.609				
	0.3		0.0	81	78	0.19	0.22	0.03	1.05	0.231	0.2625	0.0315	0.616665				
	0.1		0.0	81	80	0.19	0.2	0.03	1.05	0.231	0.2415	0.0105	0.483	0.632877	0.122601	0.878080	260.00
L.C																	
KM 52	0.0	36	0.0	80	80	0.2	0.2	-0.005	1.05	0.20475	0.20475	0	0.4095				
	0.2		0.0	86	86	0.14	0.14	-0.005	1.05	0.14175	0.14175	0	0.2835				
	0.4		0.0	71	66	0.29	0.34	-0.005	1.05	0.29925	0.35175	0.0525	0.856275				
	0.6		0.0	71	68	0.29	0.32	-0.005	1.05	0.29925	0.33075	0.0315	0.753165				
	0.8		0.0	71	71	0.29	0.29	-0.005	1.05	0.29925	0.29925	0	0.5985				
R.C	0.9		0.0	74	70	0.26	0.3	-0.005	1.05	0.26775	0.30975	0.042	0.74172				
	0.7		0.0	71	69	0.29	0.31	-0.005	1.05	0.29925	0.32025	0.021	0.6405				
	0.5		0.0	71	69	0.29	0.31	-0.005	1.05	0.29925	0.32025	0.021	0.6405				
	0.3		0.0	84	84	0.16	0.16	-0.005	1.05	0.16275	0.16275	0	0.3255				
	0.1		0.0	84	82	0.16	0.18	-0.005	1.05	0.16275	0.18375	0.021	0.3675	0.561666	0.190703	0.943072	290.00
L.C																	
KM 53	0.0		0.0	74	74	0.26	0.26	-0.005	1.05	0.26775	0.26775	0	0.5355				
	0.2		0.0	68	68	0.32	0.32	-0.005	1.05	0.33075	0.33075	0	0.6615				
	0.4		0.0	65	65	0.35	0.35	-0.005	1.05	0.36225	0.36225	0	0.7245				
	0.6		0.0	45	45	0.55	0.55	-0.005	1.05	0.57225	0.57225	0	1.1445				
	0.5		0.0	54	52	0.46	0.48	-0.005	1.05	0.47775	0.49875	0.021	0.9975				
	0.3		0.0	68	68	0.32	0.32	-0.005	1.05	0.33075	0.33075	0	0.6615				
	0.1		0.0	69	68	0.31	0.32	-0.005	1.05	0.32025	0.33075	0.0105	0.6615	0.7695	0.201558	1.172617	370.00
L.C																	
KM 69	0.0	34	0.0	66	65	0.34	0.35	0.005	1.05	0.36225	0.37275	0.0105	0.7455				
	0.2		0.0	70	69	0.3	0.31	0.005	1.05	0.32025	0.33075	0.0105	0.6615				
	0.4		0.0	60	58	0.4	0.42	0.005	1.05	0.42525	0.44625	0.021	0.8925				
	0.6		0.0	72	70	0.28	0.3	0.005	1.05	0.29925	0.32025	0.021	0.6405				
	0.8		0.0	66	64	0.34	0.36	0.005	1.05	0.36225	0.38325	0.021	0.7665				
R.C	0.9		0.0	81	78	0.19	0.22	0.005	1.05	0.20475	0.23625	0.0315	0.564165				
	0.7		0.0	80	78	0.2	0.22	0.005	1.05	0.21525	0.23625	0.021	0.4725				
	0.5		0.0	83	82	0.17	0.18	0.005	1.05	0.18375	0.19425	0.0105	0.3885				
	0.3		0.0	77	72	0.23	0.28	0.005	1.05	0.24675	0.29925	0.0525	0.751275				
	0.1		0.0	80	78	0.2	0.22	0.005	1.05	0.21525	0.23625	0.021	0.4725	0.635544	0.151211	0.937967	280.00
L.C																	
KM 70	0.0	34	0.0	60	60	0.4	0.4	0.005	1.05	0.42525	0.42525	0	0.8505				
	0.2		0.0	64	62	0.36	0.38	0.005	1.05	0.38325	0.40425	0.021	0.8085				
	0.4		0.0	64	64	0.36	0.36	0.005	1.05	0.38325	0.38325	0	0.7665				
	0.6		0.0	71	68	0.29	0.32	0.005	1.05	0.30975	0.34125	0.0315	0.774165				
	0.8		0.0	71	67	0.29	0.33	0.005	1.05	0.30975	0.35175	0.042	0.82572				
R.C	0.9		0.0	64	62	0.36	0.38	0.005	1.05	0.38325	0.40425	0.021	0.8085				
	0.7		0.0	77	71	0.23	0.29	0.005	1.05	0.24675	0.30975	0.063	0.80233				
	0.5		0.0	72	70	0.28	0.3	0.005	1.05	0.29925	0.32025	0.021	0.6405				
	0.3		0.0	66	62	0.34	0.38	0.005	1.05	0.36225	0.40425	0.042	0.93072				
	0.1		0.0	61	60	0.39	0.4	0.005	1.05	0.41475	0.42525	0.0105	0.8505	0.805943	0.070633	0.947119	295.00

L.C KM 71	0.0		0.0	70	67	0.3	0.33	0.005	1.05	0.32025	0.35175	0.0315	0.795165				
	0.2		0.0	81	80	0.19	0.2	0.005	1.05	0.20475	0.21525	0.0105	0.4305				
	0.4		0.0	71	67	0.29	0.33	0.005	1.05	0.30975	0.35175	0.042	0.82572				
	0.6		0.0	71	70	0.29	0.3	0.005	1.05	0.30975	0.32025	0.0105	0.6405				
	0.8		0.0	81	79	0.19	0.21	0.005	1.05	0.20475	0.22575	0.021	0.4515				
R.C	0.9		0.0	38	34	0.12	0.16	0.005	1.05	0.13125	0.17325	0.042	0.46872				
	0.7		0.0	82	80	0.18	0.2	0.005	1.05	0.19425	0.21525	0.021	0.4305				
	0.5		0.0	77	74	0.23	0.26	0.005	1.05	0.24675	0.27825	0.0315	0.648165				
	0.3		0.0	84	82	0.16	0.18	0.005	1.05	0.17325	0.19425	0.021	0.3885				
	0.1		0.0	76	72	0.24	0.28	0.005	1.05	0.25725	0.29925	0.042	0.72072	0.579999	0.156541	0.893081	260.00
L.C KM 72	0.0	36	0.0	71	70	0.29	0.3	-0.005	1.05	0.29925	0.30975	0.0105	0.6195				
	0.2		0.0	77	75	0.23	0.25	-0.005	1.05	0.23625	0.25725	0.021	0.5145				
	0.4		0.0	64	60	0.36	0.4	-0.005	1.05	0.37275	0.41475	0.042	0.95172				
	0.6		0.0	42	39	0.58	0.61	-0.005	1.05	0.60375	0.63525	0.0315	1.362165				
	0.8		0.0	52	49	0.48	0.51	-0.005	1.05	0.49875	0.53025	0.0315	1.152165				
R.C	0.9		0.0	72	69	0.28	0.31	-0.005	1.05	0.28875	0.32025	0.0315	0.732165				
	0.7		0.0	71	70	0.29	0.3	-0.005	1.05	0.29925	0.30975	0.0105	0.6195				
	0.5		0.0	51	49	0.49	0.51	-0.005	1.05	0.50925	0.53025	0.021	1.0605				
	0.3		0.0	49	47	0.51	0.53	-0.005	1.05	0.53025	0.55125	0.021	1.1025				
	0.1		0.0	72	71	0.28	0.29	-0.005	1.05	0.28875	0.29925	0.0105	0.5985	0.871321	0.276304	1.423930	420.00
L.C KM 73	0.0		0.0	69	67	0.31	0.33	-0.005	1.05	0.32025	0.34125	0.021	0.6825				
	0.2		0.0	62	58	0.38	0.42	-0.005	1.05	0.39375	0.43575	0.042	0.99372				
	0.4		0.0	71	70	0.29	0.3	-0.005	1.05	0.29925	0.30975	0.0105	0.6195				
	0.6		0.0	72	70	0.28	0.3	-0.005	1.05	0.28875	0.30975	0.021	0.6195				
	0.8		0.0	67	61	0.33	0.39	-0.005	1.05	0.34125	0.40425	0.063	0.99183				
R.C	0.9		0.0	72	64	0.28	0.36	-0.005	1.05	0.28875	0.37275	0.084	0.98994				
	0.7		0.0	72	72	0.28	0.28	-0.005	1.05	0.28875	0.28875	0	0.5775				
	0.5		0.0	71	67	0.29	0.33	-0.005	1.05	0.29925	0.34125	0.042	0.80472				
	0.3		0.0	58	52	0.42	0.48	-0.005	1.05	0.43575	0.49875	0.063	1.18083				
	0.1		0.0	69	61	0.31	0.39	-0.005	1.05	0.32025	0.40425	0.084	1.05294	0.851299	0.205327	1.261953	400.00
L.C KM 74	0.0		0.0	72	64	0.28	0.36	-0.005	1.05	0.28875	0.37275	0.084	0.98994				
	0.2		0.0	62	61	0.38	0.39	-0.005	1.05	0.39375	0.40425	0.0105	0.8085				
	0.4		0.0	77	76	0.23	0.24	-0.005	1.05	0.23625	0.24675	0.0105	0.4935				
	0.6		0.0	72	70	0.28	0.3	-0.005	1.05	0.28875	0.30975	0.021	0.6195				
	0.8		0.0	81	80	0.19	0.2	-0.005	1.05	0.19425	0.20475	0.0105	0.4095				
R.C	0.9		0.0	81	78	0.19	0.22	-0.005	1.05	0.19425	0.22575	0.0315	0.543165				
	0.7		0.0	66	64	0.34	0.36	-0.005	1.05	0.35175	0.37275	0.021	0.7455				
	0.5		0.0	71	68	0.29	0.32	-0.005	1.05	0.29925	0.33075	0.0315	0.753165				
	0.3		0.0	77	72	0.23	0.28	-0.005	1.05	0.23625	0.28875	0.0525	0.730275				
	0.1		0.0	69	64	0.31	0.36	-0.005	1.05	0.32025	0.37275	0.0525	0.898275	0.699132	0.172935	1.045002	340.00
L.C KM 75	0.0		0.0	74	72	0.26	0.28	-0.005	1.05	0.26775	0.28875	0.021	0.5775				
	0.2		0.0	81	80	0.19	0.2	-0.005	1.05	0.19425	0.20475	0.0105	0.4095				
	0.4		0.0	79	76	0.21	0.24	-0.005	1.05	0.21525	0.24675	0.0315	0.585165				
	0.6		0.0	72	69	0.28	0.31	-0.005	1.05	0.28875	0.32025	0.0315	0.732165				
	0.7		0.0	72	72	0.28	0.28	-0.005	1.05	0.28875	0.28875	0	0.5775				
	0.5		0.0	77	71	0.23	0.29	-0.005	1.05	0.23525	0.29925	0.063	0.73183				
	0.3		0.0	80	74	0.2	0.26	-0.005	1.05	0.20475	0.26775	0.063	0.71883				
	0.1		0.0	71	71	0.29	0.29	-0.005	1.05	0.29925	0.29925	0	0.5985	0.622623	0.110725	0.844074	245.00

TABLE No. 4.6

ANALYSIS OF BANKELMAN BEAM DEFLECTION DATA - NH-9

NAME OF ROAD : NH-9
SECTION : VZA-NANDIGAMA

METHOD OF MEASUREMENT : CGRA
NO.OF TRAFFIC:
LANES : TWO

RAINFALL : < 1000
SUBGRADE : CLAYEY

PI : > 15
MOISTURE CONTENT = 12 %

DATE : JAN 93

PERMISSIBLE DEFLECTION : Km 217/0-Km 252/0 = 0.6 mm
PERMISSIBLE DEFLECTION : Km 252/0-Km 265/0 = 0.55 mm

S.NO	CARRIA-GEWAY	LOCATION OF TEST POINT AND IDENTIFI-CATION OF LANE	PAVEMENT TEMPERA-TURE (IN C)	DIAL GAUGE READING			DEFLECTION (mm)		CORRECTIONS (mm)		CORRECTED DEFLECTIONS (mm)			TRUE DEFLECTION mm				
				INITIAL	INTERMEDIATE	FINAL	INTERMEDIATE	FINAL	TEMPERATURE	SEASONAL	INTERMEDIATE Di	FINAL Df	Df-Di	D	MEAN D	STANDARD DEVIATION	CHARACTERISTIC DEFLECTION (mm)	OVERLAY MM
1		2	3	4	5	6	7	8										
	L.C KM 218	0.0	44	0.0	81	80	0.19	0.2	-0.045	1.2	0.174	0.186	0.012	0.372				
		0.2		0.0	79	77	0.21	0.23	-0.045	1.2	0.198	0.222	0.024	0.444				
		0.4		0.0	81	79	0.19	0.21	-0.045	1.2	0.174	0.198	0.024	0.396				
		0.6		0.0	71	70	0.29	0.3	-0.045	1.2	0.294	0.306	0.012	0.612				
		0.8		0.0	62	61	0.38	0.39	-0.045	1.2	0.402	0.414	0.012	0.828				
	R.C	0.9		0.0	66	64	0.34	0.36	-0.045	1.2	0.354	0.378	0.024	0.756				
		0.7		0.0	72	72	0.28	0.28	-0.045	1.2	0.282	0.282	0	0.564				
		0.5		0.0	72	72	0.28	0.28	-0.045	1.2	0.282	0.282	0	0.564				
		0.3		0.0	69	69	0.31	0.31	-0.045	1.2	0.318	0.318	0	0.636				
		0.1		0.0	66	62	0.34	0.38	-0.045	1.2	0.354	0.402	0.048	0.94368	0.611568	0.177500	0.966569	250.00
	L.C KM 219	0.0		0.0	69	68	0.31	0.32	-0.045	1.2	0.318	0.33	0.012	0.66				
		0.2		0.0	62	61	0.38	0.39	-0.045	1.2	0.402	0.414	0.012	0.828				
		0.4		0.0	66	66	0.34	0.34	-0.045	1.2	0.354	0.354	0	0.708				
		0.6		0.0	72	70	0.28	0.3	-0.045	1.2	0.282	0.306	0.024	0.612				
		0.8		0.0	62	62	0.38	0.38	-0.045	1.2	0.402	0.402	0	0.804				
	R.C	0.9		0.0	66	62	0.34	0.38	-0.045	1.2	0.354	0.402	0.048	0.94368				
		0.7		0.0	75	74	0.25	0.26	-0.045	1.2	0.246	0.258	0.012	0.516				
		0.5		0.0	71	70	0.29	0.3	-0.045	1.2	0.294	0.306	0.012	0.612				
		0.3		0.0	75	74	0.25	0.26	-0.045	1.2	0.246	0.258	0.012	0.516.				
		0.1		0.0	71	70	0.29	0.3	-0.045	1.2	0.294	0.306	0.012	0.612	0.631163	0.132529	0.946227	245.00
	L.C KM 220	0.0	44	0.0	61	56	0.39	0.44	-0.045	1.2	0.414	0.474	0.06	1.1226				
		0.2		0.0	68	68	0.32	0.32	-0.045	1.2	0.33	0.33	0	0.66				
		0.4		0.0	71	69	0.29	0.31	-0.045	1.2	0.294	0.318	0.024	0.636				
		0.6		0.0	71	70	0.29	0.3	-0.045	1.2	0.294	0.306	0.012	0.612				
		0.8		0.0	62	61	0.38	0.39	-0.045	1.2	0.402	0.414	0.012	0.828				
	R.C	0.9		0.0	66	64	0.34	0.36	-0.045	1.2	0.354	0.378	0.024	0.756				
		0.7		0.0	72	72	0.28	0.28	-0.045	1.2	0.282	0.282	0	0.564				
		0.5		0.0	72	72	0.28	0.28	-0.045	1.2	0.282	0.282	0	0.564				
		0.3		0.0	69	69	0.31	0.31	-0.045	1.2	0.318	0.318	0	0.636				
		0.1		0.0	66	62	0.34	0.38	-0.045	1.2	0.354	0.402	0.048	0.94368	0.732228	0.173675	1.079579	270.00

L.C																	
KM 221	0.0		0.0	69	68	0.31	0.32	-0.045	1.2	0.318	0.33	0.012	0.66				
	0.2		0.0	62	61	0.38	0.39	-0.045	1.2	0.402	0.414	0.012	0.828				
	0.4		0.0	66	66	0.34	0.34	-0.045	1.2	0.354	0.354	0	0.708				
	0.6		0.0	72	70	0.28	0.3	-0.045	1.2	0.282	0.306	0.024	0.612				
	0.8		0.0	62	62	0.38	0.38	-0.045	1.2	0.402	0.402	0	0.804				
R.C	0.9		0.0	66	62	0.34	0.38	-0.045	1.2	0.354	0.402	0.048	0.94368				
	0.7		0.0	61	58	0.39	0.42	-0.045	1.2	0.414	0.45	0.036	1.00476				
	0.5		0.0	71	70	0.29	0.3	-0.045	1.2	0.294	0.306	0.012	0.612				
	0.3		0.0	62	60	0.38	0.4	-0.045	1.2	0.402	0.426	0.024	0.852				
	0.1		0.0	71	70	0.29	0.3	-0.045	1.2	0.294	0.306	0.012	0.612	0.763644	0.136730	1.037105	265.00
L.C																	
KM 222	0.0		0.0	51	51	0.49	0.49	-0.045	1.2	0.534	0.534	0	1.068				
	0.2		0.0	52	52	0.48	0.48	-0.045	1.2	0.522	0.522	0	1.044				
	0.4		0.0	55	54	0.45	0.46	-0.045	1.2	0.486	0.498	0.012	0.996				
	0.6		0.0	52	50	0.48	0.5	-0.045	1.2	0.522	0.546	0.024	1.092				
	0.8		0.0	55	55	0.45	0.45	-0.045	1.2	0.486	0.486	0	0.972				
R.C	0.9		0.0	55	54	0.45	0.46	-0.045	1.2	0.486	0.498	0.012	0.996				
	0.7		0.0	54	53	0.46	0.47	-0.045	1.2	0.498	0.51	0.012	1.02				
	0.5		0.0	55	54	0.45	0.46	-0.045	1.2	0.486	0.498	0.012	0.996				
	0.3		0.0	52	51	0.48	0.49	-0.045	1.2	0.522	0.534	0.012	1.068				
	0.1		0.0	54	54	0.46	0.46	-0.045	1.2	0.498	0.498	0	0.996	1.0248	0.0384	1.1016	285.00
L.C																	
KM 223	0.0		0.0	50	50	0.5	0.5	-0.045	1.2	0.546	0.546	0	1.092				
	0.2		0.0	55	54	0.45	0.46	-0.045	1.2	0.486	0.498	0.012	0.996				
	0.4		0.0	52	51	0.48	0.49	-0.045	1.2	0.522	0.534	0.012	1.068				
	0.6		0.0	50	49	0.5	0.51	-0.045	1.2	0.546	0.558	0.012	1.116				
	0.8		0.0	62	61	0.38	0.39	-0.045	1.2	0.402	0.414	0.012	0.828				
R.C	0.9		0.0	74	73	0.26	0.27	-0.045	1.2	0.258	0.27	0.012	0.54				
	0.7		0.0	50	50	0.5	0.5	-0.045	1.2	0.546	0.546	0	1.092				
	0.5		0.0	56	55	0.44	0.45	-0.045	1.2	0.474	0.486	0.012	0.972				
	0.3		0.0	57	56	0.43	0.44	-0.045	1.2	0.462	0.474	0.012	0.948				
	0.1		0.0	52	51	0.48	0.49	-0.045	1.2	0.522	0.534	0.012	1.068	0.972	0.166276	1.304553	345.00
L.C																	
KM 224	0.0	42	0.0	50	50	0.5	0.5	-0.035	1.2	0.558	0.558	0	1.116				
	0.2		0.0	50	49	0.5	0.51	-0.035	1.2	0.558	0.57	0.012	1.14				
	0.4		0.0	64	64	0.36	0.36	-0.035	1.2	0.39	0.39	0	0.78				
	0.6		0.0	70	69	0.3	0.31	-0.035	1.2	0.318	0.33	0.012	0.66				
	0.8		0.0	92	92	0.08	0.08	-0.035	1.2	0.054	0.054	0	0.108				
R.C	0.9		0.0														
	0.7		0.0	74	72	0.26	0.28	-0.035	1.2	0.27	0.294	0.024	0.588				
	0.5		0.0	69	69	0.31	0.31	-0.035	1.2	0.33	0.33	0	0.66				
	0.3		0.0	61	60	0.39	0.4	-0.035	1.2	0.426	0.438	0.012	0.876				
	0.1		0.0	50	50	0.5	0.5	-0.035	1.2	0.558	0.558	0	1.116	0.782666	0.313012	1.408691	360.00
L.C																	
KM 225	0.0		0.0	52	50	0.48	0.5	-0.035	1.2	0.534	0.558	0.024	1.116				
	0.2		0.0	68	65	0.32	0.35	-0.035	1.2	0.342	0.378	0.036	0.86076				
	0.4		0.0	48	45	0.52	0.55	-0.035	1.2	0.582	0.618	0.036	1.34076				
	0.6		0.0	54	52	0.46	0.48	-0.035	1.2	0.51	0.534	0.024	1.068				
	0.8		0.0	70	67	0.3	0.33	-0.035	1.2	0.318	0.354	0.036	0.81276				

R.C	0.9		0.0	64	63	0.36	0.37	-0.035	1.2	0.39	0.402	0.012	0.804				
	0.7		0.0	61	59	0.39	0.41	-0.035	1.2	0.426	0.45	0.024	0.9				
	0.5		0.0	68	66	0.32	0.34	-0.035	1.2	0.342	0.366	0.024	0.732				
	0.3		0.0	69	65	0.31	0.35	-0.035	0	0	0	0	0				
	0.1		0.0	70	68	0.3	0.32	-0.035	1.2	0.318	0.342	0.024	0.684	0.831828	0.335547	1.502923	390.00
L.C																	
KM 226	0.0		0.0	86	84	0.14	0.16	-0.035	1.2	0.126	0.15	0.024	0.3				
	0.2		0.0	71	70	0.29	0.3	-0.035	1.2	0.306	0.318	0.012	0.636				
	0.4		0.0	70	69	0.3	0.31	-0.035	1.2	0.318	0.33	0.012	0.66				
	0.6		0.0	72	71	0.28	0.29	-0.035	1.2	0.294	0.306	0.012	0.612				
	0.8		0.0	64	64	0.36	0.36	-0.035	1.2	0.39	0.39	0	0.78				
R.C	0.9		0.0	72	71	0.28	0.29	-0.035	1.2	0.294	0.306	0.012	0.612				
	0.7		0.0	71	70	0.29	0.3	-0.035	1.2	0.306	0.318	0.012	0.636				
	0.5		0.0	71	70	0.29	0.3	-0.035	1.2	0.306	0.318	0.012	0.636				
	0.3		0.0	68	64	0.32	0.36	-0.035	1.2	0.342	0.39	0.048	0.91968				
	0.1		0.0	71	71	0.29	0.29	-0.035	1.2	0.306	0.306	0	0.612	0.640368	0.147044	0.934456	235.00
L.C																	
KM 227	0.0		0.0	75	72	0.25	0.28	-0.035	1.2	0.258	0.294	0.036	0.69276				
	0.2		0.0	65	62	0.35	0.38	-0.035	1.2	0.378	0.414	0.036	0.93276				
	0.4		0.0	82	82	0.18	0.18	-0.035	1.2	0.174	0.174	0	0.348				
	0.6		0.0	60	58	0.4	0.42	-0.035	1.2	0.438	0.462	0.024	0.924				
	0.8		0.0	75	72	0.25	0.28	-0.035	1.2	0.258	0.294	0.036	0.69276				
R.C	0.9		0.0	70	68	0.3	0.32	-0.035	1.2	0.318	0.342	0.024	0.684				
	0.7		0.0	61	56	0.39	0.44	-0.035	1.2	0.426	0.486	0.06	1.1466				
	0.5		0.0	68	65	0.32	0.35	-0.035	1.2	0.342	0.378	0.036	0.86076				
	0.3		0.0	84	83	0.16	0.17	-0.035	1.2	0.15	0.162	0.012	0.324				
	0.1		0.0	78	76	0.22	0.24	-0.035	1.2	0.222	0.246	0.024	0.492	0.709764	0.252507	1.214778	320.00
L.C																	
KM 228	0.0	41	0.0	72	71	0.28	0.29	-0.03	1.2	0.3	0.312	0.012	0.624				
	0.2		0.0	68	65	0.32	0.35	-0.03	1.2	0.348	0.384	0.036	0.87276				
	0.4		0.0	70	70	0.3	0.3	-0.03	1.2	0.324	0.324	0	0.648				
	0.6		0.0	61	68	0.39	0.32	-0.03	1.2	0.432	0.348	-0.084	0.696				
	0.8		0.0	64	61	0.36	0.39	-0.03	1.2	0.396	0.432	0.036	0.96876				
R.C	0.9		0.0	76	75	0.24	0.25	-0.03	1.2	0.252	0.264	0.012	0.528				
	0.7		0.0	65	63	0.35	0.37	-0.03	1.2	0.384	0.408	0.024	0.816				
	0.5		0.0	66	66	0.34	0.34	-0.03	1.2	0.372	0.372	0	0.744				
	0.3		0.0	70	69	0.3	0.31	-0.03	1.2	0.324	0.336	0.012	0.672				
	0.1		0.0	72	71	0.28	0.29	-0.03	1.2	0.3	0.312	0.012	0.624	0.653956	0.239087	1.132130	300.00
L.C																	
KM 229.0	0.0	44	0.0	40	38	0.6	0.62	-0.045	1.2	0.666	0.69	0.024	1.38				
	0.2		0.0	51	48	0.49	0.52	-0.045	1.2	0.534	0.57	0.036	1.24476				
	0.4		0.0	77	75	0.23	0.25	-0.045	1.2	0.222	0.246	0.024	0.492				
	0.6		0.0	55	53	0.45	0.47	-0.045	1.2	0.486	0.51	0.024	1.02				
	0.8		0.0	51	49	0.49	0.51	-0.045	1.2	0.534	0.558	0.024	1.116				
R.C	0.9		0.0	50	46	0.5	0.54	-0.045	1.2	0.546	0.594	0.048	1.32768				
	0.7		0.0	80	75	0.2	0.25	-0.045	1.2	0.186	0.246	0.06	0.6666				
	0.5		0.0	69	66	0.32	0.34	-0.045	1.2	0.33	0.354	0.024	0.708				
	0.3		0.0	62	58	0.38	0.42	-0.045	1.2	0.402	0.45	0.048	1.03968				
	0.1		0.0	69	68	0.31	0.32	-0.045	1.2	0.318	0.33	0.012	0.66	0.965472	0.297535	1.560543	400.00

L.C																	
KM 230	0.0		0.0	76	75	0.24	0.25	-0.045	1.2	0.234	0.246	0.012	0.492				
	0.2		0.0	64	60	0.36	0.4	-0.045	1.2	0.378	0.426	0.048	0.99168				
	0.4		0.0	62	60	0.38	0.4	-0.045	1.2	0.402	0.426	0.024	0.852				
	0.6		0.0	66	62	0.34	0.38	-0.045	1.2	0.354	0.402	0.048	0.94368				
	0.8		0.0	72	70	0.28	0.3	-0.045	1.2	0.282	0.306	0.024	0.612				
R.C	0.9		0.0	38	35	0.62	0.65	-0.045	1.2	0.69	0.726	0.036	1.55676				
	0.7		0.0	77	75	0.23	0.25	-0.045	1.2	0.222	0.246	0.024	0.492				
	0.5		0.0	51	48	0.49	0.52	-0.045	1.2	0.534	0.57	0.036	1.24476				
	0.3		0.0	44	40	0.56	0.6	-0.045	1.2	0.618	0.666	0.048	1.47168				
	0.1		0.0	48	45	0.52	0.55	-0.045	1.2	0.57	0.606	0.036	1.31676	0.997332	0.372082	1.741497	435.00
L.C																	
KM 231	0.0	38	0.0	38	34	0.62	0.66	-0.015	1.2	0.726	0.774	0.048	1.63768				
	0.2		0.0	51	48	0.49	0.52	-0.015	1.2	0.57	0.606	0.036	1.31676				
	0.4		0.0	68	62	0.32	0.38	-0.015	1.2	0.366	0.438	0.072	1.08552				
	0.6		0.0	74	73	0.26	0.27	-0.015	1.2	0.294	0.306	0.012	0.612				
	0.8		0.0	57	54	0.43	0.46	-0.015	1.2	0.498	0.534	0.036	1.17276				
R.C	0.9		0.0	52	50	0.48	0.5	-0.015	1.2	0.558	0.582	0.024	1.164				
	0.7		0.0	50	48	0.5	0.52	-0.015	1.2	0.582	0.606	0.024	1.212				
	0.5		0.0	66	62	0.34	0.38	-0.015	1.2	0.39	0.438	0.048	1.01568				
	0.3		0.0	60	58	0.4	0.42	-0.015	1.2	0.462	0.486	0.024	0.972				
	0.1		0.0	68	65	0.32	0.35	-0.015	1.2	0.366	0.402	0.036	0.90876	1.114716	0.266559	1.647835	420.00
L.C																	
KM 232	0.0		0.0	72	70	0.28	0.3	-0.015	1.2	0.318	0.342	0.024	0.684				
	0.2		0.0	68	66	0.32	0.34	-0.015	1.2	0.366	0.39	0.024	0.78				
	0.4		0.0	62	58	0.38	0.42	-0.015	1.2	0.438	0.486	0.048	1.11168				
	0.6		0.0	70	68	0.3	0.32	-0.015	1.2	0.342	0.366	0.024	0.732				
	0.8		0.0	54	52	0.46	0.48	-0.015	1.2	0.534	0.558	0.024	1.116				
R.C	0.9		0.0	76	74	0.24	0.26	-0.015	1.2	0.27	0.294	0.024	0.588				
	0.7		0.0	70	69	0.3	0.31	-0.015	1.2	0.342	0.354	0.012	0.708				
	0.5		0.0	71	70	0.29	0.3	-0.015	1.2	0.33	0.342	0.012	0.684				
	0.3		0.0	70	69	0.3	0.31	-0.015	1.2	0.342	0.354	0.012	0.708				
	0.1		0.0	56	52	0.44	0.48	-0.015	1.2	0.51	0.558	0.048	1.25568	0.836736	0.220217	1.277170	280.00
L.C																	
KM 233	0.0		0.0	64	61	0.36	0.39	-0.015	1.2	0.414	0.45	0.036	1.00476				
	0.2		0.0	72	72	0.28	0.28	-0.015	1.2	0.318	0.318	0	0.636				
	0.4		0.0	73	73	0.27	0.27	-0.015	1.2	0.306	0.306	0	0.612				
	0.6		0.0	81	80	0.19	0.2	-0.015	1.2	0.21	0.222	0.012	0.444				
	0.8		0.0	74	72	0.26	0.28	-0.015	1.2	0.294	0.318	0.024	0.636				
R.C	0.9		0.0	72	71	0.28	0.29	-0.015	1.2	0.318	0.33	0.012	0.66				
	0.7		0.0	70	69	0.3	0.31	-0.015	1.2	0.342	0.354	0.012	0.708				
	0.5		0.0	76	75	0.24	0.25	-0.015	1.2	0.27	0.282	0.012	0.564				
	0.3		0.0	70	69	0.3	0.31	-0.015	1.2	0.342	0.354	0.012	0.708				
	0.1		0.0	60	60	0.4	0.4	-0.015	1.2	0.462	0.462	0	0.924	0.689676	0.156104	1.001884	265.00

L.C KM 234	0.0	37	0.0	50	48	0.5	0.52	-0.01	1.2	0.588	0.612	0.024	1.224				
	0.2		0.0	48	46	0.52	0.54	-0.01	1.2	0.612	0.636	0.024	1.272				
	0.4		0.0	69	66	0.31	0.34	-0.01	1.2	0.36	0.396	0.036	0.39576				
	0.6		0.0	69	69	0.31	0.31	-0.01	1.2	0.36	0.36	0	0.72				
	0.8		0.0	79	77	0.21	0.23	-0.01	1.2	0.24	0.264	0.024	0.528				
R.C	0.9		0.0	60	58	0.4	0.42	-0.01	1.2	0.468	0.492	0.024	0.984				
	0.7		0.0	71	70	0.29	0.3	-0.01	1.2	0.336	0.348	0.012	0.696				
	0.5		0.0	66	66	0.34	0.34	-0.01	1.2	0.396	0.396	0	0.792				
	0.3		0.0	61	59	0.39	0.41	-0.01	1.2	0.456	0.48	0.024	0.96				
	0.1		0.0	74	74	0.26	0.26	-0.01	1.2	0.3	0.3	0	0.6	0.867276	0.236089	1.339454	350.00
L.C KM 235	0.0		0.0	61	58	0.39	0.42	-0.01	1.2	0.456	0.492	0.036	1.09376				
	0.2		0.0	62	59	0.38	0.41	-0.01	1.2	0.444	0.48	0.036	1.26476				
	0.4		0.0	58	54	0.42	0.46	-0.01	1.2	0.492	0.54	0.048	1.21968				
	0.6		0.0	71	70	0.29	0.3	-0.01	1.2	0.336	0.348	0.012	0.596				
	0.8		0.0	72	70	0.28	0.3	-0.01	1.2	0.324	0.348	0.024	0.696				
R.C	0.9		0.0	75	72	0.25	0.28	-0.01	1.2	0.288	0.324	0.036	0.75276				
	0.7		0.0	64	64	0.36	0.36	-0.01	1.2	0.42	0.42	0	0.84				
	0.5		0.0	60	58	0.4	0.42	-0.01	1.2	0.468	0.492	0.024	0.984				
	0.3		0.0	69	68	0.31	0.32	-0.01	1.2	0.36	0.372	0.012	0.744				
	0.1		0.0	65	62	0.35	0.38	-0.01	1.2	0.408	0.444	0.036	0.99276	0.907872	0.176878	1.261628	320.00
L.C KM 236	0.0	35	0.0	61	58	0.39	0.42	0.00	1.2	0.468	0.504	0.036	1.11276				
	0.2		0.0	71	68	0.29	0.32	0.00	1.2	0.348	0.384	0.036	0.87276				
	0.4		0.0	58	54	0.42	0.46	0.00	1.2	0.504	0.552	0.048	1.24368				
	0.6		0.0	68	66	0.32	0.34	0.00	1.2	0.384	0.408	0.024	0.816				
	0.8		0.0	70	68	0.3	0.32	0.00	1.2	0.36	0.384	0.024	0.758				
R.C	0.9		0.0	71	69	0.29	0.31	0.00	1.2	0.348	0.372	0.024	0.744				
	0.7		0.0	68	65	0.32	0.35	0.00	1.2	0.384	0.42	0.036	0.94476				
	0.5		0.0	72	70	0.28	0.3	0.00	1.2	0.336	0.36	0.024	0.72				
	0.3		0.0	69	67	0.31	0.33	0.00	1.2	0.372	0.396	0.024	0.792				
	0.1		0.0	79	74	0.21	0.26	0.00	1.2	0.252	0.312	0.06	0.7996	0.881256	0.163026	1.207309	320.00
L.C KM 237	0.0		0.0	68	65	0.32	0.35	0.00	1.2	0.384	0.42	0.036	0.94476				
	0.2		0.0	58	56	0.42	0.44	0.00	1.2	0.504	0.528	0.024	1.056				
	0.4		0.0	55	51	0.45	0.49	0.00	1.2	0.54	0.588	0.048	1.31568				
	0.6		0.0	69	67	0.31	0.33	0.00	1.2	0.372	0.396	0.024	0.792				
	0.8		0.0	82	80	0.18	0.2	0.00	1.2	0.216	0.24	0.024	0.48				
R.C	0.9		0.0	68	65	0.32	0.35	0.00	1.2	0.384	0.42	0.036	0.94476				
	0.7		0.0	65	62	0.35	0.38	0.00	1.2	0.42	0.456	0.036	1.01676				
	0.5		0.0	85	85	0.15	0.15	0.00	1.2	0.18	0.18	0	0.36				
	0.3		0.0	64	62	0.36	0.38	0.00	1.2	0.432	0.456	0.024	0.912				
	0.1		0.0	69	65	0.31	0.35	0.00	1.2	0.372	0.42	0.048	0.97968	0.880164	0.264005	1.408174	380.00

