NATIONAL TRANSPORT RESEARCH CENTRE

GOVERNMENT OF PAKISTAN

MINISTRY OF COMMUNICATIONS

LABORATORY TESTING OF KASHMIR HIGHWAY

(Zero Point – Aabpara Section)

2-33

NTRC – 187

MAY, 1996

NATIONAL TRANSPORT RESEARCH CENTRE

MINISTRY OF COMMUNICATIONS

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LABORATORY TESTING OF KASHMIR HIGHWAY (ZERO POINT - AABPARA SECTION)

May, 1996

FOREWARD

NTRC examined the possible cause(s) of premature failure of Kashmir Highway through field visits, in-situ and laboratory testing of materials.

The study was carried out by a team of engineers, under the esteem leadership of Mr. Sadiq Swati, Senior Chief, NTRC. The team members were:

1) Mr. Bashir Ahmed, Deputy Chief
2) Mr. Tahir Sharif, Deputy Chief
3) Mr. Mohammad Naeem, Assistant Chief
4) Mr. Hameed Akhtar, Research Officer
5) Mr. Khizar Javed, Research Officer

The study benefited greatly from discussions and valuable contribution from a number of individuals from the Capital Development Authority (CDA), Islamabad.

I wish to convey my sincere thanks to all those who were assisted in carrying out the study.

BASHIR AHMED
Deputy Chief

last its design life the failure is termed as premature failure of the pavement. Unfortunately, this is the case in our country where most of the pavements fail prematurely resulting in loss of billions of rupees to the national exchequer.

2. SCOPE OF THE STUDY

The scope of this study is to find out the possible causes of the premature failure of the Kashmir Highway, controlled by Capital Development Authority, CDA, Islamabad which provides a very important link offtaking from National Highway (N-5) near Cocacola factory and joining Murree road at Dhokri.

3. METHODOLOGY

The methodology adopted in this study to find out the possible causes of the premature failure of the Kashmir Highway is consisted of the following steps:-

i) Background of the section.

ii) Field data collection and insitu testing.

iii) Laboratory testing of materials.

iv) Analysis of the data.

v) Results and the recommendations for future.

4. BACKGROUND OF THE SECTION

About 1 1/2 years ago, due to the rehabilitation of IJP road, the CDA diverted the traffic of the National Highway (N-5) to the Kashmir Highway. The Zero Point - Aabpara section which was probably not designed for the heavy loads could not cope with the heavy traffic of N-5 and failed within six months. The section was again redesigned which consisted of 12 inches of crushed stone base and 6 cm of asphaltic binder over which 5 cm of asphaltic wearing course.

The rehabilitation work was completed in December, 1995 by M/S Karcoon Private Ltd. The road was than opened to traffic. Soon after becoming operational, the pavement surface started showing signs of distress such at many places, in the form of alligator cracking in the asphaltic concrete layers. As a result of which the road section was again closed and the road section is still closed for traffic.

Various tests were carried out by the Central Engineering Laboratory of CDA to determine the probable causes of road failure. Consultants namely M/S SAMPAK Lahore was also invited to investigate the causes and to recommend the adequate design of the pavement and side drain.

5. FIELD DATA COLLECTION

For the collection of the field data following surveyes were performed:-

i) Visual inspection of the pavement.

ii) Determination of field density and in-situ CBR of the various pavement layers.

iii) Material samples collection for each layer of pavement for laboratory testings.

5.1 VISUAL INSPECTION

The physical condition survey of the scrapped existing pavement was carried out visualy by a team of NTRC Engineers. During the visual inspection, it is observed that Asphaltic concrete layer of the pavement has already been scarified from the surface. Figures 5.1.1 to 5.1.3 shows heaps of asphaltic layer (binder and wearing courses) removed from the surface and dumped at various locations. Due to removal of the asphaltic layer through bulldozers, the base course layer has been loosened to a certain depth. This is clearly visible from the fig 5.1.4 and fig 5.1.5 However, few inches blow the surface, the base course was fully intact.The sub-base layer was found in undisturbed condition.

Side drains on both sides run along the full road section. However, the condition of the drains were found very poor, due to improper maintenance. Although the drains were constructed of stone masonary, the geometry of the section has been totally deshaped and has become irregular and the drain was found choked at most of the locations. But on the testing day by the NTRC staff, it was found being cleared off vegetation & deposited material by the CDA staff. Fig 5.1.6 shows the position of the drain. Fig 5.1.7 shows the drain being cleared by CDA staff, while Fig.5.1.8 shows the chocked drain on the left side of the road.

Fig. 5.1.1 Heap of Asphaltic binder and wearing course layers after removal by the bulldozer.

