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TECHNICAL REPORT ON THE VISIT OF
COASTAL HIGHWAY
(LIARI-ORMARA SECTION)

NTRC- 221

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EXECUTIVE SUMMARY

As desired by the Minister, the team of three NTRC experts has surveyed the 248 kilometers Liari - Ormara Section of Coastal Highway (Map at Annex-I). The road was constructed by F.W.O. during 1985-92 reportedly at an expenditure of Rs. 466 million i.e. Rs. 1.9 million per km. (exact cost could not be confirmed). Presently, the road has 3.65 wide 20 cm. thick gravel surface; 3 meters katcha shoulders; 1.0 to 2.5 meters high embankment and 10 meter formation width with 7.3 meter wide drainage structures. It was, however, extensively damaged by floods in 1992. An amount of Rs. 300 million has been provided in the ADP for 2000-2001 by N.H.A. The salient features of the survey results are as follows :-

- (a) Topography: From the point of view of terrain, the road can be divided into three sections namely: Liari - Agore (120 Km.); Agore - Malam (33 Km.) and Malam - Ormara (95 Km.).
- (b) Liari - Agore Section (120 Kms): The road runs through mostly plain terrain. Approximately, 30 km of the road surface has slight corrugations, indicating sub-base failure. The cross drainage structures in the section are generally satisfactory. However, 10 km. section from kilometers 60 to 70 was excessively damaged due to inadequate cross drainage.
- (c) Agore - Malam Section (33 Kms): The existing alignment runs through the hilly area and has been badly damaged by the last flood. WAPDA intend to construct a dam at Agore on Hingol river, therefore, the alignment needs to be shifted towards sea.
- (d) Malam - Ormara Section (95 Kms): Approximately, 55 km. of the existing alignment traverses through hilly areas between Gikki and Buzi passes and has been washed away by flash floods at many locations. The remaining 40 kms has a flat terrain and is in fair condition.

(e) Traffic: The average daily traffic on the Liari - Ormara Section was recorded at 41 vpd in 1993, which was then projected to increase to 386 vpd after a period of 20 years. The present traffic is not more than 30 vpd. It is estimated that after the road is improved, the first year traffic (including diverted and generated) would not be more than 60 vpd. Assuming a liberal growth rate of 8%, which is generally adopted for developed areas, the traffic after another 20 years would be less than 300 vpd.

(f) Objective: The contemplated improvements must aim at the following objectives :-

- (1) Ensure all-weather dependable connection.
- (2) Provide reasonably comfortable journey.
- (3) Meet the traffic demand for 20 years.
- (4) Minimize the capital investment.
- (5) Ensure minimum maintenance.

(g) Conclusions: Keeping in view the above objectives and future traffic need, the following conclusions can be drawn :-

- (1) The present specifications of the road should be adequate for 20 years.
- (2) The pavement is, however, structurally inadequate.
- (3) In certain sections, drainage structure, both cross as well as longitudinal are inadequate, which results in road being prone to damage by flash flooding.
- (4) The katcha shoulders require major maintenance effort, which under the prevailing topographical, soil and climate conditions are not appropriate.
- (5) The katcha road surface generates considerable dust which becomes a menace for long distance journeys and need to be rectified.

(h) Recommendations: The following recommendations are made to meet the objectives:-

- (1) The stretches totaling 185 km with the existing 3.65-meter gravel in good condition should be laid over with 20 cm. base course to achieve greater pavement strength.
- (2) The totally damaged sections (62 Km) should be re-constructed

with 20 cm sub-base and 20 cm base.

- (3) The entire road should be sealed with single coat to overcome the dust menace.
- (4) Shoulders on either side should be graveled (as per design developed by NTRC for low cost roads) to achieve stability against the rain damage.
- (5) Additional cross drainage structure, properly protected by stone pitching, should be provided in areas susceptible to flash flooding (sheet flow).
- (6) Adequate longitudinal drain should be provided in hilly areas.
- (7) Proper traffic signs should be provided along the road.

The above improvement should provide a dependable all-weather and reasonably comfortable link, with capacity of upto 500 vpd, sufficient for next 30 years and should not cost more than Rs. 1,000 million, i.e. Rs. 4,000 million per km.

1. SOCIO-ECONOMIC CONDITIONS

According to 1981 Census, Makran Division had a population of 653,000 person, which has been increased to 816,000 as reported in 1998 Census. The population growth is estimated at 1.3% per annum. Makran division has an area of 54,646 sq. km. only. A majority of the population in Makran division is self employed. There are two segments of population namely; nomads and settlers. The nomads earn their livelihood through rearing of live stock while the settled population is engaged in fishing in the coastal areas.

The two major towns Liari and Ormara have population of 15,500 and 18,200 persons respectively. This includes both rural and urban population. In Ormara, vast majorities of the people are fishermen while few are engaged in agriculture and other supporting professions. There is no other significance economic activity worth mentioning in the Ormara city. However, a naval harbour is being established there. It is expected that the completion of naval base and road under consideration would help boosting the economic activity and the traffic.

2. EXISTING ROAD CONDITIONS

Liari-Ormara is the first section of the Coastal Makran road and has a length of 248 kms. The road takes off from the RCD highway (N-25) between Karachi and Uthal near the town of Liari, which is connected with the RCD highway through a 14 kms long road. This link road is a 3.65m (12 ft.) wide bituminous road. However, the condition of the road is also poor.

From Liari to Ormara, the road has a length of 248 kms. It was constructed by the FWO and C&W Department, Baluchistan as a shingle road during 1985-1992 at an estimated expenditure of Rs 466 million (the figure of exact cost could not be compared. The road has a 3.65m wide shingled portion pavement with 3m shoulder on either side. A map showing location of Liari-Ormara section of Makran Coastal highway is attached as Annex-I. As regards the topography of the area is concerned, the Liari-Ormara section of the Coastal Highway is divided into three sub-sections as under :

a) **Liari-Agore Section** : This section has a length of about 120 kms. The existing alignment of the road is quite satisfactory. The terrain is mostly plain. The height of the embankment on the existing road is quite satisfactory and ranges between 1-25m. The top formation width is about 10 meters with centrally gravel portion as 3.7m and 3m shoulders on either side. The centrally graveled portion has been found well compacted due to compaction from moving traffic. However, due to corrugations, the surface is bumpy at about 30 kms of length. The shoulders at the verges were loose and mostly affected by raincoats. Photographs-1 to 10 shows the condition of Liari-Agore Section of the road. There were many cross-drainage structures constructed by FWO/C&W which were found intact and structurally adequate. The structures were mostly 7.3m wide. Few structures were found damaged due to flood flows. The embankment was found damaged by the sheet flows at few locations where new cross drainage structures are required to be constructed, specially 10 km reach from kilometers 60+000 to 70+000 was excessively damaged due to inadequate cross drainage and the road needs complete reconstruction.

b) **Agore-Malam Section**: The existing alignment of Agore-Malam section runs through hilly area. This section has been badly damaged by the last flood. The road has been removed from many locations by flash floods, leaving behind loose clayey-silt materials. The soils along the alignment are generally silty clay/clayey silt and occurs as soft and compacted mud stone. WAPDA has planned to construct a dam at Agore on Hingol river. Due to construction of this dam, the existing road from Agore to Malam would be submerged. Therefore, the alignment needs to be shifted towards sea. It was not possible for the team to travel on this proposed route. Photographs 11 to 15 show the condition of the road section.

c) **Malam-Ormara Section**: The existing alignment of this section has a length of 95 kms and runs about 55 kms in hilly areas passing through Gikki pass and Buzi pass while the last 40 kms have a flat terrain. Photographs 16 to 20 show some views of road in this section. Travelling through the initial 55 kms is very difficult and torturous. The road has been washed away by flash

foods at many locations. Buzi pass is located at 156 kms from Liari. The top formation width is generally less than 10 meters in the initial 55 kms section. Vehicles with high bed and 4x4 facility can only cross this section. However, the last 40 kms length of the road which runs in flat area has got sufficient embankment height with formation width of 10 meters. Structures constructed are intact.