L.C KM 238	0.0	34	0.0	69	66	0.31	0.34	0.005	1.2	0.378	0.414	0.036	0.93276				
	0.2		0.0	71	70	0.29	0.3	0.005	1.2	0.354	0.366	0.012	0.732				
	0.4		0.0	76	76	0.24	0.24	0.005	1.2	0.294	0.294	0	0.588				
	0.6		0.0	69	69	0.31	0.31	0.005	1.2	0.378	0.378	0	0.756				
	0.8		0.0	72	70	0.28	0.3	0.005	1.2	0.342	0.366	0.024	0.732				
R.C	0.9		0.0	50	48	0.5	0.52	0.005	1.2	0.606	0.63	0.024	1.26				
	0.7		0.0	62	60	0.38	0.4	0.005	1.2	0.462	0.486	0.024	0.972				
	0.5		0.0	45	42	0.55	0.58	0.005	1.2	0.666	0.702	0.036	1.50876				
	0.3		0.0	52	50	0.48	0.5	0.005	1.2	0.582	0.606	0.024	1.212				
	0.1		0.0	62	59	0.38	0.41	0.005	1.2	0.462	0.498	0.036	1.10076	0.979428	0.274869	1.529167	390.00
L.C KM 239	0.0		0.0	36	33	0.64	0.67	0.005	1.2	0.774	0.81	0.036	1.72476				
	0.2		0.0	48	45	0.52	0.55	0.005	1.2	0.63	0.666	0.036	1.43676				
	0.4		0.0	42	39	0.58	0.61	0.005	1.2	0.702	0.738	0.036	1.53076				
	0.6		0.0	68	66	0.32	0.34	0.005	1.2	0.39	0.414	0.024	0.828				
	0.8		0.0	58	56	0.42	0.44	0.005	1.2	0.51	0.534	0.024	1.068				
R.C	0.9		0.0	61	59	0.39	0.41	0.005	1.2	0.474	0.498	0.024	0.996				
	0.7		0.0	64	62	0.36	0.38	0.005	1.2	0.438	0.462	0.024	0.924				
	0.5		0.0	60	60	0.4	0.4	0.005	1.2	0.486	0.486	0	0.972				
	0.3		0.0	61	58	0.39	0.42	0.005	1.2	0.474	0.51	0.036	1.12476				
	0.1		0.0	70	70	0.3	0.3	0.005	1.2	0.366	0.366	0	0.732	1.138704	0.314500	1.767704	430.00
L.C KM 240	0.0	46	0.0	64	61	0.36	0.39	0.005	1.2	0.438	0.474	0.036	1.05276				
	0.2		0.0	68	65	0.32	0.35	0.005	1.2	0.39	0.426	0.036	0.95676				
	0.4		0.0	55	52	0.45	0.48	0.005	1.2	0.546	0.582	0.036	1.26876				
	0.6		0.0	54	53	0.46	0.47	0.005	1.2	0.558	0.57	0.012	1.14				
	0.8		0.0	69	67	0.31	0.33	0.005	1.2	0.378	0.402	0.024	0.804				
R.C	0.9		0.0	72	70	0.28	0.3	0.005	1.2	0.342	0.366	0.024	0.732				
	0.7		0.0	51	49	0.49	0.51	0.005	1.2	0.594	0.618	0.024	1.236				
	0.5		0.0	49	45	0.51	0.55	0.005	1.2	0.618	0.666	0.048	1.47168				
	0.3		0.0	62	58	0.38	0.42	0.005	1.2	0.462	0.51	0.048	1.15968				
	0.1		0.0	50	48	0.5	0.52	0.005	1.2	0.606	0.63	0.024	1.26	1.108164	0.214710	1.537585	390.00
L.C KM 241	0.0	46	0.0	51	49	0.49	0.51	-0.055	1.2	0.522	0.546	0.024	1.092				
	0.2		0.0	71	71	0.29	0.29	-0.055	1.2	0.282	0.282	0	0.564				
	0.4		0.0	59	57	0.41	0.43	-0.055	1.2	0.426	0.45	0.024	0.9				
	0.6		0.0	62	61	0.38	0.39	-0.055	1.2	0.39	0.402	0.012	0.804				
	0.8		0.0	49	47	0.51	0.53	-0.055	1.2	0.546	0.57	0.024	1.14				
R.C	0.9		0.0	52	49	0.48	0.51	-0.055	1.2	0.51	0.546	0.036	1.19676				
	0.7		0.0	62	58	0.38	0.42	-0.055	1.2	0.39	0.438	0.048	1.01568				
	0.5		0.0	66	62	0.34	0.38	-0.055	1.2	0.342	0.39	0.048	0.91968				
	0.3		0.0	72	72	0.28	0.28	-0.055	1.2	0.27	0.27	0	0.54				
	0.1		0.0	59	57	0.41	0.43	-0.055	1.2	0.426	0.45	0.024	0.9	0.907212	0.211539	1.330291	340.00
L.C KM 242	0.0	44	0.0	49	46	0.51	0.54	-0.045	1.2	0.558	0.594	0.036	1.29276				
	0.2		0.0	59	59	0.41	0.41	-0.045	1.2	0.438	0.438	0	0.876				
	0.4		0.0	69	69	0.31	0.31	-0.045	1.2	0.318	0.318	0	0.636				
	0.6		0.0	52	51	0.48	0.49	-0.045	1.2	0.522	0.534	0.012	1.068				
	0.8		0.0	62	60	0.38	0.4	-0.045	1.2	0.402	0.426	0.024	0.852				

R.C	0.9		0.0	65	62	0.35	0.38	-0.045	1.2	0.366	0.402	0.036	0.90876				
	0.7		0.0	56	54	0.44	0.46	-0.045	1.2	0.474	0.498	0.024	0.996				
	0.5		0.0	45	42	0.55	0.58	-0.045	1.2	0.606	0.642	0.036	1.38876				
	0.3		0.0	62	62	0.38	0.38	-0.045	1.2	0.402	0.402	0	0.804				
	0.1		0.0	59	55	0.41	0.45	-0.045	1.2	0.438	0.486	0.048	1.11168	0.993396	0.216803	1.427002	360.00
L.C																	
KM 243	0.0	42	0.0	71	70	0.29	0.3	-0.035	1.2	0.306	0.318	0.012	0.636				
	0.2		0.0	76	76	0.24	0.24	-0.035	1.2	0.246	0.246	0	0.492				
	0.4		0.0	72	70	0.28	0.3	-0.035	1.2	0.294	0.318	0.024	0.636				
	0.6		0.0	69	69	0.31	0.31	-0.035	1.2	0.33	0.33	0	0.66				
	0.8		0.0	54	50	0.46	0.5	-0.035	1.2	0.51	0.558	0.048	1.25568				
R.C	0.9		0.0	62	60	0.38	0.4	-0.035	1.2	0.414	0.438	0.024	0.876				
	0.7		0.0	62	60	0.38	0.4	-0.035	1.2	0.414	0.438	0.024	0.876				
	0.5		0.0	52	60	0.38	0.4	-0.035	1.2	0.414	0.438	0.024	0.876				
	0.3		0.0	77	76	0.23	0.24	-0.035	1.2	0.234	0.246	0.012	0.492				
	0.1		0.0	72	70	0.28	0.3	-0.035	1.2	0.294	0.318	0.024	0.636	0.743568	0.219805	1.183178	310.00
L.C																	
KM 244	0.0		0.0	80	78	0.2	0.22	-0.035	1.2	0.198	0.222	0.024	0.444				
	0.2		0.0	72	71	0.28	0.29	-0.035	1.2	0.294	0.306	0.012	0.612				
	0.4		0.0	72	72	0.28	0.28	-0.035	1.2	0.294	0.294	0	0.588				
	0.6		0.0	82	80	0.18	0.2	-0.035	1.2	0.174	0.198	0.024	0.396				
	0.8		0.0	62	62	0.38	0.38	-0.035	1.2	0.414	0.414	0	0.828				
R.C	0.9		0.0	69	60	0.31	0.4	-0.035	1.2	0.33	0.438	0.108	1.19023				
	0.7		0.0	65	60	0.35	0.4	-0.035	1.2	0.378	0.438	0.06	1.0506				
	0.5		0.0	69	69	0.31	0.31	-0.035	1.2	0.33	0.33	0	0.66				
	0.3		0.0	70	70	0.3	0.3	-0.035	1.2	0.318	0.318	0	0.636				
	0.1		0.0	76	74	0.24	0.26	-0.035	1.2	0.246	0.27	0.024	0.54	0.694488	0.242674	1.179837	305.00
L.C																	
KM 245	0.0		0.0	60	59	0.4	0.41	-0.035	1.2	0.438	0.45	0.012	0.9				
	0.2		0.0	82	82	0.18	0.18	-0.035	1.2	0.174	0.174	0	0.348				
	0.4		0.0	72	70	0.28	0.3	-0.035	1.2	0.294	0.318	0.024	0.636				
	0.6		0.0	58	56	0.42	0.44	-0.035	1.2	0.462	0.486	0.024	0.972				
	0.8		0.0	80	72	0.2	0.28	-0.035	1.2	0.198	0.294	0.096	0.86736				
R.C	0.9		0.0	80	80	0.2	0.2	-0.035	1.2	0.198	0.198	0	0.396				
	0.7		0.0	64	60	0.36	0.4	-0.035	1.2	0.39	0.438	0.048	1.01568				
	0.5		0.0	61	60	0.39	0.4	-0.035	1.2	0.426	0.438	0.012	0.876				
	0.3		0.0	81	80	0.19	0.2	-0.035	1.2	0.186	0.198	0.012	0.396				
	0.1		0.0	70	70	0.3	0.3	-0.035	1.2	0.318	0.318	0	0.636	0.704304	0.242768	1.189841	310.00
L.C																	
KM 246	0.0		0.0	71	70	0.29	0.3	-0.035	1.2	0.306	0.318	0.012	0.636				
	0.2		0.0	88	88	0.12	0.12	-0.035	1.2	0.102	0.102	0	0.204				
	0.4		0.0	53	51	0.47	0.49	-0.035	1.2	0.522	0.546	0.024	1.092				
	0.6		0.0	41	40	0.59	0.6	-0.035	1.2	0.666	0.678	0.012	1.356				
	0.8		0.0	82	80	0.18	0.2	-0.035	1.2	0.174	0.198	0.024	0.396				
R.C	0.9		0.0	80	80	0.2	0.2	-0.035	1.2	0.198	0.198	0	0.396				
	0.7		0.0	52	50	0.48	0.5	-0.035	1.2	0.534	0.558	0.024	1.116				
	0.5		0.0	41	40	0.59	0.6	-0.035	1.2	0.666	0.678	0.012	1.356				
	0.3		0.0	72	72	0.28	0.28	-0.035	1.2	0.294	0.294	0	0.588				
	0.1		0.0	81	80	0.19	0.2	-0.035	1.2	0.186	0.198	0.012	0.396	0.7536	0.412136	1.577873	395.00

L.C KM 247	0.0	41	0.0	87	86	0.13	0.14	-0.03	1.2	0.12	0.132	0.012	0.264				
	0.2		0.0	82	81	0.18	0.19	-0.03	1.2	0.18	0.192	0.012	0.384				
	0.4		0.0	52	48	0.48	0.52	-0.03	1.2	0.54	0.588	0.048	1.31568				
	0.6		0.0	72	70	0.28	0.3	-0.03	1.2	0.3	0.324	0.024	0.648				
	0.8		0.0	79	79	0.21	0.21	-0.03	1.2	0.216	0.216	0	0.432				
R.C	0.9		0.0	80	79	0.2	0.21	-0.03	1.2	0.204	0.216	0.012	0.432				
	0.7		0.0	78	77	0.22	0.23	-0.03	1.2	0.228	0.24	0.012	0.48				
	0.5		0.0	75	74	0.25	0.26	-0.03	1.2	0.264	0.276	0.012	0.552				
	0.3		0.0	78	77	0.22	0.23	-0.03	1.2	0.228	0.24	0.012	0.48				
	0.1		0.0	71	70	0.29	0.3	-0.03	1.2	0.312	0.324	0.012	0.648	0.563568	0.273977	1.111523	290.00
L.C KM 248	0.0		0.0	62	59	0.38	0.41	-0.03	1.2	0.42	0.456	0.036	1.01676				
	0.2		0.0	66	65	0.34	0.35	-0.03	1.2	0.372	0.384	0.012	0.768				
	0.4		0.0	45	42	0.55	0.58	-0.03	1.2	0.624	0.66	0.036	1.42476				
	0.6		0.0	52	48	0.48	0.52	-0.03	1.2	0.54	0.588	0.048	1.31568				
	0.8		0.0	70	69	0.3	0.31	-0.03	1.2	0.324	0.336	0.012	0.672				
R.C	0.9		0.0	55	54	0.45	0.46	-0.03	1.2	0.504	0.516	0.012	1.032				
	0.7		0.0	58	56	0.42	0.44	-0.03	1.2	0.468	0.492	0.024	0.984				
	0.5		0.0	62	59	0.38	0.41	-0.03	1.2	0.42	0.456	0.036	1.01676				
	0.3		0.0	67	65	0.33	0.35	-0.03	1.2	0.36	0.384	0.024	0.768				
	0.1		0.0	50	48	0.5	0.52	-0.03	1.2	0.564	0.588	0.024	1.176	1.017396	0.229150	1.475696	380.00
L.C KM 249	0.0	28	0.0	82	81	0.18	0.19	0.035	1.2	0.258	0.27	0.012	0.54				
	0.2		0.0	64	62	0.36	0.38	0.035	1.2	0.474	0.498	0.024	0.996				
	0.4		0.0	68	65	0.32	0.35	0.035	1.2	0.426	0.462	0.036	1.02876				
	0.6		0.0	69	67	0.31	0.33	0.035	1.2	0.414	0.438	0.024	0.876				
	0.8		0.0	72	71	0.28	0.29	0.035	1.2	0.378	0.39	0.012	0.78				
R.C	0.9		0.0	70	70	0.3	0.3	0.035	1.2	0.402	0.402	0	0.804				
	0.7		0.0	78	76	0.22	0.24	0.035	1.2	0.306	0.33	0.024	0.66				
	0.5		0.0	74	72	0.26	0.28	0.035	1.2	0.354	0.378	0.024	0.756				
	0.3		0.0	56	52	0.44	0.48	0.035	1.2	0.57	0.618	0.048	1.37568				
	0.1		0.0	79	77	0.21	0.23	0.035	1.2	0.294	0.318	0.024	0.636	0.845244	0.228890	1.303024	340.00
L.C KM 250	0.0		0.0	87	85	0.13	0.15	0.035	1.2	0.198	0.222	0.024	0.444				
	0.2		0.0	75	75	0.25	0.25	0.035	1.2	0.342	0.342	0	0.684				
	0.4		0.0	83	81	0.17	0.19	0.035	1.2	0.246	0.27	0.024	0.54				
	0.6		0.0	82	80	0.18	0.2	0.035	1.2	0.258	0.282	0.024	0.564				
	0.8		0.0	50	48	0.5	0.52	0.035	1.2	0.642	0.666	0.024	1.332				
	0.9		0.0	40	40	0.6	0.6	0.035	1.2	0.762	0.762	0	1.524				
	0.7		0.0	74	72	0.26	0.28	0.035	1.2	0.354	0.378	0.024	0.756				
	0.5		0.0	80	80	0.2	0.2	0.035	1.2	0.282	0.282	0	0.564				
	0.3		0.0	70	70	0.3	0.3	0.035	1.2	0.402	0.402	0	0.804				
	0.1		0.0	82	82	0.18	0.18	0.035	1.2	0.258	0.258	0	0.516	0.7728	0.346640	1.466080	370.00

L.C																	
KM. 251	0.0	43	0.0	72	71	0.28	0.29	-0.04	1.2	0.288	0.3	0.012	0.6				
	0.2		0.0	82	80	0.18	0.2	-0.04	1.2	0.168	0.192	0.024	0.384				
	0.4		0.0	75	74	0.25	0.26	-0.04	1.2	0.252	0.264	0.012	0.528				
	0.6		0.0	51	50	0.49	0.5	-0.04	1.2	0.54	0.552	0.012	1.104				
	0.8		0.0	50	48	0.5	0.52	-0.04	1.2	0.552	0.576	0.024	1.152				
	0.9		0.0	62	62	0.38	0.38	-0.04	1.2	0.408	0.408	0	0.816				
	0.7		0.0	50	49	0.5	0.51	-0.04	1.2	0.552	0.564	0.012	1.128				
	0.5		0.0	54	52	0.46	0.48	-0.04	1.2	0.504	0.528	0.024	1.056				
	0.3		0.0	68	67	0.32	0.33	-0.04	1.2	0.336	0.348	0.012	0.696				
	0.1		0.0	68	67	0.32	0.33	-0.04	1.2	0.336	0.348	0.012	0.696	0.816	0.263781	1.343563	350.00
L.C																AVERAGE FOR SECTION I =	335.15
KM 252	0.0		0.0	62	62	0.38	0.38	-0.04	1.2	0.408	0.408	0	0.816				
	0.2		0.0	55	55	0.45	0.45	-0.04	1.2	0.492	0.492	0	0.984				
	0.4		0.0	61	60	0.39	0.4	-0.04	1.2	0.42	0.432	0.012	0.864				
	0.6		0.0	77	75	0.23	0.25	-0.04	1.2	0.228	0.252	0.024	0.504				
	0.8		0.0	82	82	0.18	0.18	-0.04	1.2	0.168	0.168	0	0.336				
R.C	0.9		0.0	85	80	0.15	0.2	-0.04	1.2	0.132	0.192	0.06	0.5586				
	0.7		0.0	85	80	0.15	0.2	-0.04	1.2	0.132	0.192	0.06	0.5586				
	0.5		0.0	62	62	0.38	0.38	-0.04	1.2	0.408	0.408	0	0.816				
	0.3		0.0	60	59	0.4	0.41	-0.04	1.2	0.432	0.444	0.012	0.888				
	0.1		0.0	64	64	0.36	0.36	-0.04	1.2	0.384	0.384	0	0.768	0.70932	0.196077	1.101474	350.00
L.C																	
KM 253	0.0	39	0.0	76	74	0.24	0.26	-0.02	1.2	0.264	0.288	0.024	0.576				
	0.2		0.0	60	58	0.4	0.42	-0.02	1.2	0.456	0.48	0.024	0.96				
	0.4		0.0	65	65	0.35	0.35	-0.02	1.2	0.396	0.396	0	0.792				
	0.6		0.0	64	64	0.36	0.36	-0.02	1.2	0.408	0.408	0	0.816				
	0.8		0.0	60	60	0.4	0.4	-0.02	1.2	0.456	0.456	0	0.912				
R.C	0.9		0.0	62	62	0.38	0.38	-0.02	1.2	0.432	0.432	0	0.864				
	0.7		0.0	72	70	0.28	0.3	-0.02	1.2	0.312	0.336	0.024	0.672				
	0.5		0.0	62	62	0.38	0.38	-0.02	1.2	0.432	0.432	0	0.864				
	0.3		0.0	60	58	0.4	0.42	-0.02	1.2	0.456	0.48	0.024	0.96				
	0.1		0.0	64	64	0.36	0.36	-0.02	1.2	0.408	0.408	0	0.816	0.8232	0.115624	1.054448	330.00
L.C																	
KM 254	0.0		0.0	72	70	0.28	0.3	-0.02	1.2	0.312	0.336	0.024	0.672				
	0.2		0.0	82	80	0.18	0.2	-0.02	1.2	0.192	0.216	0.024	0.432				
	0.4		0.0	87	85	0.13	0.15	-0.02	1.2	0.132	0.156	0.024	0.312				
	0.6		0.0	76	76	0.24	0.24	-0.02	1.2	0.264	0.264	0	0.528				
	0.8		0.0	65	62	0.35	0.38	-0.02	1.2	0.396	0.432	0.036	0.96876				
R.C	0.9		0.0	62	60	0.38	0.4	-0.02	1.2	0.432	0.456	0.024	0.912				
	0.7		0.0	67	65	0.33	0.35	-0.02	1.2	0.372	0.396	0.024	0.792				
	0.5		0.0	86	86	0.14	0.14	-0.02	1.2	0.144	0.144	0	0.288				
	0.3		0.0	84	82	0.16	0.18	-0.02	1.2	0.168	0.192	0.024	0.384				
	0.1		0.0	80	70	0.2	0.3	-0.02	1.2	0.216	0.336	0.12	1.0212	0.630996	0.265241	1.161478	370.00
L.C																	
KM 255	0.0		0.0	65	63	0.35	0.37	-0.02	1.2	0.396	0.42	0.024	0.84				
	0.2		0.0	78	78	0.22	0.22	-0.02	1.2	0.24	0.24	0	0.48				
	0.4		0.0	72	70	0.28	0.3	-0.02	1.2	0.312	0.336	0.024	0.672				
	0.6		0.0	75	72	0.25	0.28	-0.02	1.2	0.276	0.312	0.036	0.72876				
	0.8		0.0	76	76	0.24	0.24	-0.02	1.2	0.264	0.264	0	0.528				

R.C	0.9		0.0	74	74	0.26	0.26	-0.02	1.2	0.288	0.288	0	0.576				
	0.7		0.0	72	72	0.28	0.28	-0.02	1.2	0.312	0.312	0	0.624				
	0.5		0.0	72	70	0.28	0.3	-0.02	1.2	0.312	0.336	0.024	0.672				
	0.3		0.0	72	70	0.28	0.3	-0.02	1.2	0.312	0.336	0.024	0.672				
	0.1		0.0	68	68	0.32	0.32	-0.02	1.2	0.36	0.36	0	0.72	0.651276	0.099284	0.849845	245.00
L.C KM 256	0.0	33	0.0	68	65	0.32	0.35	0.01	1.2	0.396	0.432	0.036	0.96876				
	0.2		0.0	82	80	0.18	0.2	0.01	1.2	0.228	0.252	0.024	0.504				
	0.4		0.0	83	81	0.17	0.19	0.01	1.2	0.216	0.24	0.024	0.48				
	0.6		0.0	80	78	0.2	0.22	0.01	1.2	0.252	0.276	0.024	0.552				
	0.8		0.0	62	62	0.38	0.38	0.01	1.2	0.468	0.468	0	0.936				
R.C	0.9		0.0	80	78	0.2	0.22	0.01	1.2	0.252	0.276	0.024	0.552				
	0.7		0.0	80	78	0.2	0.22	0.01	1.2	0.252	0.276	0.024	0.552				
	0.5		0.0	80	79	0.2	0.21	0.01	1.2	0.252	0.264	0.012	0.528				
	0.3		0.0	82	82	0.18	0.18	0.01	1.2	0.228	0.228	0	0.456				
	0.1		0.0	70	70	0.3	0.3	0.01	1.2	0.372	0.372	0	0.744	0.627276	0.178500	0.984276	315.00
L.C KM 257	0.0		0.0	65	65	0.35	0.35	0.01	1.2	0.432	0.432	0	0.864				
	0.2		0.0	66	64	0.34	0.36	0.01	1.2	0.42	0.444	0.024	0.888				
	0.4		0.0	65	65	0.35	0.35	0.01	1.2	0.432	0.432	0	0.864				
	0.6		0.0	85	85	0.15	0.15	0.01	1.2	0.192	0.192	0	0.384				
	0.8		0.0	78	78	0.22	0.22	0.01	1.2	0.276	0.276	0	0.552				
R.C	0.9		0.0	70	67	0.3	0.33	0.01	1.2	0.372	0.408	0.036	0.92076				
	0.7		0.0	77	75	0.23	0.25	0.01	1.2	0.288	0.312	0.024	0.624				
	0.5		0.0	74	72	0.26	0.28	0.01	1.2	0.324	0.348	0.024	0.696				
	0.3		0.0	64	64	0.36	0.36	0.01	1.2	0.444	0.444	0	0.888				
	0.1		0.0	66	64	0.34	0.36	0.01	1.2	0.42	0.444	0.024	0.888	0.756876	0.174287	1.105451	350.00
L.C KM 258	0.0		0.0	62	62	0.38	0.38	0.01	1.2	0.468	0.468	0	0.936				
	0.2		0.0	60	60	0.4	0.4	0.01	1.2	0.492	0.492	0	0.984				
	0.4		0.0	62	60	0.38	0.4	0.01	1.2	0.468	0.492	0.024	0.984				
	0.6		0.0	81	79	0.19	0.21	0.01	1.2	0.24	0.264	0.024	0.528				
	0.8		0.0	80	79	0.2	0.21	0.01	1.2	0.252	0.264	0.012	0.528				
R.C	0.9		0.0	52	52	0.48	0.48	0.01	1.2	0.588	0.588	0	1.176				
	0.7		0.0	80	80	0.2	0.2	0.01	1.2	0.252	0.252	0	0.504				
	0.5		0.0	74	66	0.26	0.34	0.01	1.2	0.324	0.42	0.096	1.11936				
	0.3		0.0	60	58	0.4	0.42	0.01	1.2	0.492	0.516	0.024	1.032				
	0.1		0.0	60	60	0.4	0.4	0.01	1.2	0.492	0.492	0	0.984	0.877536	0.243458	1.364453	410.00
L.C KM 259	0.0	35	0.0	52	50	0.48	0.5	0.00	1.2	0.576	0.6	0.024	1.2				
	0.2		0.0	64	64	0.36	0.36	0.00	1.2	0.432	0.432	0	0.864				
	0.4		0.0	88	88	0.12	0.12	0.00	1.2	0.144	0.144	0	0.288				
	0.6		0.0	75	72	0.25	0.28	0.00	1.2	0.3	0.336	0.036	0.77676				
	0.8		0.0	81	81	0.19	0.19	0.00	1.2	0.228	0.228	0	0.456				
R.C	0.9		0.0	81	80	0.19	0.2	0.00	1.2	0.228	0.24	0.012	0.48				
	0.7		0.0	75	73	0.25	0.27	0.00	1.2	0.3	0.324	0.024	0.648				
	0.5		0.0	75	73	0.25	0.27	0.00	1.2	0.3	0.324	0.024	0.648				
	0.3		0.0	72	70	0.29	0.3	0.00	1.2	0.336	0.36	0.024	0.72				
	0.1		0.0	61	60	0.39	0.4	0.00	1.2	0.468	0.48	0.012	0.96	0.734076	0.251735	1.207547	389.00

L.C																
KM 260	0.0	0.0	74	74	0.26	0.26	0.00	1.2	0.312	0.312	0	0.624				
	0.2	0.0	83	80	0.17	0.2	0.00	1.2	0.204	0.24	0.036	0.58476				
	0.4	0.0	76	76	0.24	0.24	0.00	1.2	0.288	0.288	0	0.576				
	0.6	0.0	82	80	0.18	0.2	0.00	1.2	0.216	0.24	0.024	0.48				
	0.8	0.0	70	70	0.3	0.3	0.00	1.2	0.36	0.36	0	0.72				
R.C	0.9	0.0	70	66	0.3	0.34	0.00	1.2	0.36	0.408	0.048	0.95568				
	0.7	0.0	72	66	0.28	0.34	0.00	1.2	0.336	0.408	0.072	1.02552				
	0.5	0.0	82	76	0.18	0.24	0.00	1.2	0.216	0.288	0.072	0.78552				
	0.3	0.0	76	70	0.24	0.3	0.00	1.2	0.288	0.36	0.072	0.92952				
	0.1	0.0	83	81	0.17	0.19	0.00	1.2	0.204	0.228	0.024	0.456	0.7137	0.192930	1.099560	350.00
L.C																
KM 261	0.0	0.0	72	72	0.28	0.28	0.00	1.2	0.336	0.336	0	0.672				
	0.2	0.0	72	70	0.28	0.3	0.00	1.2	0.336	0.36	0.024	0.72				
	0.4	0.0	80	80	0.2	0.2	0.00	1.2	0.24	0.24	0	0.48				
	0.6	0.0	71	71	0.29	0.29	0.00	1.2	0.348	0.348	0	0.696				
	0.8	0.0	72	72	0.28	0.28	0.00	1.2	0.336	0.336	0	0.672				
R.C	0.9	0.0	82	76	0.18	0.24	0.00	1.2	0.216	0.288	0.072	0.78552				
	0.7	0.0	70	66	0.3	0.34	0.00	1.2	0.36	0.408	0.048	0.95568				
	0.5	0.0	70	66	0.3	0.34	0.00	1.2	0.36	0.408	0.048	0.95568				
	0.3	0.0	80	76	0.2	0.24	0.00	1.2	0.24	0.288	0.048	0.71568				
	0.1	0.0	72	72	0.28	0.28	0.00	1.2	0.336	0.336	0	0.672	0.732456	0.133767	0.999991	310.00
L.C																
KM 262	0.0	0.0	84	84	0.16	0.16	0.00	1.2	0.192	0.192	0	0.384				
	0.2	0.0	82	82	0.18	0.18	0.00	1.2	0.216	0.216	0	0.432				
	0.4	0.0	80	80	0.2	0.2	0.00	1.2	0.24	0.24	0	0.48				
	0.6	0.0	82	80	0.18	0.2	0.00	1.2	0.216	0.24	0.024	0.48				
	0.8	0.0	84	83	0.16	0.17	0.00	1.2	0.192	0.204	0.012	0.408				
R.C	0.9	0.0	80	74	0.2	0.26	0.00	1.2	0.24	0.312	0.072	0.83352				
	0.7	0.0	80	76	0.2	0.24	0.00	1.2	0.24	0.288	0.048	0.71568				
	0.5	0.0	80	76	0.2	0.24	0.00	1.2	0.24	0.288	0.048	0.71568				
	0.3	0.0	80	76	0.2	0.24	0.00	1.2	0.24	0.288	0.048	0.71568				
	0.1	0.0	82	82	0.18	0.18	0.00	1.2	0.216	0.216	0	0.432	0.559656	0.157216	0.874088	275.00
L.C																
KM 263	0.0	0.0	54	52	0.46	0.48	0.00	1.2	0.552	0.576	0.024	1.152				
	0.2	0.0	75	73	0.25	0.27	0.00	1.2	0.3	0.324	0.024	0.648				
	0.4	0.0	49	47	0.51	0.53	0.00	1.2	0.612	0.636	0.024	1.272				
	0.6	0.0	68	67	0.32	0.33	0.00	1.2	0.384	0.396	0.012	0.792				
	0.8	0.0	58	56	0.42	0.44	0.00	1.2	0.504	0.528	0.024	1.056				
R.C	0.9	0.0	75	73	0.25	0.27	0.00	1.2	0.3	0.324	0.024	0.648				
	0.7	0.0	58	57	0.42	0.43	0.00	1.2	0.504	0.516	0.012	1.032				
	0.5	0.0	74	72	0.26	0.28	0.00	1.2	0.312	0.336	0.024	0.672				
	0.3	0.0	58	55	0.42	0.45	0.00	1.2	0.504	0.54	0.036	1.18476				
	0.1	0.0	65	63	0.35	0.37	0.00	1.2	0.42	0.444	0.024	0.888	0.934476	0.224421	1.383319	425.00
L.C																
KM 264	0.0	0.0	58	57	0.42	0.43	0.00	1.2	0.504	0.516	0.012	1.032				
	0.2	0.0	56	55	0.44	0.45	0.00	1.2	0.528	0.54	0.012	1.08				
	0.4	0.0	75	73	0.25	0.27	0.00	1.2	0.3	0.324	0.024	0.648				
	0.6	0.0	51	49	0.49	0.51	0.00	1.2	0.588	0.612	0.024	1.224				
	0.8	0.0	60	59	0.4	0.41	0.00	1.2	0.48	0.492	0.012	0.984				

R.C	0.9	0.0	68	67	0.32	0.33	0.00	1.2	0.384	0.396	0.012	0.792				
	0.7	~~0.0~~	~~56~~	54	~~0.44~~	~~0.46~~	~~0.00~~	1.2	~~0.528~~	~~0.552~~	~~0.024~~	~~1.104~~				
	0.5	0.0	58	54	0.42	0.46	0.00	1.2	0.504	0.552	0.048	1.24368				
	0.3	0.0	75	72	0.25	0.28	0.00	1.2	0.3	0.336	0.036	0.77676				
	0.1	0.0	72	70	0.28	0.3	0.00	1.2	0.336	0.36	0.024	0.72	0.960444	0.201942	1.364329	415.00
KM 265	0.0	0.0	71	69	0.29	0.31	0.00	1.2	0.348	0.372	0.024	0.744				
	0.2	0.0	69	68	0.31	0.32	0.00	1.2	0.372	0.384	0.012	0.768				
	0.4	0.0	68	66	0.32	0.34	0.00	1.2	0.384	0.408	0.024	0.816				
	0.6	0.0	84	83	0.16	0.17	0.00	1.2	0.192	0.204	0.012	0.408				
	0.8	0.0	81	79	0.19	0.21	0.00	1.2	0.228	0.252	0.024	0.504				
R.C	0.9	0.0	68	67	0.32	0.33	0.00	1.2	0.384	0.396	0.012	0.792				
	0.7	0.0	85	84	0.15	0.16	0.00	1.2	0.18	0.192	0.012	0.384				
	0.5	0.0	90	89	0.1	0.11	0.00	1.2	0.12	0.132	0.012	0.264				
	0.3	0.0	78	77	0.22	0.23	0.00	1.2	0.264	0.276	0.012	0.552				
	0.1	0.0	80	79	0.2	0.21	0.00	1.2	0.24	0.252	0.012	0.504	0.5736	0.185111	0.943822	300.00

AVERAGE FOR SECTION II = 344.6428 mm

TABLE 4.7

VIJAYAWADA-ELURU ROAD, NH-5 - 4 LANING

REACH KM. 3.4 - 13.0

Flexible Pavement Design (Based on SHELL Design Curves)

Pavement Composition		10 Years
Bituminous Concrete		40 mm
Dense Bituminous Macadam		160 mm
Wet Mix Macadam		275 mm
Granular Sub-base		
Layer 1		175 mm
Layer 2		100 mm
Total	=	750 mm

500 mm thick sub-grade of selected material having CBR of 7% will be provided

The sub-base material should conform to

i) Lower Layer - Locally available material having CBR of 10%

ii) Upper Layer - Coarse grained material having CBR of 30% which will also serve as a drainage layer

TABLE 4.8

ELURU BYPASS, NH-5, 2-LANE ROAD

LENGTH OF BYPASS - 17.88 KM.

