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NATIONAL TRANSPORT RESEARCH CENTRE

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REPORT  
ON  
LAHORE - ISLAMABAD MOTORWAY

NTRC-201

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Deputy Chief

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## EXECUTIVE SUMMARY

A task force has been set up under the Chairmanship of Federal Minister for Communications to monitor and expedite the construction work on Lahore - Islamabad Motorway. In follow up of Minister's visit of Motorway, a team of NTRC Engineers under the guidance of M. M. Sadiq Swati, Senior Chief, NTRC visited the motorway section-III and IV. The team made a comprehensive visual inspection of various construction activities and also brought samples for testing in NTRC laboratories. In the light of visual inspections and laboratory test results, the report has been prepared.

The bitumen content in the wearing course was found to vary between 4.5 to 4.7% whereas the bitumen content as per Job Mix Formula (JMF) was  $4.6 \pm 0.3\%$ . Thus the bitumen content in the freshly laid mix & plant mix asphaltic concrete is within the specified limits. Also the bitumen properties tested in NTRC laboratories match with the J.M.F. 60 - 70 penetration grade bitumen was found to be used in the mix and is suitable for this region in view of climatic conditions.

According to the consultants namely M/s SMEC, appointed by the government of Pakistan to provide consultancy services and ensure quality of work on the Motorway project, the quality of work produced by M/s DAEWOO Corporation is satisfactory. There were no visible signs of

## **1 : INTRODUCTION**

A taskforce has been set up under the Chairmanship of federal Minister for Communications to monitor and expedite the construction work on different sections of the Lahore - Islamabad Motorway. During a site visit of the taskforce the Senior Chief, NTRC alongwith the other members of the taskforce accompanied the Minister and observed certain problems in different construction activities of the Motorway. On the direction of Senior Chief, NTRC, a team of NTRC engineers visited the Motorway Section-III and Section-IV on two different dates. The team made thorough visual inspection of the site and also collected samples from the site for testing in the laboratory.

## **2 : OBJECTIVES**

The NTRC team was assigned the following job and objectives of this report are as under:-

- i) To check the surface distress/riding quality on the section-III and IV of motorway.
- ii) To check the Bitumen content in the Asphaltic Concrete at the batching plant as well as in the freshly laid surface and in the core obtained from the wearing course.
- iii) To inspect the C-5 and C-6 bridges on section-III and report on the problems encountered and remedial measures adopted at site.
- iv) To inspect the salt range area and observe the landsliding problem and propose remedial measures.

### 3 : METHODOLOGY

A team of NTRC Engineers (composition at Annex-I) visited the motorway site on two different dates i.e. on 04-06-1997 and 06-06-1997. The methodology of the study covers the following steps:

- i) Visual Inspection of section-III and section-IV upto Kalar Kahar of the motorway.
- ii) Collection of samples from the site.
- iii) Laboratory testing of samples.
- iv) Analysis of results and Report Writing.

### 4 : VISUAL INSPECTION

4.1 Surface Distress & Riding Quality: In order to check the surface distress such as cracking or rutting, thorough visual inspections were made along the whole length of section-III and section-IV and some locations randomly selected were thoroughly inspected. It was observed that riding surface was generally in good condition and there were no visible signs of any distress in the form of rutting or cracking. Plate-1 and Plate-2 exhibits close view of the surface showing no signs of any type of distress cracking or rutting. Similarly Plate-3 and Plate-4 show the longitudinal view of the pavement were no signs of distress in the form of rutting are observed. During the visual inspection of the surface, it was observed that road roughness was being checked using ARRB profilometer. The display of the profilometer showed the International Roughness Index (IRI) of 1.5 meter/kilometer. The IRI of 1.5 m/km is the roughness requirement for the Motorway at the time of its opening. Plates- 5 & 6 show the profilometer at work.

4.2 Fly-Over Bridges: It was also observed that at certain locations, the fly-over bridges on the motorway were without approach roads. No construction activities were

seen on the approaches which means that opening of the motorway to traffic without providing grade separated crossing facilities would pose serious safety hazards both for the Motorway traffic and the traffic crossing the Motorway. Plates-7 and 8 show the problem.

4.3 Binder Course Sections: At some locations only the binder course was laid on pavement and wearing course is still to be laid. This leads to confusion to the vehicle user about the riding quality at such sections. Plates-9 & 10 show such locations.

4.4 Landslide Problem in the Salt Range Area: The Motorway is passing through the salt range area near Kaler Kahar in about one kilometer length. When the hill was blasted to make the roadway, the land slide phenomena started. According to the consultants, they have properly designed the slopes keeping in view the geological properties of the rock and after removing the over burden material, they will bring the hill side to the proper slope and shall also provide stepping/benching. According to the Assistant Resident Engineer of the consultant M/s SMEC, gabions would also be placed to prevent the land sliding. According to the consultants, it is only a matter of time and when enough overburden material is removed from the top hill, the slopes will become stable. Plates-11 to 14 exhibit the landslide problem and the construction activities going on the site.

4.5 Observations at C-6 Bridge : The main problem at C-6 bridge was tilting and development of cracks around the height of the bridge piers. The bridge piers are about 270 feet high. The tilting and cracking in the piers developed due to un-balanced earth filling around the piers. The contractor filled earth around the piers so that gantry cranes could be put near the bridge piers for hoisting the bridge girders. In fact, the contractor's technique of hoisting bridge girders using gantry cranes was not in line with the procedure laid down in the contract document. In fact the contractor should