3. TRAFFIC

During the visit to Liari-Ormara Section on 8.6.2000, 12 hours traffic count on opposite direction was undertaken from 0700 hours to 1900 hours. A total of 14 vehicles was recorded with following break-up:

-	Car	0
-	Jeep	1
-	Pick up	1
-	Wagon	1
-	Luxury Coach/Bus	2
-	Truck	9

Total: 14

It may be worthwhile to mention that trucks (2-axle) were fully loaded while the Jeeps, wagons, pick ups and buses were carrying full load of passengers. Out of the 9 trucks, 2 trucks were carrying fish to Karachi. It is not possible for the cars to travel on this section because of the condition of road mentioned above. No animal drawn cart was found on the road during the visit. Assuming that there would be same number of outgoing vehicles moving towards Ormara in 24 hours, the traffic would be increased to 28 vehicles per day. The Consultant (M/s LRA) in the feasibility report had undertaken bi-directional traffic count on the entire coastal highway in 1993-94. A comparison of the traffic count undertaken by the Consultant viz-a-viz the team's estimate on Liari-Ormara Section is summarized as under :

	Pick up Jeeps/ Car	Luxury Coaches/ Wagons	Buses	Trucks	Animal Drawn	Total
M/s LRA (1993-94)	0	9	8	10	1	24
NTRC- (2000)	0	6	4	18	0	28

The above daily traffic has been converted into AADT as 41 vpd by the Consultants which is projected to increase to 64 vpd on completion and 386 vpd after a period of 20 years.

4. OBJECTIVE

Considering the road condition on the site the objectives for the improvement of existing road has emerged as follows :

- (1) Ensure all-weather dependable connection.
- (2) Provide reasonably comfortable journey.
- (3) Meet the traffic demand for 20 years.
- (4) Minimize the capital investment.

5. TECHNICAL REQUIREMENTS FOR IMPROVEMENT

a) Capacity Requirements

The average annual daily traffic (A.A.D.T.) on the Liari-Ormara section was estimated at 60vpd. Even if a liberal growth rate of 8% is assumed on this section, the average daily traffic after a period of twenty years would be less than 300 vpd. According to the capacity standards, a single lane facility having carriageway width of 3.65 meters treated surface with 3m shoulders on either side have a capacity of 500 vpd in flat terrain, 450 vpd in rolling terrain and 350 vpd for mountainous terrain. Following these standards, a facility having a single lane of 3.65m wide with 3.0m

shoulders on either side is sufficient for a period of 20 years after completion of the project.

b) Structural Requirements

Adopting the consultants traffic figures the truck traffic plying on this section would be 32 trucks per day on completion, which would increase to 60 trucks/day in 10 years time. On an average, 42 trucks per day would use this facility during the life of the pavement. Based on this truck traffic and the equivalent standard axles (ESA) factors of Axle Load Survey report (NTRC-1995), the total number of ESA using this facility during the design life works out to be Liari-Ormara section 1.2 million. The subgrade soils are mostly silty clayey/clayey silt. The subgrade material as indicated by the Consultants has CBR of 7% or more. Based on these values, the pavement has been designed using TRL Road Note 31 as under :

- Thickness of various layers as; sub base 225 mm (9 inches).
- Base course as of 200 mm (8 inches) with a surface dressing

The detailed design and typical cross-section is indicated at Annex-II.

6. PROPOSAL FOR IMPROVEMENT AND COSTS

The survey of the road condition revealed that the existing top formation width available is generally 10m on about the entire length of Liari-Ormara section. A pavement width of 3.65m with 3m shoulders on each side can be accommodated. On the basis of capacity analysis this type of roadway facility is considered sufficient to carry the projected traffic for another 20 years.

Once it is felt that the traffic is going to exceed, its capacity can easily be enhanced to 1500 vpd by increasing the pavement width to 6.1m with 2m shoulders on either side utilising the same formation width. After improvement the facility would cater for the traffic requirements for another twenty years.

Presently, the shoulders portion are generally loose and need to be recompacted and gaveled to achieve stability against the rain damage.

As regards the condition of the existing pavement, it was found structurally inadequate. On the basis of Transport Research Laboratory Road Note 31, the pavement section needs to be strengthened by providing 200mm (8 inches) thick base course alongwith surface dressing on top (Details-Annex-II).

The existing shingle material covering 75% the road length (185m), would be served as subbase, as it has already been well compacted by the movement of existing traffic. The existing road has embankment failures at many locations with total length of about 63 kms (mostly in hilly terrain) due to flash floods. These stretches require reconstruction by providing complete pavement comprising 22.0 cm (9") thick subbase and 20 cm (8") thick base with surface treatment on top. In order to avoid future failures, causeways of sufficient lengths need to be provided at these locations. Most of the existing cross drainage structures are intact and can be used as it is. However at many locations, the drainage structures have been choked by the debris material from the sheet floods and waterways were found blocked. It is felt that no amount of efforts for keeping them clean can be helpful because one flood brings enough material to choke them again. The solution therefore, is to provide causeways or Irish bridges wherever additional structures are required, rather than to go for construction of expensive bridges and culverts. Bridges should only be constructed where no other solution is available. Moreover, the other remedial measures for protecting the road from being damaged by the water includes provision of longitudinal drains of sufficient capacity on both sides of the road while the stone pitching (rip rap) is proposed for the upstream of the embankment in the sheet flow areas.

7. COST ESTIMATE

The above proposals are estimated to cost approximately Rs 10,710 million. The details are reported in Annex-III.

8. PROPOSALS BY CONSULTANTS

M/s. I.R.A in the feasibility report considered four alternatives for the improvement of the existing shingled road to an all weather dependable black topped road as under :

Alternative-I (7.3m wide with 3m shoulder on either side)

Alternative-II (6.1m wide with 2m shoulder on either side)

Alternative-III (3.70 wide (Asphalt) with 3m shoulder on either side)

Alternative-IV (3.70 wide 9DST) with 3m shoulder on either side)

The cost estimates worked out by the consultants for the Liari-Ormara section for the alternative 7.3m pavement and 3m shoulders on either side are Rs 4.465 billions i.e. Rs 18.003 million/km.