Fig. 5.1.2 Another site showing heap of asphaltic material

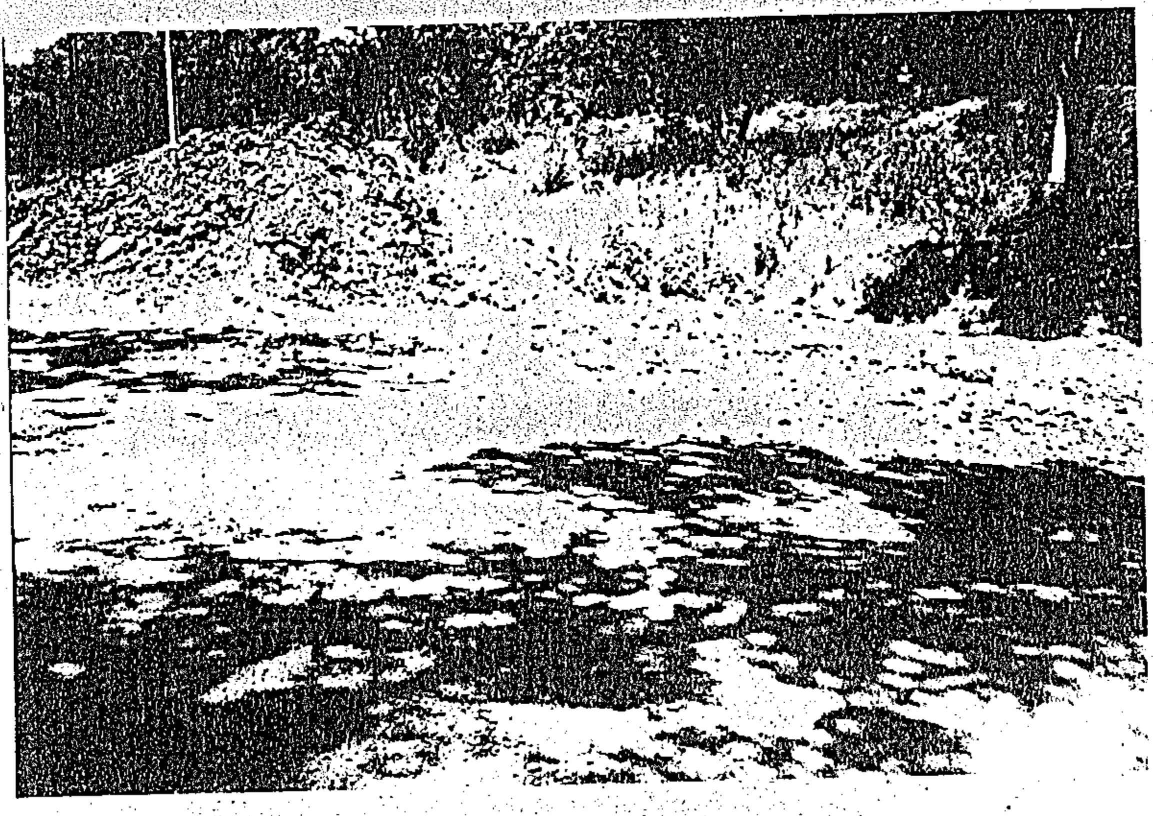

Fig. 5.1.3 Another place showing heaps of asphaltic layers.

Fig. 5.1.4 At some locations, top of the base course layer has lost to some depth

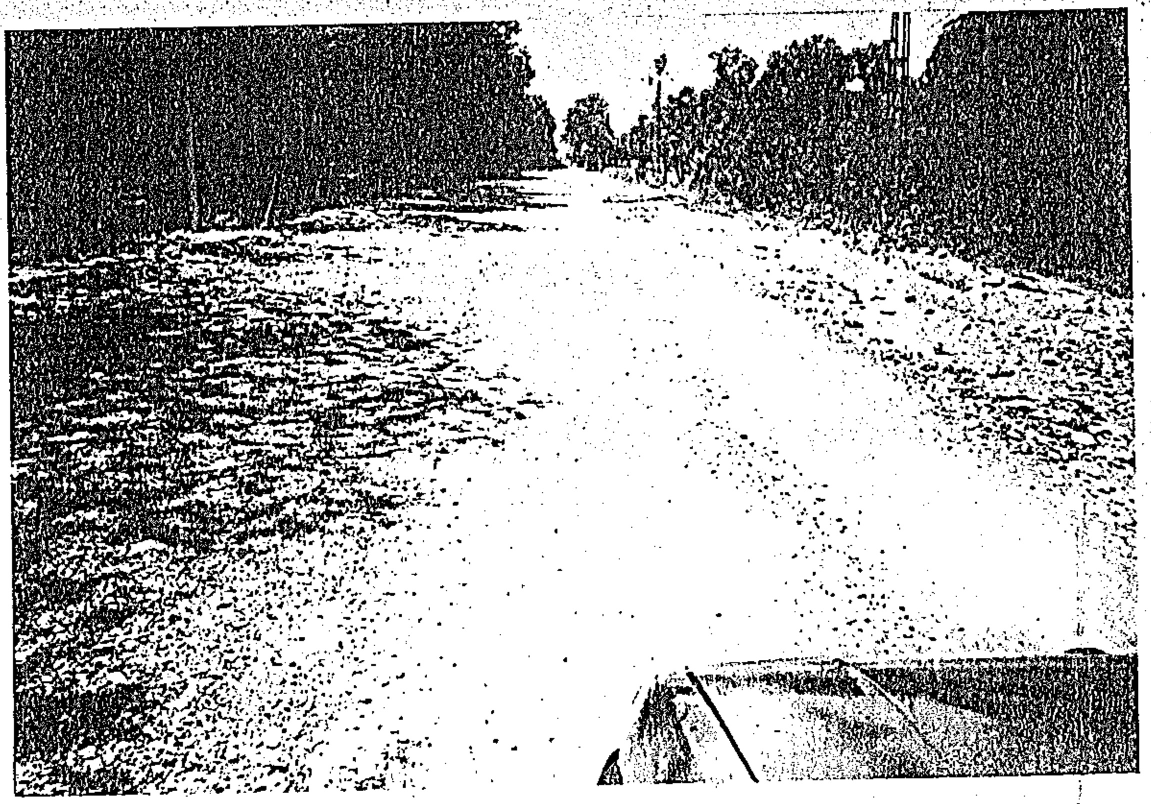

Fig. 5.1.5 Existing condition of the road surface after removal of Asphaltic Concrete surface.

Fig. 5.1.6 Irregular shape and not properly maintained drain, filled with vegetation

Fig. 5.1.7 Site drain was cleaning on the day of testing

Fig. 5.1.8 Site drain on the left side of the road found chocked.

5.2 FIELD TESTING

After visual inspection, it was decided to divide the section of the Highway from Aabpara to Zero Point, a three kilometer stretch, into three equal sections. To carry out field tests and obtain samples for the sub-grade, sub-base and base course materials, three open test pits were excavated, two pits were dug under the wheel paths and one at the centre of the road. Fig 5.2.1 and Fig 5.2.2 shows the pits excavated at site.

The following tests were carried out at site:-

a) Dynamic cone penetration (DCP) test to deterimine in-situ CBR of subgrade.

b) Field density test using sand replacement method of the subgrade material.

c) Representative materials samples collection for each layer of pavement for laboratory testing.