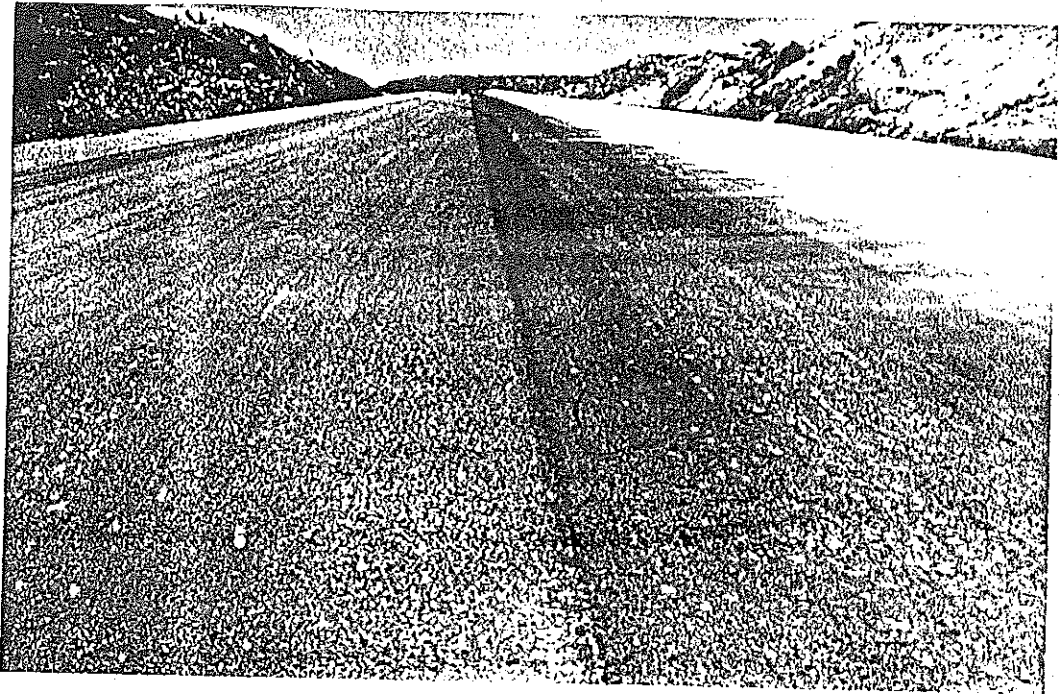


PLATE-3 : LONGITUDNAL VIEW OF MOTORWAY SURFACE

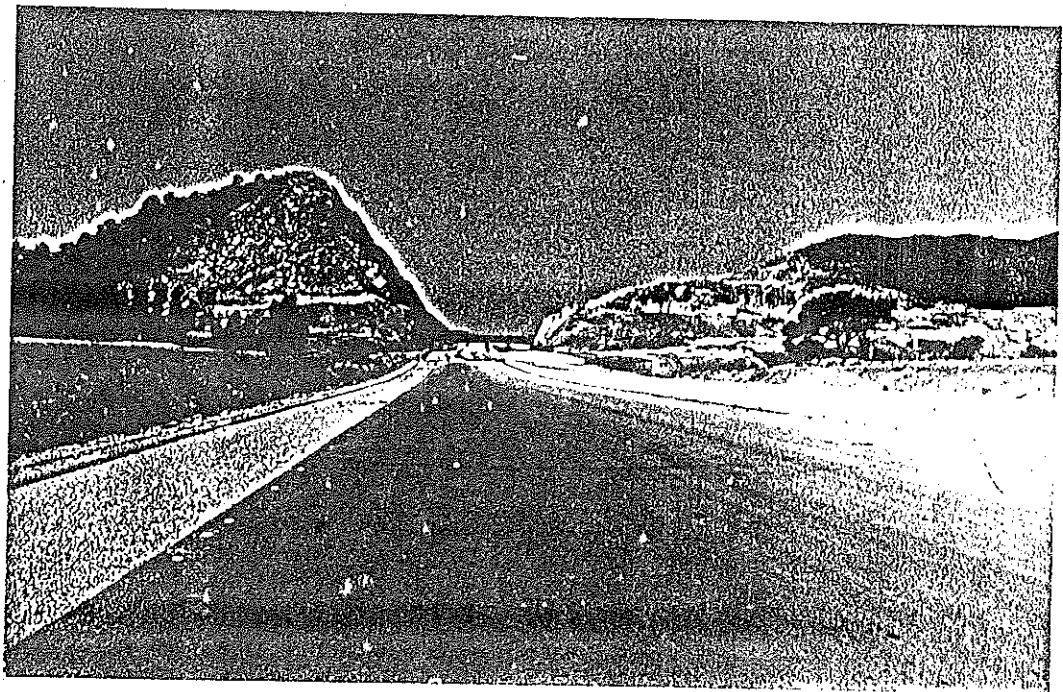


PLATE-4 : LONGITUDNAL VIEW SHOWING NO DISTRESS

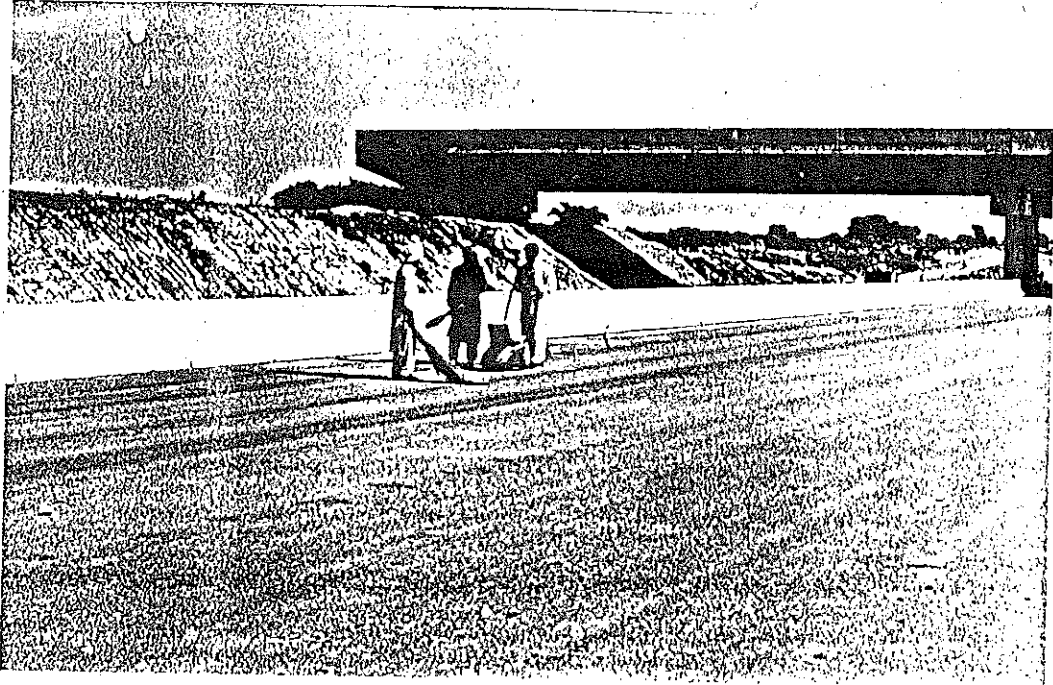


PLATE-5 : PROFILOMETER AT WORK

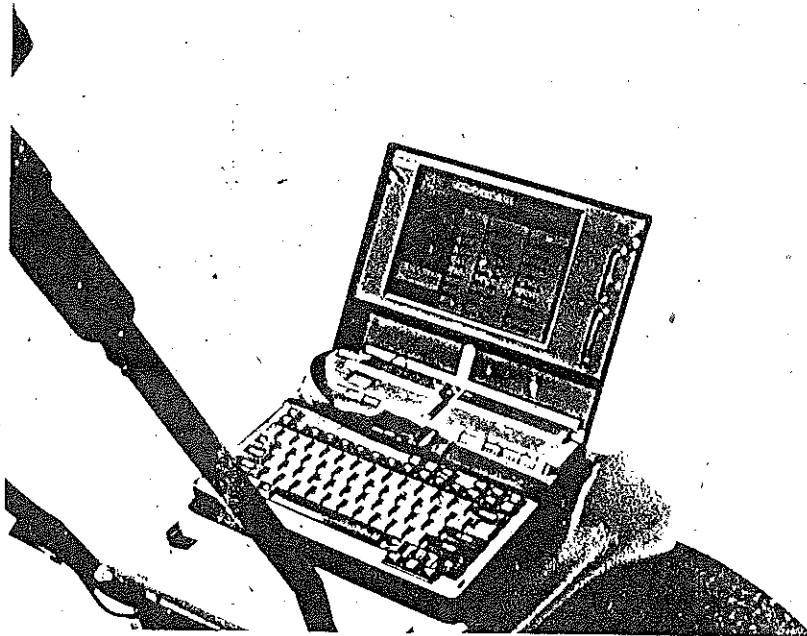


PLATE-6 : PROFILOMETER DISPLAY



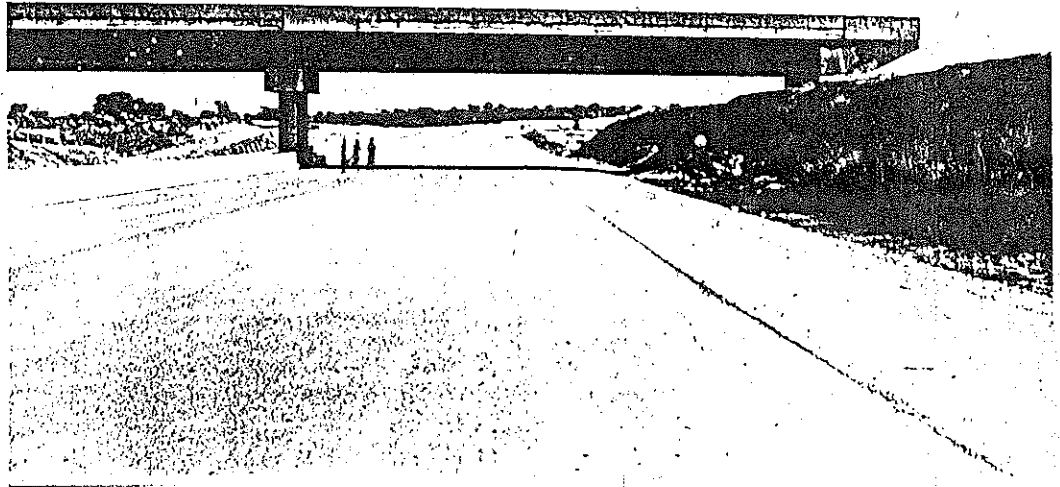


PLATE-7 : FLYOVER BRIDGE WITHOUT APPROACH ROAD

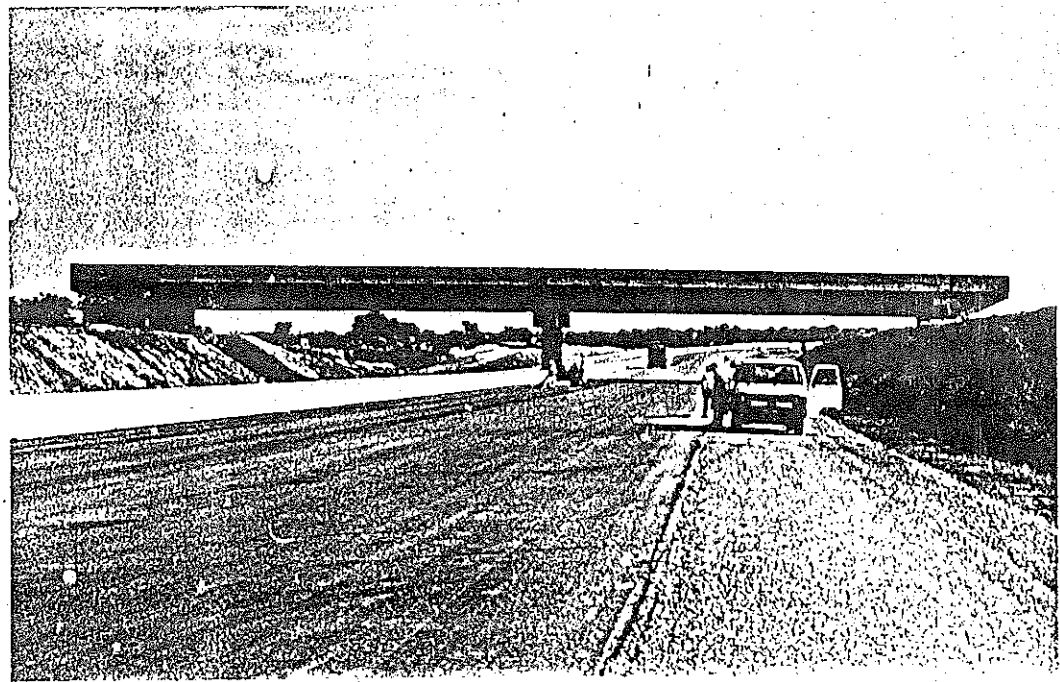


PLATE-8 : ANOTHER VIEW OF HANGING FLYOVER BRIDGE WITHOUT APPROACH ROAD

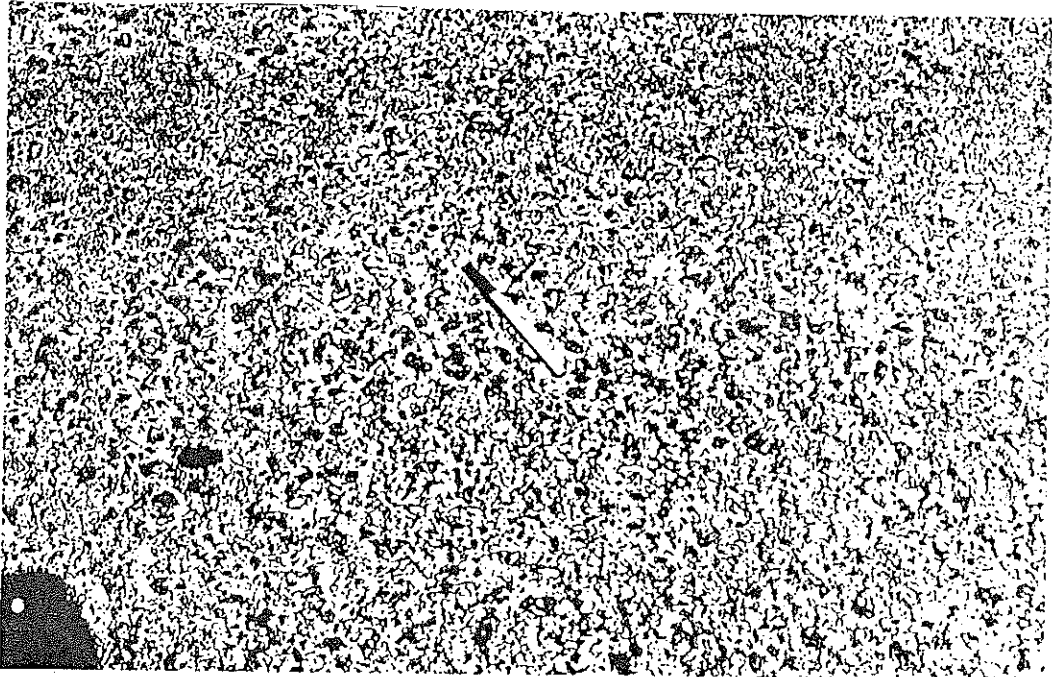


PLATE-9 : BASE COURSE SURFACE, WEARING COURSE STILL TO BE LAID

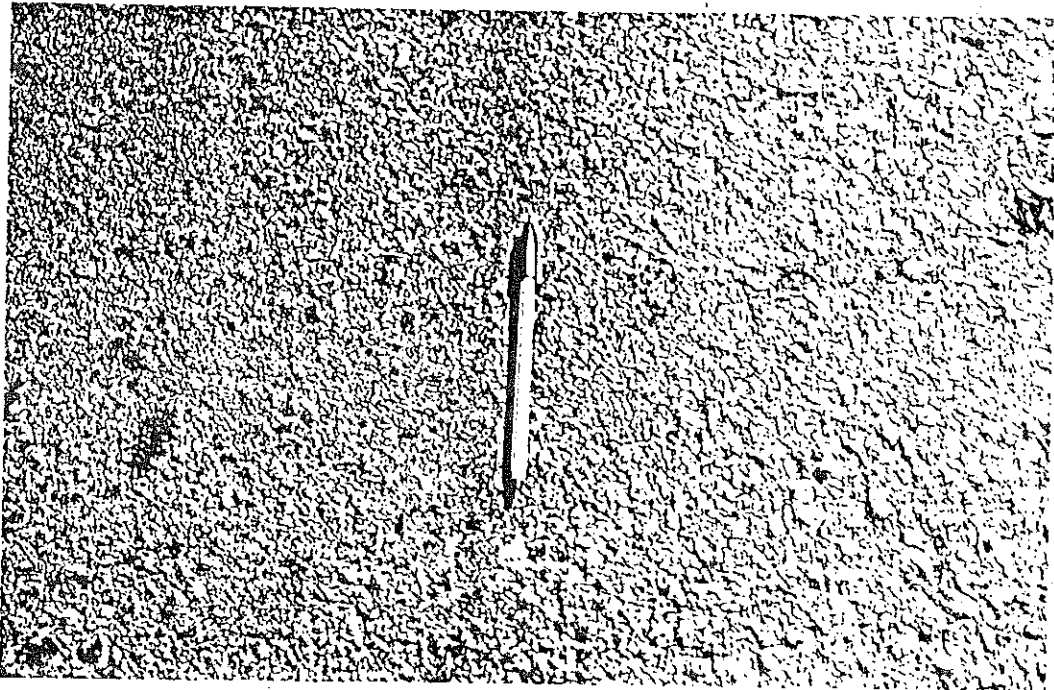


PLATE-10 : ANOTHER VIEW OF SURFACE TEXTURE ON BASE COURSE WITHOUT WEARING COURSE

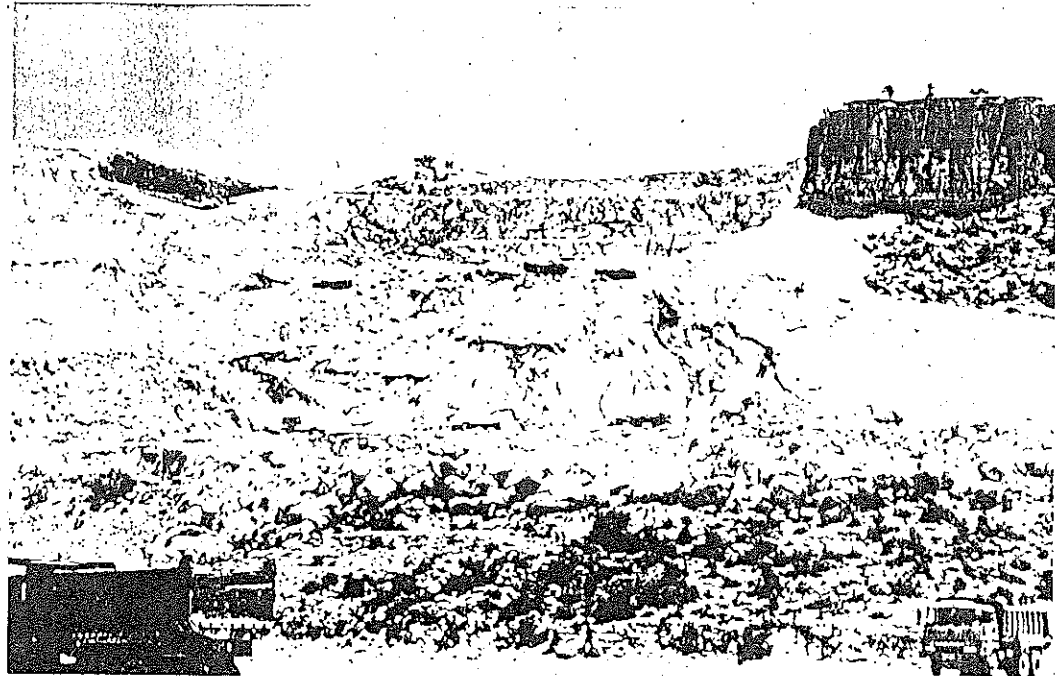