REACH KM. 53.8 TO 69.2

Flexible Pavement Design (Based on SHELL Design Curves)

Pavement Composition	10 Years
Bituminous Concrete	40 mm
Dense Bituminous Macadam	160 mm
Wet Mix Macadam	275 mm
Granular Sub-base	
Layer 1	175 mm
Layer 2	100 mm
Total =	750 mm

500 mm thick sub-grade of selected material having CBR of 7% will be provided

The sub-base material should conform to

i) Lower Layer - Locally available material having CBR of 10%

ii) Upper Layer - Coarse grained material having CBR of 30% which will also serve as a drainage layer

TABLE 4.9

NANDIGAMA TO VIJAYAWADA ROAD - NH9, 4 LANING

REACH KM. 252.0 TO 265.0

Flexible Pavement Design (Based on SHELL Design Curves)

Pavement Composition	10 Years
Bituminous Concrete	40 mm
Dense Bituminous Macadam	160 mm
Wet Mix Macadam	275 mm
Granular Sub-base	
Layer 1	175 mm
Layer 2	100 mm
Total =	750 mm

500 mm thick sub-grade of selected material having CBR of 7% will be provided

The sub-base material should conform to

i) Lower Layer - Locally available material having CBR of 10%

ii) Upper Layer - Coarse grained material having CBR of 30% which will also serve as a drainage layer

TABLE 4.10

PROPOSED THICKNESS AND COMPOSITION OF PAVEMENT LAYERS

SL. NO.	NH NO.	SECTION KM. TO KM.	NEW PAVEMENT		OVERLAY			
			DESIGN ESAL IN MILLION FOR 10 YEARS	COMPOSITION IN MM	DESIGN ESAL IN MILLION	ALLOWABLE DEFLECTION IN (MM)	EQUIVALENT GRANULAR THICKNESS IN MM (AVERAGE)	COMPOSITION IN MM
1.	5	3.4 to 13.0	35.254	GSB 300 WMM 300 DBM 130 BC 40	35.254	0.6	340	DBM = 130 BC = 40
2.	5	13.0 to 75.0 excluding Eluru bypass			59.256	0.55	327	DBM = 130 BC = 40
3.	5	Eluru bypass	52.533	GSB 300 WMM 300 DBM 150 BC 40				
4.	9	252.00 to 265.000	59.386	GSB 300 WMM 300 DBM 150 BC 40	59.386	0.55	345	DBM = 150 BC = 40
5.	9	217.00 to 252.00			38.543	0.6	335	DBM = 130 BC = 40

PAVEMENT DESIGN CALCULATIONS FOR NH5

Reach km 3.4 to 13 km.

I Four lane divided carriageway.

Growth of Traffic

	1993-94	1995-2004	2005-18
Buses	7.03	7.03	6.59
Trucks	6.72	6.38	6.04

BUSES:

Initial traffic in 1993 : 766 Nos.

Traffic in project completion year 1998 = 1076 Nos.

In the year 2004 = 1618

Traffic in design lane in year 1998 = (1076x.75)/2

= 404 per day

Traffic in design lane in year 2004 = (1618x.75)/2

= 607

TRUCKS:

Initial traffic in 1993 = 4034

Traffic in project completion year 1998 = 5513

Traffic in the year 2004 = 7991

Traffic in design lane in year 1998 = (5513x.75)/2

= 2067 per day.

Traffic in design lane in year 2004 = (7991x.75)/2

= 2797

Design life = 10 years

Vehicle Damage Factor = 3.5 for trucks and

0.5 for buses as per MOST.

iv) 10 years projection

ESAL due to Buses

$$= \frac{365x404[(1+0.0703)^{6}-1]}{0.0703} \times 0.5 + \frac{365x607[(1+0.0659)^{4}-1]}{0.0659} \times 0.5$$

$$= (0.528+0.489)10^{6}$$

$$= 1.017x10^{6}$$

ESAL due to Trucks

$$= \frac{365x2067[(1+0.0638)^{6}-1]}{0.0638} \times 3.5 + \frac{365x2797[(1+0.0604)^{4}-1]}{0.0604} \times 3.50$$

$$= (18.596+15.641)10^{6}$$

$$= 34.237x10^{6}$$

$$\text{Total ESAL} = (1.017+34.237)x10^{6} = 35.254x10^{6}$$

$$= 35.254 \text{ msa}$$

Design CBR

The CBR of the existing soil at site is 2 to 4.5%. Hence it will constitute poor subgrade. It is therefore, recommended to provide 50 cm thick layer of soil of laboratory CBR not less than 10% in the top portion of the sub-grade in the widening portion. However for design purpose a CBR of 7% has been adopted.

vi) Design thickness

New pavement design thickness is 590 mm with a CBR of 7%. Average overlay as per B.B. Test results is 339.50 mm

vii) Pavement Composition

The composition of the road crust is proposed as under which is based on the MOST guidelines for pavement design of ADB-III road projects.

a) New Carriageway

Granular sub-base of 30% CBR	=	300 mm
Wet Mix Macadam	=	300 mm
Dense Bituminous Macadam	=	130 mm
Bituminous concrete	=	40 mm
	=	770 mm

b) Strengthening of the existing carriageway :

Dense Bituminous Macadam	=	130 mm	] Equivalent] thickness
Bituminous concrete	=	40 mm	] 340 mm for 35 msa

A profile corrective course of DBM, average thickness 75 mm, will be provided before strengthening.

I Strengthening existing 2-lanes km.13.0 to km.75.0 excluding reach which will be bypassed at Eluru.

As per traffic projection, saturation will reach in the year 1999. Hence no traffic growth is considered beyond this period.

	Buses	Trucks
Initial traffic in the year 1993	852	4154
Traffic in the year 1998	1197	5677
Traffic in the year 1999	1281	6039

<u>10 Year Projection</u> (Traffic saturation in 1999)

ESAL due to buses = 365x1197x0.75x1x0.5 + 365x1281x0.75x9x0.5

$= (0.164+1.578)\times10^{6}$

$= 1.742 \times 10^{6}$

ESAL due to trucks= 365x5677x0.75x1x3.5 + 365x6039x0.75x9x3.5

$= (5.439+52.075)\times10^{6}$

$= 57.514 \times 10^{6}$

Total ESAL $= (1.742+57.514)\times10^{6}$

$= 59.256\times10^{6}$

= 59.256 msa

Allowable deflection for 10 years design ESAL 59.256 msa is 0.55 mm.

For allowable deflection of 0.55mm, the average overlay thickness works out to be 327 mm. The following composition of overlay is recommended which is equivalent to 340 mm granular thickness.

Dense Bituminous Macadam	130 mm	Equivalent thickness	260 mm.
Bituminous concrete	40mm	" "	80 mm.
			340 mm.

A layer of an average thickness of 75mm DBM will be provided for camber cum profile corrective course before strengthening layers are laid.

Eluru Bypass (New Pavement)

From O.D. survey, it is observed that about 75% traffic will pass through bypass, so 75% traffic of count station at Km.45/6 is taken for design. The traffic saturation will reach in the year 2003, so no traffic growth is considered beyond the year 2003.

	Buses	Trucks
Initial traffic in the year 1993	852	4154
Traffic in the project completion year 1998	1197	5677
Traffic in the year 2003	1681	7735

10 Years Projection

$$\text{ESAL due to buses} = \frac{365 \times 1197[(1+0.0703)^5 - 1]}{.0703} \times 0.75 \times 0.75 \times 0.5$$

$$+365 \times 1681 \times 0.75 \times 0.75 \times 0.5 \times 5$$

$$= (0.707+0.863) \times 10^6$$

$$= 1.570 \times 10^6$$

$$\text{ESAL due to trucks} = \frac{365 \times 5677[1+0.0638)^5 - 1]}{0.0638} \times 0.75 \times 0.75 \times 3.5$$

$$+365 \times 7735 \times 0.75 \times 0.75 \times 3.5 \times 5$$

$$= (23.171+27.792) \times 10^6$$

$$= 50.963 \times 10^6$$

$$\text{Total ESAL} = (1.570+50.963) \times 10^6$$

$$= 52.533 \times 10^6$$

$$= 52.533 \text{ msa}$$

Design CBR

The CBR of existing soil at site is 2 to 4%. Hence it will constitute poor subgrade. It is, therefore, recommended to provide 50cm thick layer of soil of laboratory CBR not less than 10% in the top portion of the subgrade. However, for design purpose, CBR of 7% has been adopted.

Design Thickness

Design thickness for 10 years 650 mm

Pavement Composition

Granular sub-base	300 mm
Wet Mix Macadam	300 mm
Dense Bituminous Macadam	150 mm
Bituminous concrete	40 mm
Total:	790 mm

PAVEMENT DESIGN CALCULATIONS FOR NH-9 REACH KM. 252.0 TO 265.0

I. Four Lane Divided Carriageway

Growth of Traffic

	1993-1994	1994-2004	2005-2018
Buses	7.03	7.03	6.59
Trucks	6.72	6.38	6.04

Saturation of traffic on the road will reach in the year 2007. Hence further growth in traffic is ignored beyond 2007.

Buses

Initial traffic in 1993 = 1988

Traffic in project completion year 1998 = 2793

Traffic in the year 2004 = 4198

Traffic in the year 2007 = 5084

Traffic in the design lane in 1998 = (2793x0.75)/2 = 1045

Traffic in the design lane in 2004 = (4198x0.75)/2 = 1574

Traffic in the design lane in 2007 = (5084x0.75)/2 = 1907

Trucks

Initial traffic in 1993 = 6475

Traffic in project completion year 1998 = 8849

Traffic in the year 2004 = 12826

Traffic in the year 2007 = 15293

Traffic in the design lane in 1998 = (8849x0.75)/2 = 3318

Traffic in the design lane in 2004 = (12826x0.75)/2 = 4810

Traffic in the design lane in 2007 = (15293x0.75)/2 = 5735

Design life = 10 years

Vehicle Damage Factor = 3.5 for trucks and 0.5 for buses

10 years projection (Traffic saturation in year 2007)

ESAL due to Buses

$$= \frac{365 \times 1045[(1+0.0703)^{6}-1]}{0.0703} \times 0.5 + \frac{365 \times 1574[(1+0.0659)^{3}-1]}{0.0659} \times 0.5$$

$$+ 365 \times 1907 \times 1 \times 0.5$$

$$= (1.365+0.920+0.348)10^{6}$$

$$= 2.633 \times 10^{6}$$

ESAL due to Trucks

$$= \frac{365 \times 3318[(1+0.0638)^{6}-1]}{0.0638} \times 3.5 + \frac{365 \times 4810[(1+0.0604)^{3}-1]}{0.0604} \times 3.50$$

$$+ 365 \times 5739 \times 1 \times 3.5$$

$$= (29.851+19.570+7.332)10^{6}$$

$$= 56.753 \times 10^{6}$$

$$\text{Total ESAL} = (2.633+56.753) \times 10^{6} = 59.386 \times 10^{6}$$

$$= 59.386 \text{ msa}$$

Design CBR

The CBR of existing soil at site is 2.5 to 4.5%. which will constitute poor subgrade. It is, therefore, recommended to provide 50cm thick layer of soil of laboratory CBR not less than 10% in the top portion of the subgrade. However, for design purpose, CBR of 7% has been adopted.

Design Thickness

New pavement design thickness is	=	680 mm
Average overlay as per B.B. Test result is	=	345 mm

Pavement Composition

The following crust composition is proposed

a) New Carriageway

Granular sub-base of 30% CBR	=	300 mm
Wet Mix Macadam	=	300 mm
Dense Bituminous Macadam	=	150 mm
Bituminous concrete	=	40 mm
	=	790 mm

b) Strengthening of the existing carriageway :

Dense Bituminous Macadam	=	150 mm	] Equivalent] thickness
Bituminous concrete	=	40 mm	] 380 mm for 59 msa

A profile corrective course of DBM, average thickness 75 mm, will be provided before strengthening.

II Strengthening existing 2-lanes km.217.0 to km.252.0

As per traffic projection, saturation will reach in the year 2004. Hence no traffic growth is considered beyond this period.

	Buses	Trucks
Initial traffic in the year 1993	682	2707
Traffic in the year 1998	958	3700
Traffic in the year 2004	1440	5362

10 Year Projection

$$\text{ESAL due to buses} = \frac{365\text{x}958\text{x}[(1+0.0703)^{6}-1]}{0.0703}\text{x}0.75\text{x}0.5$$

$$+365\text{x}1440\text{x}0.75\text{x}0.5\text{x}4$$

$$= (0.939+0.793)\text{x}10^{6}$$

$$= 1.732\text{x}10^{6}$$

$$\text{ESAL due to trucks} = \frac{365 \times 3700[(1+0.0638)^{6}-1]}{0.0638} \times 0.75 \times 3.5$$

$$+365 \times 5362 \times 0.75 \times 3.5 \times 3$$

$$= (21.399+15.412) \times 10^{6}$$

$$= 36.811 \times 10^{6}$$

$$\text{Total ESAL} = (1.732+36.811) \times 10^{6}$$

$$= 38.543 \times 10^{6}$$

$$= 38.543 \text{ msa}$$

Allowable deflection for 10 years design ESAL of 38.543 msa is 0.60 mm.

For allowable deflection of 0.60mm, the average overlay thickness works out to be 335 mm. The following composition of overlay is proposed which is equal to 340 mm granular thickness.

Dense Bituminous Macadam	=	130 mm	] Equivalent
Bituminous concrete	=	40 mm	] thickness 340 mm
			] for 38 msa

Before laying the strengthening layers it is proposed to provide an average 75 mm thick DBM layer for camber cum profile corrective course.

Government of India
Ministry of Surface Transport
(Roads Wing)

PARIVAHAN BHAVAN
NO.1, SANSAD MARG

No.RW/NH-33013/5/88-DO.II New Delhi: Dated: 11th, March, 1992.

To

1) The Chief Engineer of State PWDs/UT dealing with National Highways & Centrally Aided Road Projects

2) The Director General, Border Roads, Kashmir House, New Delhi

3) The Director General (Works) CPWD, Nirman Bhavan, New Delhi.

SUBJECT: Strengthening of existing flexible road pavements - Guidelines on design of overlays

Sir,

Please refer to Ministry's circular letter of even number dated the 31st March, 1989 wherein it has been decided that for deriving the overlay thickness for existing road pavements, the method prescribed in IRC 81 -1981 alone should be followed.

2. As you may be aware, IRC 81-1981 gave only tentative guidelines for overlay design on the basis of limited information that were available in the country at that time. In view of these limitations Ministry had sponsored the Research Scheme R-6, (Development of methods such as Benkelman Beam for evaluation of structural capacity of existing flexible pavement), the first phase of which is now completed. A Committee constituted by the Ministry to review pavement design procedure in the light of R-6 Phase I findings has also submitted its interim report recommending certain modifications in the overlay design procedure.

3. On the basis of the recommendations of the Committee the Ministry has tentatively decided to incorporate the following modifications in the overlay design procedure given in IRC 81 -1981 so far as overlay design for National Highways are concerned :-

3.1 For measuring pavement deflection for Benkelman Beam, only C.G.R.A. procedure based on testing under static load, shall be adopted.

Contd ... P.2/-

3.2 Correction for temperature variation on deflection values measured at pavement temperature in the range of 20°C to 55°C for flexible pavements with bituminous construction of thickness 40mm or more shall be 0.005 mm per degree centigrade change from the standard temperature of 35°C.

3.3 Correction for seasonal variation shall depend on type of subgrade soil, its field moisture content at the time of deflection survey and average annual rainfall in the area. For this purpose, subgrade soils have been divided into three broad categories, namely sandy/gravelly, clayey with low plasticity (PI ≤ 15) and clayey with high plasticity (PI > 15). Similarly, rainfall has been divided into two categories, namel low rainfall (annual rainfall ≤ 1300mm) and high rainfall (annual rainfall > 1300mm). Moisture correction factors (or seasonal correction factors) shall be obtained from Fig.1 to 6 (enclosed) for given field moisture content, type of subgrade soil and annual rainfall. The determination of subgrade type and its field moisture content shall be made below the pavement at a distance of 60cm from the pavement edge, if the lane width is less than 3.5 m and 90cm when the lane width is more. For this purpose test pits shall be dug approximately every 250-500m depending on the uniformity of subgrade, topography of the area and road profile. Care should be taken to test the soil sample for field moisture content determination at the earliest possible time with due precaution to avoid loss of moisture from the sample. After collecting samples from the test pit and obtaining other data (such as pavement layers and their thickness) the pavement should be made good immediately.

3.4 Characteristic deflection for all design purposes should be taken as the mean deflection plus two time standard deviation.

3.5 The following values of allowable deflection for different traffic conditions shall be adopted :-

Design traffic intensity in terms of Equivalent standard Axles in Million	Allowable deflec in mm
Upto 2	1.0
2 - 10	0.8
10 - 30	0.75
More than 30	0.70

3.6 The following layer equivalency factors in terms o granular base (WBM/WMM) may be adopted :-

Built up spray grout	1.0
Bituminous macadam	1.5
Dense Bituminous macadam	2.0
Bituminous Concrete/Semi-dence bituminous concrete	2.0

Contd....P.

4. It may please be noted that henceforth proposals for strengthening of existing flexible pavements of National Highways should be based on Benkelman Beam Deflection Technique as given in IRC 81-1981 but after incorporating the modifications indicated above.

5. It is requested that the above instructions may be communicated to all concerned for immediate adoption as regards future NH projects. Pavements designed and constructed on the basis of above procedure shall be monitored for at least five years and annual performance reports sent to the Ministry to serve as feedback for review of the suggested modifications. The Ministry would therefore, welcome any possible feedback on application of the "revised" procedure.

Yours faithfully,

Encl: Figure 1 to 6

(R.D. Mehta)
Superintending Engineer (Roads)
for Director General (Road Development)

Copy forwarded for information and necessary action to :-

1. All Chief Engineers in Roads Wing
2. All Regional officers/Engineer Liaison Officers
3. All Technical officers upto AE's level in Roads Wing
4. Library
5. DO I (for policy circulars folders)

Encl: Figure 1 to 6

(R.D. Mehta)
Superintending Engineer (Roads)
for Director General (Road Development)

Copy forwarded for information to :-

1. The Director, CRRI, Mathura Road, New Delhi-110 020
2. The Director, IRC, Jamnagar House, Shahjahan Road, New Delhi-110 011
3. The Director, NITHE, 174 Jorbagh, New Delhi-110 003

Encl: Figures 1 to 6

(R.D. Mehta)
Superintending Engineer (Roads)
for Director General (Road Development).

****

C

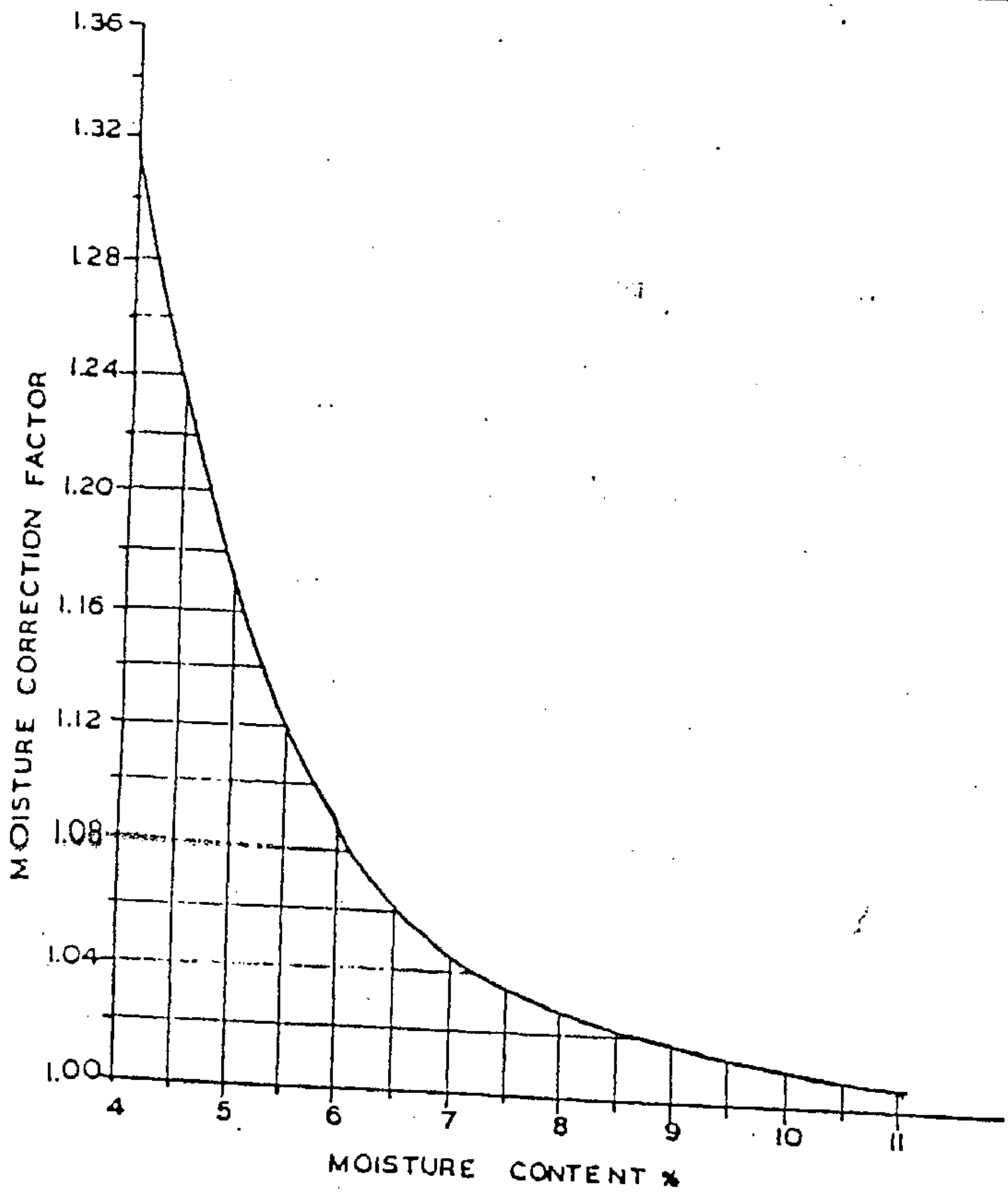


FIG. 1. MOISTURE CORRECTION FACTOR FOR SANDY/ GRAVELLY SOIL SUBGRADE FOR LOW RAINFALL AREAS (ANNUAL RAINFALL ≤ 1300mm)

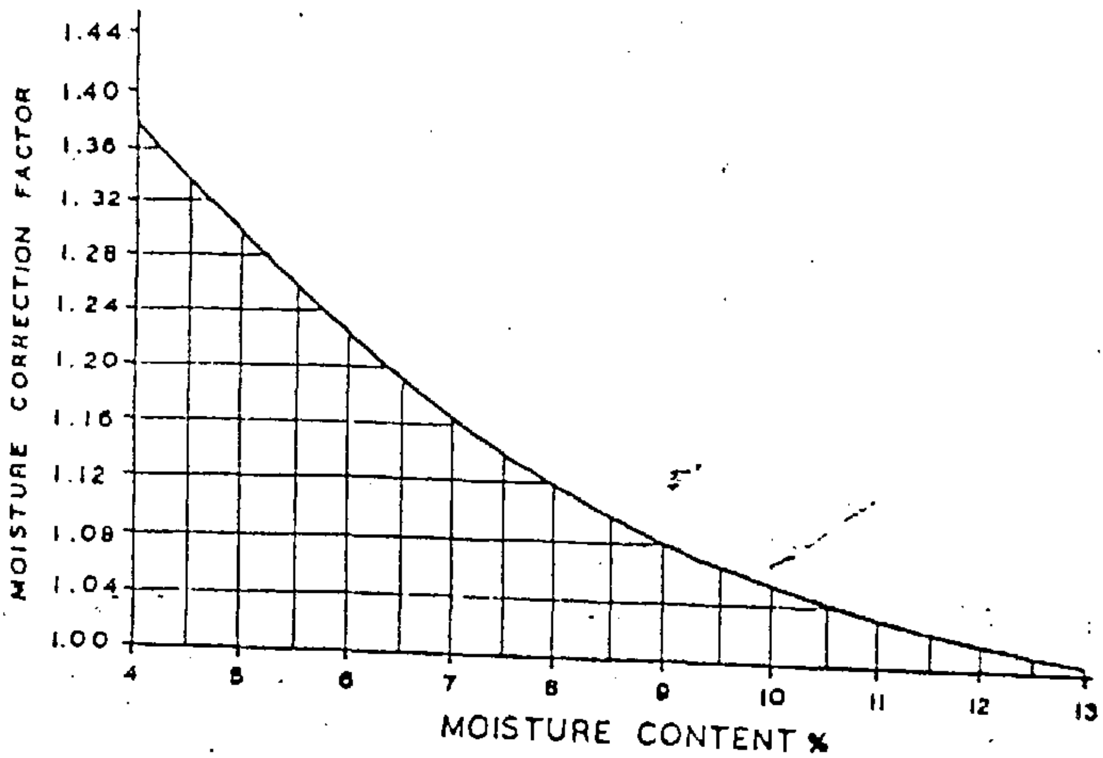


FIG. 2 MOISTURE CORRECTION FACTOR FOR SANDY / GRAVELLY SUBGRADE FOR HIGH RAINFALL AREAS.

(ANNUAL RAINFALL ≥ 1300mm)

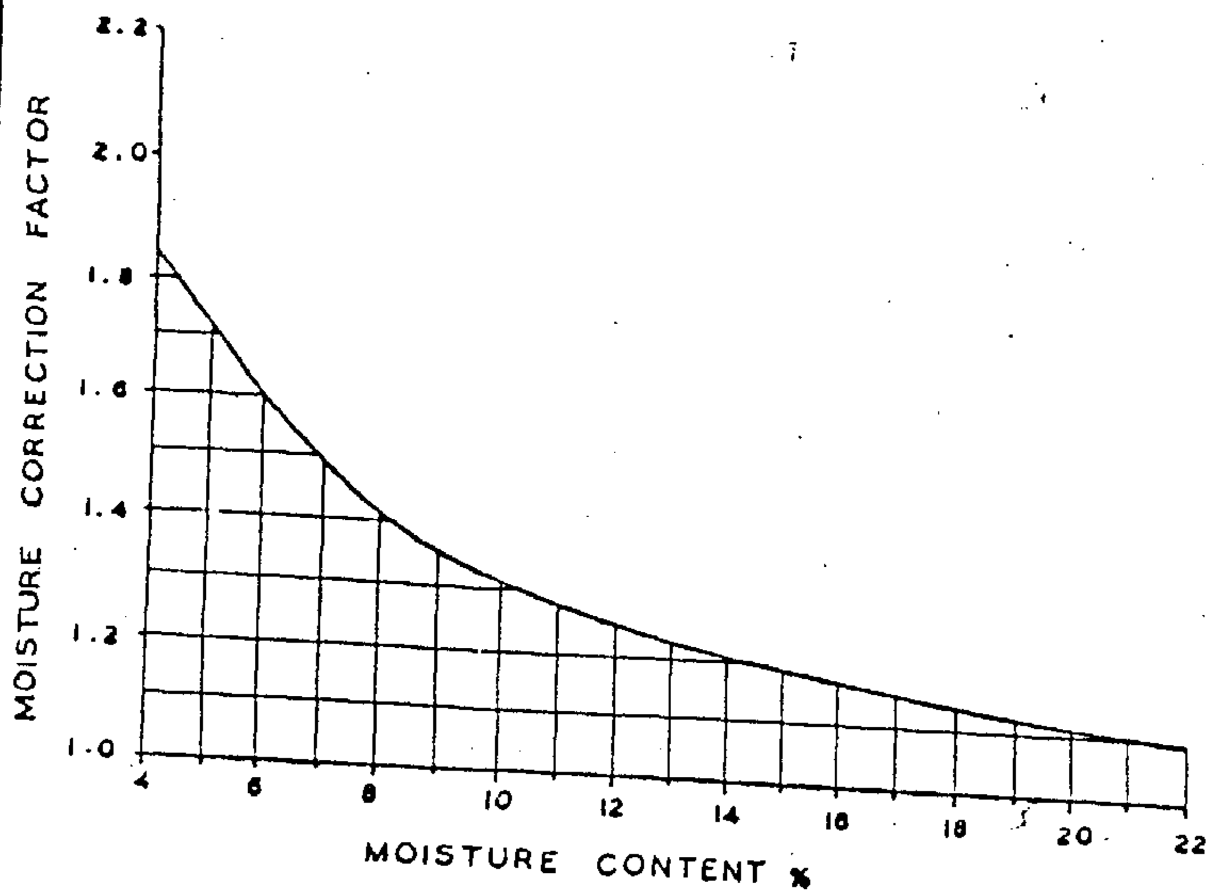


FIG. 4 MOISTURE CORRECTION FACTOR FOR CLAYEY SUBGRADE WITH LOW PLASTICITY (PI ≤ 15) FOR HIGH RAINFALL AREAS.

(ANNUAL RAINFALL ≥ 1300 mm)

C

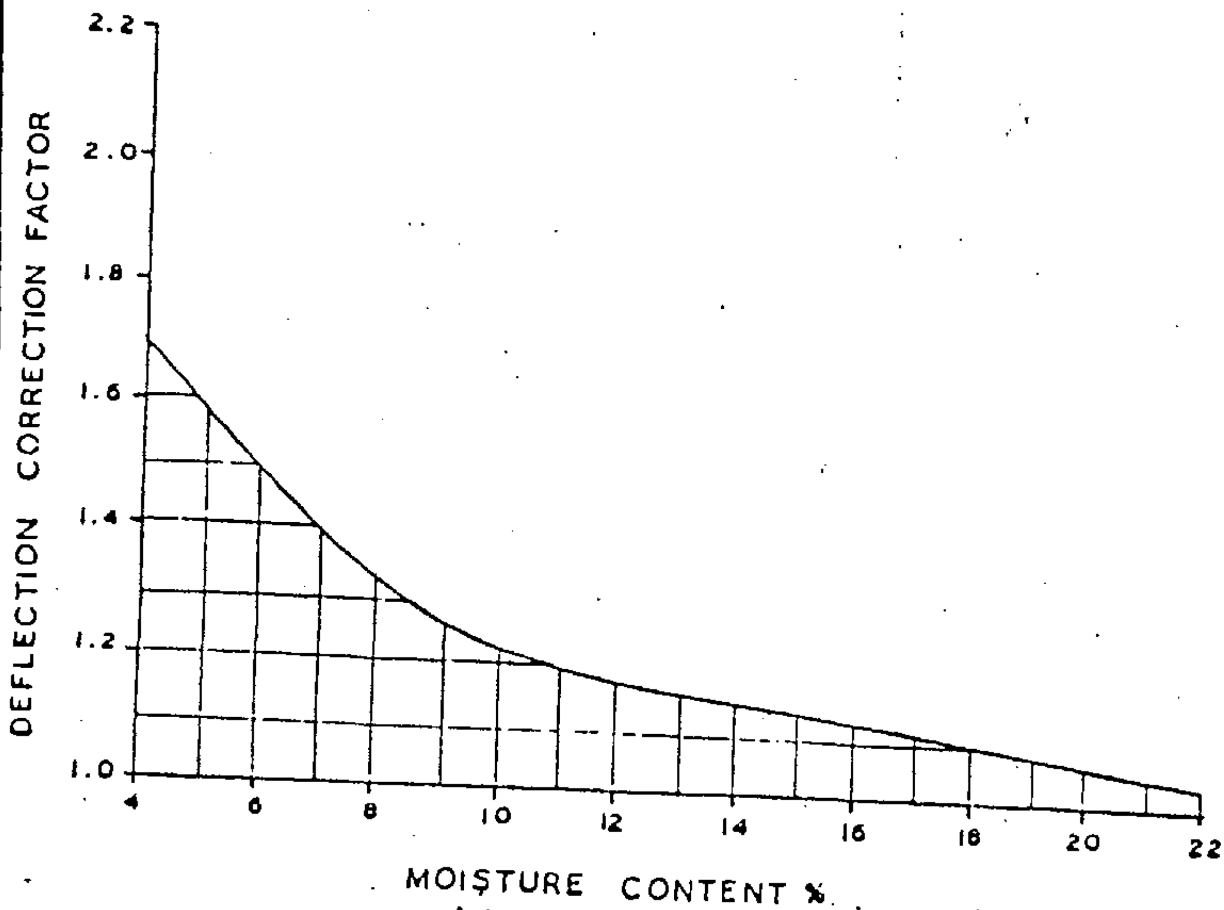


FIG. 3 MOISTURE CORRECTION FACTOR FOR CLAYEY SUBGRADE WITH LOW PLASTICITY (P I≤15) FOR LOW RAINFALL AREAS.

