GOVERNMENT OF PAKISTAN
COMMUNICATIONS DIVISION
NATIONAL TRANSPORT RESEARCH CENTRE

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QUALITY CHECKING OF SECTION-1 OF PESHAWAR – ISLAMABAD MOTORWAY (M-1)

NTRC-229

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November, 2000

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EXECUTIVE SUMMARY

The quality and durability of our highways, roads and streets has always been a major concern to the users. One such concern was shown on the appearance of news in a local newspaper related to the poor quality of work in the construction of Section-1 of Peshawar - Islamabad Motorway (M-1).

The Peshawar - Islamabad Motorway (M-1) has a total length of 151.78 Km. In 1998 M/s bayindir a Turkish firm was awarded the contract as a contractor. The total cost of the project has been worked out to be Rs. 27588 million. This motorway was initially six lanes divided carriage way, however due to economic constraint it has now been reduced to four lanes with all the structures and formation width for six lanes.

Supervision of work has been awarded to a consortium of Firms called Pakistan Motorway Consultants (PMC). Consisting of a lead consultant M/s Engineering Consultants International (Pvt) Ltd. and association of consultants including M/s Engineering Associates, M/s Snowy Mountains Engineering Corporation (SMEC), M/s A.A. Associates and M/s Louis Berger International Incorporation.

National Transport Research Centre on the request of ministry of Communications carried out necessary investigation based on performing actual filed and Laboratory tests on pavement materials.

The scope of investigation covered Section-1 of Islamabad - Peshawar Motorway (M-1) and include the following steps:

- Reconnaissance Survey of Section-1 of M-1.
- Quality Control Assessment.
  - Field observations, testing and materials sampling.
  - Laboratory testing and analysis of samples.
- Report writing

Various field and Laboratory tests were conducted on the sub-grade, aggregate & asphaltic base course and concrete materials obtained from the locations in question. These tests were performed strictly in accordance with the standard specifications setforth in the AASHTO Manuals. The brief summary of the results is as follows:-

i) Sub-grade materials sampled from two different location were found to be A-4 as per AASHTO classification with the plasticity index of 9. Field density test result at station 20+784 falls 2 percent below the minimum required percent compaction.

ii) In-site CBR values obtained on the sub-grade materials were far above the minimum required as specified by the NHA specification.

ii) Results of the field density and gradation tests on base course materials show that these were properly graded and compacted in compliance with the specifications.

Asphaltic base course materials cored from different locations when tested did meet the minimum specified requirement of the standard specification except sample obtained from station 33+745 to 33+900 has thickness more than the required tolerance.

v) The workmanship of is cement concrete structures rated as satisfactory. Bulging or honey combing has not been observed in constructed structures. Also the cement concrete samples tested for compressive strength by NTRC were found to be in accordance with the minimum specified requirement.

vi) The deformed steel bar sampled from contractors stockyard has been tested for yield and ultimate tensile strength and found as per specifications.

vii) Riding quality of the completed sections of asphaltic base course was independently rated as "Very good" on the average.

viii) The quality of on-site material testing laboratories and performance of the technicians observed were found to be satisfactory.

ix) The overall workmanship of different construction activities were found to be satisfactory.

It is apparent from the report findings that quality control test results in most cases do comply with the requirement and work so far done is satisfactory. It is quite evident that improving the quality of high profile road construction through Laboratory control that is not very difficult now a days. The National Transport Research Centre and many other Government agencies as well as private sector maintains a full scale laboratory and can be utilize in a better was to build better quality of road network in the country.

1. INTRODUCTION

1.1: GENERAL: The construction of motorways in Pakistan has been initiated to provide another North-South link in the country joining Karachi with Peshawar. It will also extend to Gawadar thereby connecting Baluchistan with the rest of the country (Pakistan Motorway Alignment at Annexure-A). Conforming to the international standards, the Pakistan Motorway is also a limited access highway. The first phase of Pakistan Motorway project i.e. Lahore-Islamabad Motorway (M-2) was completed in December 1997. It provides a completely uninterrupted flow of traffic allowing access and exit only at the ramps designed for this purpose.