5.2.1 THE DYNAMIC CONE PENETROMETER: The components and assembly of the instrument is illustrated in figure A-1 at appendix-1. Operation requires three technicians. One man holds the handle at the top, while the second raises the weight to its full extent (without actually touching the top of the handle) and alows it to drop. The third man records penetration readings in millimetres on the staff. Readings ae normally made after every fifth blow of the hammer.

5.2.2 INTREPRETATION OF RESULTS: Field results of each test are recorded in milimetres of penetration after every 5 blows of the following weight. Interpretation of results is as follows:-

a) A plot is made of penetration against cumulative blows.
b) A series of straight lines are drawn through the points on the graph. Each straight line identifies a homogenous pavement layer.
c) For each layer the thickness (in mm) and the DCP No (in mm/blow) is extracted.

By field testing, a calibration can be made between DCP strength and in-situ California Bearing Ration (CBR).

5.2.3 APPLICATION OF DCP TO THE STUDY: The road examined in this study had a base-course layer of upto 24" of crushed aggregate and sub-base layer of upto 12" of stone metal crush. Penetration of DCP through sub-base and base course layers proved slow and risked damage to the instrument. Therefore, it was decided to dig open pits of 4'x4' in size upto the top of surface of sub-grade. With the help of open pits the thicknesses of base-course and sub-base course were recorded.

Appendix 1. Fig. A-1: The dynamic cone penetration.
Appendix 1. Fig A-2. DCP results.
Appendix 1. Fig.A-3. The DCP calibration.
Appendix 1. A-4. The DCP field data shut.

5.2.4 FIELD DENSITY MEASUREMENT BY SAND CONE METHOD AS PER AASHTO T-180:

All the three locations where the open pits were excavated, the field density measurement were made as per AASHTO standards and shown in Fig.5.2.3 to 5.2.4.

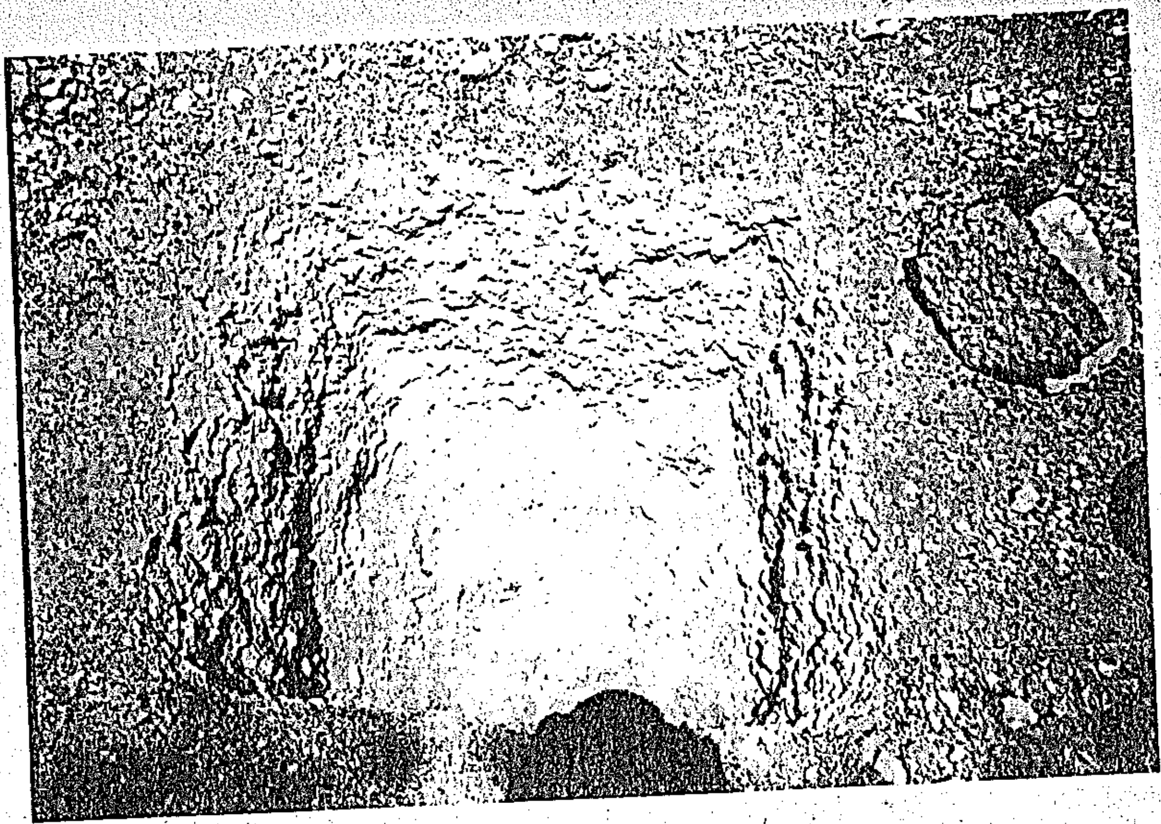

Fig. 5.2.1 Open pit No. 1 after completion of field density test by sand replacement method.