(ANNUAL RAINFALL ≤1300mm)

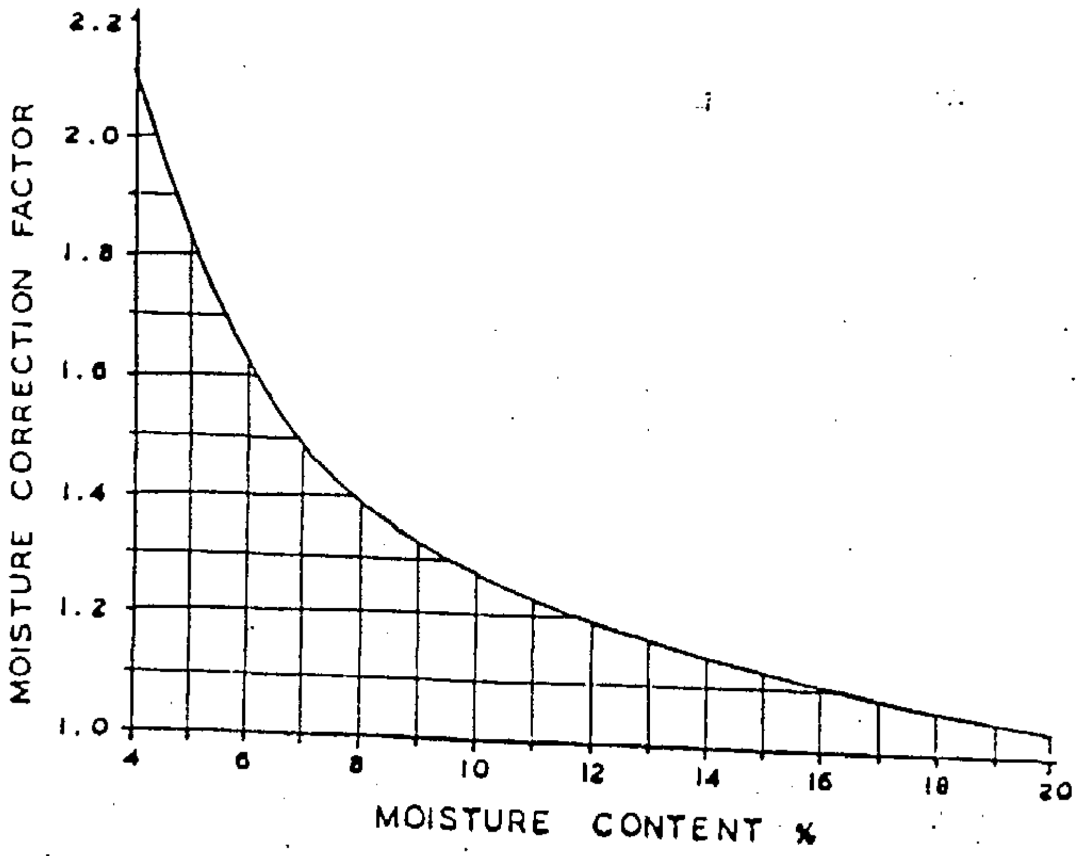


FIG. 6 MOISTURE CORRECTION FACTOR FOR CLAYEY SUBGRADE WITH HIGH PLASTICITY (P.I>15) FOR HIGH RAINFALL AREAS.

(ANNUAL RAINFALL >1300 mm)

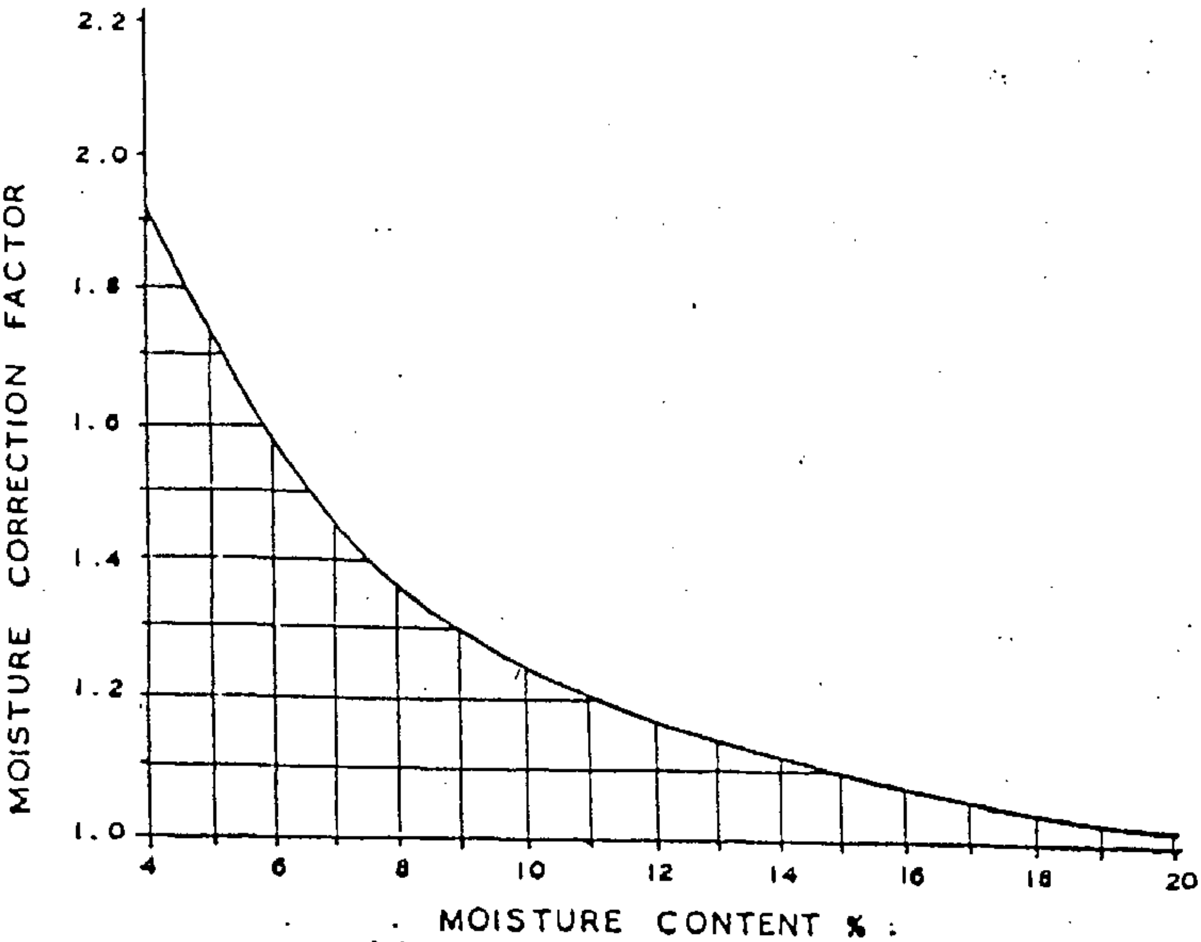
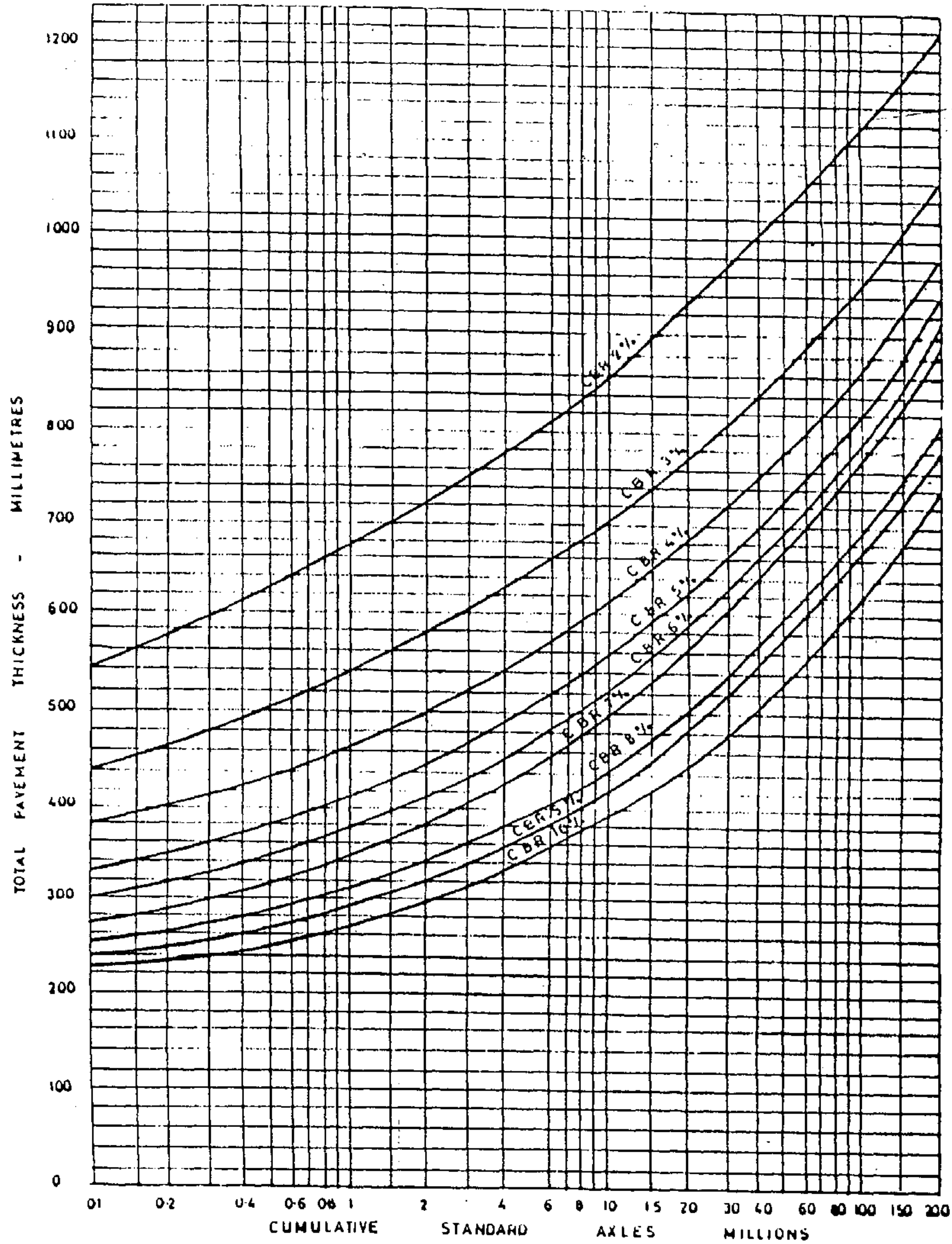


FIG. 5 MOISTURE CORRECTION FACTOR FOR CLAYEY SUBGRADE WITH HIGH PLASTICITY (PI>15) FOR LOW RAINFALL AREAS.

(ANNUAL RAINFALL ≤ 1300mm)

(FIG 4.1)

PAVEMENT THICKNESS DESIGN CHART



INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK, NEW DELHI 110016
TEL 668846, 669418 TLX 031 73236
DELHI, NOIDA, JAIPUR, BANGALORE, MADRAS, BOMBAY, MALAYSIA

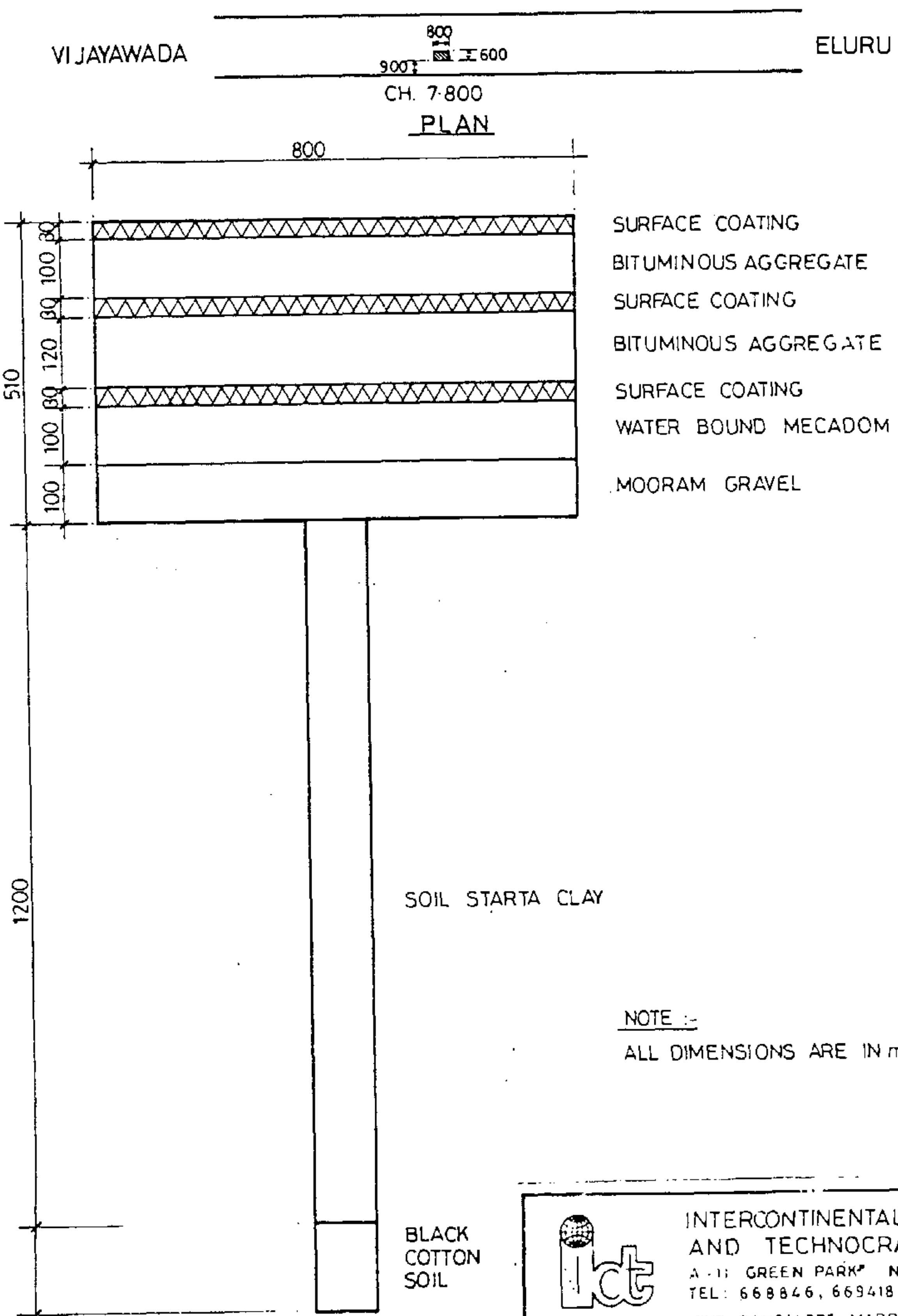
FIG 4 -1A

PROJECT ...NH-5...

SECTION ...VIJAYAWADA - ELURU...

CH. ...7·800...

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE :-

ALL DIMENSIONS ARE IN mm

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI - 110 016
TEL : 668846, 669418 TLX 031 - 65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

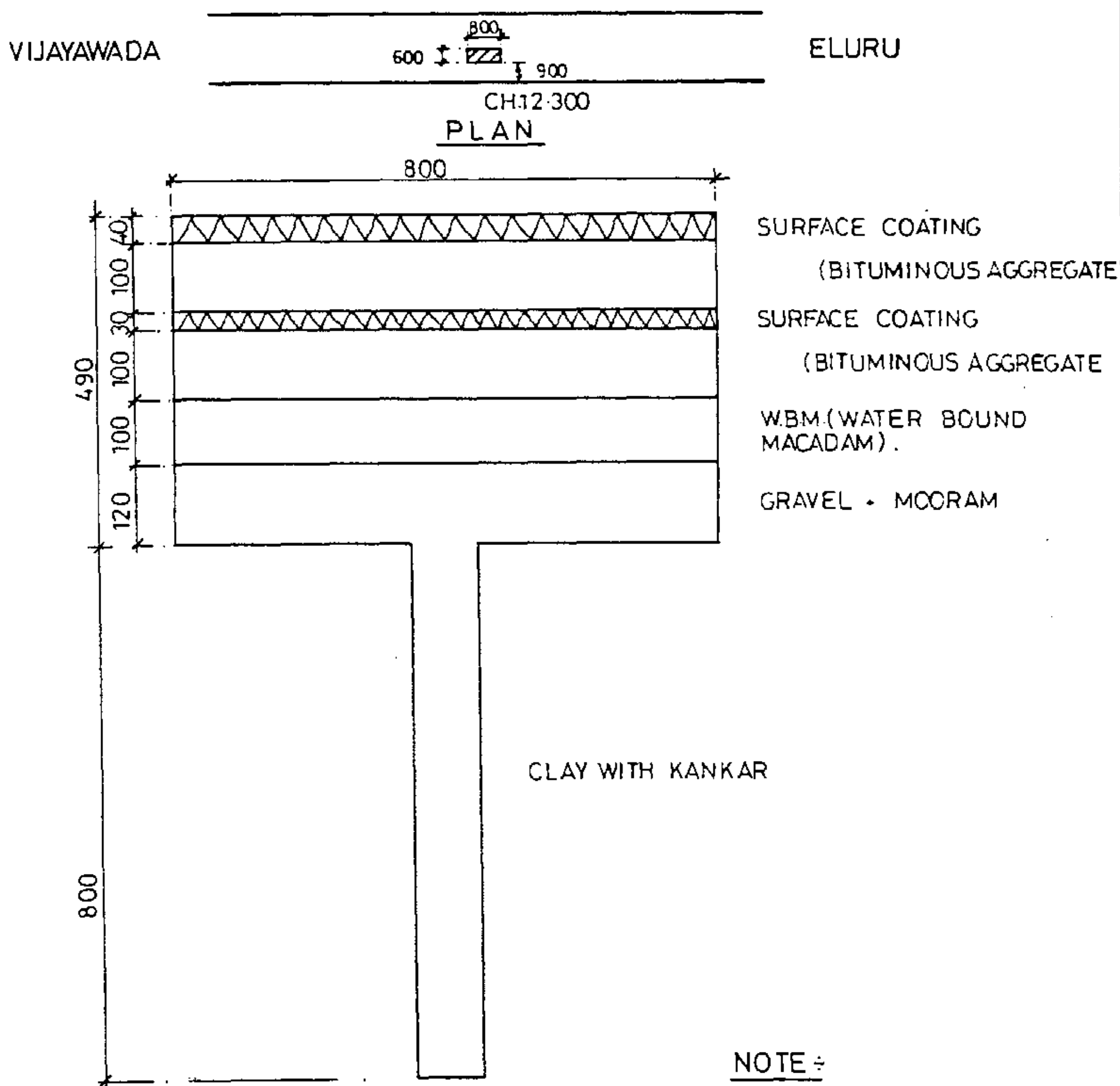
Fig 4 - 2

PROJECT ... NH-5 ...

SECTION ... VIJAYAWADA - ELURU ...

CH. ... 12.300 ...

BORE LOG CHART INCLUDING PAVEMENT THICKNESS.



NOTE :-
ALL DIMENSION ARE IN mm.

Fig. 4 - 3

PROJECT ....NH-5..............................

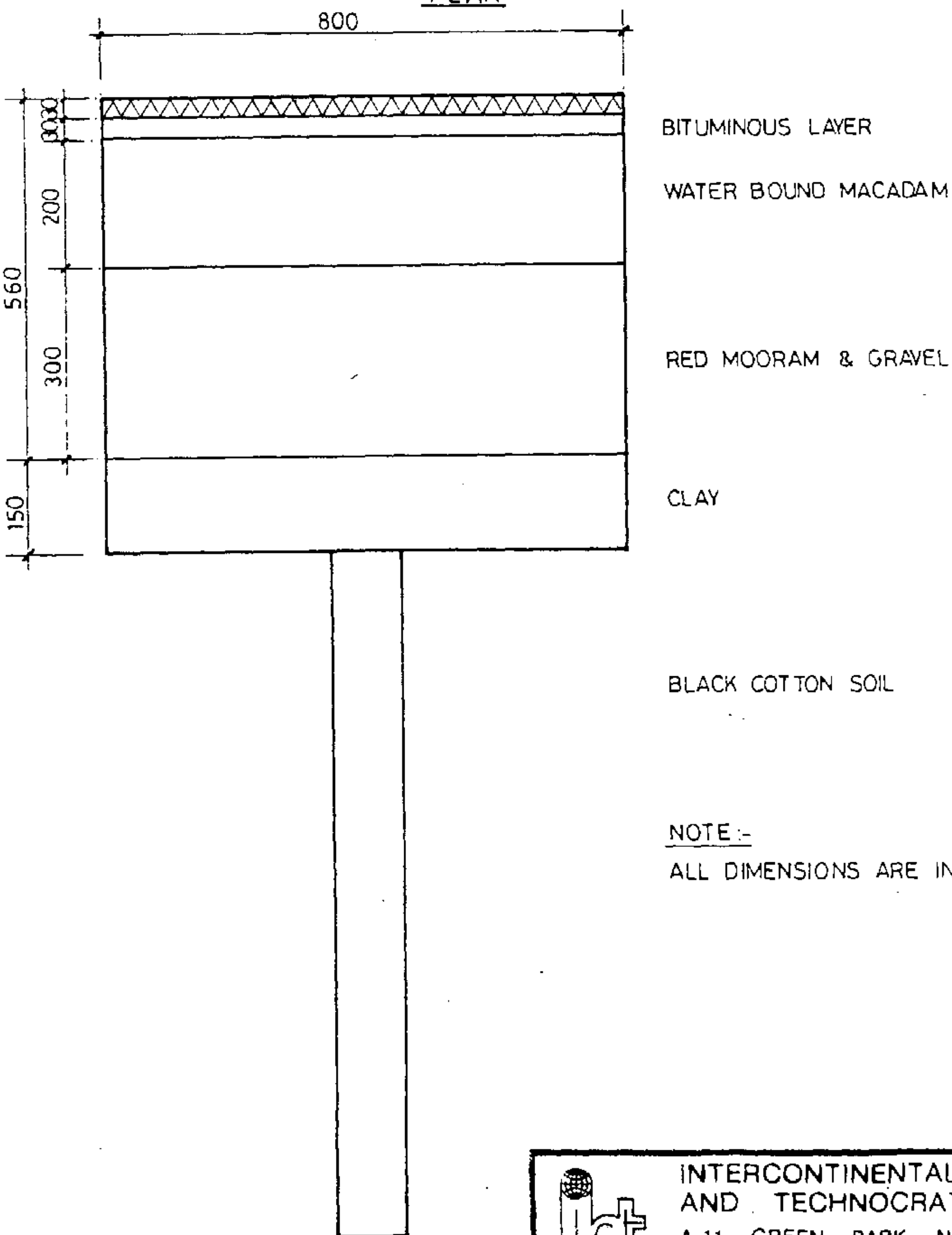
SECTION ....VIJAYAWADA - ELURU..............

CH. ....18·200..................................

BORE LOG CHART INCLUDING PAVEMENT THICKNESS

CH. 18·200

PLAN



NOTE :-

ALL DIMENSIONS ARE IN mm.

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK, NEW DELHI- 110016
TEL: 668846, 669418 TLX: 031 -73236
DELHI, NOIDA, JAIPUR, BANGALORE, MADRAS, BOMBAY, MALAYSIA.

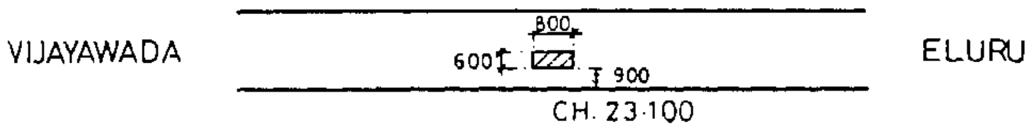
Fig. 4-4

PROJECT NH-5

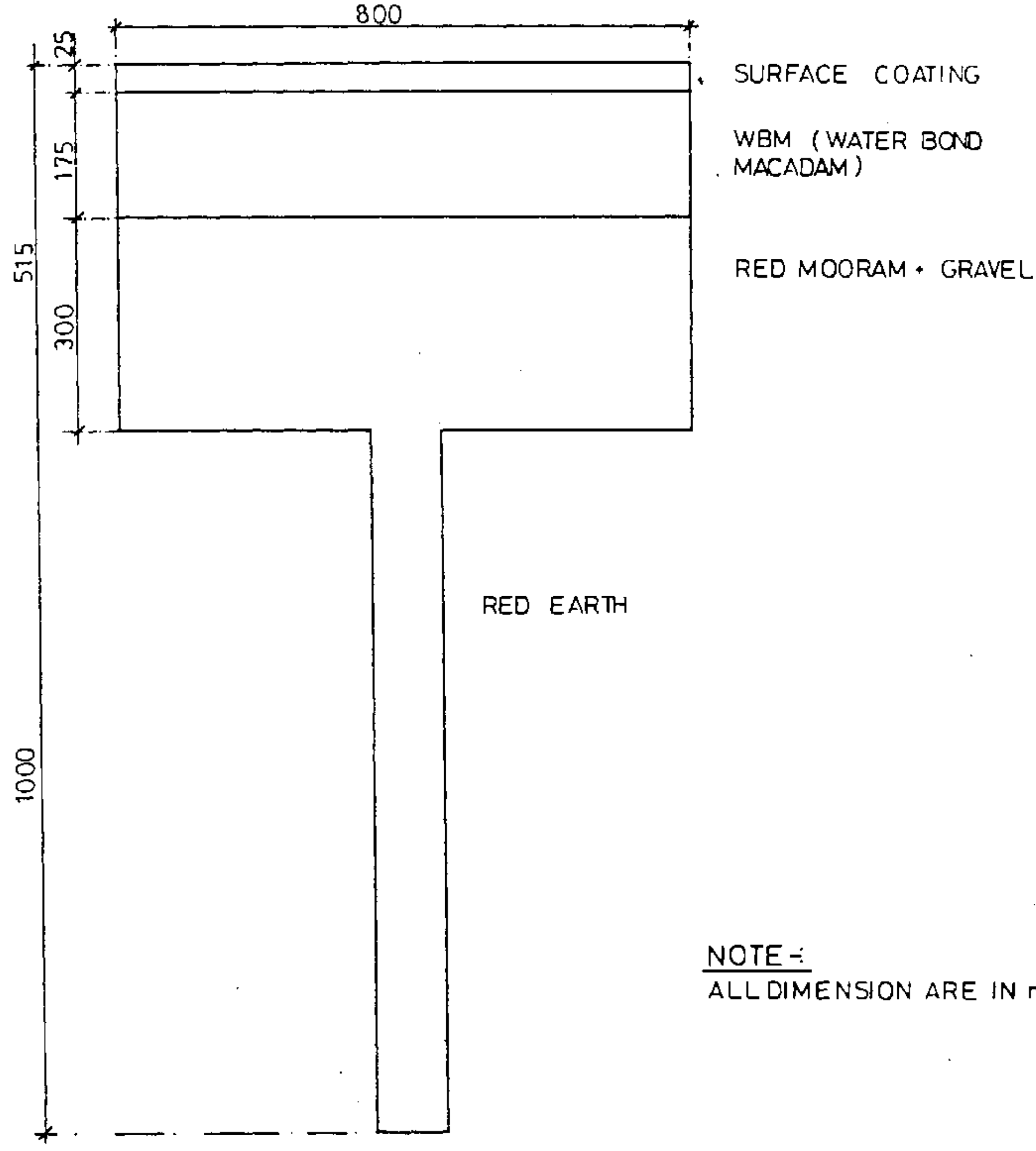
SECTION VIJAYAWADA - ELURU

CH:- 23.100

BORE LOG CHART INCLUDING PAVEMENT THICKNESS.



PLAN



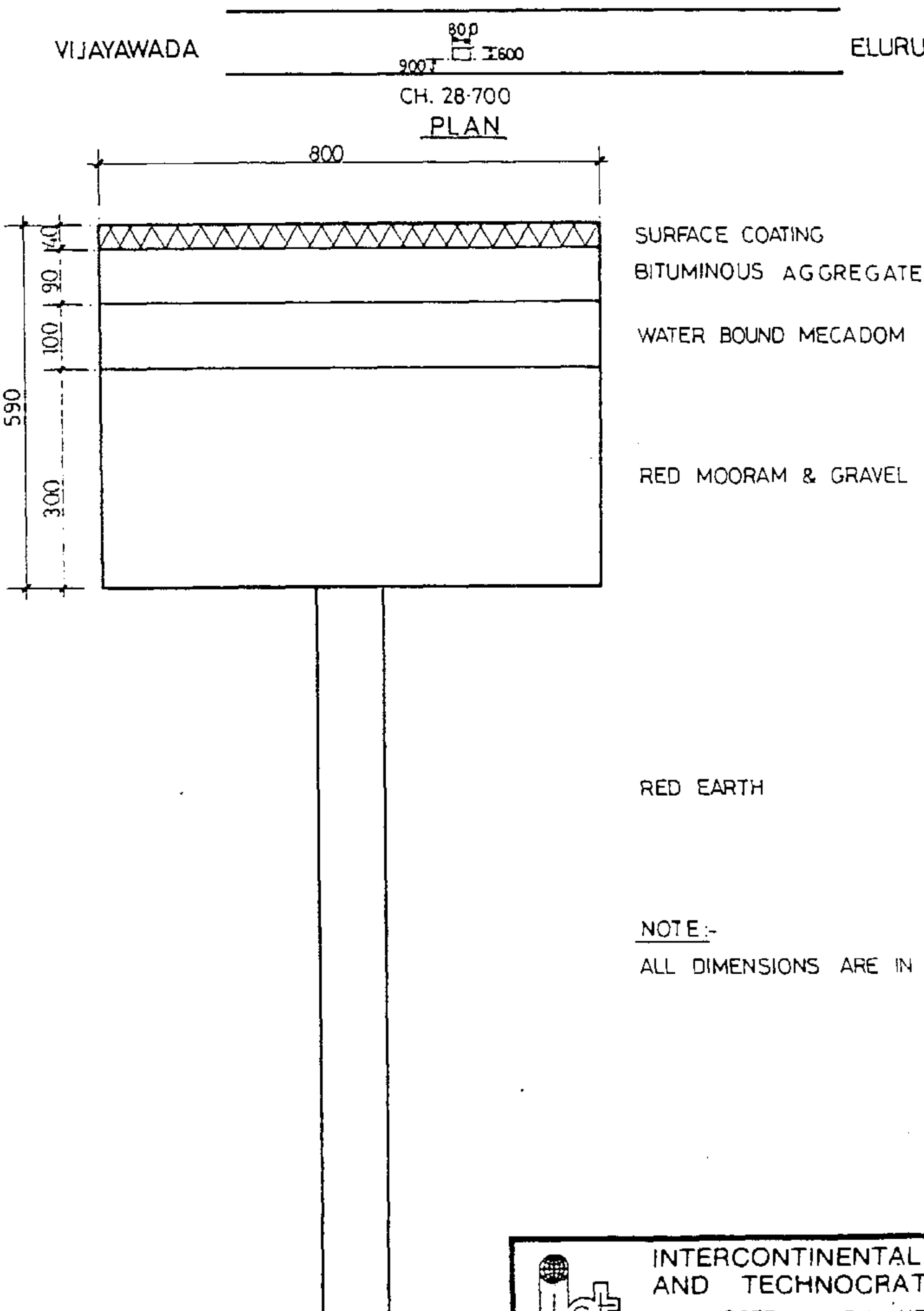
NOTE :-
ALL DIMENSION ARE IN mm.

PROJECT NH-5

SECTION VIJAYAWADA - ELURU

CH. 28·700

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE :-

ALL DIMENSIONS ARE IN m.m.