The second phase of this project Islamabad - Peshawar Motorway (M-1) has been started in 1998. The project was first initiated in 1993 but due to certain reasons it was abandoned. In 1998 after completion of the Lahore-Islamabad Motorway (M-2) the project of M-1 was revived and M/s bayindir a Turkish firm was awarded the contract on the rates on which it had been awarded in 1993 with some escalation. The total cost of the project has been worked out to be Rs 27588 million. M/s bayindir also pledged to arrange 50% of the project cost from its own sources. This motorway was initially six lanes divided highway but due to economic constraint now it has been reduced to four lanes with all the structures and formation width for six lanes.

The quality and durability in the construction of motorways has always been a major concern to the users. This requires that the team involved in construction should have a thorough understanding of the properties of pavement materials and should put emphasis on the implementation of standards and specifications. This report deals with

the assessment of quality control of construction of section-1 of the Islamabad - Peshawar Motorway (M-1).

1.2 PROJECT DESCRIPTION M-1: The Peshawar-Islamabad Motorway (M-1) has a total length of 151.78-Km (layout plan at Annexure-A).

The salient features of the project are: -

i) Four interchanges first at Burhan, the second at Swabi, the third at Raskhai Mardan & the fourth is at Charsadda.

ii) It has three major bridges one at Haro the second at Indus & the third is at Kabul River.

iii) It has a number of flyovers and under passes to facilitate the movement of vehicular traffic & local population respectively.

The supervision of construction work has been assigned to a consortium of consultancy firms called Pakistan Motorway Consultants (PMC) consisting of the following (Organisational chart of consultants at Annexure-A) :

M/s Engineering Consultants International (Pvt.) Ltd.

M/s Engineering Associates,

M/s Snowy Mountains Engineering Corporation (SMEC),

M/s A.A. Associates,

M/s Louis Berger International Incorporation

1.3 OBJECTIVE: On the appearance of news in a local newspaper related to the lack of quality assurance on the construction of Peshawar – Islamabad Motorway M-1. Secretary ministry of communications asked

NTRC for carrying out necessary investigations and submission of a report related to the issues of construction work on section-1 (Burhan - Islamabad section) of M-1.

1.4 SCOPE OF WORK: On the instructions of senior chief NTRC a team of engineers carried the work with following scope:

- Reconnaissance survey of section-I of M-1.
- Quality Assurance Checking
  - Field observations, testing and materials sampling
  - Laboratory testing and analysis of samples.
- Report writing

2. PROGRESS OF SECTION-I OF M- 1

For the construction management the project has been divided in three sections. The section-I starts from the terminating point of Lahore-Islamabad Motorway (M-2) located near Pind Nasrala in district Rawalpindi, it has length of 64.322 Km. Section II is 43.264 km in length. While, section III is 44.194 km long. The section I is again divided in two parts. Part-I of section I is 35.568 kilometre long. While, part-II of section is 28.752 kilometre in length. Table-1 summaries the progress of section 1 of M-1 as of the October, 12, 2000.

Table-1 UPDATED PROGRESS OF WORKS FROM KM 00+000 - 36+000 of M-1.

S.No	Description	Quantity completed	%age
1.	Aggregate of Sub base + Base Course	52,487 M3	6.58
2.	Bituminous Base Course	13,687M3	10.71
3.	Structures		
	i) Culverts:	57 Nos	57.57
	ii) Underpasses	11 Nos	68.75
	iii) Bridges & Flyovers	*	50.30

3. RECONNAISSANCE SURVEY

A reconnaissance survey of section I (from station 0+00 to 36+00) of the Islamabad - Peshawar Motorway (M1) was carried out by NTRC experts on October 10, 2000. Details of the reconnaissance survey are given in the following paras: -

3.1 EARTHWORKS: At station 31+800 sub-grade being prepared was observed. The practice involved in preparation of the sub-grade was accordance with the standard methods (Photographs 1 - 4).

3.2 AGGREGATE BASE COURSE: Field density test was observed by the NTRC team, being carried out on an already prepared section of the aggregate base course. The test was conducted in compliance with the standard method (Photograph 5).