In 1999, NHA floated tenders for the construction of sub-section Liari-Agore. The facility was to have pavement width of 6.1m and 2.0m shoulders on either side. The rates quoted by various firms were as follows :

M/s S.K.B.	1st Lowest	Rs 14.70 million/km
M/s Stratus	2nd Lowest	Rs 16.15 million/km
M/s General Mechanics	3rd Lowest	Rs 17.47 million/km
M/s Hussnain Const.	4th Lowest	Rs 17.66 million/km
M/s Frontier Works Org.	5th Lowest	Rs 26.46 million/km
M/s J&P	6th Lowest	Rs 29.08 million/km
M/s STFA	7th Lowest	Rs 33.08 million/km

The tenders were later on cancelled by NHA. The estimates have been updated and the costs for the various alternatives on the basis of NHA's CSR-2000 are as follows:-

Alternative-I	(7.3m wide with 3m shoulder on either side)	Rs 19.89 million/km
Alternative-II	(6.1m wide with 2m shoulder on either side)	Rs 16.22 million/km
Alternative-III	(3.70 wide (Asphalt) with 3m	Rs 12.82 million/km

shoulder on either side)

Alternative-IV (3.70 wide 9DST) with Rs 12.25 million/km
3m shoulder on either side)

9. FINDINGS & CONCLUSIONS

The findings and conclusions of the survey are as under :

- i) The construction/improvement of Liari-Ormara Section is not an economically viable project. Nor is it justified on the basis of traffic. The area is already opened up through the existing link, which at places, specifically in the hilly terrain of Buzi/Gikke Passes needs reconstruction. There is, therefore, a dire need to improve existing shingle road to a black topped road which would not only provide dependable/reliable all weather link between Karachi and Coastal city of Ormara but would also cater the strategic requirements of Pakistan Navy.
- ii) The existing pavement is however, structurally inadequate and needs to be strengthened.
- iii) The shoulder portion of the embankment is loose and needs reconstruction.
- iv) In certain sections, drainage structure, both cross as well as longitudinal are inadequate, which results in road being prone to damage by flash flooding.
- v) The katcha shoulders require major maintenance effort, which under the prevailing topographical, soil and climate conditions are not appropriate.
- vi) The katcha road surface generates considerable dust, which becomes a menace for long distance journeys and need to be rectified.
- vii) Presently, it takes more than 15 hours to travel from Liari to Ormara. The improvement of the existing road to a black topped road would reduce

the travel time to 8 hours besides saving in the vehicle operating costs.

viii) Pakistan Navy is developing a Naval Base at Ormara. The black topped road would provide an easy access from Karachi to Ormara and would help assist the development of allied facilities of the base.

ix) According to NHA estimates, a 7.3 meters paved facility with 3 meters shoulder on either side would cost about Rs 20 millions/km. Thus, the total cost from Liari to Ormara (248 km) would be Rs 5.00 billions. It is expected by NHA that by providing this facility, the capacity of the road would increase to 10,000 vpd. A two-lane facility is justified when the traffic exceeds 500 vpd. It is felt that two-lane facility, if provided now, would remain under utilized for at least 25 years.

x) The economical facility i.e. 3.65 meter sealed width with 3m shoulders on either side as proposed by NTRC would cost about around Rs 1,000 i.e. Rs 4 million per km from Liari to Ormara.

10. RECOMMENDATIONS

i) The stretches totaling 185 km with the existing 3.65 meter gravel in good condition should be laid over with 20 cm. base course to achieve greater pavement strength.

ii) The totally damaged sections (62 km) should be reconstructed with 20 cm sub-base and 20 cm base.

iii) The entire road should be sealed with single coat to overcome the dust menace.

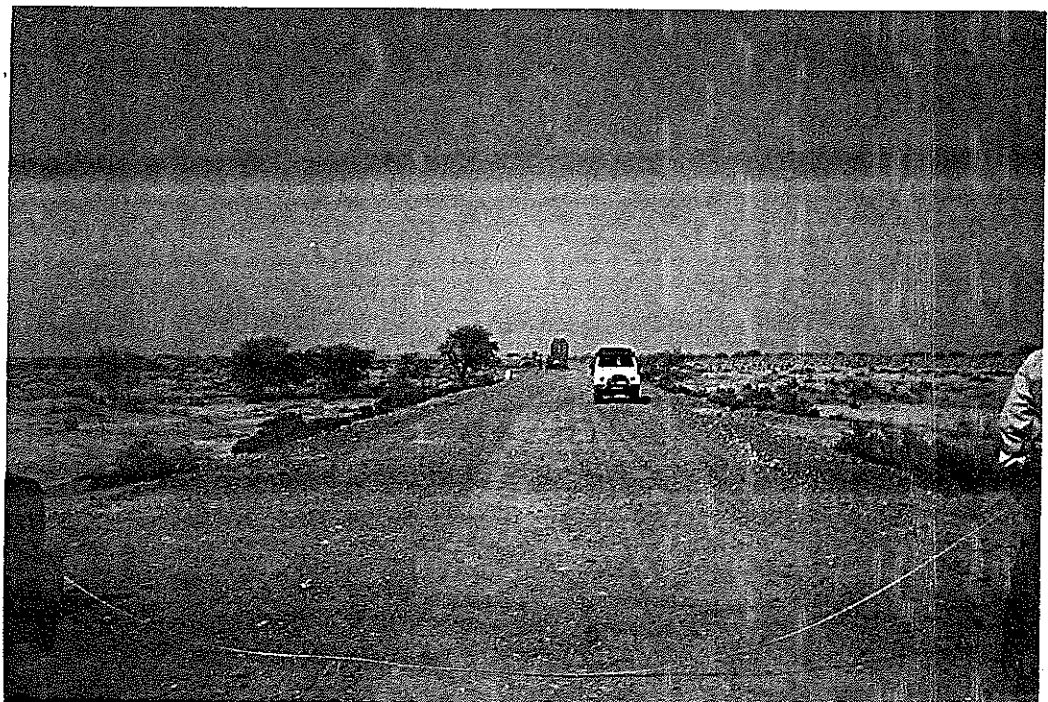
iv) Shoulders on either side should be graveled (as per design developed by NTRC for low cost roads) to achieve stability against the rain damage.

v) Additional cross drainage structure, properly protected by stone pitching, should be provided in areas susceptible to flash flooding (sheet