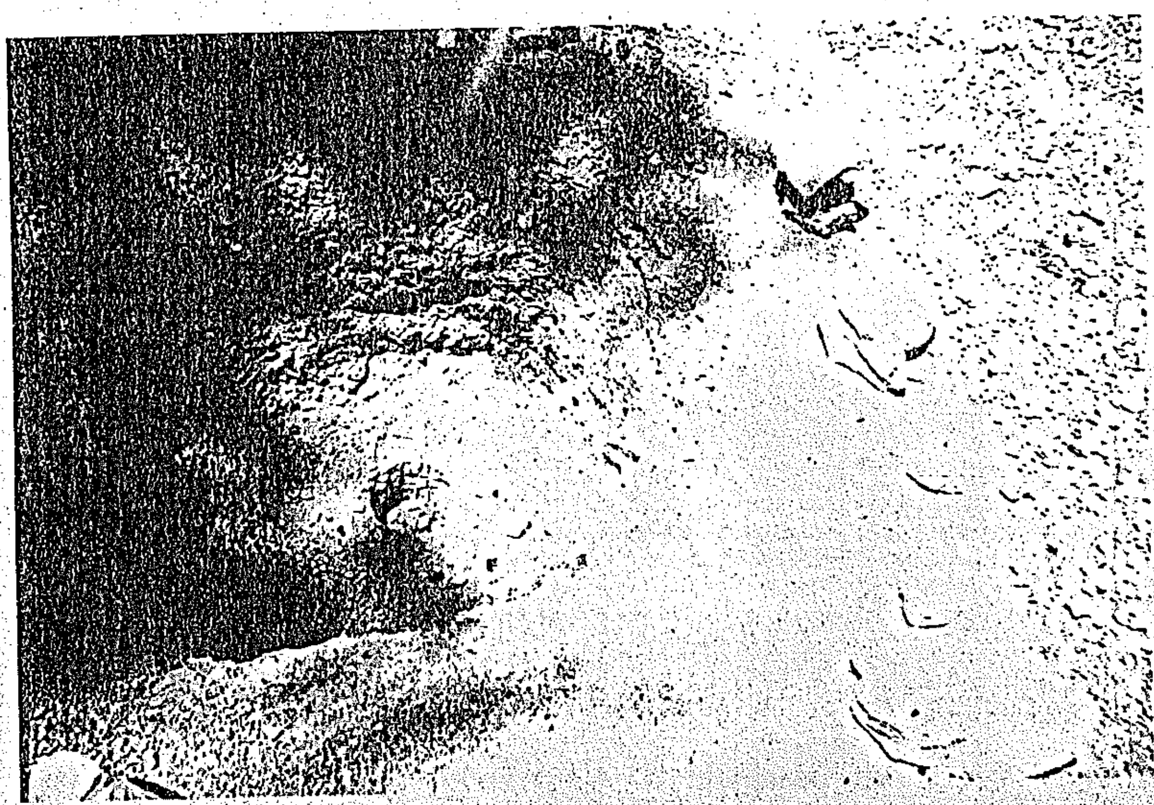

Fig. 5.2.2 Open pit No. 2 being tested by D.C.P.

Fig. 5.2.3 Open pit No. 3 being tested by D.C.P. and field density test by sand placement method

Fig. 5.2.4 Field density test of base course layer being carried out.

6. RESULTS OF TESTING

Representative of samples of materials related to all layers of the pavement were brought from the three locations and were tested according to ASTM standards in addition to the field tests. The results are placed in proceeding paras:-

6.1 SUB-GRADE

Following standard tests for the assessment of sub-grade material based on the methods described on ASTM standards specifications were conducted [2,3,4]

i) Determination of moisture content of soil as per ASTM D2216-80. Vol.04.08.

ii) Sieve analysis of fine aggregate as per, ASTM C136-84 of volume.04.02.

iii) Liquid limit, plastic limit and plasticity index of soil as per ASTM D4318-84 of Vol.04.08.

iv) Moisture-density relations of soils as per ASTM D698-78 of Vol.04.08.

v) California bearing ratio of laboratory compacted soils as per ASTM D1883-87 of Vol.04.08.

vi) Results of in-situ CBR by DCP tests.

vii) Field density measurement results by sand cone method.

The results are placed in table 6.1.1 to 6.1.3.

TABLE-6.1.1 In-situ CBR of soil by DCP tests

S.No	Location	In-situ CBR of soil(%)
1.	Opposite Khan Autos	18
2.	Opposite Adventure Inn	20
3.	Opposite Printing Corp.	17

TABLE 6.1.2 Field density of sub-grade soil by sand cone method.

S.No	Location	Field density in lb/cft.	Degree of comp(%)
1.	Opposite Khan Autos	113	97
2.	Opposite Adventure Inn	118	98
3.	Opposite Printing Corp	112	97

TABLE 6.1.3 laboratory testing results of sub-grade Soil

					GR	ADA	TION		
Location	OMC	MDD	MC	CBR	Gra	Sand	Silt	L.L	P.L
	%	l/cft	%	%	%	%	%		
Opp.Khan Autos	12	116	13	15	2	10	88	39	17
Opp.Adv.inn Hot	11	122	14	14	2	11	87	36	18
Opp.Print Corp	08	115	14	16	0	12	88	31	16

* The sub-grade soil is classified as A-6.

6.2 SUB-BASE COURSE

The tests that were conducted on the sub-base course material are:-

i) Moisture content determination as per ASTM D2216-80

ii) Gradation of material as per ASTM C136-84

iii) Moisture-density relationship as per ASTM D698-78

iv) CBR (96 hours soacked) as per ASTM D1883-87

The results obtained are placed table 6.2.

TABLE 6.2 Testing results of Sub-base materials

Location	OMC	MDD	MC	CBR	GRAV	SAND	SILT or CLAY
	%	lb/cft	%	%	%	%	%
Opp.Khan Auto	3.0	144	6.0	30	50	20	30
Opp.Adv.Inn Hot	3.0	150	6.5	35	52	20	28
Opp.Print.Corp	2.8	148	6.5	32	55	18	27

6.3 BASE-COURSE

The tests were conducted on the base course material are:-

i) Moisture content determination as per ASTM.
ii) Gradation of base course material as per ASTM
iii) Moisture density relations as per ASTM
iv) CBR determination as per ASTM (4 days socked)

Results obtain are placed at table 6.3.