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK, NEW DELHI- 110016
TEL: 668846, 669418 TLX: 031 -73236
DELHI, NOIDA, JAIPUR, BANGALORE, MADRAS, BOMBAY, MALAYSIA

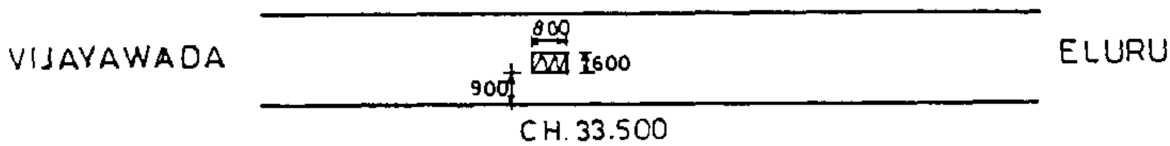
FIG. 4-6

PROJECT NH-5

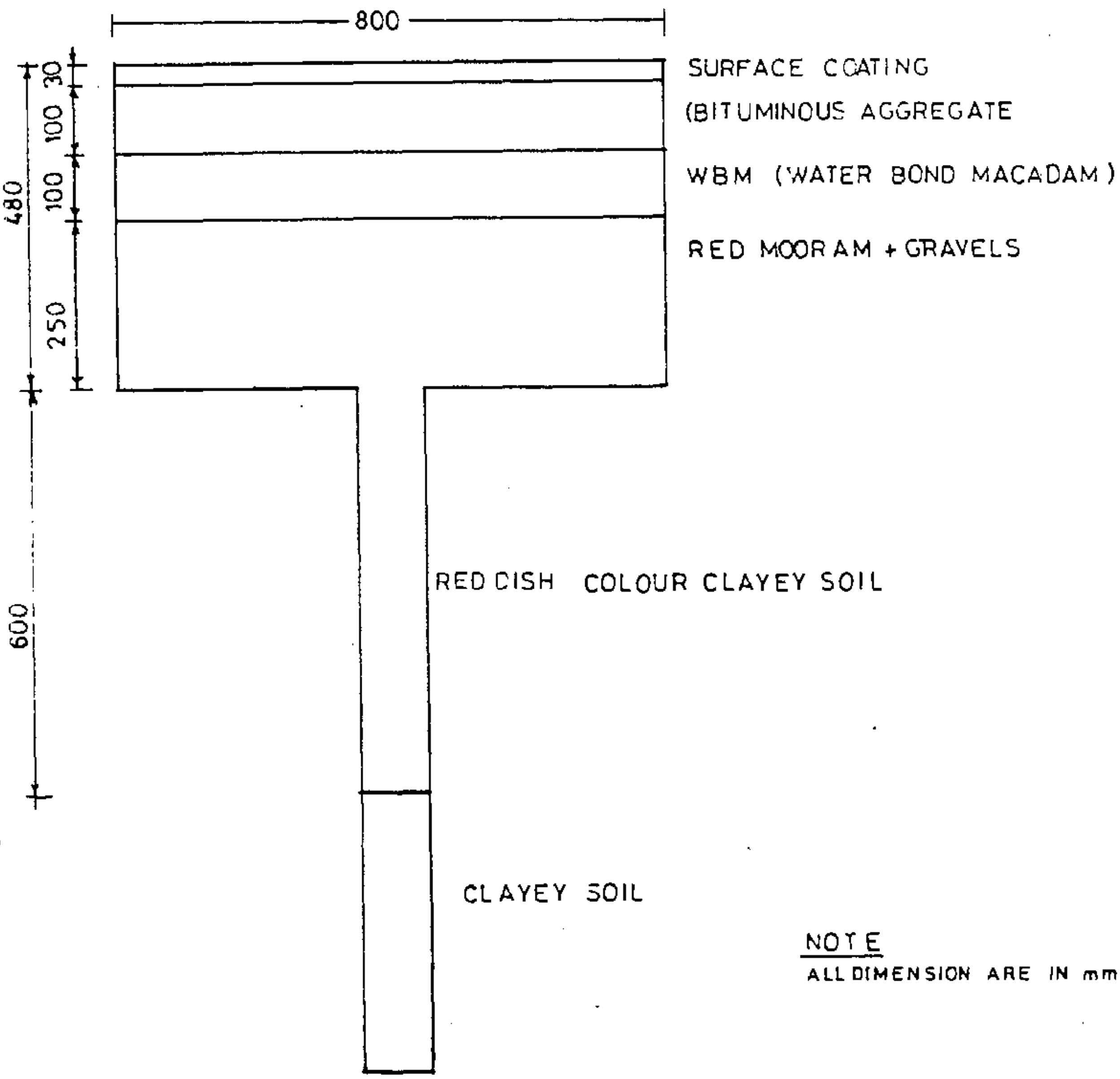
SECTION VIJAYAWADA - ELURU

CH. 33.500

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



PLAN



NOTE

ALL DIMENSION ARE IN mm

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI - 110 016
TEL: 668846, 669418 TLX. 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

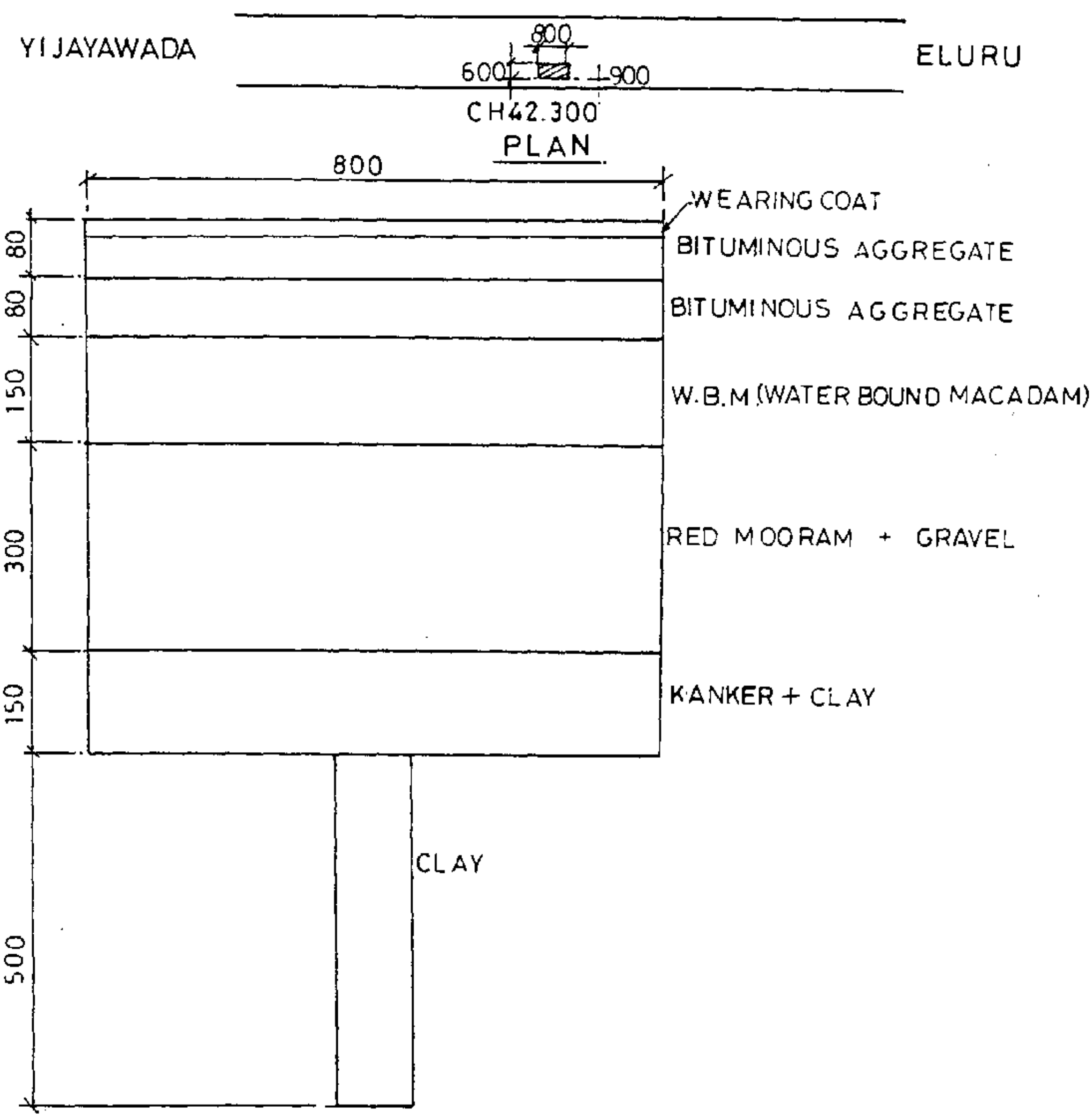
FIG. 4-7

PROJECT NH 5

SECTION VIJAYAWADA ELURU

CH 42.300

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE
ALL DIMENSIONS ARE IN mm

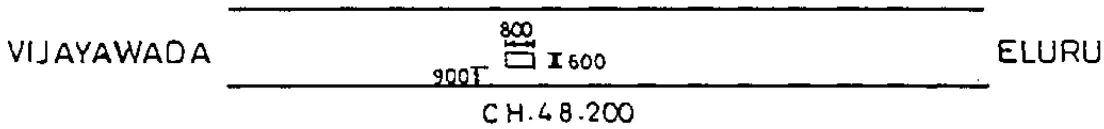
Fig. 4 -8

PROJECT ...... N.H.-5 ....

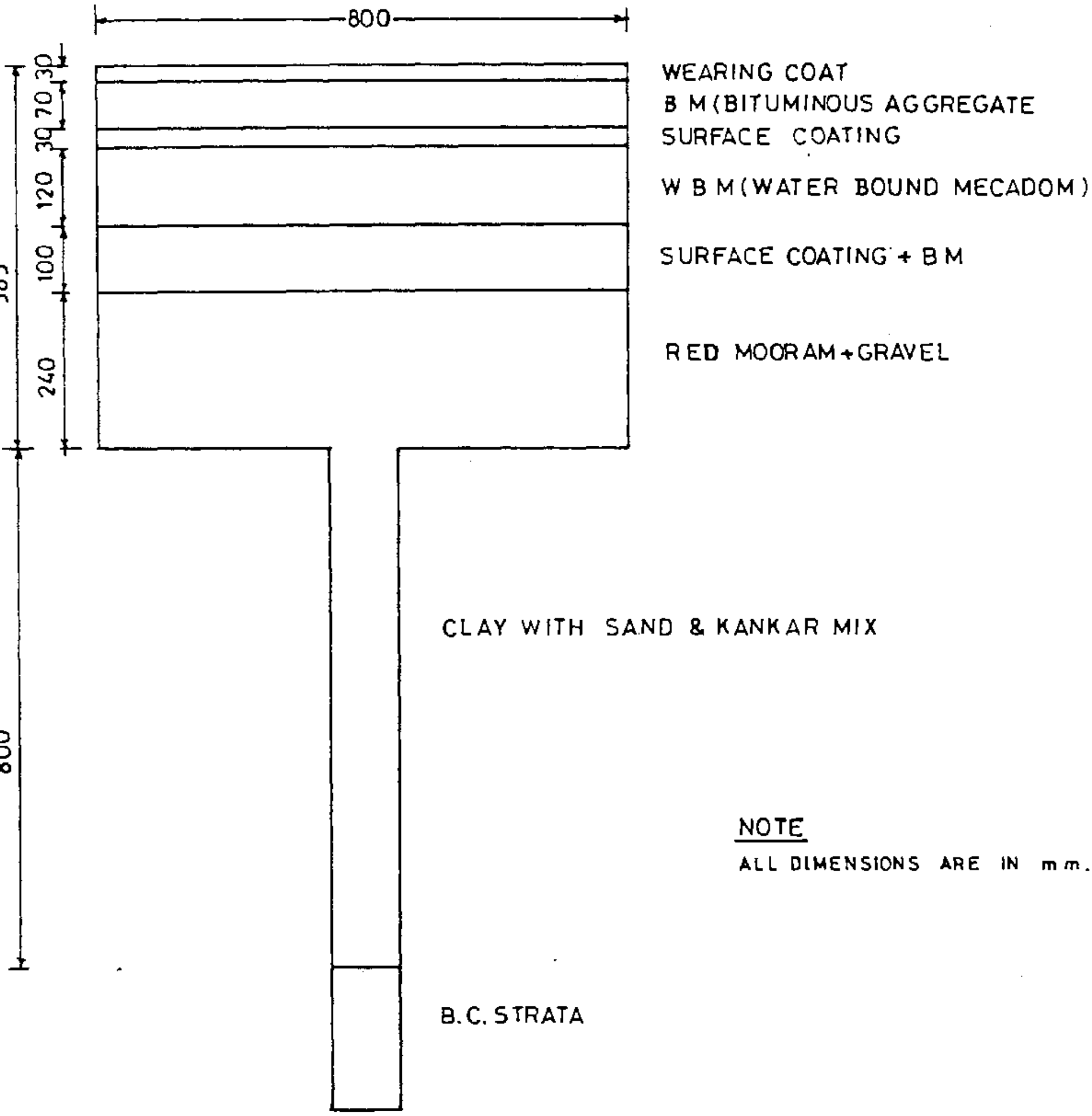
SECTION VIJAYAWADA -ELURU ....

CH. ...... 48.200 ....

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



PLAN



NOTE

ALL DIMENSIONS ARE IN mm.

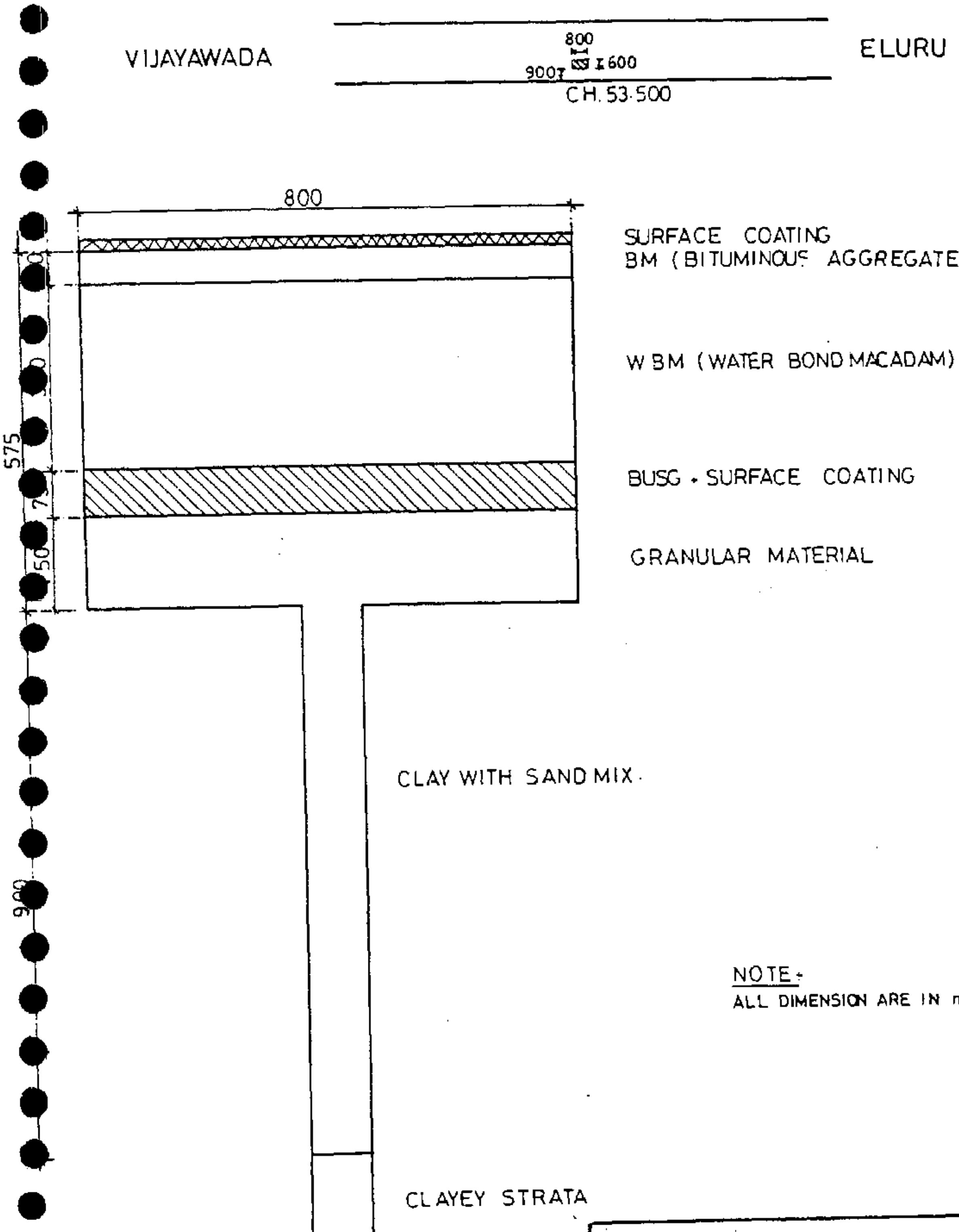
Fig. 4-9

PROJECT ....NH-5....................................

SECTION VIJAYAWADA - ELURU..............

CH. 53.500..

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE:-
ALL DIMENSION ARE IN mm.

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI - 110016
TEL: 668846, 669418 TLX: 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

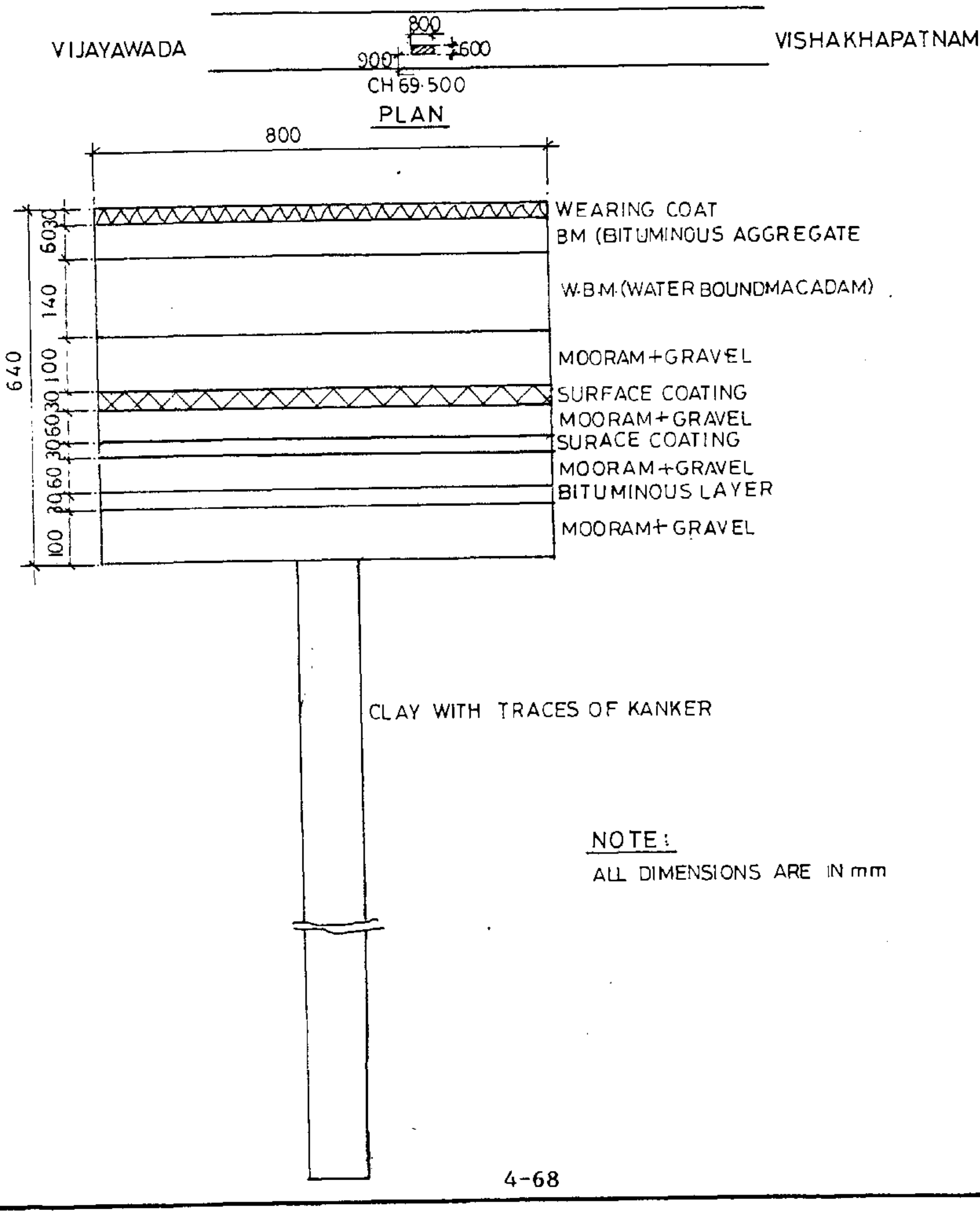
Fig. 4 -10

PROJECT ... NH-5

SECTION ... VIJAYAWADA VISHAKHAPATNAM

CH. ... 69.500

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



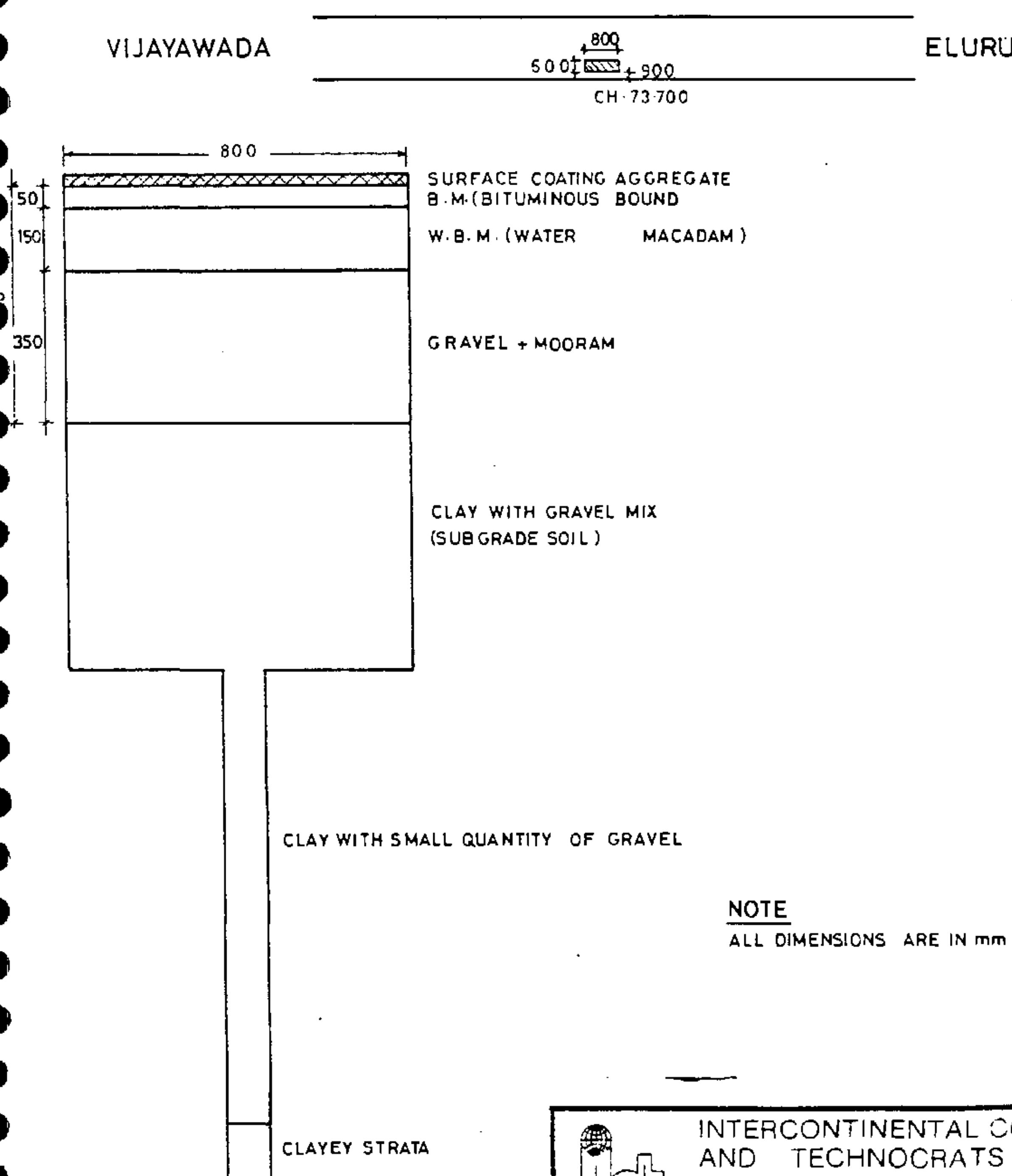
NOTE:
ALL DIMENSIONS ARE IN mm

PROJECT N.H.5

SECTION VIJAYAWADA - ELURU

CH. 73.700

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE
ALL DIMENSIONS ARE IN mm

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK, NEW DELHI- 110016
TEL. 668846. 669418 TLX: 031 -73236
DELHI NOIDA, JAIPUR, BANGALORE MADRAS BOMBAY, MALAYSIA

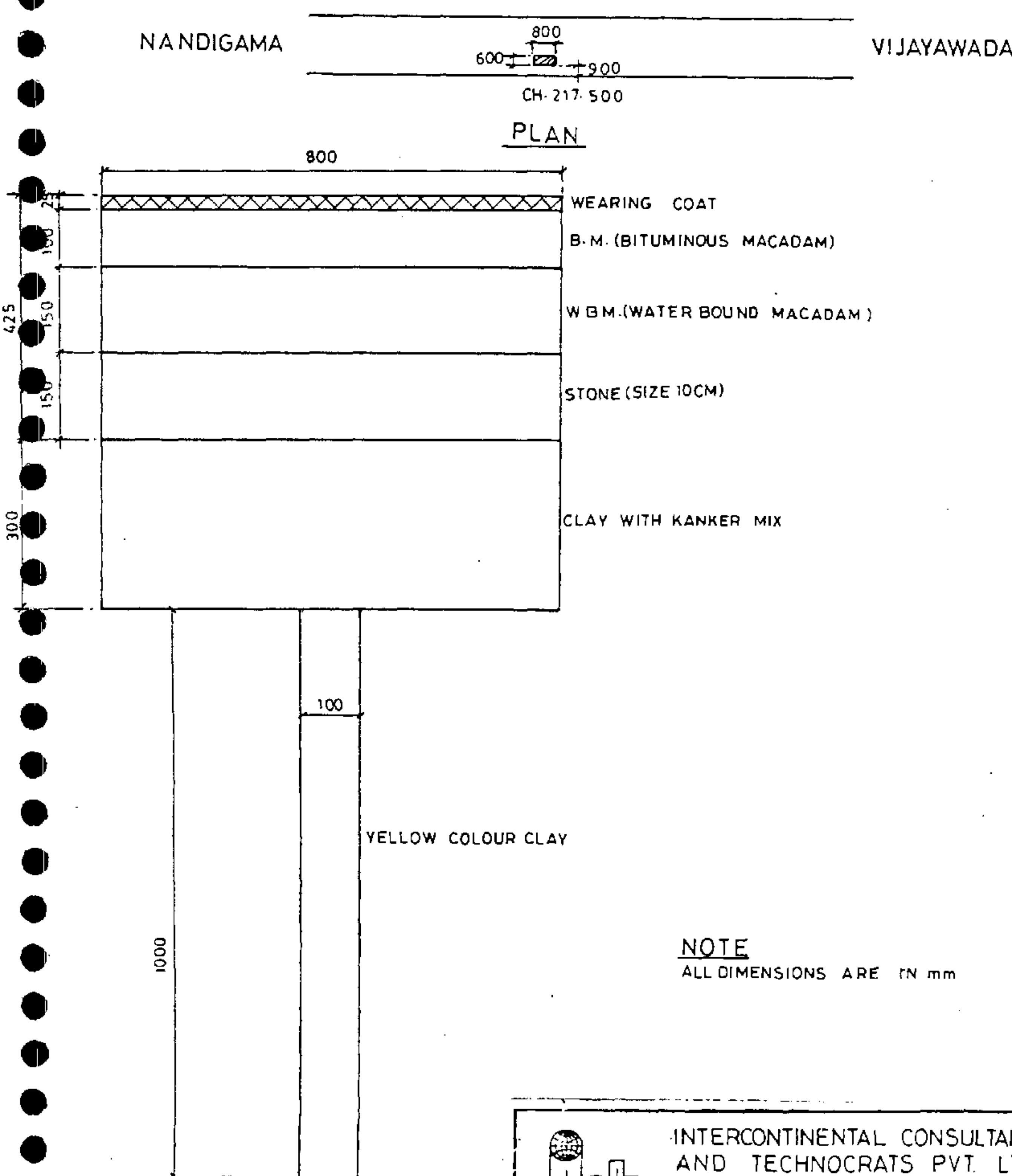
Fig. 4-12

PROJECT N.H. 9

SECTION NANDIGAMA-VIJAYAWADA

CH. 217.500

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE
ALL DIMENSIONS ARE IN mm

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI-110 016
TEL: 668846, 669418 TLX. 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

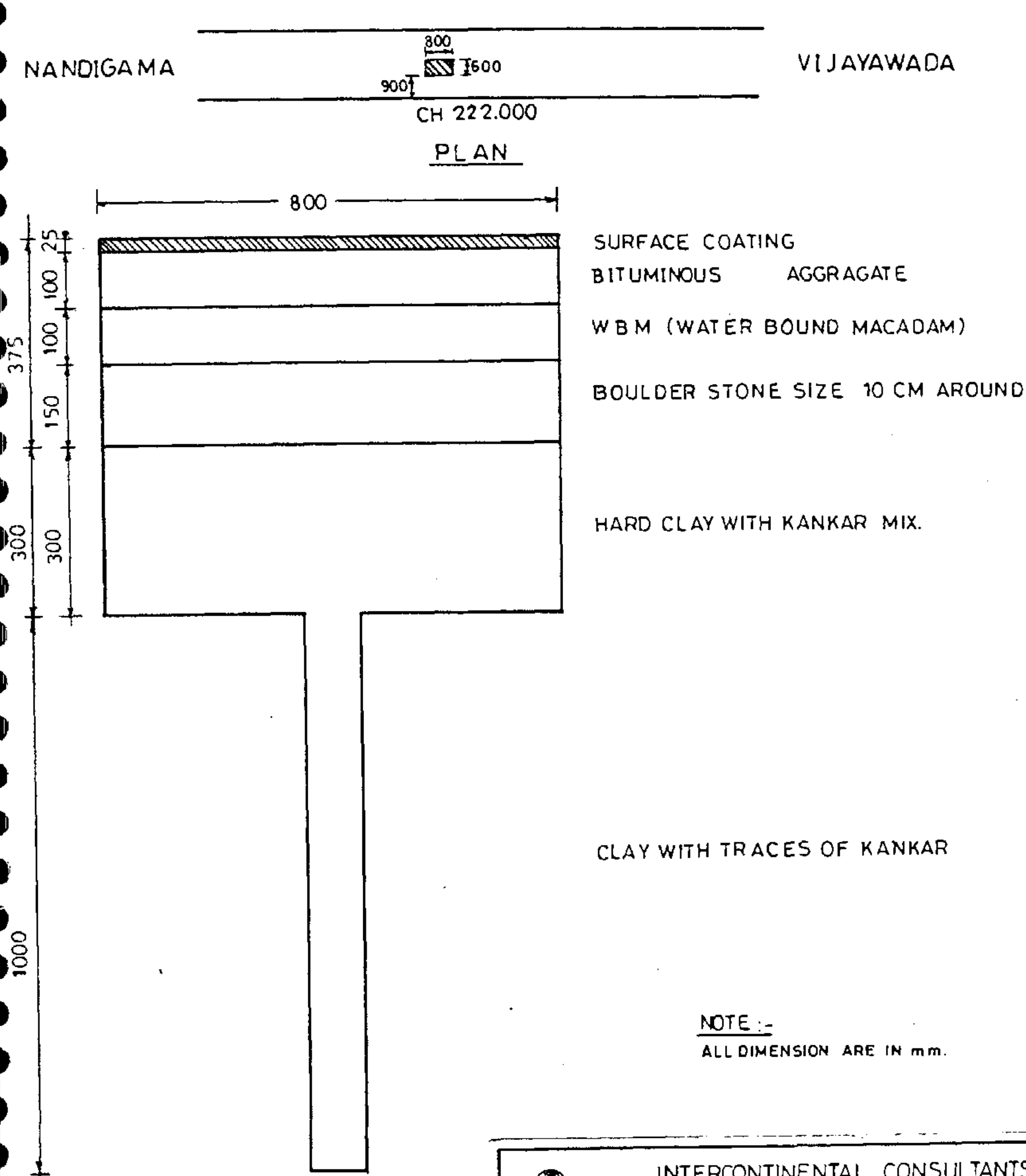
Fig. 4-13

PROJECT N.H-9

SECTION NANDIGAMA - VIJAYAWADA

CH 222.000

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE :-
ALL DIMENSION ARE IN mm.

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI-110 016
TEL: 668846, 669418 TLX: 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

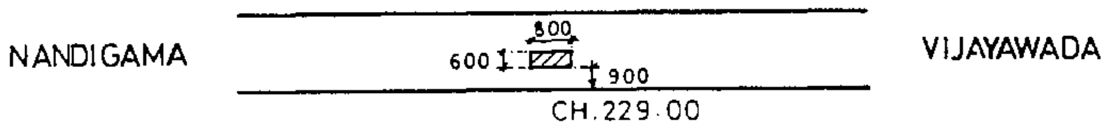
Fig. 4 -14

PROJECT NH-9

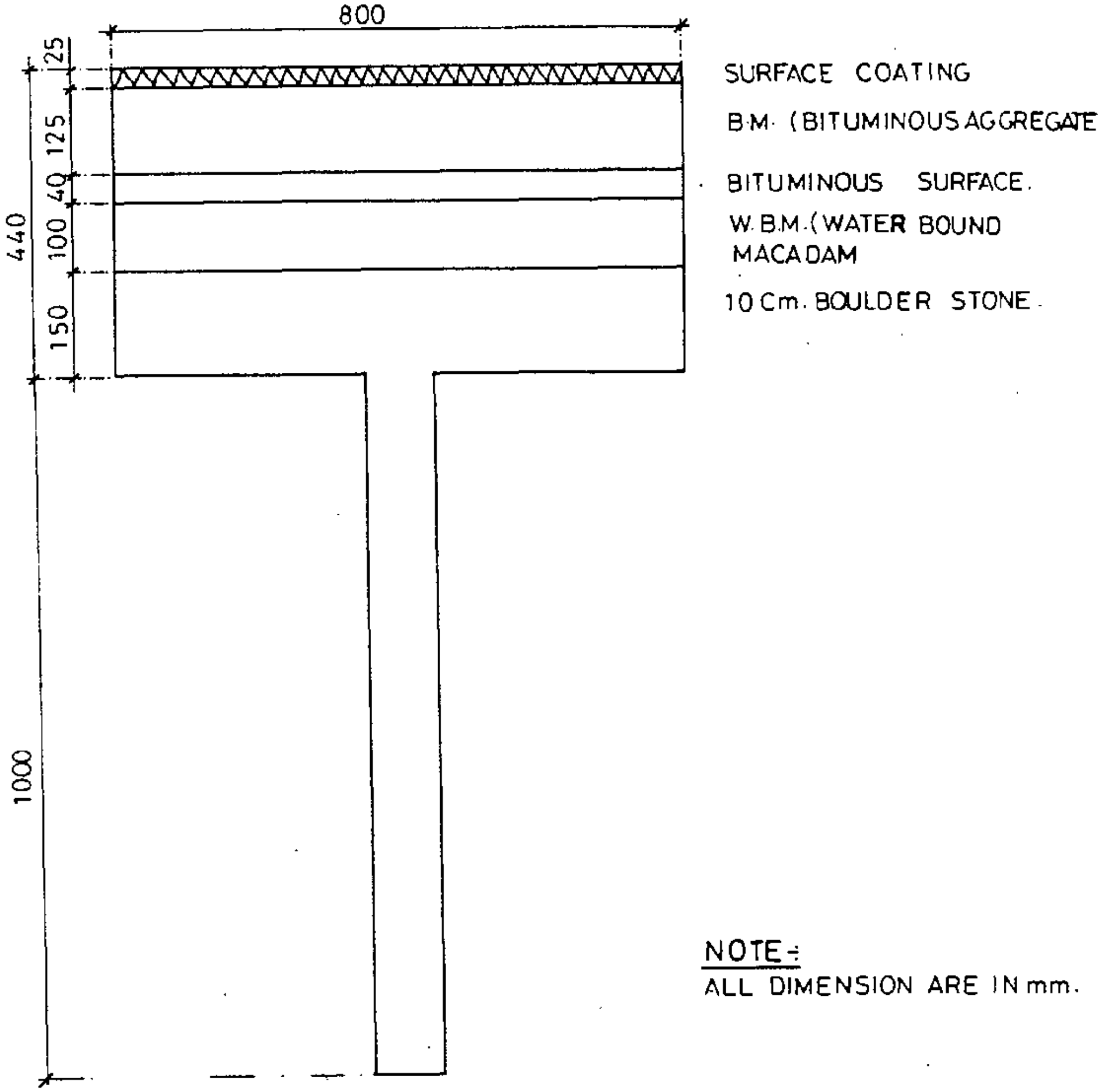
SECTION NANDIGAMA - VIJAYAWADA

CH: 229.000

BORE LOG CHART INCLUDING PAVEMENT THICKNESS.