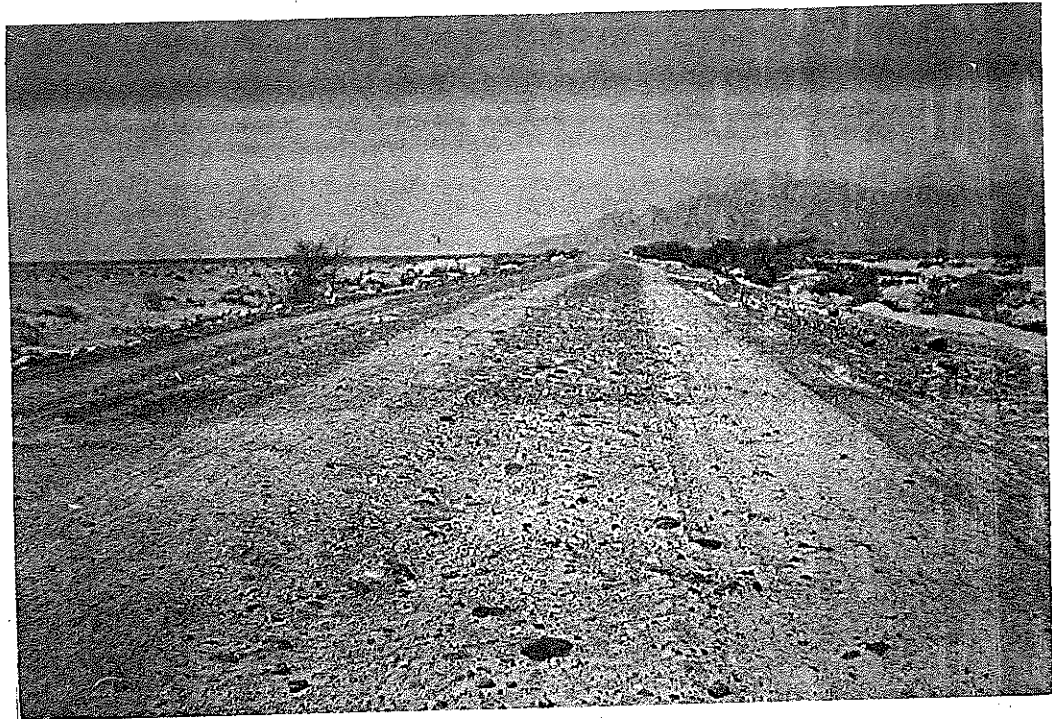
PHOTOGRAPHS



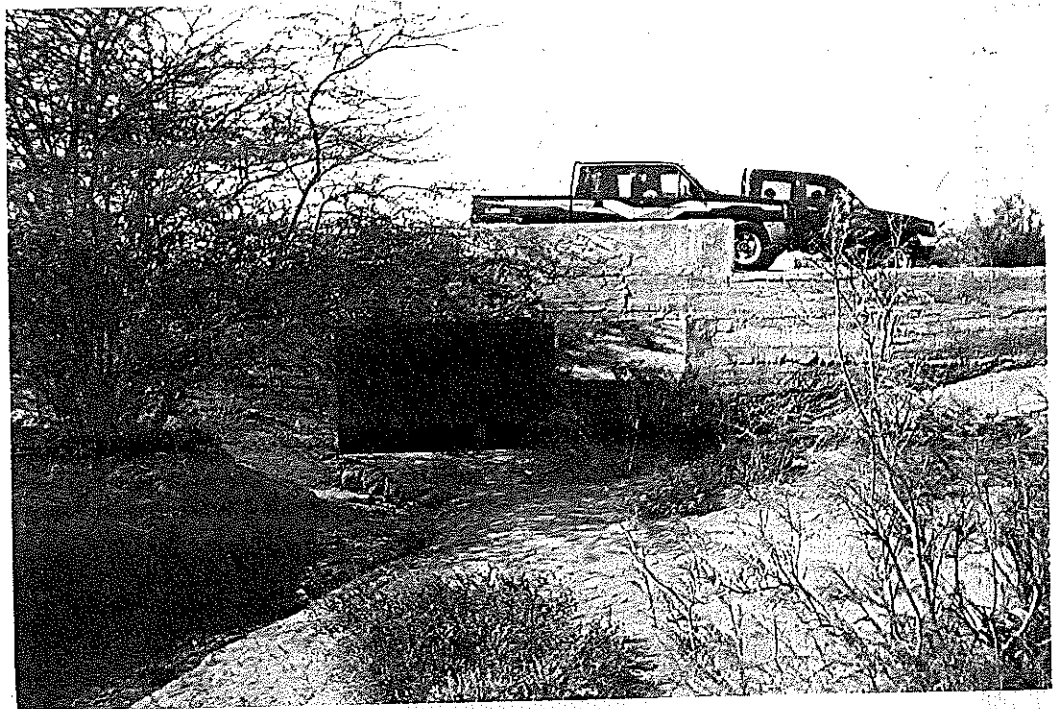
Photograph - 1 Zero Point of Coastal Highway at N-25



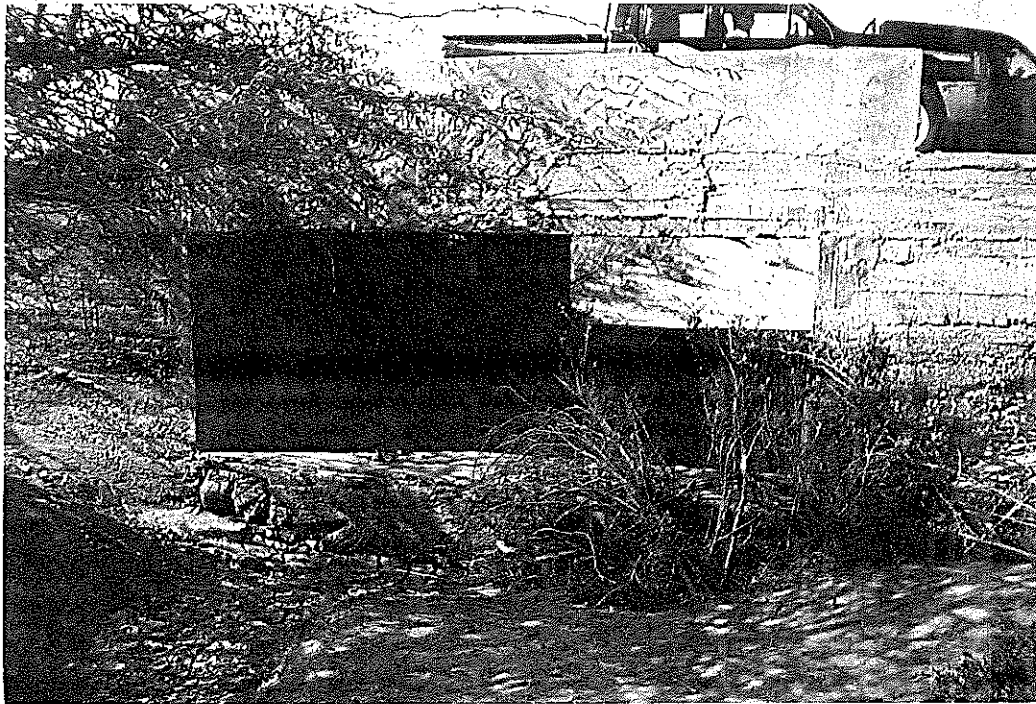
Photograph - 2 Road in good condition near Liari