TABLE 6.3 Testing results of base course materials

Location	OMC	MDD	MC	CBR	GRAV	SAND	SILT or CLAY
	%	lb/cft	%	%	%	%	%
Opp.Khan Auto	2.5	147	6.0	96	43	37	20
Opp.Adv.Inn Hot	3.0	150	6.5	95	42	39	19
Opp.Print-Corp	2.8	152	6.5	94	45	38	17

6.4 ASPHALTIC LAYERS

Tests conducted on the asphaltic layers i.e. binder course and wearing course are as follows:-

i) Bulk specific gravity and density determination of compacted bituminous mixture using saturated surface dry specimens as per ASTM D2726-89 of Vol.04.03.

ii) Quantitative extraction of bitumen from bituminous paving mixtures as per ASTM D2172-88 of Vol.04.03.

Results are placed at table 6.4.1 and table 6.4.2.

TABLE 6.4.1 Testing Results of Asphaltic Layers

Location	Sample Type	Thickness Cms	Sp.Gravity	% Bitumen By Mix
Opp.Khan Aut .	Wearing Co.	5.90	2.18	4.51
Opp.Adv.Inn	Wearing Co.	6.37	2.19	4.46
"	Binder Co.	5.54	2.18	4.30
Opp.Print.Co	Wearing Co.	6.11	2.23	4.35
"	Binder Co.	5.62	2.21	4.13

TABLE 6.4.2 Testing Results of Asphaltic Layers

		GRAD	ATION	PER	CENT	AG	E	PAS	SIN	G	
Location	Samp Type	1 "	3/4"	1/2"	3/8"	#4	#6	#16	#30	#50	#200
Opp.Khan Auto	Wearing Cr.	100	98	88	79	55	47	23	15	10	5
Opp.Adv.Inn Hotel	Wearing Cr.	100	98	90	76	58	49	24	16	11	5
"	Binder Cr.	95	78	68	60	46	36	20	15	11	5
Opp.Print.Corporato	Wearing Cr.	100	93	78	71	47	35	22	14	8	4
"	Binder Cr.	98	82	69	56	34	28	19	16	15	5

7. ANALYSIS OF RESULTS

7.1 Sub-grade soil

7.1.1 Moisture content: The field moisture content of the sub-grade soil at the three pits ranged from 2% - 12%. The OMC for the sub-grade at the three locations has been determined in the range of 12% - 14%. As such, the field moisture content is about or less than Optimum Moisture Content (OMC). However, it is pertinent to note that after the pavement failure asphaltic layer has been removed through in-situ M.C. of the various layers including subgrade has decreased considerably from the time when the road was intact. The opening of the layers to environment has caused the layers to dry up. The pavement field moisture content do not confirm to report the actual conditions at the time of failure of the road. But, at present, for us, it is not possible to determine the actual moisture content at the time of construction of road.

7.1.2 Field Density: The field density using sand replacement method reveals at the three locations to range from 112 - 118 lbs/ft3. The compaction requirements for the subgrade is 95% of the modified AASHTO test. The tests result at the three locations reveals the degree of compaction to be more than the 95% of modified AASHTO test. As such, the pavement subgrade campaction fulfils the requirement of the specified criteria of campaction.

The Atterberg limits of the subgrade soil were also determined. The soil was found plastic to be of nature.

The strength of the subgrade soil was also determined using DCP and methods and it was observed to be good subgrade material.

7.2 SUB-BASE LAYER:

The thickness of the sub-base layer was checked at all the three test pits and was found to be more than 12 inches, which was the design requirement.

The strength test of the material in the laboratory in terms of CBR value on the sub-base materials was found in the range 30 -35. The required value of CBR for sub-base material is 30% . The sampled material thus fulfills designed requirement.

The gradation of the sub-base material was also checked and was found to conform the specified range.

7.3 BASE COURSE LAYER:

The base course layer thickness was recorded at all the open pits and was found to be more than 24 inches which was according to the design requirement.

The strength of the base course layer was found to range between 94% to 96% in terms of CBR value which is higher than the design requirement of 80% for the base course layer.

The gradation of the base course layer was also determined by carrying out sieve analysis. The measurements reveal that the material falls within the AASHTO specified range.

7.4 ASPHALTIC CONCRETE:

The asphaltic layers were completely scarified from the base course and were found in heaps at site as may be see in photographs Fig. 5.1.1 to Fig.5.1.3

The asphaltic layer samples were collected from these heaps and were brought to laboratory. The binder layer and the wearing course layer were separated by cutting under saw in the laboratory.

The thickness of the binder course was found to be 2.5 inch while that of wearing course was found 2.0 inch. Due to scarification, the representative samples giving the actual thickness of asphaltic layer could not be collected. However the thicknesses measured from the scarified samples were found according to the design thicknessness. Extraction tests were also carried out on the sawed samples. The results reveal the bitumen content to fall within the job mix formula. The gradation of the aggregate material was also found within the specified range.

8. CONCLUSIONS

Unfortunately, most of our roads fail prematurely resulting in loss of billion of rupees. Various factors attributed to the present conditions are, lack of quality control, use of substandard materials, lack of technical knowhow, inefficient execution, non provision of drainage, heavy axle loads and extreme weather conditions, and poor maintenance. The case study road failed soon after its opening to traffic causing loss of million of rupees. However before drawing the conclusions, the most important aspect to be kept in mind is that the existing site conditions do not simulate/represent original conditions that existed when the road was constructed and when it was opened to traffic.

Following conclusions can be drawn from the study:

a) The bottom of the side drain was considerably less than 1.5 meter below the formation level required for efficient and safe discharge.

b) The shoulders of the road section along most of its length were constructed with reverse slope to the pavement. This resulted in water creeping under the wearing surface and consequent stripping of the pavement layers.

c) In Pakistan, soacked CBR is normally used as a criteria for designing of pavements. The test is an outdated one and has its limitations. Designing of pavement on the basis of soaked CBR value does not guarantee that the pavement would not fail under repeated heavy axle loadings once the subgrade becomes saturated due to poor drainage condition or rising of water table.

d) There was a total lack of maintenance of the section. The side drains were found choked with vegetation.