PLAN



NOTE:-
ALL DIMENSION ARE IN mm.

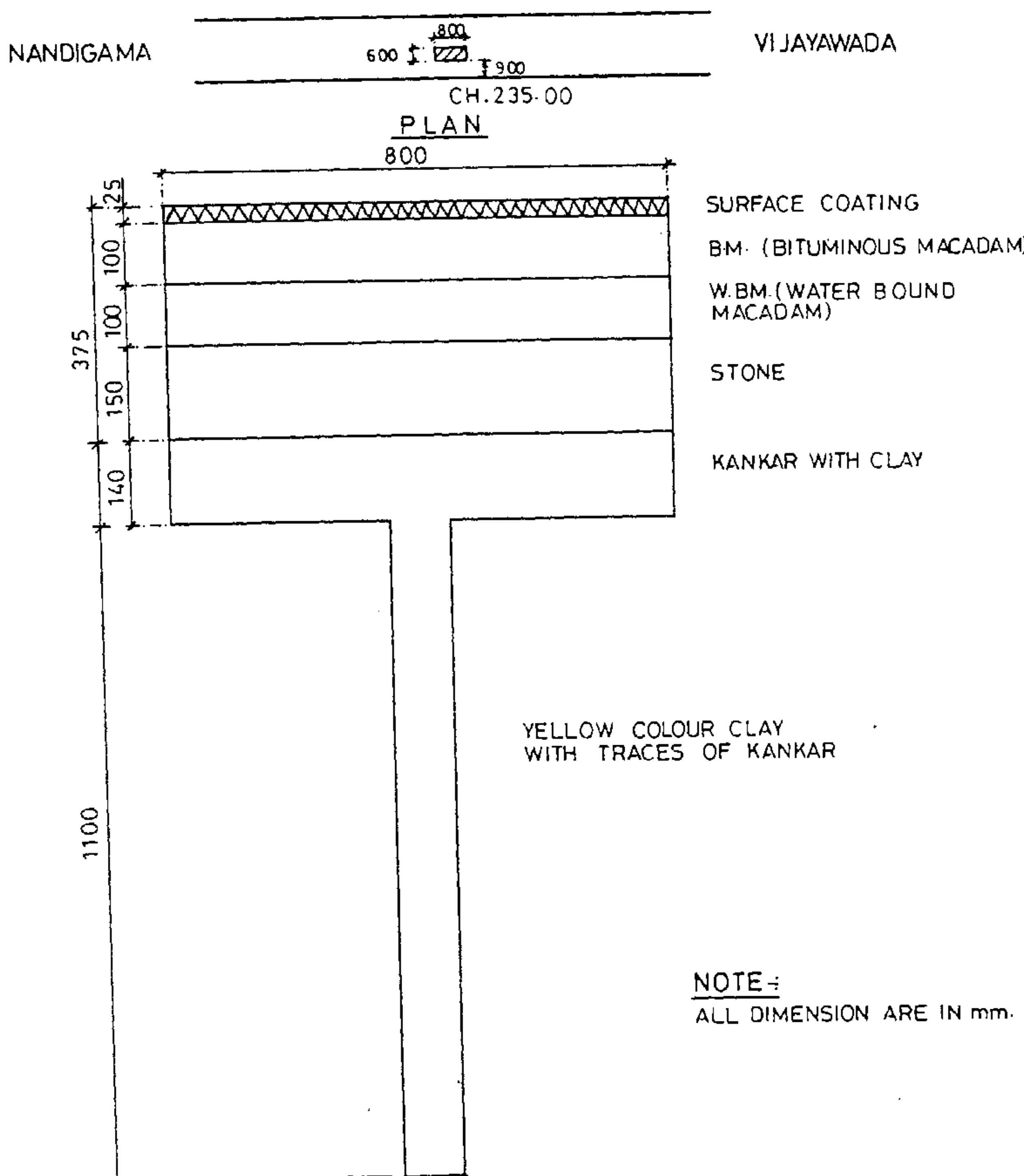
Fig. 4-15

PROJECT ... NH-9

SECTION ... NANDIGAMA - VIJAYAWADA

CH: 235.000

BORE LOG CHART INCLUDING PAVEMENT THICKNESS.



NOTE:-
ALL DIMENSION ARE IN mm.

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI - 110016
TEL: 668846, 669418 TLX: 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

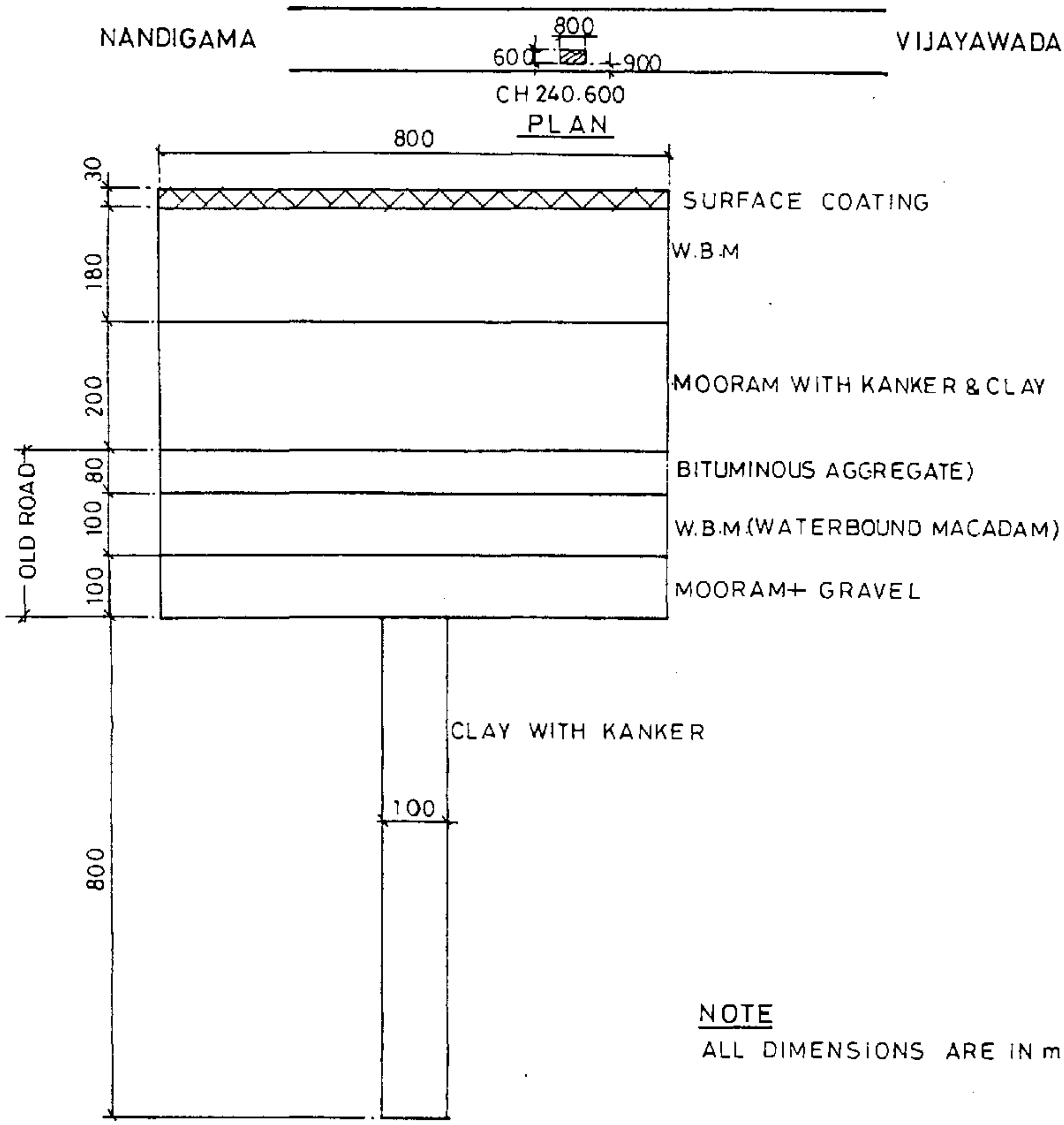
Fig 4-16

PROJECT N.H.9

SECTION NANDIGAMA-VIJAYAWADA

CH 240.600

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE
ALL DIMENSIONS ARE IN mm

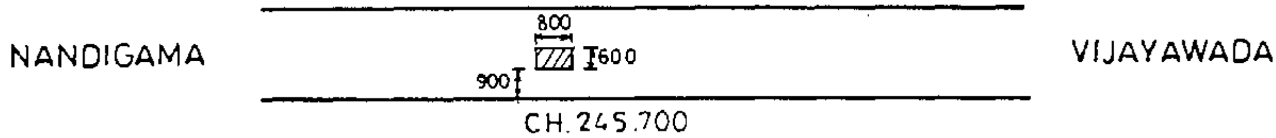
Fig. 4-17

PROJECT NH-9

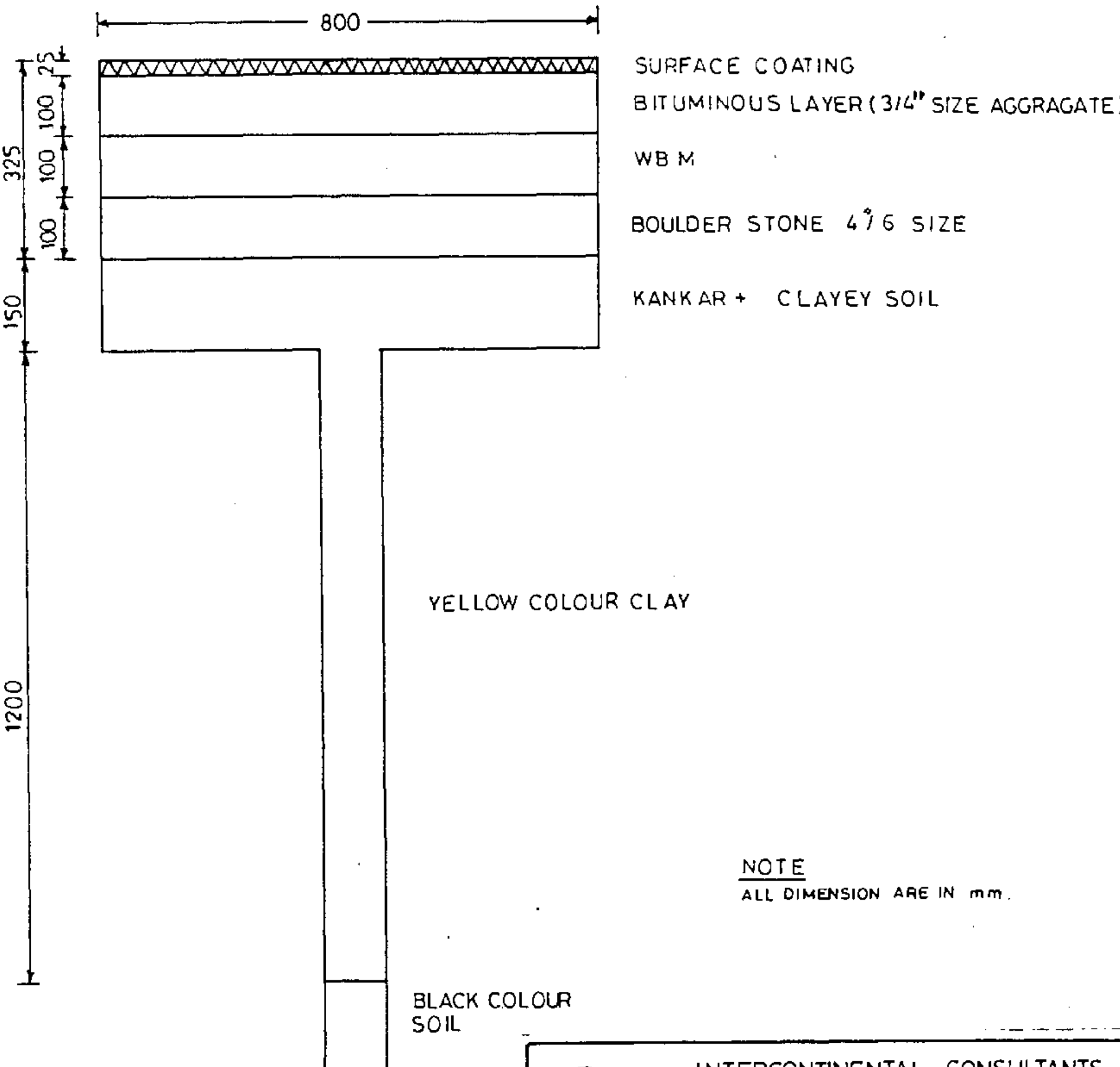
SECTION NANDIGAMA-VIJAYAWADA

CH. 245.700

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



PLAN



NOTE

ALL DIMENSION ARE IN mm.

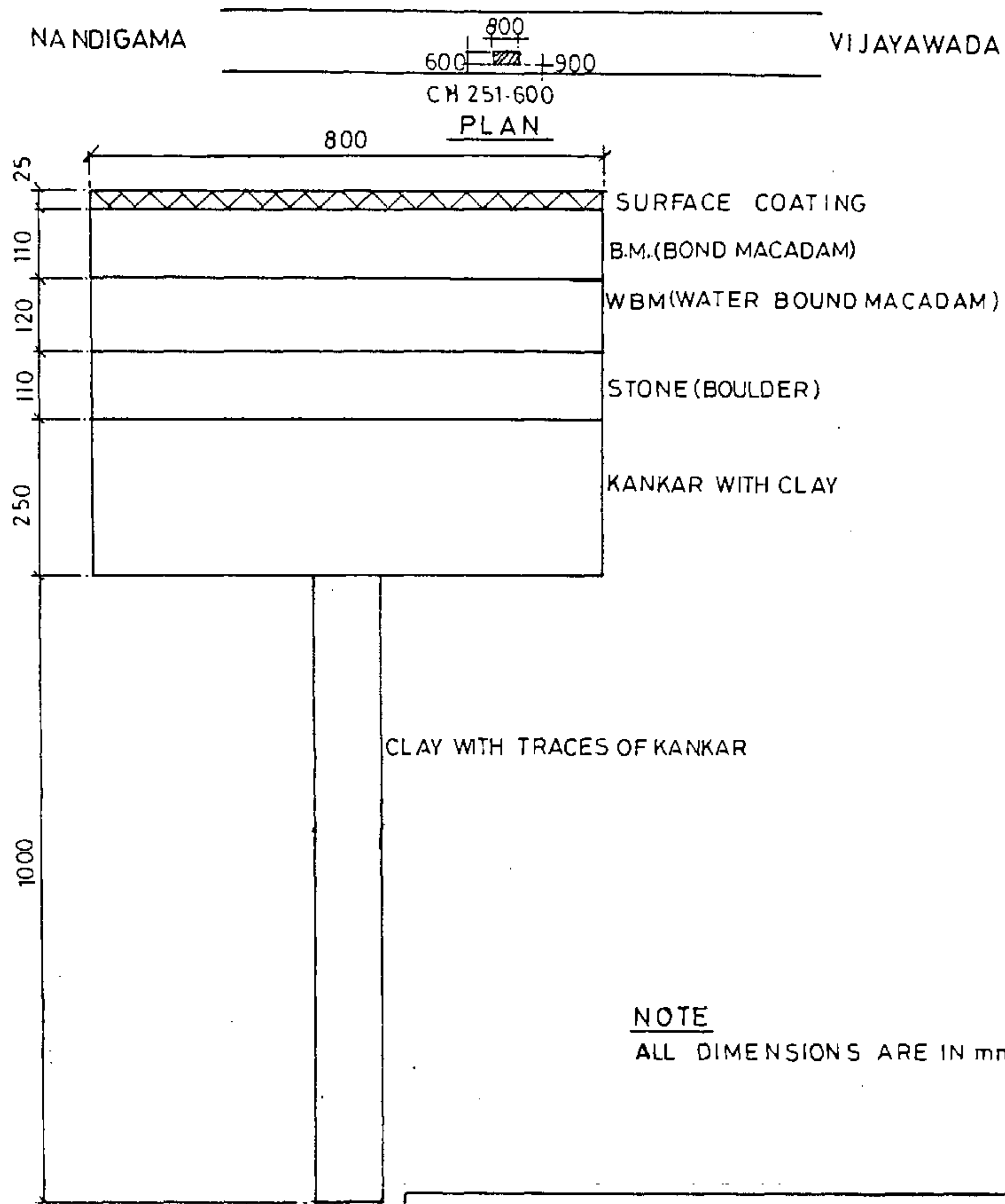
INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI - 110 016
TEL: 668846, 669418 TLX: 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

PROJECT N.H.9

SECTION NANDIGAMA VIJAYAWADA

CH - 251.000

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE
ALL DIMENSIONS ARE IN mm

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD
A-11 GREEN PARK NEW DELHI - 110016
TEL 668846, 669418 TLX 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

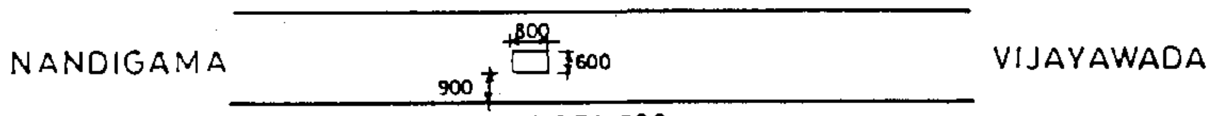
Fig.4-19

PROJECT NH-9

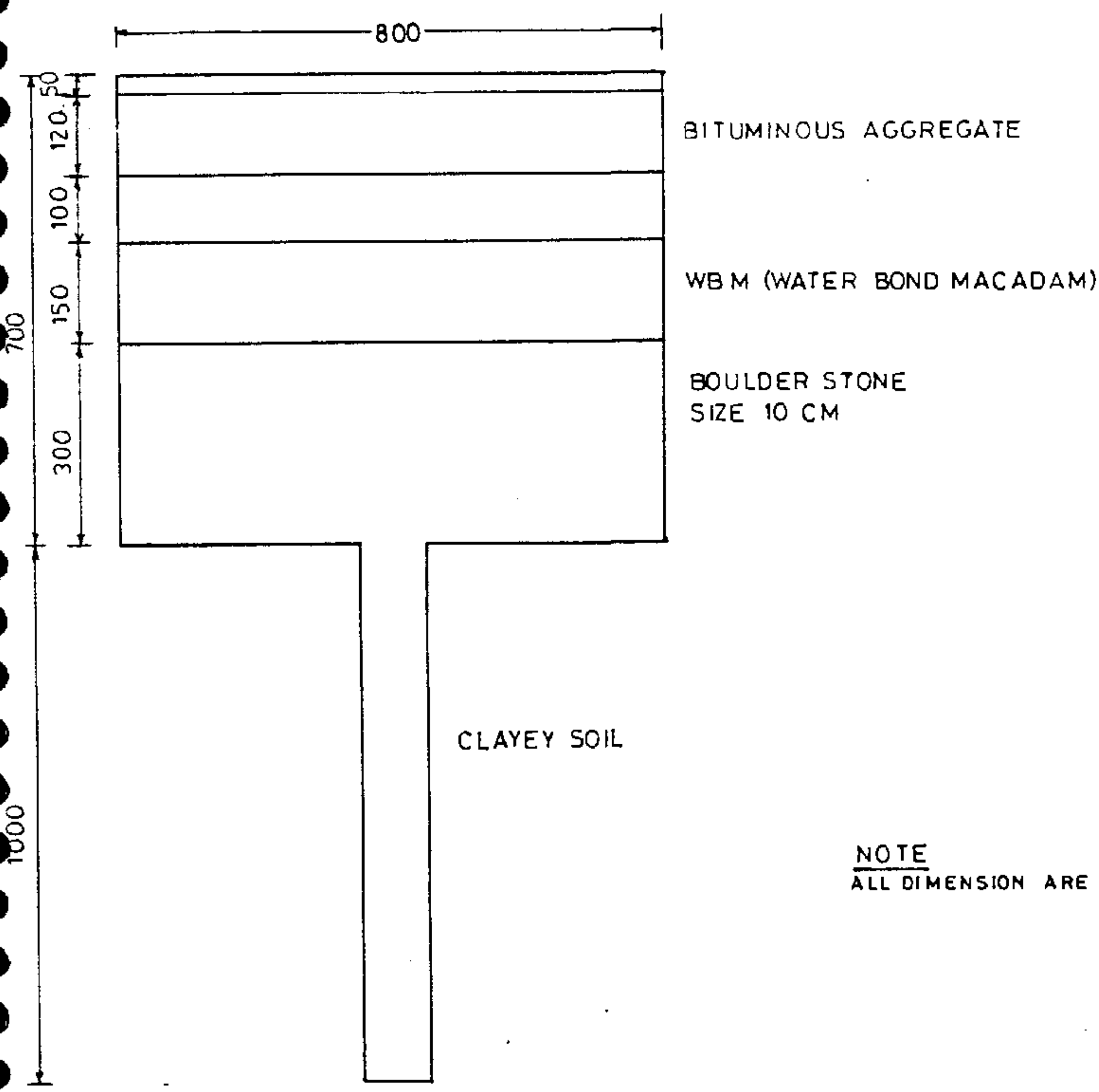
SECTION NANDIGAMA - VIJAYAWADA

CH. 254.600

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



PLAN



NOTE
ALL DIMENSION ARE IN mm.

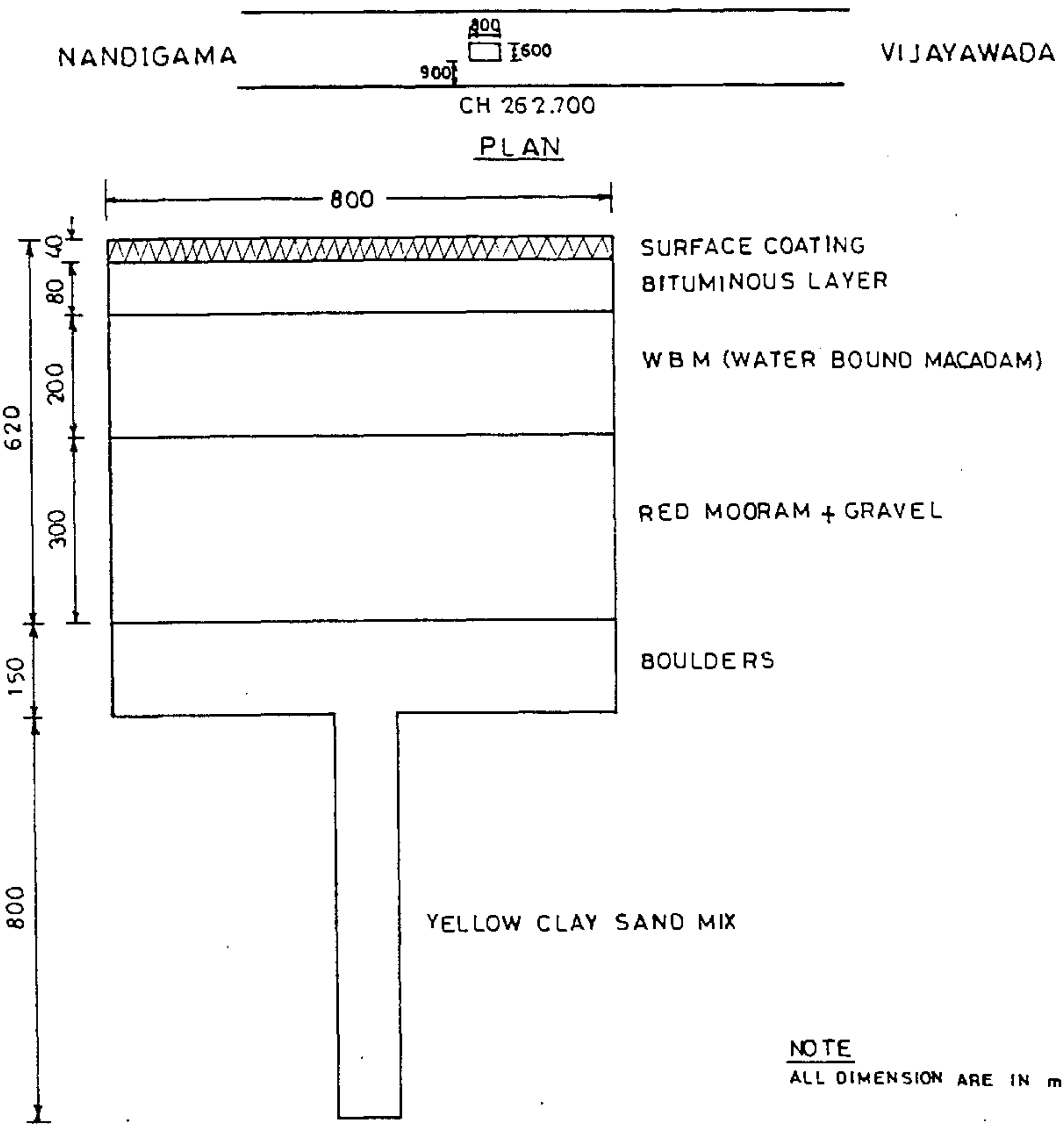
INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI - 110 016
TEL: 668846, 669418 TLX: 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

PROJECT NH-9

SECTION NANDIGAMA-VIJAYAWADA

CH. 262.700

BORE LOG CHART INCLUDING PAVEMENT THICKNESS



NOTE
ALL DIMENSION ARE IN mm

INTERCONTINENTAL CONSULTANTS AND TECHNOCRATS PVT. LTD.
A-11 GREEN PARK NEW DELHI-110016
TEL: 668846, 659418 TLX: 031-65436
DELHI • NOIDA • JAIPUR • BANGALORE • MADRAS • BOMBAY • MALAYSIA

CHAPTER - 5

5.0 BRIDGES

(i) Inventory has been prepared for the existing bridge structures located on NH-5 and NH-9 for the road stretches proposed to be retained except Eluru bypass on NH-5, which is a realigned section.

(ii) Proposals have been framed for individual bridge structure conforming to National Highway standards.

(iii) Some of the existing structures, which are in good condition are proposed for retention as 2 lane bridges.

(iv) At present, there is only one causeway falling on the existing NH-5 near Eluru town which is proposed to be bypassed. In order to make Eluru bypass an all-weather road, it is proposed to provide a high level bridge at the corresponding location of this causeway on Eluru bypass.

(v) There are at present two railway level crossings and one road overbridge on the existing NH-5 passing through Eluru town. With the provision of Eluru bypass, two road overbridges are required.

(vi) The design principles adopted have been brought out in subsequent paras of this chapter.

5.1 DETAILS OF EXISTING BRIDGES

5.1.1 Condition Survey

i) Based on survey carried out, details of the existing bridge structures are given in Annexure 5.1 for NH-5 for the section from km. 3.4 to km. 75.00 except the section from km. 53.800 to km. 69.200 proposed as Eluru bypass and Annexure 5.2 for NH-9 for the section from km. 217.00 to km. 265.00. These Annexures indicate the details of existing bridges such as span arrangement, total length, pier dimensions, design loading (wherever available), skew angle of crossing, carriageway width, footpaths provided or not, type of superstructure, substructure and foundations; bearings, wearing course, protection works, year of construction (wherever available) and the present condition of the structures.

ii) Depending upon the total length of existing bridges, these are classified as under as per Ministry of Surface Transport [MOST] standards :

A. Major bridges of length greater than 60 m

NH-5	NH-9
4 Nos.	2 Nos.
(S.Nos. 1,2,3 & 4 of Annexure 5.1)	(S.Nos. 3 & 7 of Annexure 5.2)

B. Minor bridges of length varying from 6m to 60 m

NH-5	NH-9
9 Nos.	8 Nos.
(S.Nos. 5 to 13 of Annexure 5.1)	(S.Nos. 1,2,4,5,6, 8,9 & 10 of Annexure 5.2)

5.1.2 Existing Bridge Structures

a) A perusal of Annexure 5.1 reveals that for NH-5 the 4 (S.Nos. 1,2,3 & 4) major bridges are with RCC T-beam and slab type superstructure (except S.No 1), RCC substructure and well foundations. The other 9 minor bridges (S.Nos. 5 to 13) have RCC slab type superstructure with cement concrete/stone masonry substructure and open foundations.

b) Similarly, Annexure 5.2 shows that for NH-9, Paritala major bridge (S.No. 3) is with RCC T-beam and slab superstructure, RCC substructure and well foundations. The other Budameru major bridge (S.No. 7) is a small span structure with RCC slab type superstructure, stone masonry substructure and open foundations. The rest 8 minor bridges comprise of :

i) 6 Nos. (S.Nos. 1,2,4,5,6 and 10) with RCC slab type superstructure, RCC substructure and open foundations.

ii) One No. (S.No. 8) with RCC T-beam and slab type superstructure, RCC substructure and open foundations.

iii) One No. (S.No. 9) is a combination of arch and slab superstructure, stone masonry substructure and open foundations.

5.2 STRUCTURAL AND CARRIAGEWAY WIDTH PROPOSALS FOR NEW BRIDGES

5.2.1 Guidelines for Framing Proposals

The proposals for new bridge structures have been evolved based on the latest guidelines contained in Ministry of Surface Transport (Roads Wing)'s circular No. RW/33044/2/88-DO II dated 21.9.90 regarding "Width of

bridges on National Highways". Parameters stated in this circular regarding bridge structures on 2-lane and 4-lane National Highways are as under :

5.2.1.1 Bridges upto 30 M Length

a) 2-lane National Highways

i) Overall width of bridge between outer faces of railing kerbs shall be 12 m.

ii) The roadway of these bridges will have a two-directional crossfall (i.e. camber). However, where future widening to 4-lanes is anticipated, the design of the structure should cater for additional load caused by camber correction required for changing it to unidirectional slope.

iii) On 2-lane National Highways being improved by way of provision of 1.5 m paved shoulders on either side, widening of the existing bridges should, as far as possible, be done simultaneously so that the cross sections on the bridge and approaches match each other i.e. the width of the bridge shall be kept as 12 m between the outer faces of railing kerbs. If widening is not feasible, the existing bridge deck may be replaced. In some cases, an entirely new bridge may have to be constructed.

b) 4-lane National Highways

i) On 4-lane sections, the inner face of the raised median kerb on the road and that on the bridge on the right hand side will be in line with each other. Like-wise, the outer edge of road formation and the outer face of the railing kerb on the left hand side will be in line with each other.

ii) On four lane National Highways, the overall width of the bridge deck shall be identical to that of the approaches. Normally, the total width shall be 24 m (9.75+4.5+9.75) between the outer faces of railing kerbs.

iii) Where central median width is more than 4.5m or where the two carriageways are at different levels, 2 independent bridges may be provided to cater for each direction of travel. The width of each independent bridge shall be such that the outer edge of the railing kerb on the left hand side shall be in line with the outer edge of the roadway. Further, the width of the bridge between outer face of the left railing kerb and

inner face of the right railing kerb shall be 9.75 m.

iv) Each carriageway shall have unidirectional cross slope.

v) For the additional 2 -lane bridge being constructed parallel to the existing two lane bridge, the total width shall be 9.75 m (between inner face of central median/right railing kerb and the outer face of left railing kerb) with unidirectional cross slope.

vi) The existing two lane bridge shall also be widened to 9.75 m and provided with unidirectional cross slope. If widening is not feasible, the existing bridge deck may be replaced. In some cases, an entirely new bridge may have to be constructed.

vii) Central medians of upto 4.5m width between the two carriageways of a four lane bridge shall be covered with slabs, except at locations where the two carriageways are at different levels.

viii) No raised footpaths should be provided unless the same are otherwise existing on the approaches.

5.2.1.2 Bridges over 30 m length

a) 2-lane National Highways

i) For two-lane National Highways, carriageway width of bridges shall be kept as 7.5 m within the inner faces of kerbs.

ii) For two-lane bridges, raised footpaths, at least 1.5 m wide, on each side of the carriageway shall be provided, wherever considered necessary.

b) 4-lane National Highways

i) For new four lane National Highways, the carriageway width of each two lane bridge shall be kept as 7.5 m within the inner faces of railing kerbs. Raised footpath, if required, shall be provided on the left side of each carriageway.

ii) In the case of two lane National Highways being widened to four lanes, raised footpath for the additional two lane bridge, if required, may be provided only on the left side of the carriageway.