Photograph - 3 Closer view of road surface



Photograph - 4 Newly constructed Box Culvert



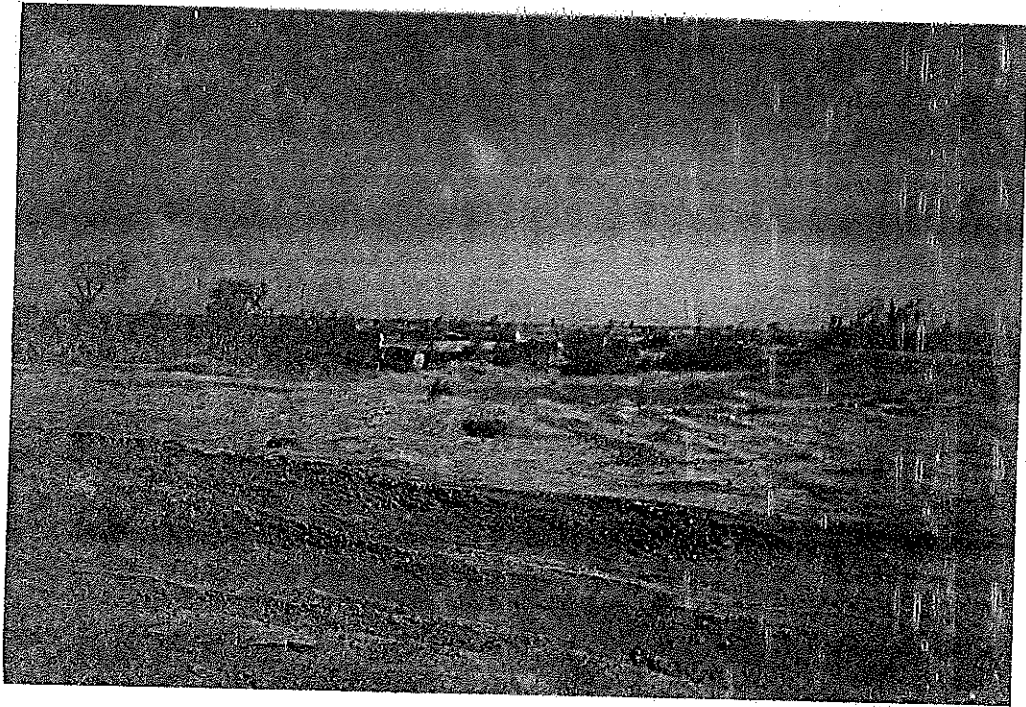
Photograph - 5

Closer view of Box Culvert



Photograph - 6

Road Damaged due to flood



Photograph - 7 Damaged structure due to flood



Photograph - 8 Truck stuck in sand at damaged portion



Photograph - 9 Road passing through plain terrain



Photograph - 10 Road shoulders damaged due to rain cuts



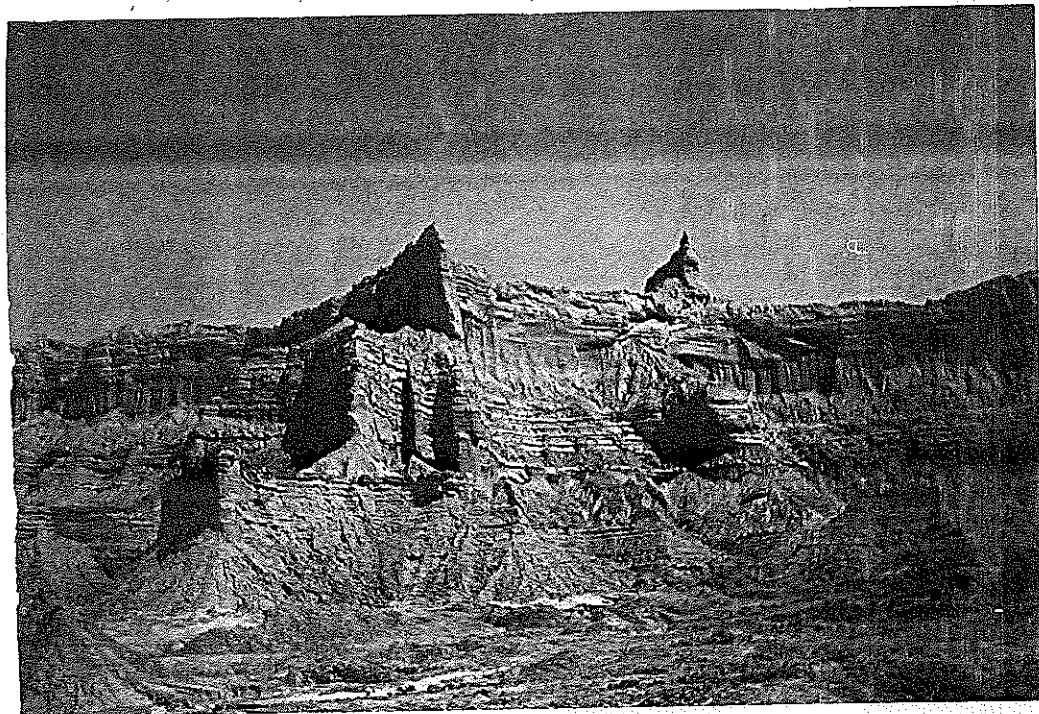
Photograph - 11 Road passing through Hingol River



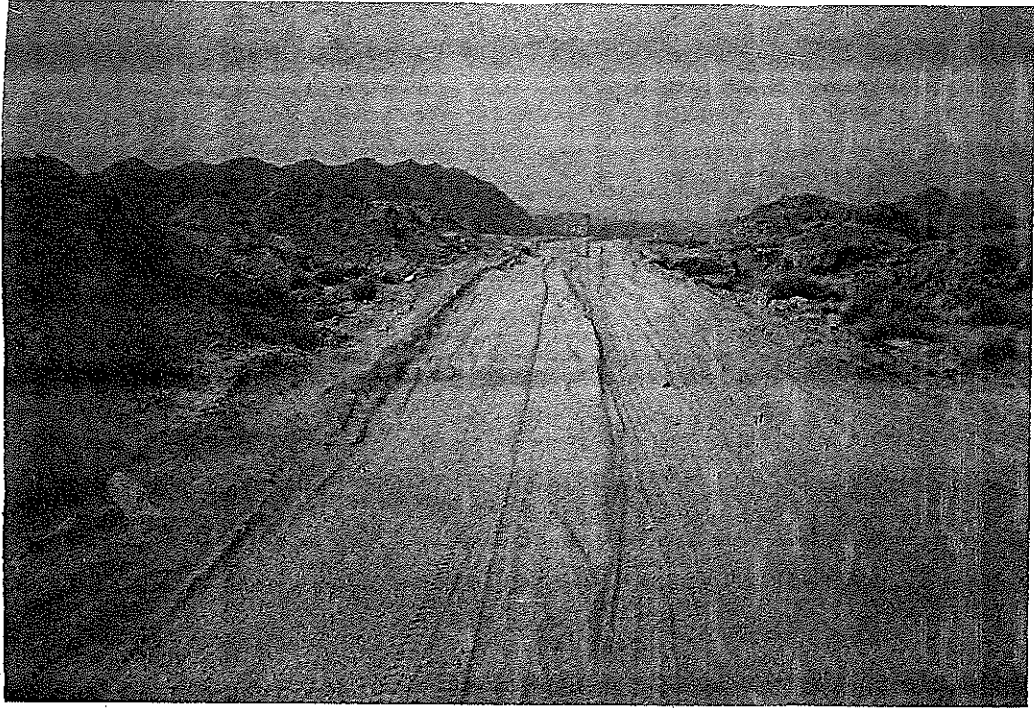
Photograph - 12 Shoulders in very bad condition at Agore - Malam Section