3.3 ASPHALT BASE COURSE (RIDING QUALITY): Riding quality of the asphalt base course of various sections completed with three layers were assessed in accordance with AASHTO scale of 0 to 5 with zero being the poor. An independent rating of 4.0 (very good) is given to the completed section. It is anticipated that the riding quality of the pavement will further improve after asphaltic wearing surface course will be laid (Photograph 6).

3.4 CULVERTS: Already completed culverts at various locations were visually observed and appear to be in good condition, excepts the wing walls of culvert at station 29+730 that had already been repaired for minor bulging problem. No major defects were observed in culverts at other locations (Photographs 7 - 8).

3.5 ROTARY INTERCHANGE # 3: At this location deformed steel and post tension cables in one of the girder were observed. No evidence of any bad workmanship and/or defect were found. NTRC team also visually

inspected the concreting operation in one of the cast-in-place pier at this location. The procedure adopted for placing and quality control of concrete pour were in accordance with the standard methods. All other already completed concrete structural components did not show any sign of distress and/ or defect (Photographs 9 - 14).

3.6 Burhan Bridge 1B at N-5:At this location, the team visually observed the pre-cast girders for Railway Bridge, no traces of honey combing and or bulging were found. However, some few pre-cast girders have only the conduits without post tension cables (Photographs 15 - 16).

3.7 DOTAL KHAS NALA BRIDGE: This bridge is located at station 34+137. Girders at this location were already stressed and were in good shape except one girder which has already been rejected by project consultants due to some honey combing and bulging in the concrete (Photographs 17 & 18).

3.8 FLYOVERS: Some of the already completed structural components of Flyovers at various locations between station 0+00 and 36+00 were observed and found to be in satisfactory conditions. No traces of honey containing and/or bulging of concrete were found. At km 11.971 stressing of post tension cables in one of the flyover girder was observed. The stressing operation was carried out according to the standard practice (Photograph 20).

4. QUALITY CONTROL ASSESSMENT

Exercising a proper quality control over for the construction of motorways, highways & roads is the fore most responsibility of agencies involved in the construction through out the world. Lack of such control results in serious deterioration of the pavement conditions in no time

giving rise to poor riding quality, functional and/ or structural failures to the pavement and discomfort to the road users. The quality of work completed by the contractor M/s Bayindir Construction Incorporation which was verified by the project consultants M/s Pakistan Motorway Consultants (PMC) on section-I of Islamabad - Peshawar Motorway (M-1) was assessed by the NTRC team.

Various field and Laboratory tests were carried out on sub-grade, sub-base, base course and asphaltic base course materials. These tests were performed strictly in accordance with the standard specifications set forth in the AASHTO/ ASTM Manual. In addition structures such as culverts and bridges consisting of post-tensioned girders and piers were visually observed. Freshly poured cement concrete was sampled and analysed for its quality by the NTRC team.

4.1 FILED DENSITY: Field Density Tests of various pavement layers were conducted by the NTRC team using standard sand replacement method as per AASHTO, T-191. Result of tests at different locations for various layers of work items are detailed in Table- 2.

Table- 2 Results of Field Density Tests.

S.No	Represent Test Chainage (km)	Station (km)	Layer Tested	Date	Compaction Achieved (%)	Compaction Required (%)	Remarks
1	23+830 to 23+930	23+898	Base Course	10-10-2000	100.5	100	Pass
2	23+930 to 24+050	24+000	Base Course	10-10-2000	100.5	100	Pass
3	20+700 to 20+800	20+784	Sub-grade	16-10-2000	93	95	Fail
4	20+800 to 20+900	20+850	Sub-grade	16-10-2000	95	95	Pass

Except the sub-grade at station 20+780, all other test result compliance with the requirement. The sheets showing the field density test results duly verified by the inspecting team are placed at Annexure–B.

4.2 LABORATORY DENSITY VALUES: In order to compare the values of maximum dry densities and optimum moisture contents of sub-grade and granular base materials conducted in laboratory by the project consultants. The same were also carried out in the NTRC Laboratory for which samples of sub-grade and granular materials were collected from the site and bathing / mixing plant. Both test results fall in the same range. Table-3 below presents the comparison of the two results.