PLATE-11 : LANDSLIDES - BENCHING/STEPPING BEING PROVIDING

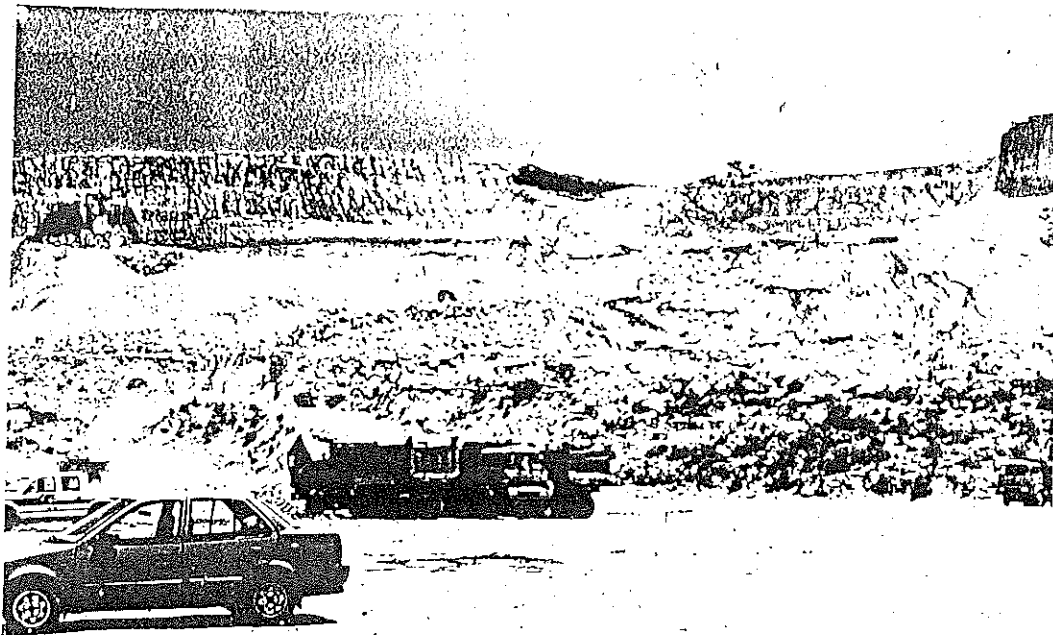


PLATE-12 : ANOTHER VIEW OF CONSTRUCTION ACTIVITIES IN LANDSLIDE AREA



PLATE-13 : OVERBURDEN MATERIAL BEING REMOVED FROM  
SLIDING AREA

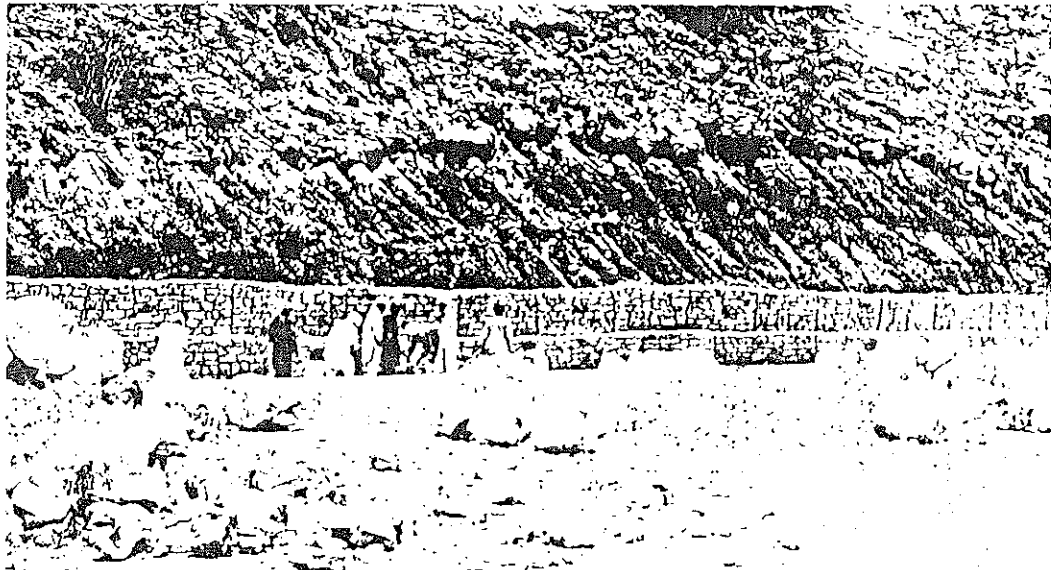


PLATE-14 : GABIONS BEING PLACED AT THE TOE OF THE  
LANDSLIDING

have used the launching platform to hoist the girders. Now the filling around the piers have been removed and the hollow section of the pier is injected with cement concrete. After removal of the earth filling around the piers and injection of cement concrete, the cracks have been rectified and the bridge piers are now in correct position. The contractor has also mobilized proper launching platforms for hoisting the girders. Plates-15 to 19 show the problems encountered and the present position after remedial measures.

**4.6 Observations at C-5 Bridge:** The problem at C-5 bridge appeared in the form of cracks in the pier cap due to settling down of one pier of the C-5 bridge. This problem has been overcome by placing two RCC foundations adjacent to the problematic pier. On top of the RCC foundations, heavy steel columns have been put and after jacking up the pier cap to its original position using high pressure pneumatic jacks, steel plates have been pushed under the pier cap to fill the gap. After bringing the pier cap into the original position, the jacks have been released. The cracks in the pier cap have been properly drilled out & filled up with proper epoxy material. Plates-20 to 21 show the treatment made to C-5 bridge.