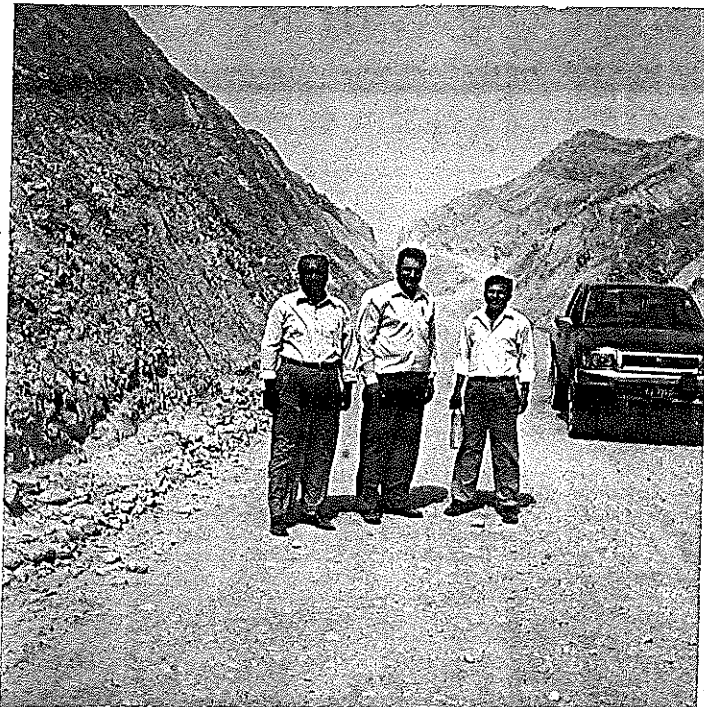
Photograph - 13 Road passing through clayey mountain in section-2



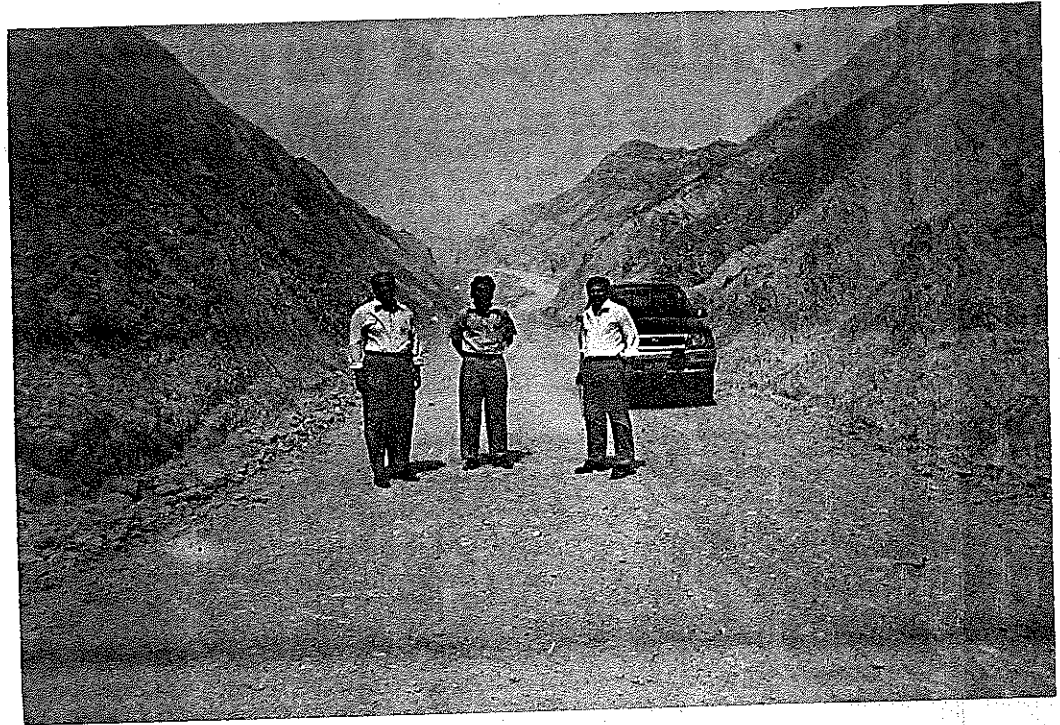
Photograph - 14 View of clayey mountains



Photograph - 15 Nearly no road exists at Section-2



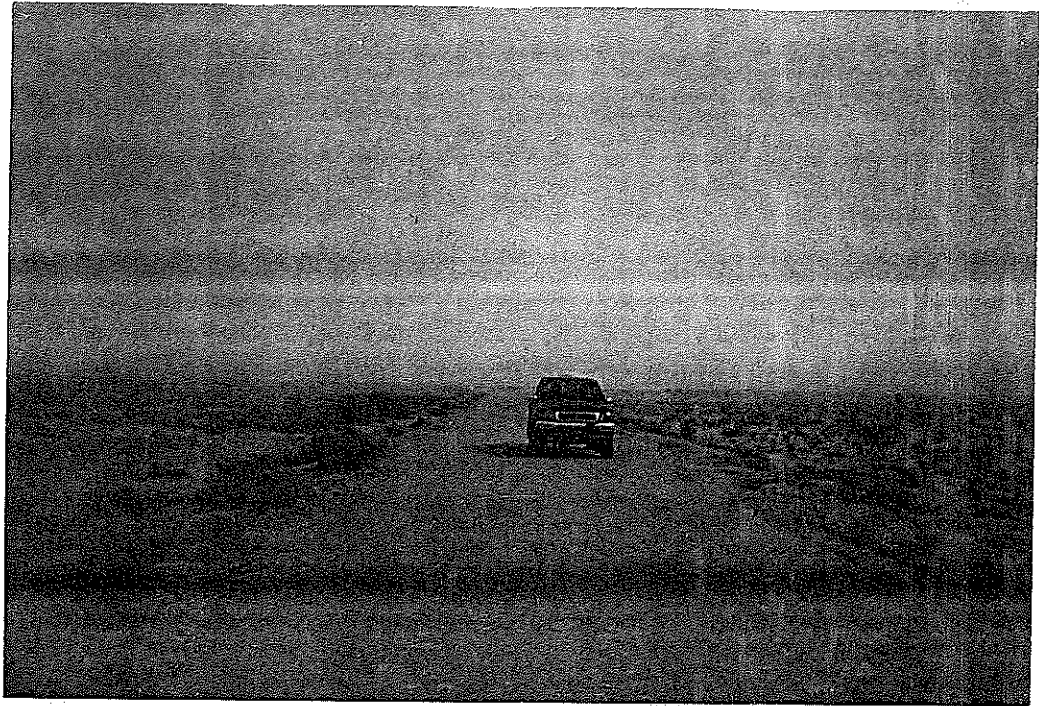
Photograph - 16 Road crossing Buzi pass



Photograph - 17 Another view of road through Gikki and Buzi passes



Photograph - 18 View of road from inside the vehicle



Photograph - 19 Road passing through plain area near Ormara



Photograph - 20 Road showing kilometer post near Ormara

ANNEXURES

PAVEMENT DESIGN

LIARI - ORMARA SECTION

<u>Traffic</u>	<u>Truck</u>			<u>Total</u>
	<u>2-Axle</u>	<u>3-Axle</u>	<u>>3-Axle</u>	
Upon completion	23	3	2	28
10 years past completion	61	7	9	77
Average	42	5	5	52

ESA for Design Life

2-Axle	=	42x365x10x4.67	=	715911
3-Axle	=	5x365x10x11.65	=	212613
>3-Axle	=	5x365x10x12.99	=	237068