5.2.1.3 Road overbridges

The above provision shall also generally apply to all road overbridges except where any deviations have to be made due to specific site constraints.

5.2.2 Proposed new structures

i) On NH-5, proposals are framed for 2 lane bridges except bridges at km 5.17, 71.22 and 73.61 which are on proposed 4-lane sections. Similarly, on N.H.9, proposals are framed for 2 lane bridges except bridges at km. 253.50, 253.60, 254.65 and 262.19 which are on proposed 4 lane section.

ii) Annexure 5.3 gives complete information about proposed 2 lane and 4 lane bridges on NH-5 such as effective span, clear span; type of superstructure, substructure and foundations; total length, carriageway width, footpaths provided or not and proposed deck R.Ls. for existing bridges recommended for replacement and new bridges proposed on Eluru bypass. For facility of appreciating these bridge proposals, corresponding details of the existing bridges are also presented side by side in Annexure 5.3. Information on the same lines is compiled for 2 lane and 4 lane bridges falling on NH-9 as per Annexure 5.4. Care has been taken to evolve span arrangement for the existing bridges proposed for replacement in such a way that the clear linear waterway for the new structures is not less than that of the existing ones. Footpaths have been proposed in case they are available on the existing bridges or wherever, considered essential.

5.2.3 Proposed programme for new bridges

5.2.3.1 Category I - Minor Bridges upto 30 m individual length

For bridges falling under category - I, the total width of deck required as per 'MOST' guidelines stated in para 5.2.1.1 is 12.00 m for 2 lane carriageway facility. The carriageway width after allowing for 0.55 m for railing kerb on either side comes to 10.90 m for a 2 lane bridge. In case of a 4 lane bridge, the carriageway width after allowing for half the median width (i.e. 2.25 m) and railing kerb of 0.55 m on one side comes to 9.20 m for each 2 lanes. From Annexure 5.3 (NH-5) and Annexure 5.4 (NH-9), it is seen that the position about existing bridges falling under this category emerges as under :

A. Bridges with carriageway width more than 10.9/9.2 m for 2 lane/4 lane.

a) <u>N.H.5 (Annexure 5.3)</u>

Existing 2 lane Veerapalli bridge (S.No. 10) is proposed for retention since carriageway width is 11 m and the structure is in good condition.

b) <u>N.H. 9 (Annexure 5.4)</u>

i) Existing 2 lane bridge at km. 254.650 (S.No. 9) is proposed to be replaced by a 4 lane bridge with covered median since the condition of the existing arch-cum-slab structure is very poor though carriageway width is 10.8 m as against 9.2 m required for a 4 lane road.

ii) Existing 2 lane bridge at km. 262.19 (S.No. 10) is proposed to be retained since carriageway width available is 12.25 m > 9.2 m required for 4 lane and the condition of the structure is good. For 4 laning, additional 2 lane bridge is proposed with an open median.

B. Bridges with less carriageway width but good structural condition

Based on decisions arrived at during discussions held with 'MOST' and PWD Officers on bridge proposals of Category-I contained in Draft Feasibility Report, the following 2-lane existing bridges with lesser carriageway width but with good structural condition are proposed to be retained as such.

a) <u>N.H.5 (Annexure 5.3)</u>

Four nos. (S.Nos. 5,6,7 and 9) are proposed to be retained.

b) <u>N.H.9 (Annexure 5.4)</u>

Four nos. (S.Nos. 2,4,5 and 6) are proposed to be retained.

C. Bridges proposed for replacement

Two lane bridges proposed for replacement at the existing locations because of very much insufficient carriageway width in comparison to the latest 'MOST' standards as well as structural condition being not good are :

i) NH-5 (Annexure 5.3)

1 No. i.e. S.No. 23 is proposed as a 4 lane bridge.

ii) NH-9 (Annexure 5.4)

1 No. i.e. S.No. 1 is proposed as a 2 lane bridge.

D. New Bridges

Construction of 7 Nos. (S.Nos. 13,14,15,17,18,19 and 20) new bridges is recommended on Eluru bypass on NH-5 as per Annexure 5.3.

5.2.3.2 Category II-Minor Bridges above 30 m and upto 60 m length

For bridges falling under this category, the carriageway width required as per 'MOST' guidelines stated in para 5.2.1.2 is 7.5 m within the inner faces of kerbs. The position about these bridges emerges as under from Annexure 5.3 (NH-5) and Annexure 5.4 (NH-9) :

a) NH-5 (Annexure 5.3)

i) One no. (S.No. 8) existing 2 lane bridge is proposed to be retained since carriageway width is sufficient and the condition of the structure is good.

ii) One no. (S.No. 11) 2 lane bridge is already under construction with 7.5 m carriageway width.

iii) One no. (S.No. 24) 2 lane bridge is proposed for replacement with a 4 lane structure at the existing location since carriageway width is 5.8 m against requirement of 7.5 m.

b) N.H-9 (Annexure 5.4)

One no. (S.No. 8) existing 2 lane bridge is proposed to be retained since carriageway width is marginally less (i.e. 7.4 m as against requirement of 7.5 m) and the condition of the structure is good. For 4 laning, additional 2 lane bridge is proposed with an open median.

5.2.3.3 Major Bridges of length more than 60 m

The carriageway width required for major bridges as per 'MOST' guidelines stated in para 5.2.1.2 is 7.5 m within the inner faces of kerbs. The position about this category of bridges emerges as under from Annexure 5.3 (NH-5) and Annexure 5.4 (NH-9).

a) NH-5 (Annexure 5.4)

i) All the 4 existing 2 lane major bridges (S.Nos. 1,2,3 and 4) are proposed to be retained since carriageway widths are sufficient except for one (S.No. 3), where it is marginally less i.e. 7.3 m. as against 7.5 m and the condition of the four structures is good.

ii) Additional 2 lane bridge is proposed by the side of existing bridge (S.NO.1) with an open median.

iii) Two bridges (S.Nos. 16 and 21) are proposed as new construction on Eluru bypass.

b) NH-9 (Annexure 5.4)

i) Two existing 2 lane bridges (S.Nos. 3 and 7) are proposed to be retained since the condition of the structures is good and carriageway widths are sufficient except for one (S.No. 7), where it is marginally less i.e. 7.3 m as against requirement of 7.5m.

ii) In order to provide for 4 lane bridge at one location (S.No. 7), additional 2 lane bridge is proposed.

5.2.3.4 Reasons for not widening or replacement of superstructure of existing bridges proposed for replacement

The question of widening the width of bridges or complete replacement of superstructure by widening the substructure and foundations of existing bridges has been carefully examined and based on reasons stated below, it is considered that neither of the two alternatives will be technically feasible.

i) Majority of the existing bridges are with slab type superstructures. Thus widening may destroy the edge stiffening action provided to the unsupported edge of the slab by the railing beam since the same will have to be cut and reduced in height to bring it in level with the top of slab. Moreover, this measure may introduce a longitudinal joint in the slab, which may prove detrimental to the superstructure because of ingress of water through this joint and pounding of vehicular loads over the joint.

ii) Uniform behaviour of existing and extended part of substructure and foundations cannot be ensured for the black cotton/clayey type of strata available at the founding levels of the existing bridges. In case of differential settlement between existing and extended substructure, the complete replaced superstructure may get distressed.

iii) Construction problems may crop up during execution of proposed extension in order to ensure a matching joint between old and new substructure and foundations because existing slopes and offsets in the existing structure may not be safe to take up additional loads imposed by new extended structure.

iv) Saving in cost by retaining the existing substructure and foundations may be nominal since that will get partly offset by the cost of dismantling the existing superstructure complete for relaying a new one. The operation of dismantling the existing superstructure may also endanger the structural stability of existing substructure and foundations.

v) For T-beam and slab type superstructure, widening may present structural and constructional problems.

vi) Structural adequacy may not be available in the existing structures to accommodate 2.5% (1 in 40) slope on top of deck in place of the existing one of 1 in 62.5 for asphaltic concrete and 1 in 75 for cement concrete wearing courses. Camber correction required for 2.5% slope definitely imposes heavy superimposed dead loads.

5.2.3.5 Certain modifications not possible for existing bridges proposed to be retained

The modifications that cannot be complied with for existing bridges proposed to be retained are stated below:

i) Modifications required to be carried out for camber correction on top of deck from a two directional available at present as stated in previous para to a unidirectional of 1 in 40 for 4 lane sections will impose additional superimposed dead load. The existing structure may not be safe for this addtional superimposed dead load and thus perforce 2-way camber will have to be retained.

ii) Because of widening and strengthening of the existing 2 lane road, the existing road levels will get increased. This will necessitate the deck levels of existing bridges to be increased correspondingly to match with that on the approaches. Such a proposal will impose additional dead load on the bridge which may prove detrimental for the structural stability. In order to avoid this situation, the strengthening in immediate approaches of the bridge may have to be tapered for bringing it in level with the bridge deck.

iii) In 4 lane sections, the median in between the two bridges will have to be left open and not covered in order not to impose additional dead load on the existing bridge.

5.2.3.6 Summary of bridges proposed for replacement/construction at new locations :

A. NH-5 (Annexure 5.3)

Total 24 Nos.

- Existing Road 13 Nos. (S.Nos. 1 to 11, 23 and 24)
  - Major 4 Nos. (S.Nos.1, 2,3 and 4) All retained as 2 lane bridges
  - Additional 2 lane major bridge proposed 1. NO. (S.No.1)
  - Minor 9 Nos. (S.Nos.5 to 11, 23 & 24)
    - 'L' upto 30m 6 Nos. (S.Nos. 5,6 7,9,10 & 23)
      - Retained as 2 lane bridges 5 Nos. (S.Nos.5,6 7,9 & 10)
      - Replacement as 4 lane bridge at existing location 1 No. (S.No.23)
    - 'L' above 30 m and upto 60 m 3 Nos. (S.Nos. 8,11 and 24)
      - Retained as 2 lane bridge 1 No. (S.No.8)
      - Replacement as 4 lane bridge at existing location 1 No. (S.No.24)
      - New bridge already under construction 1 No. (S.No.11)
- New Construction on Eluru Bypass 9 Nos. (S.Nos. 13 to 21)
  - Major 2 Nos. (S.Nos. 16 & 21)
  - Minor-7 Nos. ('L' upto 30m) (S.Nos. 13 to 15 and 17 to 20)
- ROBs on Eluru Bypass 2 Nos. (S.Nos. 12 & 22) (To be planned and executed by Railways).

Thus the programme for bridges on NH-5 is:

i)	Major 2 lane bridges retained	= 4	(S.Nos.1,2,3 & 4)
ii)	Minor 2 lane bridges retained	= 6	(S.Nos.5,6,7,8,9 & 10)
iii)	ROBs on Eluru bypass proposed	= 2	(S.Nos.12 & 22)
iv)	Minor 2 lane bridge under construction	= 1	(S.No.11)
v)	New 2 lane Major bridges on Eluru Bypass	= 2	(S.Nos.16 & 21)
vi)	New 2 lane Minor bridges on Eluru Bypass	= 7	(S.Nos.13,14, 15,17,18,19 & 20)
vii)	4 lane minor bridge at existing location	= 2	(S.Nos.23 & 24)
viii)	Additional 2 lane major bridge	= 1	(S.No.1)

B. NH-9 (Annexure 5.4)

```
                              Total 10 Nos.
                                    :
           /------------------------------------\
           :                                    :
       2 Lane Section                   4 Lane Section
       6 Nos.                           4 Nos.
       (S.Nos. 1 to 6)                  (S.Nos. 7 to 10)
           :                                    :
   /------------\                      /----------------\
   :            :                      :                :
Major       Minor                     Major            Minor
1 No.       (`L' upto                 1 No.            3 Nos.
(S.No. 3)   30 m)                     (S.No.7)         (S.Nos. 8,9
   :        5 Nos.                      :              and 10)
   :        (S.Nos.1,                   :                 :
Retained    2,4,5 & 6)                  :                 :
                :                  /--------------\       :
                :                  :              :       :
                :              Retained       Proposed    :
          All proposed         existing       additional  :
          to be retained       2 lane         2 lane      :
          except S.No.1        1 No.          1 No.       :
          to be replaced       (S.No.7)       (S.No.7)    :
          at the existing                                 :
          location.                /------------------------------\
                                   :                              :
                               `L' upto 30 m                   `L' > 30 m
                               2 Nos. (S.Nos.                   1 No.
                               9 and 10)                        (S.No.8)
                                   :                              :
  /--------------------------------\                   /-------------\
  :               :                :                   :             :
Retained      Proposed        Proposed            Retained       Proposed
existing      additional      4 lane              existing       addit-
2 lane        2 lane          1 No.               2 lane         ional
1 No.         1 No.           (S.No.9)            1 No.          2 lane
(S.No.10)     (S.No.10)                           (S.No.8)       1 No.
                                                                 (S.No.8)
```

Thus the programme for bridges on NH-9 is :

i)	Major 2 lane bridges retained	= 2 (S.Nos.3 & 7)
ii)	Minor 2 lane bridges retained	= 6 (S.Nos.2,4,5,6,8 & 10)
iii)	Replacement of 2 lane minor bridge	= 1 (S.No.1)
iv)	Proposed 4 lane minor bridge	= 1 (S.No. 9)
v)	Additional 2 lane major bridge	= 1 (S.No. 7)
vi)	Additional 2 lane minor bridges	= 2 (S.Nos.8 & 10)

5.2.4 Bridge Structural Proposals

Detailed designs of bridges will be carried out as per IRC Codes. Salient features taken into consideration for preparation of General Arrangement Drawings (GADs) are described below :

5.2.4.1 Span Arrangement and Waterway

While choosing span arrangement for an individual bridge, the following factors have been considered :

i) For the existing bridges proposed for replacement, neither excessive scour, nor overtopping of bridge proper and nor breaching of close approaches has been reported as confirmed during local enquiry and thus it has been ensured that the proposed span arrangement affords clear waterway, deck level, vertical clearance, and total length of bridge not less than that of the existing one.

ii) In 4 lane section, where additional 2 lane bridges are proposed by the side of existing bridges, neither excessive scour, nor overtopping of bridge and nor breaching of immediate approaches to the existing bridges has been confirmed during local enquiry, the span arrangement has been chosen either similar to the existing one or multiples of the existing one taking due care that the widths and centrelines of piers for the proposed bridge align with that of the existing one.

iii) For bridges located on Eluru bypass on NH-5, span arrangement has been decided keeping in view the waterway required, proposed longitudinal road profile and the minimum vertical clearance required as per code.

5.2.4.2 Loadings

All the bridges will be designed for the critical of IRC single lane of class 70 R or two lanes of class A loading as well as loads and forces as per IRC:6-1966.

5.2.4.3 Proposed Superstructure

It is proposed to provide slab type superstructures in reinforced concrete for all the bridges except bridge across Tamileru river on N.H.5, where it is proposed to adopt 'MOST' standard designs of PSC girders and RCC slab for 35 m span arrangement. Similarly, for V.T.P.S. cooling channel on N.H.9, it is proposed to adopt PSC continuous voided slab in order to provide a larger span in the centre which can be easily constructed without closure of the canal. Endeavour has been made to adopt 'MOST' standard designs for R.C.C. slabs, wherever feasible. Slab type superstructures will ensure less depth for the

superstructures and consequently deck levels may not have to be raised unnecessarily. Elastomeric and PTFE Pot bearings are proposed for Tamileru and V.T.P.S. bridges respectively.

5.2.4.4 Substructure and foundations

Substructure and foundations are proposed in RCC in order to have slender sections which will impose less pressure on black cotton/clayey foundation strata. For slab type superstructures, open foundations with bed protection are proposed and for Tamileru and V.T.P.S. bridges well/pile foundations are proposed in order to take heavy loads.

5.2.4.5 Design discharge, waterway and scour level

Annexure 5.5 gives detailed information, based on which design discharges, waterways and scour levels have been worked out for proposed new bridges on Eluru Bypass on NH-5 and also such parametres are brought out for other bridges.

5.3 ROAD OVERBRIDGES

On proposed Eluru bypass on NH-5, two road overbridges are recommended based on the following criteria.

"Where bypasses are being suggested and the railway line crosses the bypasses, the product of number of fast moving vehicles that may utilise the bypasses and number of closures exceeds 25,000".

5.4 COST OF BRIDGES

The cost for replacement/construction of bridges has been worked out and given in the relevant Chapter.

5.5 GENERAL ARRANGEMENT DRAWINGS (GAD)

General Arrangement Drawings (GAD) for all the bridges proposed for replacement/construction have been prepared. Drg. No. for each & every bridge is also indicated in Annexures 5.3 and 5.4.

ANNEXURE 5.1

DETAILS OF EXISTING BRIDGES ON NH-5 FROM VIJAYAWADA-ELURU SECTION KM. 3.400 TO KM. 75.000 (EXCEPT ELURU BYPASS SECTION)

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	SPAN ARRANGEMENT NO.x LENGTH (EXP. JOINT TO EXP. JOINT) (m)	LENGTH OF BRIDGE FACE TO FACE OF ABUTMENTS (m)	WIDTH OF PIER (m)	SKEW ANGLE (DEGREES)	CARRIAGEWAY WIDTH (m)	FOOTPATHS (m)	TOTAL WIDTH OF DECK (m)	CLEAR WATERWAY (m)	SUPERSTRUCTURE	SUB-STRUCTURE: ABUTMENT	SUB-STRUCTURE: PIER	TYPE OF FOUNDATIONS	TYPE OF BEARINGS	WEARING COURSE	PROTECTION WORKS	YEAR OF CONSTRUCTION	PRESENT CONDITION OF BRIDGE: SUPERSTRUCTURE	SUBSTRUCTURE	FOUNDATIONS	BEARINGS	PARAPETS	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	6/1	5.170	BANDAR CANAL	2x12.4 +1x48.1 = 72.90	71.7	1.24	48.00	7.85	1.6	11.25	53.50 (Width of Canal at FSL)	PSC Box	RCC	RCC	WELL	METALLIC	CC	-	-	GOOD	GOOD	GOOD	GOOD	GOOD	Bridge needs normal repairs. Overall conditon of structure good. Waterway adequate. Proposed to be retained.
2	15/4	14.900	RIVES CANAL BRIDGE CUM ROB	15.60+15.30 +15.45+15.55 +15.65+15.20 +15.70+15.30 +15.70+15.20 (ROB)=154.65	153.85	0.80	41.41	7.50	1.50	11.00	67.00 (Of Canal only)	RCC T-Beam & Slab	RCC	RCC	WELL	NEOPRENE	CC+MSS	Stone Pitching with apron	1986	GOOD	GOOD	GOOD	GOOD	GOOD	Bridge needs normal maintenance. Replacement of some of the expansion joints. To be retained. Waterway adequate.
3	20/1	19.400	BUDAMERU BRIDGE	8x26.90 = 215.20	214.35	0.85	20.63	7.30	Nil	8.30	201.00	RCC T-Beam & Slab	RCC	RCC	WELL	METALLIC	CC+MSS	Stone Pitching with apron	1967	GOOD	GOOD	GOOD	GOOD	70 % DAMAGED	Resetting of some bearings after jacking up. Replacement of some drainage spouts. Spalled beam edges. Cleaning top of abutment and pier at bearing level. To be retained. Waterway adequate.
4	21/2	20.430	ELURU CANAL BRIDGE	22.00+22.62 +21.90=66.52	65.72	0.80	44.42	7.50	1.50	11.00	26.40	RCC T-Beam & Slab	RCC	RCC	WELL	NEOPRENE	CC+MSS	Stone Pitching with apron	1979	GOOD	GOOD	GOOD	GOOD	10 % DAMAGED	Requires normal maintenance To be retained. Waterway adequate.
5	29/3	28.620	AVUTAPALLY	4.72+4.72 +4.88=14.32	13.20	0.80	Square	7·50	Nil	7.45	3.80+4.08 +3.8 =11.68	RCC Slab	CC	CC	OPEN	NIL	Bituminous	Stone Pitching with apron	1973	FAIR	FAIR	FAIR	N.A.	L/S 40% R/S 50% DAMAGED	Pier concrete spalled. To be replaced with bridge having 12m overall width of deck. Waterway adequate.
6	32/3	31.630	ATTUKARAM	3x6.80=20.40	19.00	0.80	Square	7.20	Nil	[illegible]	5.85+5.77 +5.78 =17.40	RCC Slab	CC	CC	OPEN	NIL	Bituminous	Nil	1974	GOOD	CRACKS IN WING WALL JUNCTION. PIER-GOOD	GOOD	N.A.	L/S 90% R/S 20% DAMAGED	To be replaced with bridge having 12m overall width of deck. Waterway adequate.
7	36/1	35.610	TELAPROLU	3x6.75=20.25	19.45	0.80	Square	7.50	Nil	[illegible]	17.85	RCC Slab	CC	CC	OPEN	NIL	CC	Stone Pitching with apron	1988	GOOD	GOOD	GOOD	N.A.	L/S ONE PANEL DAMAGED	To be replaced with bridge having 12m overall width of deck. Waterway adequate.
8	38/1	37.200	AMPAPURAM	6x6.75=40.50	39.70	0.80	Square	7.50	Nil	[illegible]	35.70	RCC Slab	CC	CC	OPEN	NIL	CC	Stone Pitching with apron	1988	GOOD	GOOD	GOOD	N.A.	GOOD	To be retained. Waterway adequate.

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	SPAN ARRANGEMENT NO.x LENGTH (EXP. JOINT TO EXP. JOINT) (m)	LENGTH OF BRIDGE FACE TO FACE OF ABUTMENTS (m)	WIDTH OF PIER (m)	SKEW ANGLE (DEGREES)	CARRIAGEWAY WIDTH (m)	FOOTPATHS (m)	TOTAL WIDTH OF DECK (m)	CLEAR WATERWAY (m)	SUPERSTRUCTURE	SUB-STRUCTURE: ABUTMENT	SUB-STRUCTURE: PIER	TYPE OF FOUNDATIONS	TYPE OF BEARINGS	WEARING COURSE	PROTECTION WORKS	YEAR OF CONSTRUCTION	PRESENT CONDITION OF BRIDGE: SUPERSTRUCTURE	SUBSTRUCTURE	FOUNDATIONS	BEARINGS	PARAPETS	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
9	39/3	38.800	DHAMAHES-WARAPURAM	3x5.75=17.25	16.45	0.80	Square	7.45	Nil	8.50	14.85	RCC Slab	CC	CC	OPEN	NIL	Bituminous	Nil	-	GOOD	GOOD	GOOD	N.A.	30 % DAMAGED	To be replaced with bridge having 12m overall width of deck. Waterway adequate.
10	42/2	41.950	VEERAPALLI	2x3.90=7.80	7.00	0.70	Square	11.00	Nil	11.60	6.30	RCC Slab	SM	SM	OPEN	NIL	Bituminous	Nil	-	GOOD	FAIR	FAIR	N.A.	NIL	Minor cracks in Pier and Abutment stone masonry to be grouted. To be retained. Waterway adequate.
11	49/2	48.750	RAMALERU VAGU	9x3.75=33.75	33.00	0.75	?.7	5.50	Nil	6.00	27.00	RCC Slab	SM	SM	OPEN	NIL	Bituminous	Nil	-	POOR	POOR	POOR	N.A.	NIL	Construction of new bridge is in progress.
12	72/1	71.220	SEETHAMPETA CANAL BRIDGE	5x3.85=19.25	18.45	0.80	Square	5.80	Nil	6.60	15.25	RCC Slab	SM	SM	OPEN	NIL	Bituminous	Stone Pitching with apron	-	POOR	POOR	POOR	N.A.	L/S 90% R/S 70% DAMAGED	To be replaced with bridge having 12m overall width of deck. Waterway adequate.
13	74/2	73.610	GUNDERU DRAIN	9x3.80=34.20	33.40	0.80	Square	5.80	Nil	6.70	27.00	RCC Slab	SM	SM	OPEN	NIL	Bituminous	Stone Pitching with apron	-	FAIR	GOOD	GOOD	N.A.	L/S 80% R/S 10% DAMAGED	To be replaced with bridge having 7.5 m carriageway width. Waterway adequate.

DETAILS OF EXISTING BRIDGES ON NH-9 FROM NANDIGAMA-VIJAYAWADA SECTION KM.217.000 TO KM. 265.000

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	SPAN ARRANGEMENT NO.x LENGTH (EXP. JOINT TO EXP. JOINT) (m)	LENGTH OF BRIDGE FROM THE OUTSIDE OF DIRT WALLS (m)	WIDTH OF PIER (m)	CARRIAGE-WAY WIDTH (m)	FOOT-PATHS (m)	TOTAL WIDTH OF DECK (m)	CLEAR WATERWAY (m)	SUPER-STRUCTURE	SUB-STRUCTURE: ABUTMENT	SUB-STRUCTURE: PIER	TYPE OF FOUNDATIONS	TYPE OF BEARINGS	WEARING COURSE	PROTECTION WORKS	YEAR OF CONSTRUCTION	PRESENT CONDITION OF BRIDGE: SUPER-STRUCTURE	SUB-STRUCTURE	FOUNDATIONS	BEARINGS	PARAPETS	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1.	231/1	230.365	Irrigation Channel	5.85+5.75 = 11.60	12.22	0.80	7.50	No	8.50	2x5.05 =10.10	RCC Slab	RCC	RCC	Open	No	Bituminous	No	-	Good	Good	Good	N.A.	Right side 50% damaged	Carriageway of existing 2 lane bridge is insufficient. Proposed for reconstruction as 2 lane bridge at the existing location
2.	234/1	233.220	-	5.78+5.74 +5.78 = 17.30	17.92	0.70	7.50	No	8.50	3x5.07 =15.21	RCC Slab	RCC	RCC	Raft	No	Bituminous	Stone pitching to approaches	1977	Good	Good	Good	N.A.	Left side 3 panesl & Right side 2 panels damaged	Carriageway of existing 2 lane bridge is insufficient. Proposed for reconstruction as 2 lane bridge at the existing location
3.	241/1	240.060	Paritata bridge	5x16.45 = 82.25	83.45	1.60	7.50	1.5	11.00	5x14.85 =74.25	RCC T-Beam & Slab	RCC	RCC	Well	Neoprene	Cement Concrete	Stone pitching to approaches	1981	Good	Good	Good	Good	Left side 10m length of parapet damaged	Carriageway of existing bridge is sufficient and the structure is in good condition. Existing 2 lane bridge is proposed to be retained.
4.	247/1	246.020	- -	4x5.2 = 20.8	21.42	0.60	7.50	No	8.30	4x4.60 =18.40	RCC Slab	RCC	RCC	Open	No	Bituminous	Stone pitching to approaches	-	Good	Good	Good	N.A.	Left side completely damaged Right side 4 panels damaged	Carriageway of existing 2 lane bridge is insufficient. Proposed for reconstruction as 2 lane bridge at the existing location
5.	24[illegible]	247.450	-	3x5.36 = 16.08	16.70	0.60	7.50	No	8.00	3x4.75 =14.25	RCC Slab	RCC	RCC	Open	No	Bituminous	Stone pitching to approaches	-	Good	Good	Good	N.A.	Left side 50% damaged	Carriageway of existing 2 lane bridge is insufficient. Proposed for reconstruction as 2 lane bridge at the existing location

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	SPAN ARRANGEMENT NO.x LENGTH (EXP. JOINT TO EXP. JOINT) (m	LENGTH OF BRIDGE FROM THE OUTSIDE OF DIRT WALLS (m)	WIDTH OF PIER (m)	CARRIAGE-WAY WIDTH (m)	FOOT-PATHS (m)	TOTAL WIDTH OF DECK (m)	CLEAR WATERWAY (m)	SUPER-STRUCTURE	SUB-STRUCTURE ABUTMENT	SUB-STRUCTURE PIER	TYPE OF FOUNDATIONS	TYPE OF BEARINGS	WEARING COURSE	PROTECTION WORKS	YEAR OF CONSTRUCTION	PRESENT CONDITION OF BRIDGE: SUPER-STRUCTURE	SUB-STRUCTURE	FOUNDATIONS	BEARINGS	PARAPETS	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
6.	252/2	251.64[illegible]	-	2x5.2 = 10.4	[illegible]	0.60	7.20	No	8.00	2x4.6 =9.2	RCC Slab	RCC	RCC	Open	No	Bituminous	No	-	Fair	Good	Good	N.A.	Left side 40% damaged Right side 60% damaged	Carriageway of existing 2 lane bridge is insufficient. Proposed for reconstruction as 2 lane bridge at the existing location
7.	254/1	253.50[illegible]	Budameru Diversion Channel	15x3.55 +2x3.42[illegible] = 60.1[illegible]	60.72	0.80	7.30	No	8.30	15x2.75 +2x2.6 =46.45	RCC Slab	Stone Masonry	Stone Masonry	Raft	No	Bituminous	Stone pitching to approaches and c.c flooring on bed	-	Good	Good	Good	N.A.	Good	Existing 2 lane bridge proposed to be retained since carriageway width is marginally less and the condition of the structure is good. Additional 2 lane bridge is proposed.
8.	254/2	253.65[illegible]	V.T.P.S. Cooling Water Channel	11.10+[illegible].10 +11.0+[illegible].9 = 55.1[illegible]	5[illegible].75	1.00	7.40	No	8.40	10.10+ 10.10+ 10.00+ 9.90+ 10.0	RCC T-Beam & Slab	RCC	RCC	Open	Neoprene	Cement Concrete	Stone pitching to approaches bed has lined canal	1979	Good	Good	Good	Fair	Left side 1 Panel & Right side 1 panel damaged	Existing 2 lane bridge proposed to be retained since carriageway width is marginally less and the condition of the structure is good. Additional 2 lane bridge is proposed.
9.	255/3	254.65[illegible]	-	2x4.[illegible] = 9.[illegible]	1[illegible].50	0.90	10.80	No	11.80	2x4.00 =8.00	Arch & Slab	Stone Masonry	Stone Masonry	Open	No	Bituminous	No	1974	Poor	Poor	Poor	N.A.	Left side 50% damaged	Existing 2 lane bridge proposed to be replaced at the existing location since the existing structure is in a poor condition Additional 2 lane bridge also proposed.
10.	263/2	262.[illegible]	Irrigation Channel	2x4.5 = 9.0	[illegible].62	0.90	12.25	No	13.25	2x3.60 =7.20	RCC Slab	RCC	RCC	Open	No	Bituminous	Approaches has c.c. lining and bed has c.c. flooring	-	Good	Good	Good	N.A.	Good	Carriageway of existing 2 lane bridge is sufficient and the structure is in good condition. Existing 2 lane bridge is proposed to be retained. Additional 2 lane bridge is proposed.

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	SPAN ARRANGEMENT NO.x LENGTH (EXP. JOINT TO EXP. JOINT) (m)	LENGTH OF BRIDGE FROM THE OUTSIDE OF DIRT WALLS (m)	WIDTH OF PIER (m)	CARRIAGE-WAY WIDTH (m)	FOOT-PATHS (m)	TOTAL WIDTH OF DECK (m)	CLEAR WATERWAY (m)	SUPER-STRUCTURE	SUB-STRUCTURE: ABUTMENT	SUB-STRUCTURE: PIER	TYPE OF FOUNDATIONS	TYPE OF BEARINGS	WEARING COURSE	PROTECTION WORKS	YEAR OF CONSTRUCTION	PRESENT CONDITION OF BRIDGE: SUPER-STRUCTURE	SUB-STRUCTURE	FOUNDATIONS	BEARINGS	PARAPETS	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
6.	252/2	251.640	-	2x5.2 = 10.4	11.02	0.60	7.20	No	8.00	2x4.6 =9.2	RCC Slab	RCC	RCC	Open	No	Bituminous	No	-	Fair	Good	Good	N.A.	Left side 40% damaged Right side 60% damaged	Carriageway of existing 2 lane bridge is insufficient. Proposed for reconstruction as 2 lane bridge at the existing location
7.	254/1	253.500	Budameru Diversion Channel	15x3.55 +2x3.425 = 60.10	60.72	0.80	7.30	No	8.30	15x2.75 +2x2.6 =46.45	RCC Slab	Stone Masonry	Stone Masonry	Raft	No	Bituminous	Stone pitching to approaches and c.c flooring on bed	-	Good	Good	Good	N.A.	Good	Existing 2 lane bridge proposed to be retained since carriageway width is marginally less and the condition of the structure is good. Additional 2 lane bridge is proposed.
8.	254/2	253.600	V.T.P.S. Cooling Water Channel	11.10+11.10 +11.0+10.9 = 55.10	55.75	1.00	7.40	No	8.40	10.10+ 10.10+ 10.00+ 9.90+ 10.0	RCC T-Beam & Slab	RCC	RCC	Open	Neoprene	Cement Concrete	Stone pitching to approaches bed has lined canal	1979	Good	Good	Good	Fair	Left side 1 Panel & Right side 1 panel damaged	Existing 2 lane bridge proposed to be retained since carriageway width is marginally less and the condition of the structure is good. Additional 2 lane bridge is proposed.
9.	255/3	254.650	-	2x4.9 = 9.8	10.50	0.90	10.80	No	11.80	2x4.00 =8.00	Arch & Slab	Stone Masonry	Stone Masonry	Open	No	Bituminous	No	1974	Poor	Poor	Poor	N.A.	Left side 50% damaged	Existing 2 lane bridge proposed to be replaced at the existing location since the existing structure is in a poor condition Additional 2 lane bridge also proposed.
10.	263/2	262.19	Irrigation Channel	2x4.5 = 9.0	9.62	0.90	12.25	No	13.25	2x3.60 =7.20	RCC Slab	RCC	RCC	Open	No	Bituminous	Approaches has c.c. lining and bed has c.c. flooring	-	Good	Good	Good	N.A.	Good	Carriageway of existing 2 lane bridge is sufficient and the structure is in good condition. Existing 2 lane bridge is proposed to be retained. Additional 2 lane bridge is proposed.