Table- 3 . Comparison of Laboratory Density & Optimum Moisture content.

S.No	Represent Test Chainage	Station	Layer Tested	As per Consultants		As per NTRC	
	(km)	(km)		Density (gm/cc)	OMC %	Density (gm/cc)	OMC %
1	23+830 to 23+930	23+898	Base Course	2.351	4.2	2.336	4.5
2	23+930 to 24+050	24+000	Base Course	2.351	4.2	2.336	4.5
3	20+700 to 20+800	20+784	Sub-grade	2.166	8.1	2.157	8.5
4	20+800 to 20+900	20+850	Sub-grade	2.166	8.1	2.161	8.2

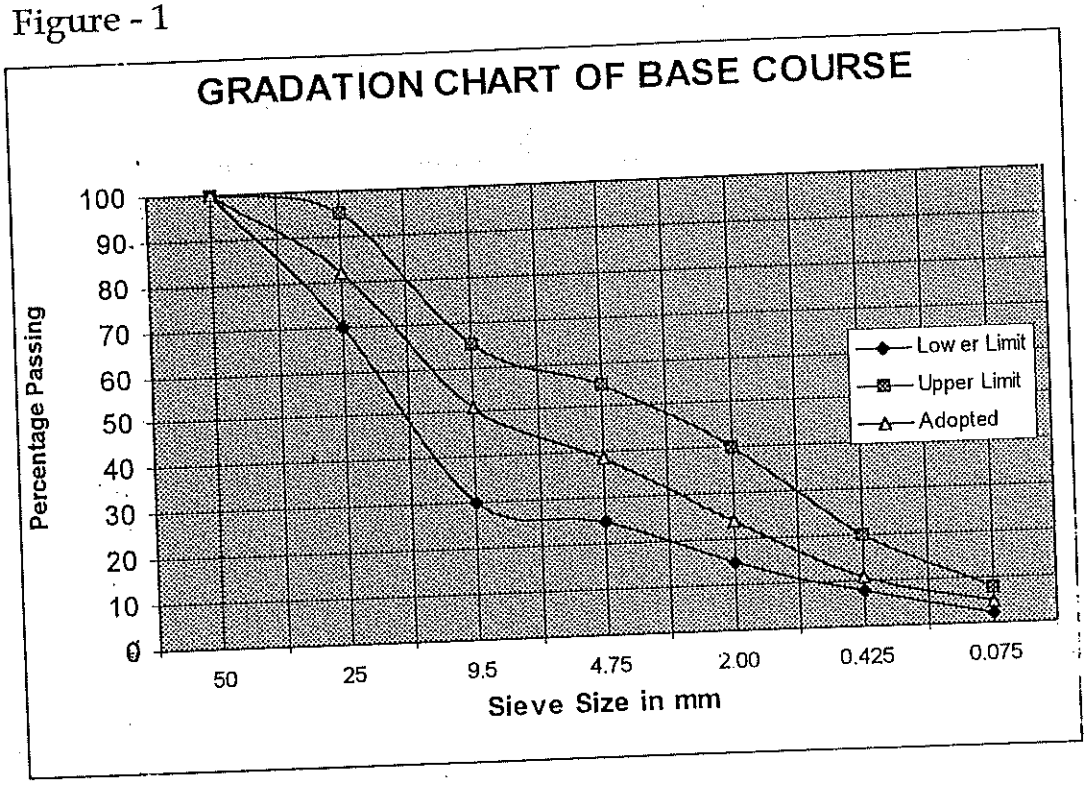
The sheets showing the results of Laboratory compaction of the materials are placed at Annexure – B.

4.3 FIELD CBR OF SUB-GRADE: For determining the In-situ CBR of the embankment and prepared sub-grade, Dynamic Cone Penetrometer (DCP) was used. Three tests were carried out at locations 20+784 and 20+850. An average in-situ CBR value of 50% was achieved which exceeds well beyond the minimum required value. Detail results of DCP testing are place at Annexure-B.