				1165592

Say MESA = 1.2

@ Av. 7% soaked CBR

Using Road Note 31

For $T_3 = 0.7 - 1.5 \text{ MESA}$

$S_3 = 6-7 \text{ (CBR \%)}$

Surface Treatment

Granular Base

GB1-GB3

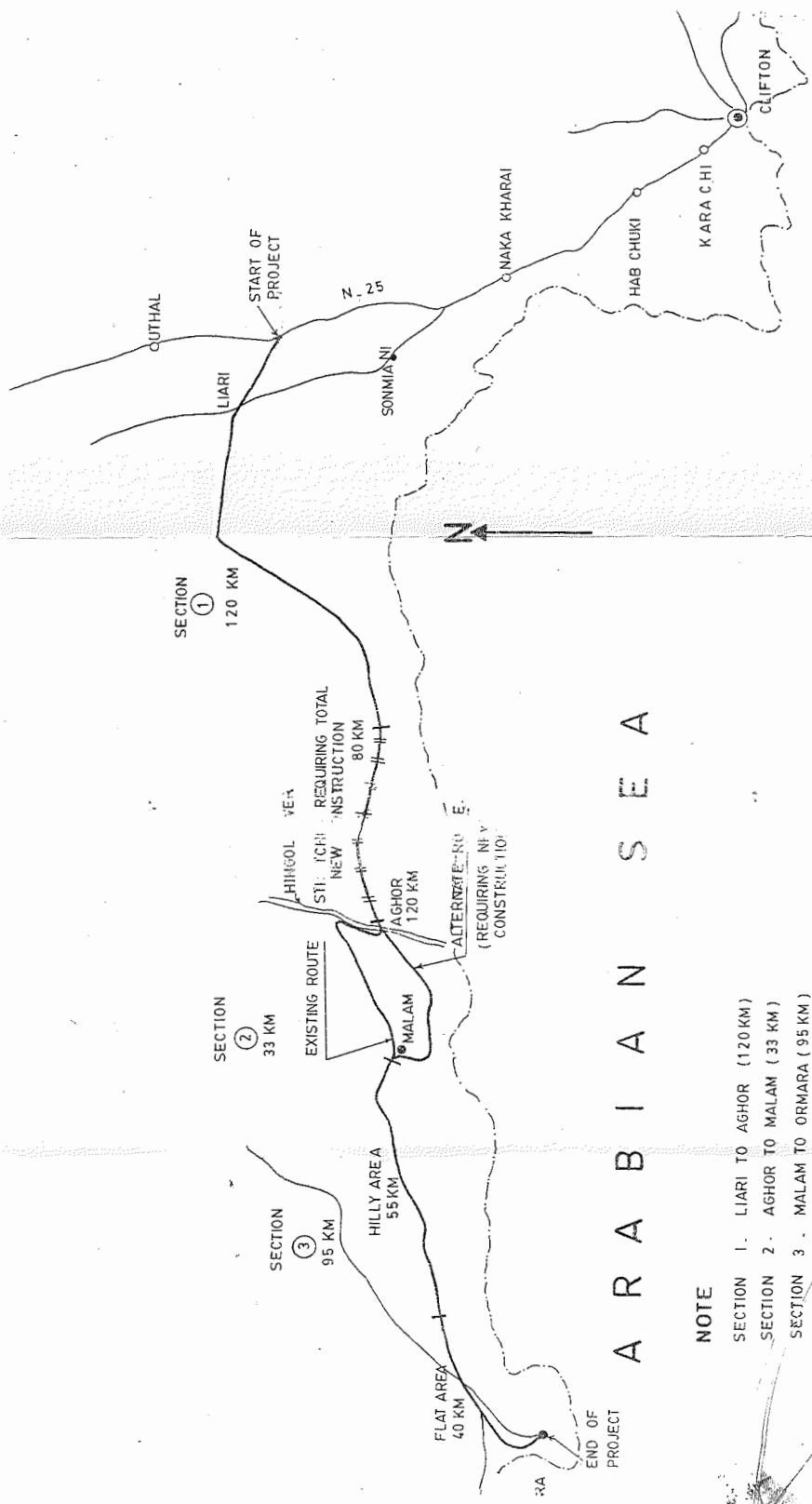
Granular Sub-base



200 mm (8 inch)

225 mm (9 inch)

MAKRAN COASTAL ROAD PROJECT FROM LIARI TO ORMARARA (248 KM)



A R A B I A N S E A

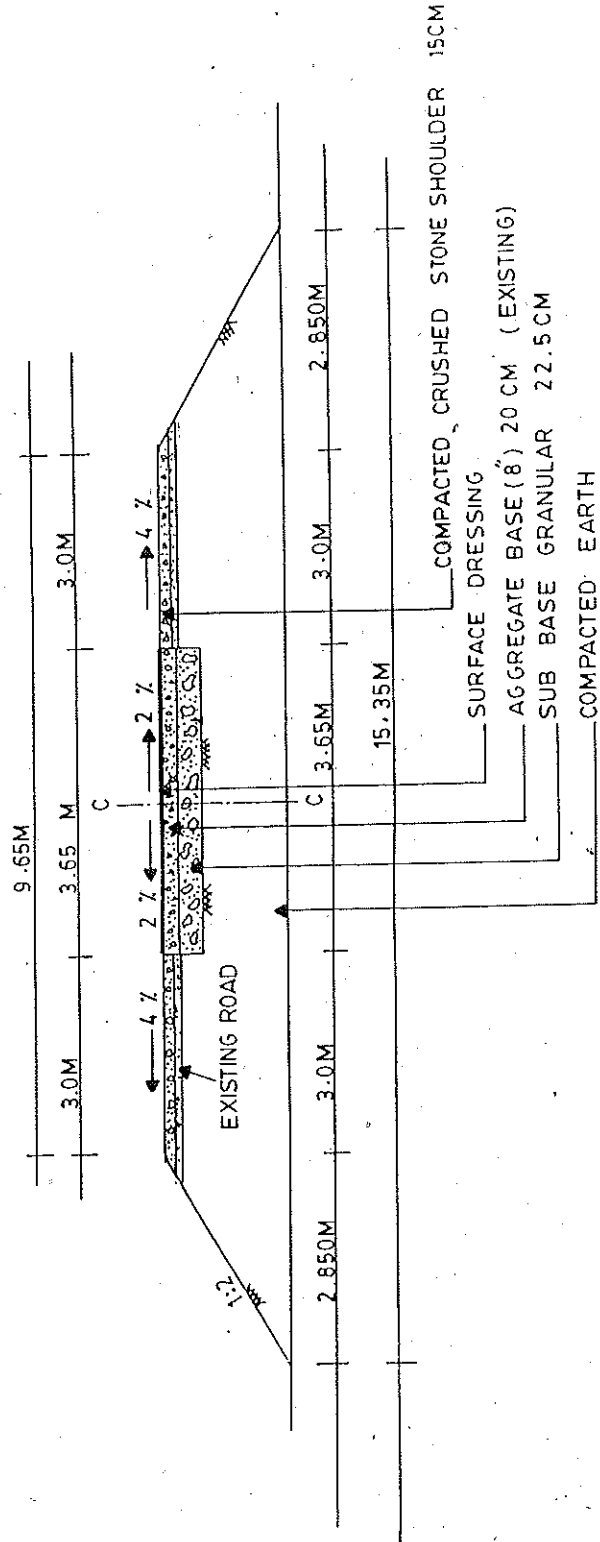
NOTE

- SECTION 1. LIARI TO AGHOR (120 KM)
- SECTION 2. AGHOR TO MALAM (33 KM)
- SECTION 3. MALAM TO ORMARARA (95 KM)