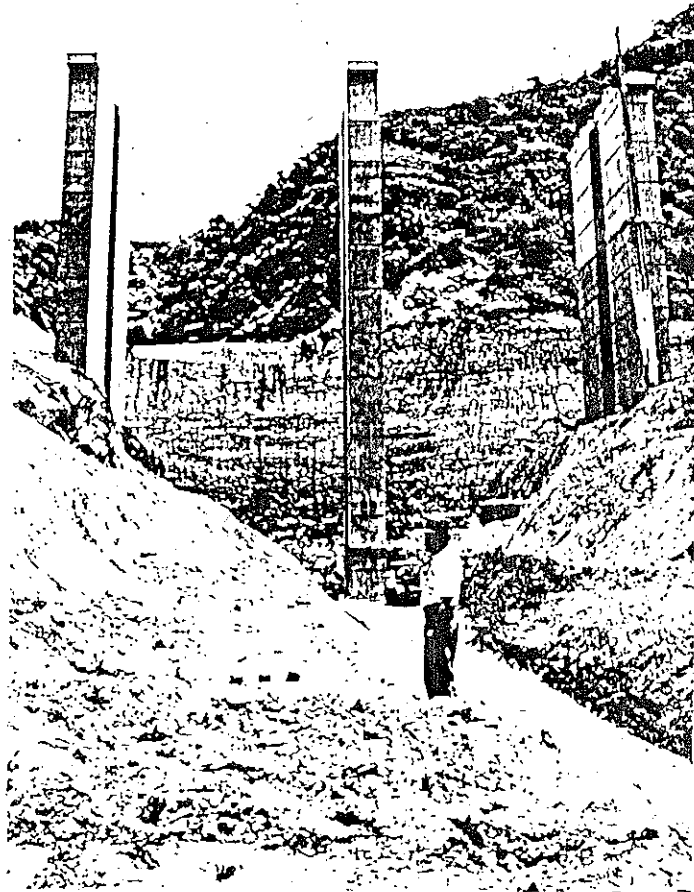


PLATE-15 : PIER AT C-6 BRIDGE (SIGNS OF EARTH FILLING  
UPTO TOP OF THE PIER ARE VISIBLE)

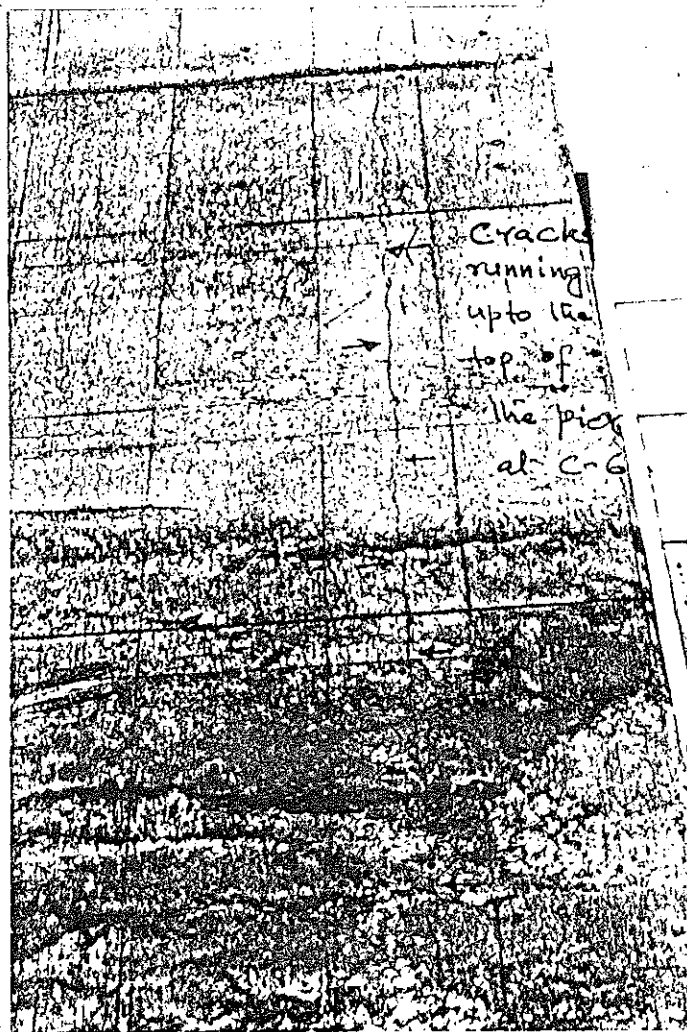


PLATE-16: LONGITUDINAL CRACK IN THE C-6 BRIDGE'S PIER  
DUE TO UN-EVEN EARTH FILLING

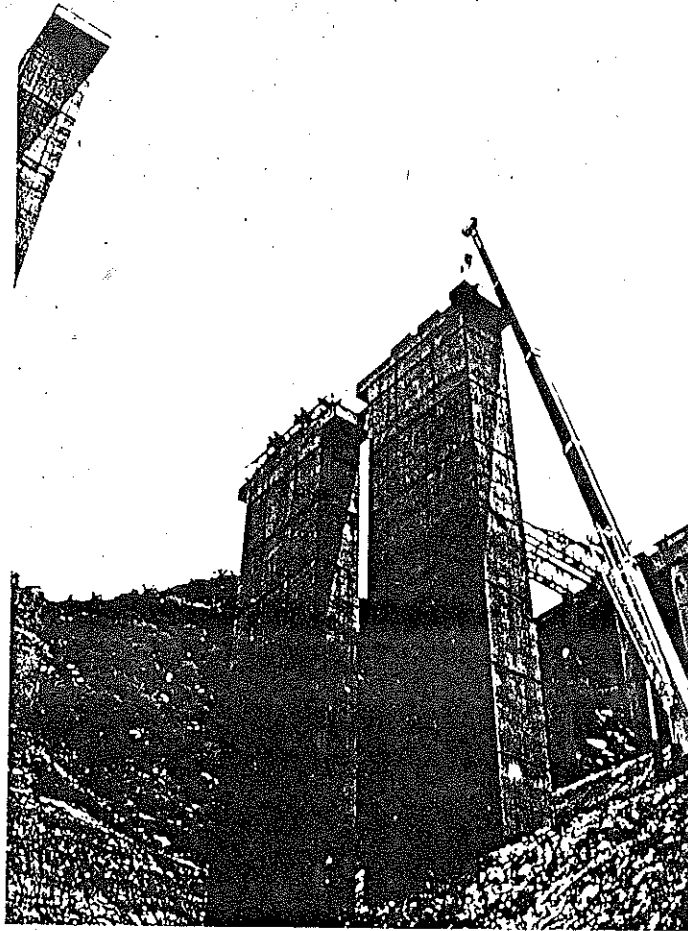


PLATE-17: GANTRY CRANE PLACED AT THE EARTH FILLING TO HOIST THE BRIDGE GIRDERS. LAUNCHING PLATFORM IS ALSO SEEN IN THE PHOTOGRAPH