4.4 GRADATIONS OF SUB-GRADE AND BASE COURSE: Material used for the sub-grade preparation has been classified as A-4, as per the AASHTO classifications PI value of 9 was obtained which falls with in the

acceptable limit of 4-12 and is categorised as fair for the use in sub-grade preparation. The gradation curve of the base course material has been found smooth and fall within the envelope limits for grading "A" as per the NHA specifications requirement for aggregate base course. Figure - 1 show the gradation envelop.

Figure - 1



4.5 ASPHALTIC BASE COURSE: For the conformation of thickness and compaction of the already paved asphaltic base course, cores were drilled in the presence of NTRC engineers. Four cores were drilled randomly from sections where all the three layers of base course have been completed. Table-4 below presents test results of the thickness of asphaltic base course and the bulk specific gravity of the cores conducted in accordance with AASHTO T 166-88.

Table - 4. Core Density and Thickness of Asphaltic Base Course.

S.No	Represent Test Chainage (km)	Station (km)	Average Height (mm)	Average Diameter (mm)	Core Density (gms/cc)	Core Density (gms/cc) T-166
1	34+607 to 34+713	34+659	228	101.4	2.356	2.341
2	34+487 to 34+606	34+549	228	101.3	2.359	2.327
3	33+745 to 33+900	33+808	243	101.4	2.397	2.395
4	33+180 to 33+325	33+271	228	101.3	2.409	2.383

Analysis of cores revealed that out of the total four cores three have thickness of 228 mm against the required thickness of 230 mm. Where as one core has thickness of 243 mm. This shown that three cores are shy of thickness and are deficient in thickness by 2 mm compared to NHA specification, which allow upto 10 mm for deficiency in layer thickness. Whereas, one core which is 13 mm more than the required thickness of asphaltic base course is against the NHA specifications that allow only 5 mm for increase in thickness of asphaltic base course.

Table - 5 below presents the degree of compaction achieved at site in paved asphaltic base course relative to Marshall density acquired in laboratory.

Table - 5 Degree of Compaction of Asphaltic Base Course.

S.No	Represent Test Chainage (km)	Station (km)	Core Density (gms/cc) T-166	Average Marshall Density (gms/cc)	Compaction Achieved (%)	Compaction Required (%)
1	34+607 to 34+713	34+659	2.341	2.394	97.79	97
2	34+487 to 34+606	34+549	2.327	2.389	97.40	97
3	33+745 to 33+900	33+808	2.395	2.397	99.91	97
4	33+180 to 33+325	33+271	2.383	2.405	99.08	97

In all the samples the compaction achieved at the site in asphaltic base course complies with the required specifications.

4.6 COMPRESSIVE STRENGTH OF CEMENT CONCRETE: In order to check the quality of fresh cement concrete that has been used in structures, the concrete pored on 11th October, 2000 at location 37+015 km for the construction of a culvert, was sampled by the NTRC engineers. The class of concrete was "A" and had been departure from the batch plant at 12:40 while it arrived at site on 12:55. Also the slump test and temperature of the concrete was examined. The concrete was placed in accordance with the standard practice.

For the assessment of the strength of the concrete six concrete cylinders mold from the same batch were brought to NTRC laboratory for the curing and further testing. Three of these were tested on 19-10-2000 for eight days strength, while remaining three were tested on 08-11-2000 for 28 days strength as per AASHTO T 22-90. Table-6 below shows the compressive strength of cylinders.

Table - 6 Compressive Strength of Cement Concrete.

Core No.	Date of Testing	Compressive Strength (psi)	Average Compressive Strength (psi)
1	19-10-200	4451	4107 (8 days)
2	19-10-200	3975	
3	19-10-200	3895	
4	08-11-2000	5128	5135 (28 days)
5	08-11-2000	5446	
6	08-11-2000	4833	

For seven days cured samples an average strength of 4107 psi was achieved from three samples. While for other three samples cured for 28 days an average strength of 5135 psi was obtained against the requirement of 3000 psi for the class "A" type of cement concrete (Tests results are placed at Annexure-B). Compressive strength of some of the structural components at various locations checked by the rebound hammer were found to be over 5000 psi.