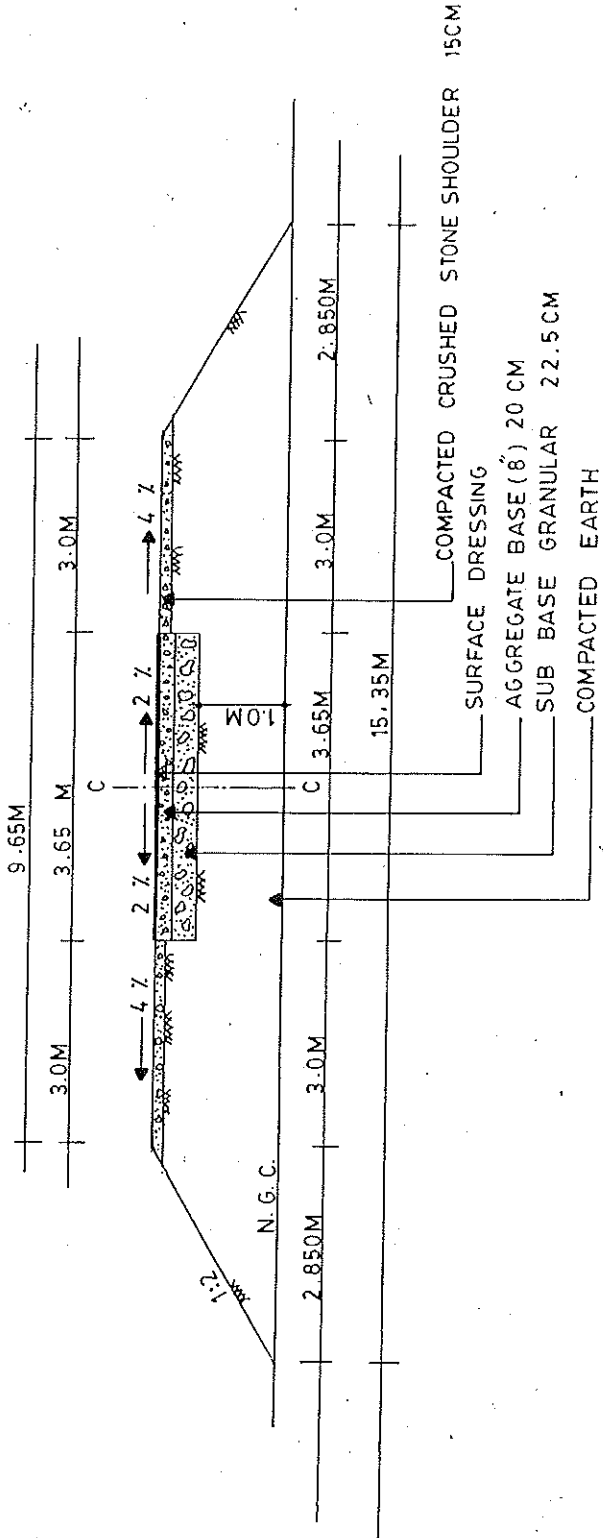
MAKRAN COASTAL ROAD PROJECT
PROPOSED LIARI-ORMARA SECTION FOR STRETCHES
REQUIRING REHABILITATION

185 KM



TYPICAL ROAD SECTION

MAKRAN COASTAL ROAD PROJECT
PROPOSED LIARI-ORMARA SECTION FOR STRETCHES
REQUIRING NEW CONSTRUCTION



TYPICAL ROAD SECTION

ROUGH COST ESTIMATES

Rough cost estimates for the two portions i.e. one requiring rehabilitation and the other requiring new constructions are detailed below:-

Section I (186 Kms)

(Requiring Rehabilitation)

I : Estimated Quantities

i)	Earth work	=	$186,000 \times 2 \times 1/2 \times 2.85 \times 1.425$
		=	755,392 Cu.m
ii)	Base course (20 cm thick)	=	$3.65 \times 0.20 \times 186,000$
		=	135780 Cu.m
iii)	Shoulders (Crushed stone with Khakka on top of it 15 cm thick)	=	$(3.15 \times 0.15 \times 186,000) \times 2$
		=	175,770 Cu.m
iv)	Sealed surface	=	$3.65 \times 186,000$
		=	678,900 Sq.m

Annexure - III (Sheet-2)

II : Cost Estimates (Section-I)

<u>S.No.</u>	<u>Items</u>	<u>Quantity</u>	<u>Rate (Rs.)</u>	<u>Amount (Mill. Rs)</u>
1	Earth Work	755,392 (M ³)	128.80	97.29
2	Base Course (20 cm) of crushed stone	135,780 (M ³)	768.94	104.40
3	Compacted shoulders of Crushed stone with Khaka on top of it (15 cm)	175,770 (M ³)	768.94	135.16
4	Single surface treatment	678,900 (M ²)	33.65	22.84
			Sub-Total	<u>359.69</u>
5.	Add for structures (40%) (mainly causeways			143.88
6.	Drainage and Erosion works (15%) (Riprap, stone ditch lining etc.)			53.95
7.	Ancillary Works (10%) (Sign boards, kilometer posts, guardrails)			35.97
8.	General Items (5%)			<u>18.00</u>
			Sub-Total	611.49
	Contingencies (3%)			<u>18.34</u>
			Total Rs.	<u>629.83</u>

Section II (63 Kms)

(Requiring New Construction)

I : Estimated Quantities

$$\begin{aligned} \text{I) Earth Work} &= \frac{[(9.65+15.35) \times 1.425 - (0.425 \times 3.65) - (3.15 \times 2 \times 0.15)] \times 63,000}{2} \\ &= 965,034 \text{ Cu.m} \end{aligned}$$

ii) Pavement

a) Granular Sub Base (22.5 cm)	=	0.225 x 3.65 x 63,000
	=	51,739 Cu.m
b) Aggregate Base (22 cm)	=	0.20 x 3.65 x 63,000
	=	45,990 Cu.m
c) Surface Treatment	=	63,000 x 3.65
	=	229,950 Sq.m

iii) Shoulders

Crushed stone with Khaka on top	=	2 x 3.15 x 0.15 x 63,000
	=	59,535 Cu.m

Annexure - III (Sheet-4)

II : Cost Estimates (Section-II)

<u>S.No.</u>	<u>Items</u>	<u>Quantity</u>	<u>Rate</u>	<u>Amount</u>
1	Formation of Embankment from borrow excavation in common material	965,034 (M ³)	128.80	124.3
2	Granular Sub Base (27.5 cm)	51,739 (M ³)	397.11	20.55
3	Aggregate Base Course (20 cm)	45,990 (M ³)	768.94	35.36
4	Compacted shoulders Crushed stone with Khaka on top of it (15 cm)	59,535 (M ³)	768.94	45.78
5	Single surface treatment	229,950 (M ²)	33.11	7.61
			Total	<u>233.60</u>
6.	Add for Structures (40%) (Mainly Causeways)			93.44
7.	Drainage and Erosion works (15%) (Riprap, stone ditch lining etc.)			35.04
8.	Ancillary Works (10%) i.e. Sign boards, kilometer posts, guard rails			23.36
9.	General Items (5%)			<u>11.68</u>
			Sub-Total	397.12
	Contingencies (3%)			<u>11.14</u>
			Total.	<u>408.26</u>

Total Cost = Cost (Section-I) + Cost (Section-II)
 = 629.83 + 408.26
 = Rs. 1038.09 million