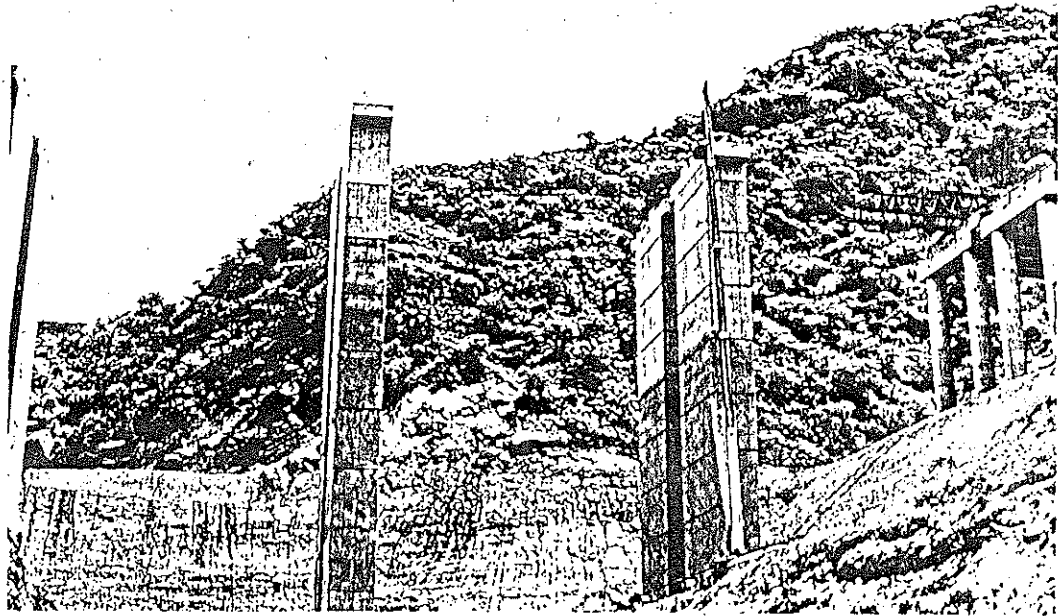


PLATE-18 : GANTREY CRANE AND LAUNCHING PLATFORM SEEN IN THE PHOTOGRAPH

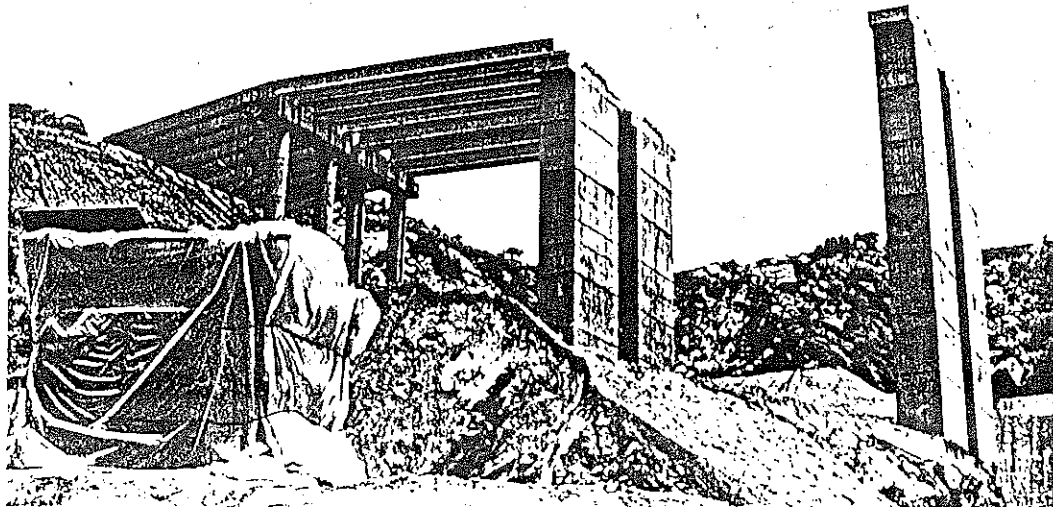


PLATE-19 : GIRDERS ARE HOISTED ON THE PIERS

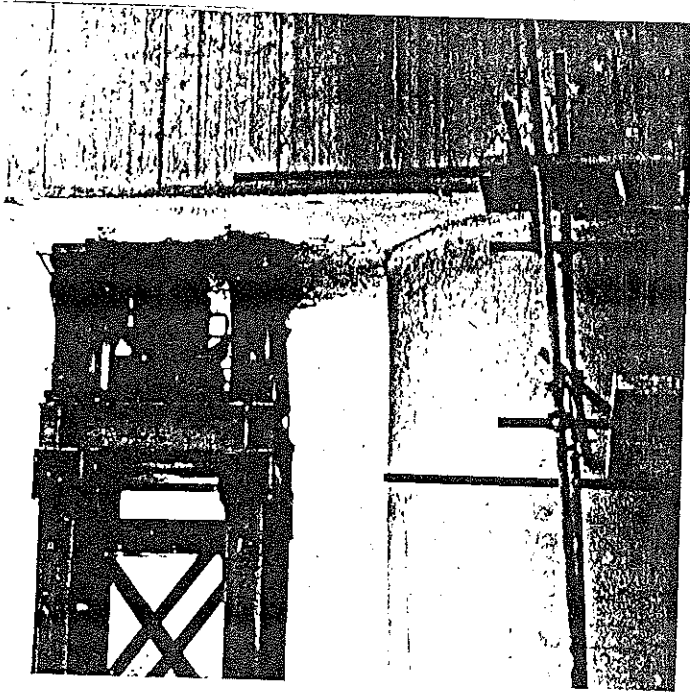


PLATE-20 : PIER CAP JACKED UP AND STEEL COLUMN PLACED UNDER THE CAP

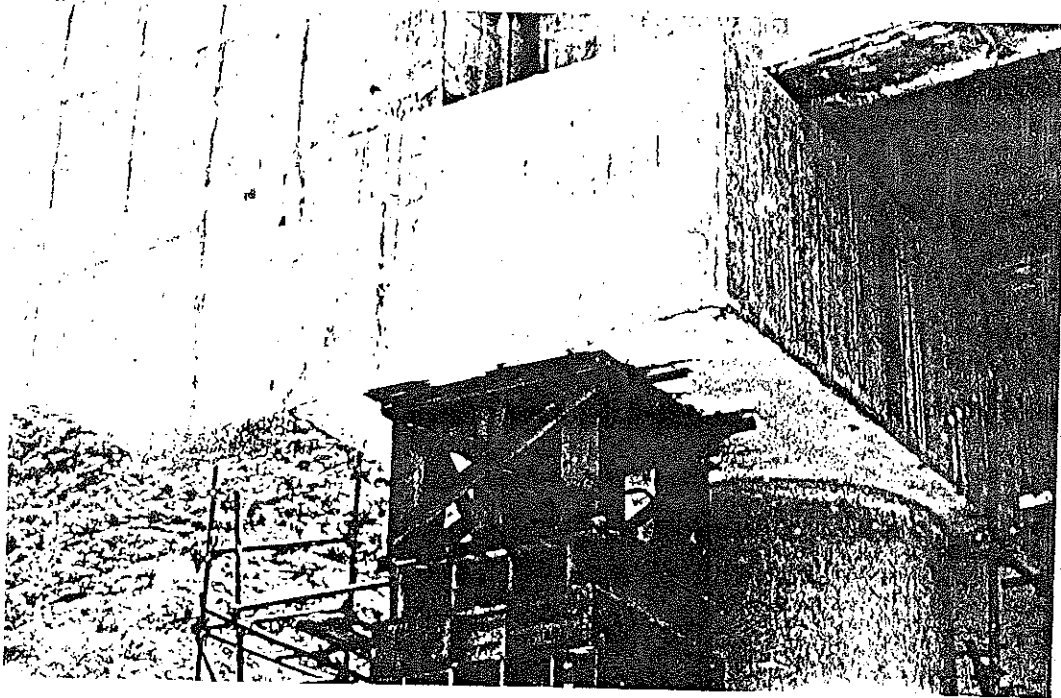


PLATE-21 : ANOTHER VIEW OF STEEL COLUMN UNDER THE PIER CAP

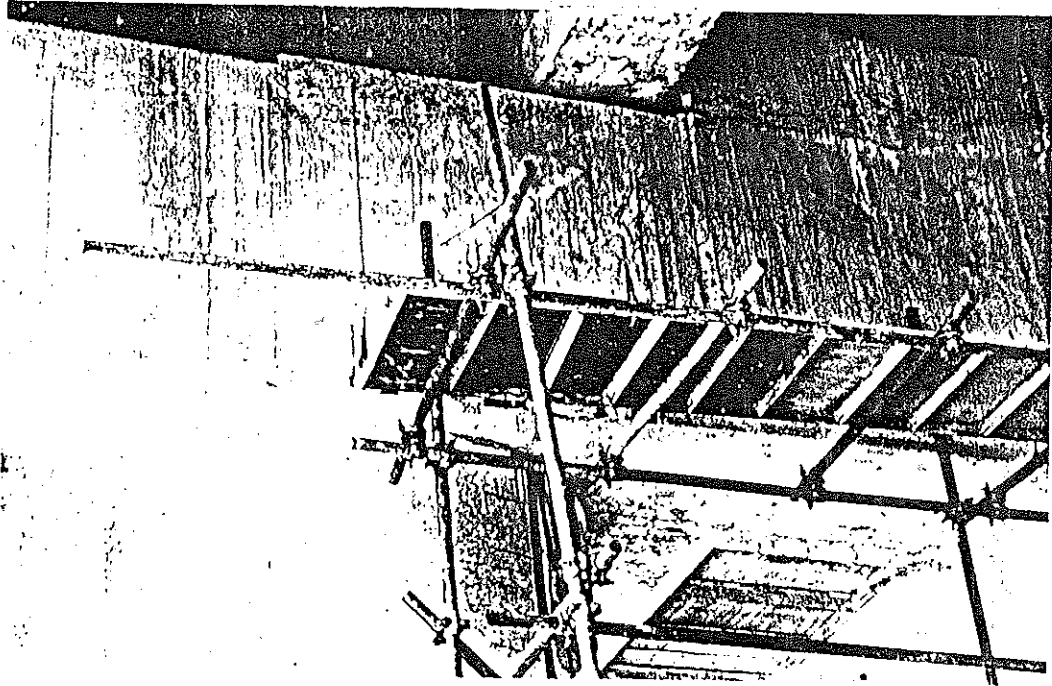


PLATE-22 : THE CRACKS IN THE PIER CAP DRILLED OUT AND FILLED WITH EPOXY MATERIAL

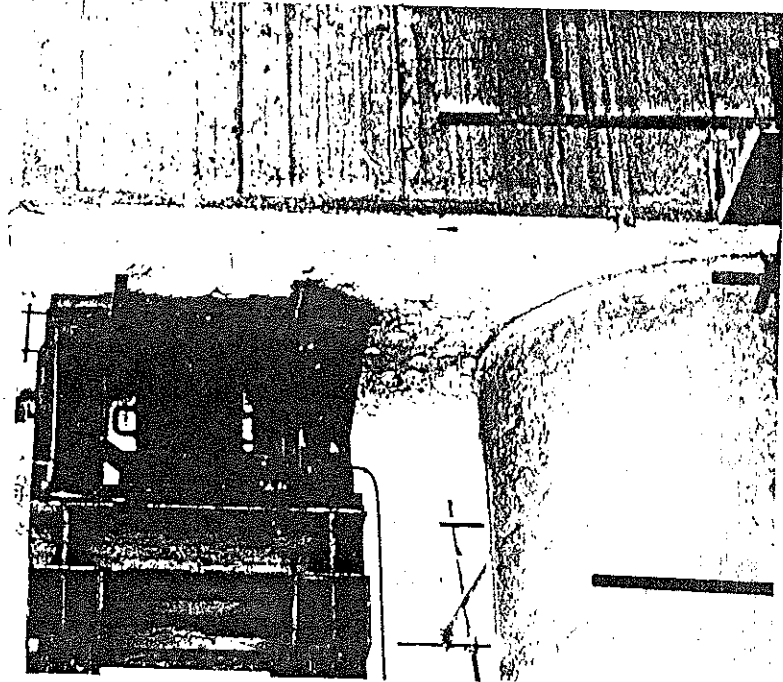


PLATE-23 : JACK STILL IN POSITION BUT PRESSURE IS RELEASED

## 5 : COLLECTION OF SAMPLES

The samples of the following description were collected as detailed below:

5.1 Sample No. AC-I: This sample was obtained from the freshly laid asphaltic concrete wearing course near Chakri from Section-III of Motorway where inner lane near New Jersey barrier was being paved. Paver was in operation and the sample No. AC-I was obtained from the freshly laid surface. Plate-24 and 25 show the location and execution of the work.

5.2 Sample No. AC-II: This sample was obtained from the batching plant at km 309 of the Motorway. The sample No. AC-II was obtained from the freshly mixed asphaltic concrete dumped into the dump truck from the batching plant.

5.3 Sample No. AC-III: This sample was a core drilled out of the wearing course and provided by the Assistant Resident Engineer of the Consultant M/s SMEC while the team visited the Base Camp.

5.4 Bitumen Sample No. B-I: Bitumen sample was collected from the batching plant to check the properties of bitumen.

5.5 Sample No. SS-I: This was the material sample obtained from the salt range area. The sample was obtained from the material falling down the landslide. Plates-26 & 27 show the location of the landslide area from where the sample was obtained.