COMPARISON OF STRUCTUREAL DETAILS OF
EXISTING AND PROPOSED BRIDGES ON NH-5 VIJAYWADA-ELURU SECTION
KM. 3.400 TO KM. 75.000

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	EXISTING BRIDGE: C/C SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUNDATION	CARRIAGE WAY WIDTH (m)	FOOTPATHS PROVIDED OR NOT (m)	EXISTING DECK R.L. (m)	TOTAL LENGTH (m)	PROPOSED BRIDGE: EFFECTIVE SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUNDATION	TOTAL LENGTH (m)	CARRIAGE WAY WIDTH (m)	PROPOSED DECK R.L. (m)	STRUCTURE DESIGNATION	REMARKS	GENERAL ARRANGEMENT DRAWING (GAD) NO.
1	6/1	5.17	Bandar Canal	2x12.4 +1x48.1 =72.90 (Skew)	2x11.6 +1x46.86 =69.18 (Skew)	PSC Box	RCC	Well	7.85	1.6	22.207	73.50	2x12.4 +1x4.81 =72.90 (Skew	2x11.6 +1x46.5 =69.18 (Skew	PSC	RCC	Pile	73.50	7.5	22.207	4 Lane with open median	Existing 2 lane bridge proposed to be retained since carriageway width is more than sufficient. Additional 2 lane bridge proposed.	NH-5/AP/VE BR-6/1
				(Existing 2 lane bridge retained)								(Additional 2 lane bridge proposed)											
2	15/4	14.90	Ryves Canal cum ROB	10 Spans varying from 15.20 to 15.70 (Skew)	10 Spans varying from 14.40 to 14.90 (Skew)	RCC T-Beam & Slab	RCC	Well	7.50	1.5		156.05 (Skew)	Existing bridge proposed to be retained since carriageway width is sufficient for a 2-lane road and the bridge was constructed in the year 1986 and is in good condition.									-	-
3	20/1	19.40	Buda-meru Bridge	8x26.90 =215.20 (Skew)	8x26.05 =208.40 (Skew)	RCC T-Beam & Slab	RCC	Well	7.30	No		215.84 (Skew)	Existing bridge proposed to be retained even though carriageway width is slightly less than that required as per present standards since the bridge is in good condition (construction year 1967).									-	-
4	21/2	21.43	Eluru Canal	1x22.0 +1x22.62 +1x21.90 =66.52 (Skew)	1x21.2 +1x21.82 +1x21.10 =64.12 (Skew)	RCC T-Beam & Slab	RCC	Well	7.50	1.5		67.33 (Skew)	Existing bridge proposed to be retained since carriageway width is sufficient for a 2-lane road and the bridge was constructed in the year 1979 and is in good condition.									-	-
5	29/3	28.62	Avuta-pally	2x4.72 +1x4.88 =14.32	2x3.92 +1x4.08 =11.92	RCC Slab	CC	Open	7.50	No	18.346	14.92	As per decision arrived at during joint inspection with MOST & PWD Officers existing bridge is proposed to be retained even though carriageway width is less than that required as per 'MOST' standards since condition of the structure is good.									-	-
6	32/3	31.63	Attu-karan	3x6.80 =20.40	3x6.00 =18.00	RCC Slab	CC	Open	7.20	No	15.816	21.83	As per decision arrived at during joint inspection with MOST & PWD Officers existing bridge is proposed to be retained even though carriageway width is less than that required as per 'MOST' standards since condition of the structure is good.									-	-
7	36/1	35.61	Tela-prolu	3x6.75 =20.25	3x5.95 =17.85	RCC Slab	CC	Open	7.50	No	16.753	20.85	As per decision arrived at during joint inspection with MOST & PWD Officers, existing bridge is proposed to be retained even though carriageway width is less than that required as per 'MOST' standards since condition of the structure is good.									-	-

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	EXISTING BRIDGE C/C SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUNDATION	CARRIAGE WAY WIDTH (m)	FOOT-PATHS PROVIDED OR NOT (m)	EXISTING DECK R.L. (m)	TOTAL LENGTH (m)	PROPOSED BRIDGE EFFECTIVE SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUNDATION	TOTAL LENGTH (m)	CARRIAGE WAY WIDTH m	PROPOSED DECK R.L. (m)	STRUCTURE DESIGNATION	REMARKS	GENERAL ARRANGEMENT DRAWING (GAD) NO.
8	38/1	37.20	Ampa-puram	6x6.75 =40.5	6x5.95 =35.70	RCC Slab	CC	Open	7.50	No	17.273	41.10	Existing bridge proposed to be retained since carriageway width is sufficient for a 2-lane road and the bridge was constructed in the year 1988 and is in good condition.										
9	39/3	38.80	Umama-heswara-puram	3x5.75 =17.25	3x4.95 =14.85	RCC Slab	CC	Open	7.45	No	16.583	17.85	As per decision arrived at during joint inspection with MOST & PWD Officers, existing bridge is proposed to be retained even though carriageway width is less than that required as per 'MOST' standards since condition of the structure is good.									-	-
10	42/2	41.95	Veera-palli	2x3.90 =7.80	2x3.20 =6.40	RCC Slab	Stone Masonary	Open	11.00	No	17.755	8.40	Existing bridge proposed to be retained since carriageway width is sufficient and the condition is good.										
11	49/2	45.75	Kamale-ru vagu	9x3.75 =33.75 (Skew)	9x3.00 =27.00 (Skew)	RCC Slab	Stone Masonary	Open	5.50	No		34.36	New bridge is already under construction. (8 x 6.20 m)							21.210			
12	55A/1	0.60	R.O.B.	No existing bridge since this is a new alignment i.e. Eluru Bypass									Approx. length of 12 m may be required to cover 2 Broad Gauge Tracks									To be planned and executed by Railways	
13	56A/1	1.770		-DO-									3x6.4 =19.2 m	3x6.0 =18.0 m	RCC Slab	RCC	Open	21.08	10.90	18.250	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR-56A/1
14	62A/1	7.59		-DO-									3x6.4 =19.2 m	3x6.0 =18.0 m	RCC Slab	RCC	Open	21.05	10.90	21.800	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR-62A/1
15	62A/2	7.615		-DO-									3x8.0 =24.0 m	3x7.6 =22.8 m	RCC Slab	RCC	Open	25.85	10.90	21.800	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR-62A/2
16	65A/1	10.20	Tamleru River	i) West Tamleru on NH-5 = 7 spans of 10 m with pier height of 3 m ii) East Tamleru on NH-5 = 6 spans of 13.05 m with pier height of 2 to 3 m iii) Rly. bridge No.95 on West Tamleru = 6 spans of 14 m iv) Rly. bridge No.102 on East Tamleru = 4 spans of 13.5 m									5x35.0 =175 m	5x34.1 =170.5	PSC Girder & RCC Slab	RCC	Well	186.135	7.50	25.231	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR65A/1
17	66A/1	11.87		No existing bridge since this is a new alignment i.e. Eluru Bypass									1x8.0 =8.0 m	7.6 m	RCC Slab	RCC	Open	9.14	10.90	19.750	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR-66A/1
18	67A/1	12.75		-DO-									3x5.0 =15.0 m	3x4.6 =13.8 m	RCC Slab	RCC	Open	16.85	10.90	18.550	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR-67A/1

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE Km	NAME OF RIVER BRIDGE	EXISTING BRIDGE: C/C SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUNDATION	CARRIAGE WAY WIDTH (m)	FOOT-PATHS PROVIDED OR NOT (m)	EXISTING DECK R.L. (m)	TOTAL LENGTH (m)	PROPOSED BRIDGE: EFFECTIVE SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUNDATION	TOTAL LENGTH (m)	CARRIAGE WAY WIDTH (m)	PROPOSED DECK R.L. (m)	STRUCTURE DESIGNATION	REMARKS	GENERAL ARRANGEMENT DRAWING (GAD) NO.
19	68A/1	[illegible]		No existing bridge since this is a new alignment i.e. Eluru Bypass									3x8.0 =24.0 m	3x7.6 =22.8 m	RCC Slab	RCC	Open	25.88	10.90	18.550	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR-68A/1
20	69A/1	14.[illegible]		-DO-									3x5.0 =15.0 m	3x4.6 =13.8 m	RCC Slab	RCC	Open	16.88	10.90	14.750	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR-69A/1
21	71A/1	16.6[illegible]	[illegible]	i) Vented causeway on NH-5 = 27 spans of 5.2 m with pier height of 1.9 m ii) Rly. bridge No. 104 = 12 spans of 12.2 m									15x10.0 =150 m	15x9.6 =144 m	RCC Slab	RCC	Open	156.92	7.50	14.156	2 lane	New bridge proposed on Eluru bypass	NH-5/AP/VR BR-71A/1
22	72A/1	16.[illegible]	R.O.B.	No existing bridge since this is a new alignment i.e. Eluru Bypass									Approx. length of 19 m may be required to cover 2 Broad Gauge Tracks									To be planned and executed by Railways	
23	72/1 (75/1)	71.[illegible]	Seetham-peta canal	5x3.85 =19.25	5x3.05 =15.25	RCC Slab	Stone Masonary	Open	5.80	No	10.938	19.85	3x6.00 =18.00	3x5.6 =16.80	RCC Slab	RCC	Open	19.88	9.20	10.938	4 lane with covered median	Proposed a 4 lane bridge in compliance to decision taken during discussions held with MOST & PWD Officers.	NH-5/AP/VR BR-72/1
24	74/1 (77/1)	73.[illegible]	Gunderu Drain	9x3.8 =34.20	9x3.00 =27.00	RCC Slab	Stone Masonary	Open	5.80	No	9.948	34.80	5x6.00 =30.00	5x5.6 =28.00	RCC Slab	RCC	Open	32.72	7.50	9.948	4 lane with covered median	Proposed a 4 lane bridge in compliance to decision taken during discussions held with MOST & PWD Officers.	NH-5/AP/VR BR-74/1

COMPARISON OF STRUCTURAL DETAILS OF EXISTING AND PROPOSED BRIDGES OF NH-9
NANDIGAMA TO VIJAYAWADA (KM. 217.000 TO KM. 265.000)

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	EXISTING BRIDGE C/C SPAN m	CLEAR SPAN (m	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUN-DATION	CARRI-AGE WAY WIDTH (m)	FOOT-PATHS PROVIDED OR NOT (m)	EXIST-ING DECK R.L. (m)	TOTAL LENGTH (m)	C/C SPAN (m)	PROPOSED BRIDGE EFFEC-TIVE SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUN-DATION	TOTAL LENGTH (m)	CARRI-AGE WAY WIDTH (m)	PROPOSED DECK R.L. (m)	STRUC-TURE DESIGNA-TION	MEDIAN COVERED OR NOT WITH 4 LANING	REMARKS	GENERAL ARRANGEMENT DRAWING (GAD) NO.
1.	231/1	[illegible]	Irrigat-ional Channel	5.8[illegible] =1[illegible]	2x5.0[illegible] =10.[illegible]	RCC Slab	RCC	Open	7.50	No	51.16	12.22	1x10.8[illegible]	1x10.50	1x10.10	RCC Slab	RCC	Open	11.54	10.90	51.36	2 lane	N.A.	Carriageway of existing 2 lane bridge is insuffi-cient. Proposed for reconstruction as 2-lane bridge at the existing location.	NH-9/[illegible] BP-23[illegible]
2.	234/1	[illegible]	-	5.7[illegible]+5.74 +5.71 =17.[illegible]	3x5.07 =15.2[illegible]	RCC Slab	RCC	RAFT	7.50	No	35.685	17.92		As per decision arrived at during joint inspection with MOST & PWD Officers, existing bridge is proposed to be retained even though carriageway width is less than that required as per 'MOST' standards since condition of the structure is good.										-	-
3.	241/1	24[illegible]	Paritala Bridge	5x1[illegible] =6[illegible]	5x14.85 =74.25	RCC T-Beam & Slab	RCC	Well	7.50	1.5	-	83.45		Carriageway of existing bridge is sufficient and the structure is in good condition. Existing 2 lane bridge is proposed to be retained.											
4.	247/1	24[illegible]	-	4x5.[illegible] =2[illegible]	4x4.6 =18.40	RCC Slab	RCC	Open	7.50	No	27.31	21.42		As per decision arrived at during joint inspection with MOST & PWD Officers, existing bridge is proposed to be retained even though carriageway width is less than that required as per 'MOST' standards since condition of the structure is good.										-	-
5.	248/1	24[illegible].450	-	3x[illegible] =1[illegible]	3x4.75 =14.25	RCC Slab	RCC	Open	7.50	No	25.985	16.70		As per decision arrived at during joint inspection with MOST & PWD Officers, existing bridge is proposed to be retained even though carriageway width is less than that required as per 'MOST' standards since condition of the structure is good.										-	-
6.	252/2	25[illegible]	-	2x[illegible] =1[illegible]	2x4.6 =9.2	RCC Slab	RCC	Open	7.20	No	27.165	11.02		As per decision arrived at during joint inspection with MOST & PWD Officers, existing bridge is proposed to be retained even though carriageway width is less than that required as per 'MOST' standards since condition of the structure is good.										-	-

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	EXISTING BRIDGE C/C SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUNDATION	CARRIAGE WAY WIDTH (m)	FOOT-PATHS PROVIDED OR NOT (m)	EXISTING DECK R.L. (m)	TOTAL LENGTH (m)	PROPOSED BRIDGE C/C SPAN (m)	EFFECTIVE SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUNDATION	TOTAL LENGTH (m)	CARRIAGE WAY WIDTH (m)	PROPOSED DECK R.L. (m)	STRUCTURE DESIGNATION	MEDIAN COVERED OR NOT WITH 4 LANING	REMARKS	GENERAL ARRANGEMENT DRAWING (GAD) NO.
7.	254/1	253.500	Budameru Diversion Channel	15x3.55 +2x3.425 =60.10	15x2.75 +2x2.6 =4[illegible].45	RCC Slab	Stone Masonry	Open	7.30	No	[illegible].17	60.72	5x10.65 +2x3.37 =59.99	5x10.23 +2x2.95 =57.05	5x9.83 +2x2.55 =54.25	RCC Slab	RCC	Open	60.[illegible]	7.50	26.37	4-lane	Open	Existing 2 lane bridge proposed to be retained since carriageway width is marginally less and the condition of the structure is good. Additional 2 lane bridge is proposed.	NH-9/AP/NV BR-254/1
			(Existing 2 lane bridge retained)													(Additional 2 lane bridge proposed)									

The present 2 lane Budameru brige is 60.72m long with a water fall arrangement underneath and pucca flooring extending on downstream side. Present discharge is about 9000 cusecs (7500 cusecs of its own + 1500 cusecs from V.T.P.S.). Water is diverted in Budameru through a Head Regulator provided at 16 km upstream of the bridge. On local enquiry and that from State Irrigation Department, it is learnt that discharge in this channel from Head Regulator is likely to be increased from 7500 cusecs to 15000 cusecs as per an approved scheme by widening the bed width from 60 m to 83 m. In the absence of any written communication in this regard and also the non-availability of revised section of the channel as approved by State Irrigation Department, 60.7[illegible] m long additional 2 lane bridge is proposed by the [illegible] of existing bridge for the time being subject to any official revision required based on approved scheme of Irrigation Department.

8.	254/2	253.600	V.T.P.S. Cooling water channel	11.10+ 11.10+ 11.0+ 10.9+11.0 =55.10	10.10+ 10.10+ 10.00+ 9.90+10.0 =50.10	RCC T-Beam & Slab	RCC	Open	7.40	No	2[illegible].15	55.75		2x13.5 +1x27 =54.00	2x12.5 +1x26 =51.00	PSC Continuous voided slab	RCC	Pile	55.[illegible]	7.50	26.35	4-lane	Open	Existing 2 lane bridge proposed to be retained since carriageway width is marginally less and the condition of the structure is good. Additional 2 lane bridge is proposed.	NH-9/AP/NV/ BR-254/2
			(Existing 2 lane bridge retained)													(Additional 2 lane bridge proposed)									
9.	255/3	254.650	-	2x4.9 =9.8	2x4.0 =8.0	ARCH & SLAB	Stone Masonry	Open	10.8	No	2[illegible].778	10.5	1x9.32 =9.32	1x9.0 =9.0	1x8.6 =8.6	RCC Slab	RCC	Open	10.[illegible]	[illegible].2	22.9[illegible]	4 lane	Covered	Existing 2 lane bridge proposed to be replaced at the existing location since the existing structure is in a poor condition. Additional 2 lane bridge also proposed	NH-9/AP/NV/ BR-255/3

SL. NO.	BRIDGE NO.	LOCATION AS PER SITE KM.	NAME OF RIVER/ BRIDGE	EXISTING BRIDGE: C/C SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUN-DATION	CARRI-AGE WAY WIDTH (m)	FOOT-PATHS PROVIDED OR NOT (m)	EXIST-ING DECK R.L. (m)	TOTAL LENGTH (m)	PROPOSED BRIDGE: C/C SPAN (m)	EFFEC-TIVE SPAN (m)	CLEAR SPAN (m)	TYPE OF SUPER-STRUCTURE	TYPE OF SUB-STRUCTURE	TYPE OF FOUN-DATION	TOTAL LENGTH (m)	CARRI-AGE WAY WIDTH (m)	PROPOSED DECK R.L (m)	STRUC-TURE DESIGNA-TION	MEDIAN COVERED OR NOT WITH 4 LANING	REMARKS	GENERAL ARRANGEMENT DRAWING (GAD NO.
10.	263/2	[illegible].19	Irrigation channel	2x4.5 =9.0	2x3.6 =7.2	RCC Slab	RCC	Open	[illegible].25	N.	[illegible].91	9.[illegible]	1x9 =9.00	1x8.69 =8.69	1x8.28 =8.28	RCC Slab	PCC	Open	9.[illegible]	9.2	[illegible]	4-lane	Open	Carriageway of existing bridge is sufficient and the structure is in good condition Existing 2 lane bridge is proposed to be retained. Additional 2 lane bridge proposed.	NH-9/AP/NW BP-263/2
			(Existing 2 lane bridge retained)													(Additional 2 lane bridge proposed)									

1. HYDRAULIC PARTICULARS OF PROPOSED BRIDGES

It has been ascertained during local enquiry that none of the bridges located on existing alignments of NH-5 (except the portion now proposed as Eluru bypass) and NH-9 has been subjected to either excessive scour or overtopping or breaching of immediate approaches in the past thus proving the adequacy of waterway and vertical clearance available at present for these bidges. Based on this the broad parameters taken into consideration for deciding waterway and vertical clearance for bridges to be constructed are as under :

1.1. Two lane bridges proposed to be replaced at the existing locations.

i) Waterway and vertical clearance for proposed bridges to be not less than that of the existing ones.

ii) Increase in deck levels as necessitated by the strengthening of existing 2 lane road in the immediate approaches to bridges.

1.2. Additional 2 lane bridges proposed by the side of existing 2 lane bridges (proposed to be retained) for 4 lane sections.

i) Same as in 1.1(i) above

ii) Span arrangements have been chosen either similar to the existing ones or multiples of the existing ones taking due care that the widths and centrelines of piers align with that of the existing ones.

iii) Same as in 1.1(ii) above

iv) Median kept open as the two carriageways are at different levels.

1.3. 4 lane bridges at the same location of existing 2 lane bridges

i) Same as in 1.1(i) above

ii) Same as in 1.1(ii) above

iii) Covered median since the two carriageways are at the same level.

1.4. New bridges proposed on Eluru bypass on NH-5

Eluru bypass traverses through almost flat land and at present there are no well defined channels available for drainage except Tammileru river and therefore span arrangements at various proposed bridge sites have been

decided keeping in view the size of the dip section obtained with high flood level ascertained during local enquiry or from State Irrigation Authorities. For Tamileru river the waterway has been proposed as per discharge calculations carried out by Ryve's formula and area-velocity method. Vertical clearances for bridges have been proposed as dictated by code or longitudinal profile of the road.

2. Drainage pattern and proposed drainage facilities on Eluru Bypass

During rainy season with heavy downpours, Eluru town gets often submerged even though it is getting protection from the railway embankment. New Eluru bypass has now to face that fury of high floods. Therefore, proper design of cross-drainage is of utmost importance. The topography dictates that the total flow of catchment area for the length of Eluru Bypass passes through 7 distinct zones.

2.1 First Zone is bounded by Railway embankment at km. 0.60 (Zero chainage of bypass at km. 54 of NH-5) and earthen bund by the side of Feeder channel at km. 7.60 thus measuring a length of 7.0 km. along the proposed road alignment. The ground is flat and gently sloping. The cross-drainage proposed consists of 2 nos. minor bridges at (Sl. No. 13 and 14 of Annexure 5.4) at km. 1.770 and 7.59 of bypass having design discharge capacities of 64.31 cumecs and 48.65 cumecs respectively. Over and above, culverts are also proposed in this reach as dictated by topography of the area.

2.2 Second Zone is bounded by the earthern bund beside Feeder Channel at km. 7.60 and earthern embankment of SH-43 at km. 10.41. The cross drainage consists of a major bridge across river Tamileru (S.No. 16 of Annexure 5.4) at km. 10.30 of bypass with a design discharge capacity of 869 cumecs. Irrigation channel at km. 7.615 of bypass (S.No. 15 of Annexure 5.4) is supposed to have independent discharge. Over and above, culverts are also proposed in this reach as per topography of the area.

2.3 Third Zone is bounded by the earthern embankment of SH-43 at Km. 10.41 and earthern embankment of (BT) road at km. 10.900. For cross-drainage purposes, culverts have been proposed in this reach as dictated by the site conditions.

2.4 Fourth Zone is bounded by the embankment of road at km. 10.900 and embankment at km. 11.300. For cross-drainage purposes, culverts have been proposed as dictated by site conditions.

2.5 Fifth Zone is bounded by the embankment at km 11.300 and embankment of road SH-44 at km. 14.300. For cross-drainage, 3 nos. minor bridges at km. 11.87, 12.75 & 13.54 of bypass (S.Nos. 17,18 and 19 of Annexure 5.4) with design discharge capacities of 21.32, 41.54 and 57.01

cumecs respectively. Over and above, culverts are also proposed in this reach as dictated by topography of the area.

2.6 Sixth Zone is bounded by the embankment of SH-44 road at km. 14.300 and railway embankment at km. 15.700. For cross-drainage, one no. minor bridge at km. 14.815 (S.No.20 of Annexure 5.4) has been proposed with design discharge capacity of 52.93 cumecs. Besides, culverts are also proposed in this reach.

2.7 Seventh Zone is bounded by the embankment at km. 15.700 and railway embankment at km. 16.950. For cross-drainage, one major bridge over vyasakavi at km. 16.60 (S.No. 21 of Annexure 5.4) has been proposed with a design discharge capacity of 774.8 cumecs. Besides, culverts are also proposed in this reach.

2.8 Total drainage facility through bridge proposed on Eluru bypass

Thus, total drainage facility afforded by proposed bridges (except bridge over irrigation channel) works out to 1929.5 cumecs, which can serve a catchment area of 4780 sq.km. as per Ryve's formula of $Q = CM^{2/3}$ by taking minimum value of $C = 6.8$. With value of $C = 8.82$ as deduced in para 3.2.2 hereafter for Tamileru river, the catchment area works out to 3235 sq.km. Keeping in view the proposed length of bypass as 17 km., this drainage facility afforded by bridges alone (without that due to proposed culverts) appears to be very well justified.

3. Design discharges and scour levels

i) As stated in para 1.4 above that there are no well defined channels (except Tamileru river) available at present on the proposed alignment of Eluru bypass and as such, it is not possible to obtain cross-sections of channel on the upstream and downstream sides as well as the longitdinal slope of the channel. Without this data, it is not possible to calculate the velocity of flow as well as discharge by area-velocity method. Because of flat terrain, it is also not possible to demarcate catchment area for individual streams for calculation of discharge by Ryve's formula. Therfore, recourse has been taken to evaluate discharging capacity of bridges (except Tamileru river) which are proposed with open foundations and bed flooring by vent area x velocity of flow. Vent area has been taken as clear waterway x depth of flow from HFL to top of bed flooring. A modest velocity of flow equal to 1.5 m/s has been assumed.

ii) For Tamileru bridge, design discharge has been fixed based on discharge values obtained as per area-velocity method at 500 m upstream, at bridge site, at 500 m downstream and by catchment area using Ryve's formula.

iii) Design discharges alongwith scour calculations for different proposed bridges are described in next para.

3.1 Bridges with open foundations and bed flooring

3.1.1 Minor Bridges

i) Bridge at Km. 1.770

Proposed waterway = 18.0 m

Depth of flow = 2.382 m

Q = 18.0 x 2.382 x 1.5 = 64.3 cumecs

$$d_{sm} = 1.34[Db^2/Ksf]^{1/3}$$

Where Db = Q/L = 64.3/18 = 3.572 & Ksf = 0.70

$$\therefore dsm = 1.34\ [3.572^2/0.7]^{1/3} = 3.526 \text{ m}$$

Max. scour = 1.27 dsm = 4.479 m

Scour level = 16.500 -4.479 = 12.021 m,
D/S Toe Wall level = 11.618 m $\therefore$ O.K.

ii) Bridge at Km. 7.590

Proposed waterway = 18.0 m

Depth of flow = 1.802 m

Q = 18.0 x 1.802 x 1.5 = 48.65 cumecs

Db = Q/L = 48.65/18 = 2.703 & Ksf = 0.50

$$dsm = 1.34\ [2.703^2/0.5]^{1/3} = 3.276 \text{ m}$$

Max. scour = 1.27 dsm= 4.161 m

Scour level = 20.0 - 4.161 = 15.839 m,
D/S Toe Wall level = 15.698 m $\therefore$ O.K.

iii) Bridge at Km. 11.870

Proposed waterway = 7.6 m

Depth of flow = 1.87 m

Q = 7.6 x 1.87 x 1.5 = 21.32 cumecs

Db = Q/L = 21.32/7.6 = 2.805 & Ksf = 0.50

$dsm = 1.34\ [2.805^2/0.5]^{1/3} = 3.358$ m

Max. scour = 1.27dsm = 4.265 m

Scour level = 18.0 - 4.265 = 13.735 m, ∴ D/S Toe Wall level = 13.63 m ∴ O.K.

iv) Bridge at Km. 12.75

Proposed waterway = 13.8 m

Depth of flow = 2.007 m

Q = 13.8 x 2.007 x 1.5 = 41.54 cumecs

Db = Q/L = 41.54/13.8 = 3.010 & Ksf = 0.5

$dsm = 1.34\ [3.010^2/0.5]^{1/3} = 3.520$ m

Max. scour = 1.27 dsm = 4.470 m

Scour level = 16.800 - 4.470 = 12.330 m, ∴ D/S Toe Wall level = 12.293 m ∴ O.K.

v) Bridge at Km. 13.54

Proposed waterway = 22.8 m

Depth of flow = 1.667 m

Q = 22.8 x 1.667 x 1.5 = 57.0 cumecs

Db = Q/L = 57.00/22.8 = 2.500 & Ksf = 0.50

$dsm = 1.34\ [2.50^2/0.5]^{1/3} = 3.110$ m

Max. scour = 1.27 x 3.110 = 3.950 m

Scour level = 16.8 - 3.950 = 12.850 m, ∴ D/S Toe Wall level = 12.633 m ∴ O.K.

vi) Bridge at Km. 14.815

Proposed waterway = 13.8 m

Depth of flow = 2.557 m

Q = 13.8 x 2.557 x 1.5 = 52.93 cumecs

Db = Q/L = 52.93/13.8 = 3.835 & Ksf = 0.70

$dsm = 1.34\ [3.835^2/0.7]^{1/3} = 3.700$ m

Max. scour = 1.27 dsm = 4.696 m

Scour level = 13.0 - 4.696 = 8.304 m, ∴ D/S Toe Wall level = 7.943 m ∴ O.K.

3.1.2 Major bridge at km. 16.600

Waterway = 144 m

Depth of flow = 3.587 m

Q = 144 x 3.587 x 1.5 = 774.8 cumecs

Db - Q/L - 774.8 x 1.3/144 = 6.995 & Ksf = 1.0

$$dsm = 1.34\ [6.995^2/1.]^{1/3} = 4.901 \text{ m}$$

Max. scour = 1.27 dms = 6.224 m

Scour level = 12.0 - 6.224 = 5.776 m,
D/S Toe Wall level = 5.713 m . . . O.K.

3.2 Major bridge across Tamilaru river on pile foundations

Design discharge and maximum scour levels have been worked out as described below:

3.2.1 Tamileru Reservoir Project

Details of Tamileru Reservoir Project give the following information about Tamileru river:

i)	Total catchment area	=	525 sq.miles
ii)	Catchment area upto the site of reservoir	=	236 sq.miles
iii)	Catchment area from reservoir upto bridge site	=	289 sq.miles
iv)	Maximum peak flood observed in Tamileru river at Eluru in September, 1964	=	24,500 cusecs
v)	Designed outflow discharge from reservoir into Tamileru	=	6,000 cusecs
vi)	Forecasted peak flood discharges upto reservoir site		
	50 years	=	22,500 cusecs
	100 years	=	26,350 cusecs

3.2.2 Emperical Formula for Discharge

Ryve's formula is more suited for the coastal area

$$Q \quad CM^{2/3}$$

Q = Discharge in cumecs

M = Catchment area in sq.km.

C = A constant varying from 6.8 to 10 depending upon location of bridge site from coast

In order to find value of 'C', 50 years forecasted discharge and catchment area upto reservoir site has been used

With Q= 22500 cusecs = 635.3 cumecs

M = 236 sq.miles =6.11 sq.km.

$$635.3 = C \times (611.2)^{2/3}$$

C - 8.82 Within the range of 6.8 to 10 and therefore acceptable.

Catchment area from reservoir to bridge

site = 525-236=289 sq.miles = 671 sq.km.

Using Ryve's formula with C=8.82

$$Q = 8.82 \times (671)^{2/3} = 675.9 \text{ cumecs}$$

Adding designed outflow discharge from reservoir

= 6000 cusecs = 169.5 cumecs

Total 845.4 cumecs

Thus design discharge as per emperical formula works out to 845.4 cumecs.

3.2.3 Discharge by area-velocity method

Discharge calculations have been done at 3 locations i.e at bridge site, 500 m upstream and 500 m downstream based on cross-sections taken at these places and as per calculations done below. These discharges work out as under.

500 m upstream = 766.90 cumecs
Bridge site = 869.30 cumecs
500 m downstream = 855.10 cumecs

Average value = 830.40 cumecs, which nearly matches with that worked out by empirical formula

A. AT 500 m U/S Bridge Site
HFL = 21.05 m

		A	P
5.0 x (2.237+3.667)/2	=	14.760	5.200
5.0 x (3.667+4.052)/2	=	19.298	5.015
10.0 x (4.052+4.352)/2	=	42.020	10.005
5.0 x (4.352+4.387)/2	=	21.847	5.000

		A	P
10.0 x (4.387+4.157)/2	=	42.720	10.003
20.0 x (4.157+4.397)/2	=	85.540	20.001
15.0 x (4.397+4.517)/2	=	66.855	15.000
20.0 x (4.517+4.257)/2	=	87.740	20.002
25.0 x (4.257+4.527)/2	=	109.800	25.002
20.0 x (4.527+4.052)/2	=	85.790	20.006
5.0 x (4.052+4.247)/2	=	20.748	5.004
10.0 x (4.247+3.550)/2	=	38.985	10.024
3.0 x (3.550+0.067)/2	=	5.426	4.597
		641.529 m^2	0.793 vertical retaining w
			2.237 depth at zero
			157.889 m

$R = A/P = 641.529/157.889 = 4.063$ M

Slope = 0.00024

$v = 1/0.033 \times (4.063)^{2/3} \times (0.00024)^{1/2} = 1.195$ m/s

$Q = 641.529 \times 1.195 = 766.9\ m^3/s$

B. At Bridge Site
HFL = 20.93 m

		A	P
10.0 x (1.082+3.742)/2	=	24.120	10.348
30.0 x (3.742+4.687)/2	=	126.435	30.015
30.0 x (4.687+4.472)/2	=	137.385	30.001
20.0 x (4.472+4.427)/2	=	88.990	20.000
20.0 x (4.427+4.737)/2	=	91.640	20.000
15.0 x (4.737+4.617)/2	=	70.155	15.000
10.0 x (4.617+4.367)/2	=	44.920	10.003
10.0 x (4.367+3.330)/2	=	38.485	10.054
1/2 x 3.0 x 2.847	=	4.270	4.136
		626.40 m^2	0.483
			1.082
			151.122 m

$R = A/P = 626.40/151.122 = 4.145$ M

Slope = (16.533-16.218)/1000 = 0.000315

$v = 1/n \times R^{2/3} \times S^{1/2}$

$= 1/0.033 \times (4.145)^{2/3} \times (0.000315)^{1/2} = 1.388$ m/s

$Q = 626.400 \times 1.388 = 869.3\ m^3/s$

C. 500 m D/S

HFL = 20.735 m

		A	P
5.0 x (2.252+4.137)/2	=	15.972	5.344
30.0 x (4.137+4.397)/2	=	128.010	30.001
35.0 x (4.397+4.517)/2	=	155.995	35.000
30.0 x (4.517+4.167)/2	=	130.260	30.002
25.0 x (4.167+3.822)/2	=	99.863	25.002
10.0 x (3.822+2.935)/2	=	33.785	10.039
5.0 x (2.352+0.287)/2	=	6.597	5.410
		570.482 m^2	0.583
			2.252
			0.287
			143.920 m

R = A/P = 570.482/143.920 = 3.964 M

Slope = (16.413-16.218)/500 = 0.00039

$$v = 1/n \times R^{2/3} \times S^{1/2}$$

$$= 1/0.033 \times (3.964)^{2/3} \times (0.00039)^{1/2} = 1.499 \text{ m/s}$$

$$Q = 570.482 \times 1.499 = 855.1 \text{ m}^3\text{/s}$$

3.2.4 Design discharge

A design discharge of 869 cumecs (the maximum value) is taken.

3.2.5 Effective linear waterway

Using formula

$W = C\sqrt{Q}$ with C = 4.8

$W = 4.8\sqrt{869} = 141.5$ m as against proposed of 146.2 m

3.2.6 Maximum scour levels

Mean scour depth = $d_{sm} = 1.34\,(D_b^{\,2}/K_{sf})^{1/3}$

Taking concentration of flow = 30%

Db = (869/146.2) x 1.3 = 7.727

$$dsm = 1.34 \times (7.727^2/1)^{1/3}$$

$$= 5.237 \text{ m}$$

For piers 2 dsm = 10.474 m at R.L. 10.456 m

For abutments 1.27 dsm = 6.651 m at R.L. 14.279 m