9. RECOMMENDATIONS

One of the most important aspect of highway design is the necessity for providing adequate drainage. Adequate and economical drainage is absolutely essential for the protection of the investment made in a highway structure and for safeguarding the lives of the road users. Unfortunately, this important aspect is not properly taken care off in most of our road construction projects resulting in premature failure of roads. Measures taken to control the surface water are generally termed "surface drainage" while those dealing with ground water in its various forms are called sub surface drainage.

The portions of the highway structure that provide surface drainage in rural roads include the road crown, shoulder and side slopes, longitudnal ditches, culvet and bridges.

On study site, the conditions of these portions of highway structure were found far from satisfactory. All drainage structures and appurtenances have to be kept in good working condition so as to provide free and unobstructed flow. Maintenance operations must be adequate enough to keep the ditches and culverts clean all the time. Those roads, that lack these operations normally meet the gate of failure. Conditions at the times of heavy rains and high water will give the best indication of the ability of drainage system to perform its functions properly without damage. Unfortunately this did not happen on Kashmir Highway.

REFERENCES

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[3] AMERICAN SOCIETY FOR TESTING AND MATERIALS.(1990) Annual Book of ASTM Standards Vol.04.02, Philadalphia.

[4] AMERICAN SOCIETY FOR TESTING AND MATERIALS.(1990) Annual Book of ASTM Standards Vol.04.03, Philadalphia.

APPENDIX - A

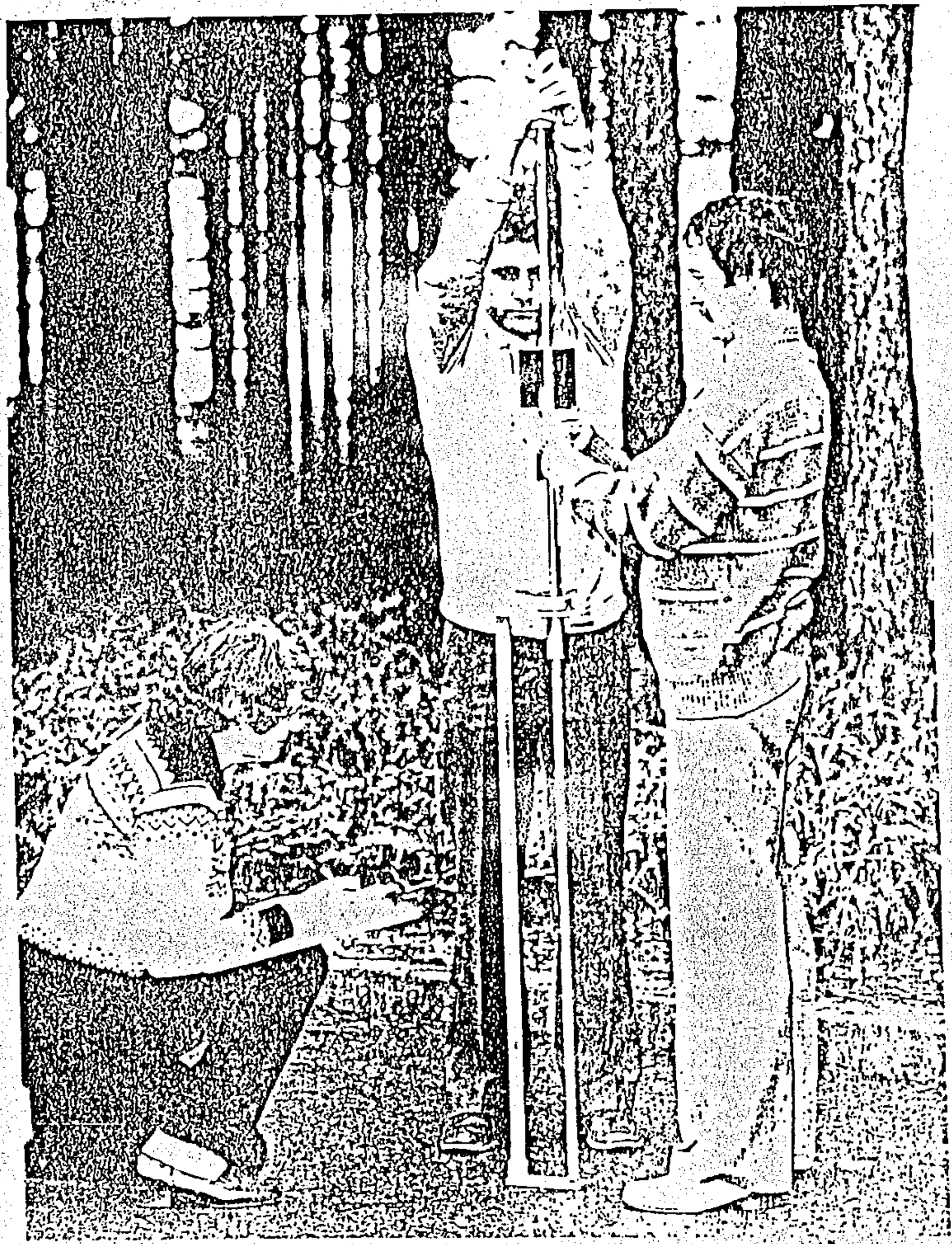

Plate 1 DCP in operation

DCP - TEST

SITE/ROAD: KENANA, SUDAN DATE: [illegible]

TEST NO: 6

SECTION NO/CHAINAGE: 2/48 ZERO READING OF DCP: 60 mm

DIRECTION: SOUTH STARTED TEST AT: TOP OF BITUMINOUS SURFACING

WHEEL PATH: VERGE SIDE

No. Blows	Σ Blows	mm	No Blows	Σ Blows	mm	No Blows	Σ Blows	mm
0	0	63	5	160	408	1	186	824
10	10	75	5	165	434			
10	20	89	3	168	457			
10	30	99	1	169	466			
10	40	118	1	170	477			
10	50	130	1	171	491			
10	60	149	1	172	513			
10	70	166	1	173	539			
10	80	181	1	174	565			
10	90	204	1	175	592			
10	100	215	1	176	620			
10	110	230	1	177	647			
10	120	253	1	178	664			
5	125	269	1	179	686			
5	130	289	1	180	705			
5	135	307	1	181	724			
5	140	326	1	182	744			
5	145	347	1	183	764			
5	150	364	1	184	784			
5	155	385	1	185	804			