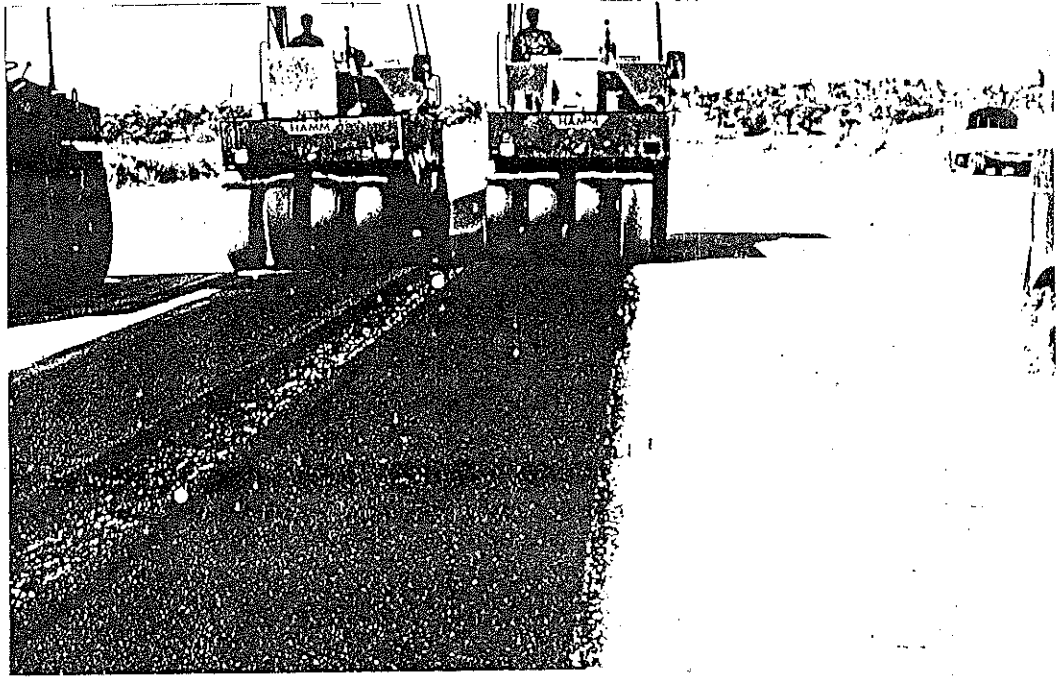


PLATE-24 : INNER LANE NEAR NEW JERSEY BARRIER BEING  
PAVED

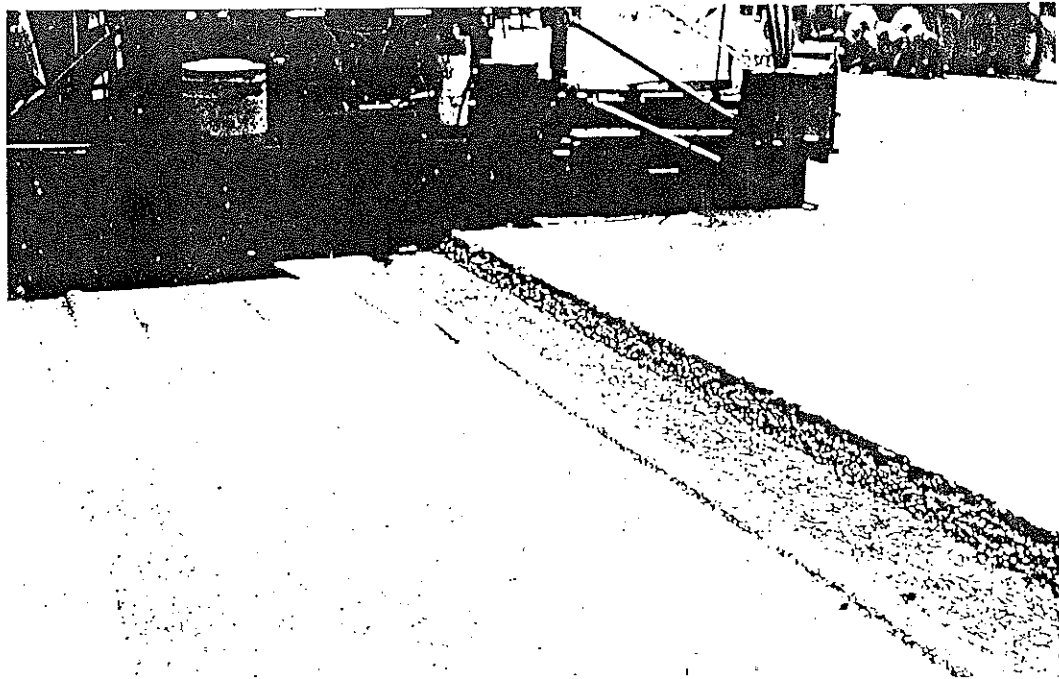


PLATE-25 : ANOTHER VIEW PAVES IN OPERATION

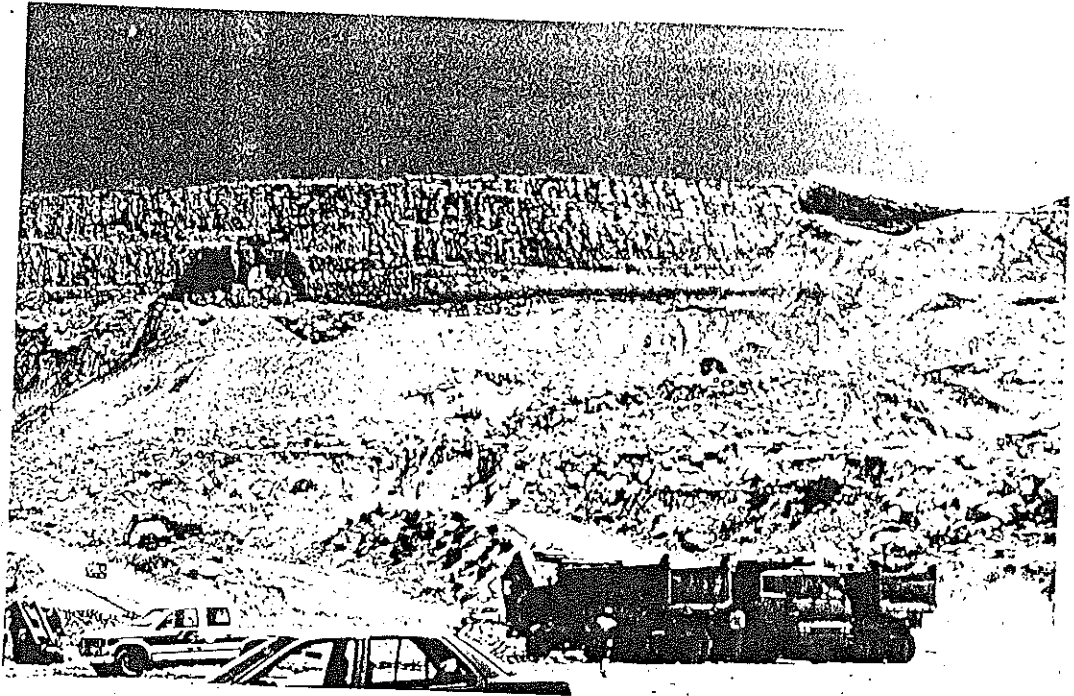


PLATE-26 : LOCATION SHOWING FROM WHERE SAMPLE OF LANDSLIDES MATERIAL

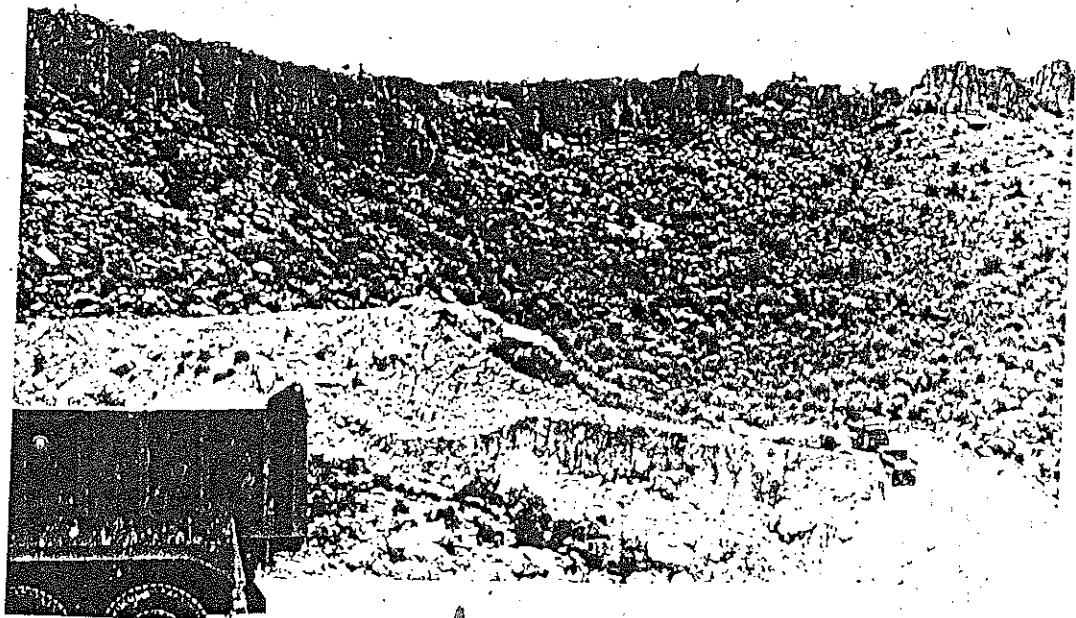


PLATE-27 : ANOTHER VIEW OF LANDSLIDES MATERIAL

## 6 : TEST RESULTS

The samples were tested in the NTRC laboratories and following results were obtained:

Table : 1 **BITUMEN CONTENT OF WEARING COURSE**

Sl. NO.	Sample No.	Sample Type	Bitumen Content Tested	Bitumen Content of Job Mix
1.	AC - I	Asphaltic Concrete ( Paver )	4.5 %	4.6 ± 0.3 %
2.	AC - II	Asphaltic Concrete ( Plant )	4.7 %	4.6 ± 0.3 %
3.	AC - III	Asphaltic Concrete ( Core )	4.5 %	4.6 ± 0.3 %

Table : 2 **GRADATION OF WEARING COURSE TESTED IN NTRC LABS.**

Sl. No.	Sample No.	Sieve Sizes ( mm )						
		19.0	12.5	9.5	4.75	2.36	.300	.075
		Passing %						
1.	AC - I	100	86	65	51	32	12	6
2.	AC - II	100	84	65	51	31	9	6
3.	AC - III	100	83	73	54	35	12	5

Table : 3 **GRADATION REQUIREMENTS OF JOB MIX**

Sl. No.	Sieve Sizes (mm)	Limit % Passing
1.	19.0	100
2.	12.5	75-87
3.	9.50	64-76
4.	4.75	45-57
5.	2.36	29-37
6.	0.300	6-14
7.	0.075	3-6

Table : 4 **BITUMEN PROPERTIES**

Sl. No.	Sample No.	Penetration Grade Tested (mm)	Softening Point Tested (C°)	Specified Penetration Grade (mm)
1.	B-1	67	41	60-70

## 7 : ANALYSIS OF RESULTS

- i) The bitumen content tested in all the three samples of asphaltic concrete wearing course was found according to specification. The bitumen content in the wearing course was found to vary between 4.5% to 4.7% where as the bitumen content as per the job mix formula was  $4.6 \pm 0.3\%$ .
- ii) The gradation of the material used in wearing course was as per the job mix formula and within the tolerance limits. Table-2 shows the gradation of the material tested in NTRC laboratories, while Table-3 shows the gradation requirements in the job mix formula. Table-2 and Table-3 show that the material passing on various sieve sizes is within the limits of mix requirements.
- iii) Properties of bitumen used such as penetration grade and softening point were found to be according to the specifications. Table-4 shows the properties of bitumen used in the wearing course of the Motorway.



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COMPOSITION OF NTRC TEAM

- |    |                                    |             |
|----|------------------------------------|-------------|
| 1. | Mr M. Sadiq Swati, Senior Chief    | Team Leader |
| 2. | Mr Bashir Ahmad, Deputy Chief      | Member      |
| 3. | Mr Muhammad Naeem, Assistant Chief | Member      |
| 4. | Mr Hameed Akhtar, Research Officer | Member      |
| 5. | Mr Khizer Javaid, Research Officer | Member      |
| 6. | Mr Mazher Hussain, Lab. Technician |             |
| 7. | Mr Ijaz Javaid, Lab. Technician    |             |