Figure 3 DCP Test Field Sheet

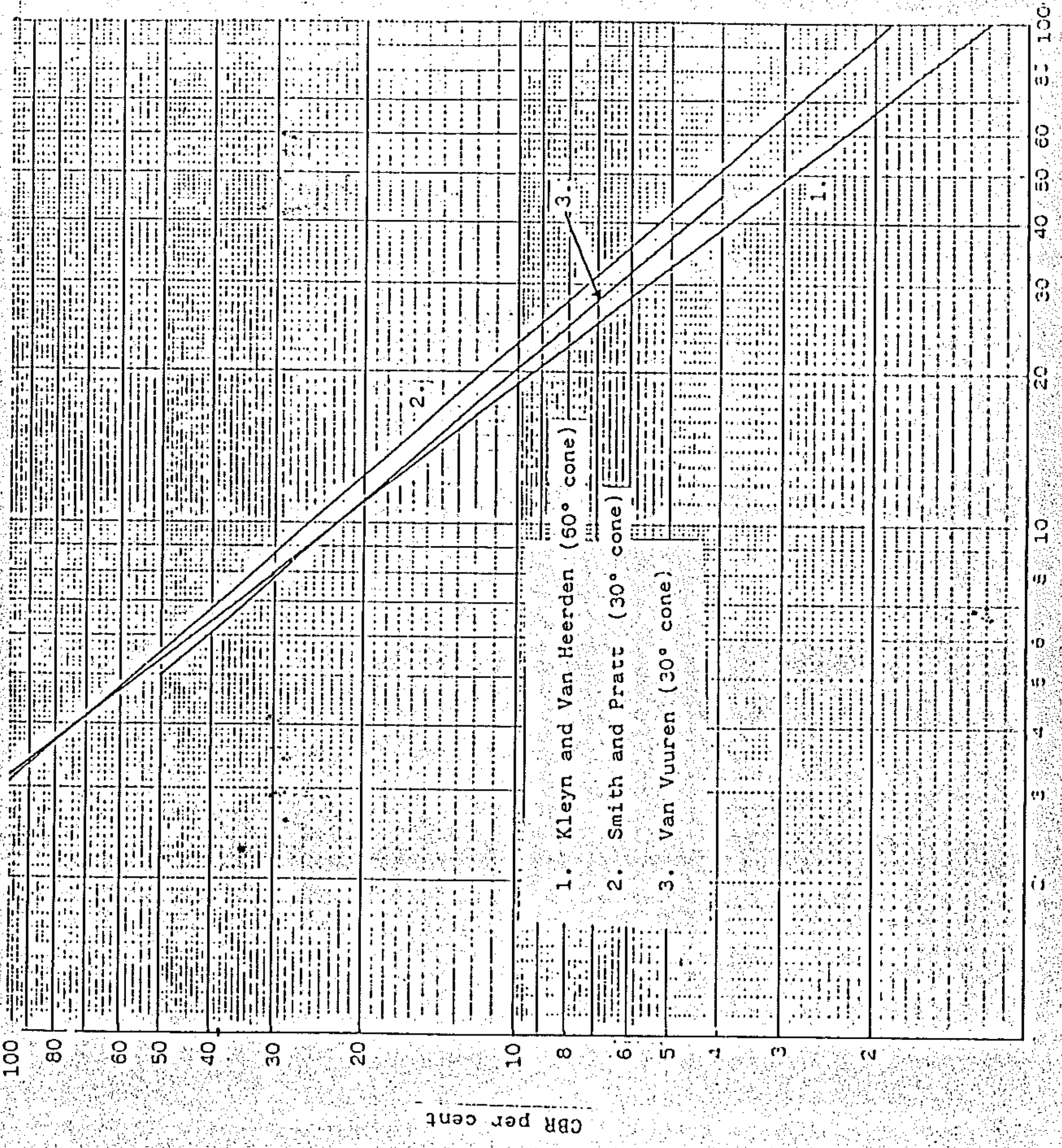

Figure 5 DCP - CBR RELATIONSHIPS

APPENDIX - B

CAPITAL DEVELOPMENT AUTHORITY
C.E. Laboratory Directorate

T.R No. Sm/2106/95

MOISTURE CONTENT TEST

Location: Kashmir Highway point-I infront of Fire-brigade

Sample No	RD	Depth (ct)	Description	Moisture content %
102	Point-I	0-1	Silty clay	16.2
103	"	1-2	"	14.6
104	"	2-3	"	15.6
105	"	3-4	"	15.0
106	"	4-5	"	14.9
107	"	5-6	"	15.6
108	"	6-7	"	18.7
109	"	7-8	"	14.8

28/9/95

(NAZID BAIG BALOCH)
Deputy Director (Materials), CEL

CAPITAL DEVELOPMENT AUTHORITY

CENTRAL ENGINEERING LABORATORY

Location Carpetting of Kashmir High Way.(Shakar Parian Loop to Jasmin Garden Road-by-M/S.Karcon (Pvt)LTD.

Technical Report No. BN/ 1597/59/96 (Binder & Wearing Courses).

Sr. No.	Sample No.	Date of Casting	Date of Testing	Bulk Specific Gravity	Stability in lbs.	Flow 1/100"	Remarks
1	BN/477	26.12.95.	23.1.95.	2.382	2410	11	(Binder Course).
2				2.367	2220	10	
3				2.349	2230	8	
AV				2.366	2230	10	
	BN/478	-"-	-"-	2.354	2130	9	
				2.322	2000	8	
				2.327	2010	8	
AV				2.334	2047	8	
	BN/479	27.12.95.	-"-	2.386	2520	12	
				2.373	2490	12	
				2.366	2360	11	
AV				2.375	2457	12	
	BN/480	-"-	-"-	2.344	2100	9	
				2.326	2010	8	
				2.331	2070	8	
AV				2.334	2060	8	
	BN/481	28.12.95.	-"-	2.327	1990	8	
				2.339	2050	8	
				2.348	2130	9	
AV				2.338	2057	8	
	BN/482	-"-	-"-	2.340	2160	9	
				2.317	1900	8	
				2.323	2030	8	
AV				2.327	2030	8	
	BN/483	31.12.95.	-"-	2.386	2470	12	(Wearing Course).
				2.347	2110	9	
				2.369	2310	11	
AV				2.367	2297	10	
	BN/484	-"-	-"-	2.351	2220	10	
				2.346	2160	9	
				2.342	2130	9	
AV				2.346	2170	9	

Required Stability = 1800 Lbs.min.
Required Flow = (8-16).

Signature
(MANZOOR HUSSAIN RAJA)
Research Officer
Central Engineering Laboratory CDA
ISLAMABAD

PCPPI—1343(94) C.D.A.—26-2-94—2,000.

Continued on page-2

CAPITAL DEVELOPMENT AUTHORITY
Central Engg: Laboratory

CAPITAL DEVELOPMENT AUTHORITY
CENTRAL ENGINEERING LABORATORY
ISLAMABAD.

I

[illegible]

EXTRACTION OF ASPHALTIC CONCRETE CORES FROM KASHMIR HIGH WAY FROM ZERO POINT TO [illegible] PARA BY M/S.[illegible] (PVT) LTD.

S. No.	Core No.	Sample No.	Location.	Off-set.	Fild density of core in PCF.	Lab.Density in PCF.	% Compaction	Required compaction.(%)
1.	1	EN/453	Infront of Darbar.	Rt.lane, 4' from CL.	141	143	[illegible]	[illegible]
[illegible]	2	EN/454	RD.6827	Rt.lane, 5' from CL.	141	"	[illegible]	"
[illegible]	3	EN/455	RD.5581.50	Rt.lane, 5' from CL.	142	"	[illegible]	"
[illegible]	4	EN/456	RD.4411	Rt.lane, 5' from CL.	140	"	[illegible]	"
[illegible]	5	EN/457	RD.2420,	~~Lt~~ Rt.Lane, 5' from CL.	149	"	101	"
[illegible]	6	EN/458	"	Lt.lane, 5' from CL.	149	"	101	"

[illegible]
Research Officer
[illegible] Lab: CDA,
Islamabad.
14/3/86

road pavement has shown distresses in the form of [illegible]

KASHMIR HIGHWAY ISLAMABAD.

V

MOST URGENT

S. No.	Location. R.D.	Pavement component.	Moisture content of insitu material.	Relative compaction.	Remarks.
1.	In between 4057-4174 (North side)	Sub grade	14.1 %	97.1 %	
2.	"	Sub Base	6.6 %	-	Damage portion.
	"	Base Course.	7.5 %	-	"
3.	3900	Sub grade	19.5 %	-	"
	"	Sub Base	5.3 %	-	"
	"	Base Course	[illegible]	-	"
4.	Electric pool 3039 North side.	Base Course	8.1 %	-	"
	"	Sub Grade	14.7 %	-	"
	"	Sub Base.	11.1 %	97.8 %	"
5.	6700 South side	Base Course	5.6 %	-	Damage portion. A water [illegible] line is running approx 3' [illegible] the road surface.
	"	Sub grade	21.9 %	101.2 %	"
		Sub Base	4.5 %	81.9 %	"
		Base course.	4.5 %	-	(P.I. of Sub base & Base course material + 9.6)
6.	East side of Ziarat.	Sub grade	3.3 %	* 99 %	Intact portion un effective.
	"	Sub Base.	4.2 %	95 %	SSDXX "
		Base Course	2.9 %	-	Damage portion.
7.	Infront of Chair man office.	Sub gravel.	10.4 %	99.9 %	"
				103.2 %	"
					Damage portion.

14/5/86

D/Research Officer(Pave) [illegible]

cores were also extracted and checked for density and percent compaction which are quite satisfactory. This confirms that workmanship during construction was perfectly [illegible]

CAPITAL DEVELOPMENT AUTHORITY
CENTRAL ENGINEERING LABORATORY
ISLAMABAD.

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Technical Report No. BN/1597/59/96.

ROUTION EXTRACTION TESTS CONDUCTED ON PREMIX SAMPLES COLLECTED FROM CARPETTING OF KASHMIR HIGH WAY DURING EXECUTION OF WORK.

S. No.	Sample No.	Date of:- Collection.	Testing.	Description.	% Asphalt content. Actual.	Specified.	Sieve Analysis, % Passing by weight. 1½"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 50	No. 200
1.	BN/485	26.12.95.	28.12.95.	Binder Course.	4.46	4.2	100	98.8	-	68.9	-	43.1	32.4	7.6	3.[illegible]
2.	BN/486	31.12.95.	1.1.96.	Wearing Course.	4.65	4.4	-	100	95.7	-	71.9	47.6	34.1	9.9	3.1
Specifications for Binder Course.							100	90/100	[illegible]	60/80	-	25/60	15/45	3/18	1/7
Specifications for Wearing Course.							-	100	90/100	-	60/80	35/65	20/50	3/20	1/8

POST TESTING AFTER APPEARING CRACKS ON THE ROAD.

S. No.	Sample No.	Description.	% Asphalt content. Actual.	Specified.	Sieve Analysis, % Passing by weight. 1½"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 50	No. 200
1.	BN/487	Binder Course.	4.6	4.2	100	100	-	68.4	[illegible]	44.2	32.3	14.0	6.7
2.	BN/488	Wearing Course.	4.73	4.4	-	100	99.2	[illegible]	75.3	52.1	38.2	13.3	5.3
Specifications for Binder Course.					100	90/100	-	60/80	-	25/60	15/45	3/18	1/7
Specifications for Wearing Course.					-	100	90/100	-	60/80	35/65	20/50	3/20	1/8

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