4.7 TENSILE STRENGTH OF STEEL: Samples of steel were collected from the stockyard of the contractor at Burhan camp. The billet deformed steel bars were tested in accordance with AASHTO M 31-89 & NHA's specifications and compared with the allowable tolerance limits. The Laboratory results on steel bars show that the yield strength was found 83 ksi which is higher than the required 75 ksi for Grade 75 steel. The ultimate tensile strength was 110 ksi that is also higher than the required tensile strength.

5. QUALITY ASSURANCE SYSTEM BY CONSULTANTS

A quality assurance program could be defined as the overall process where the joint efforts of various agencies are combined to develop or establish performance relating quality criteria. This is basically a management tool that represents management concern for quality and the efforts to assure quality.

The project consultants M/s PMC have adopted a well-formed quality assurance system. On-site laboratories are equipped with required duly calibrated apparatus. Proformas for daily materials testing have been used by the consultants and verified by materials engineer. Similarly, a

joint team of qualified and experienced engineers of various agencies has been involved in the execution of the project. For perusal photocopies of field density tests and the documentation for the disposal of discarded materials obtained from consultants are placed at Annexure-C. NTRC experts also visited the on-site materials testing laboratory and checked the daily testing record. Performance was found satisfactory.

6. CONCLUSIONS

The facts as determined by the field and laboratory investigations of section-I of the Islamabad-Peshawar motorway (M-1) enumerated in this report reveals the following:

i) Sub-grade materials sampled from two different location were found to be A-4 as per AASHTO classification with the plasticity Index of 9. Field density test result at station 20+784 falls 2 percent below the minimum required percent compaction.

ii) In-site CBR values obtained on the prepared sub-grade were found far above the minimum required as specified by the NHA specification.

iii) Results of the field density and gradation tests on base course materials show that these were properly graded and compacted in compliance with the specifications.

iv) Asphaltic base course materials cored from different locations when tested did meet the minimum specified requirement of the standard specification except sample obtained from station 33+745 to 33+900 has thickness more than the required tolerance.

v) The workmanship of cement concrete structures rated as satisfactory. Bulging or honey combing has not been observed in constructed structures. Also the cement concrete samples tested for compressive strength by NTRC were found to be in accordance with the minimum specified requirement.

vi) The deformed steel bar sampled from contractors stockyard has been tested for yield and ultimate tensile strength and found as per specifications.

vii) Riding quality of the completed sections of asphaltic base course was independently rated as "Very good" on the average.

viii) The quality of on-site material testing laboratories and performance of the technicians observed were found to be satisfactory.

ix) The overall workmanship of different construction activities were found to be satisfactory.

7. REPORT LIMITATION

This study is not intended as an indictment of any particular agencies. The main objective is to evaluate the quality of construction and its related problems of material inspection, in place performance, sampling and testing and submitted to the concerned authority to enable them to take remedial measures.

PHOTOGRAPHS

ANNEXURE-A

Pakistan Motorway Alignment

LEGEND

Motorway (on going) Islamabad - Peshawar	M1
Motorway (Completed) Islamabad - Lahore	M2
Motorway (Planned) Pindi Bhattian - Faisalabad	M3
Motorway (Planned) Faisalabad - Mulatn	M4
Motorway (Planned) Multan - D.G. Khan	M5
Motorway (Planned) D.G.Khan - Retodero	M6
Motorway (Planned) Retodero - Karachi	M7
Gwadar Link	M8

ANNEXURE-B

PMC

ISLAMABAD – PESHAWAR MOTORWAY PROJECT

FIELD DENSITY TEST (T-191) SUB-BASE/AGG. BASE COURSE

Section : One | Field No:

Location	Inspection/Survey/Quality No.		P-320			
	Represent Test Chainage	Km	23+630 23+730	23+730 23+830	23+830 23+930	23+930 24+050
	Station	Km	23+670	23+780	23+898	24+000
	Test/Retest No.					
	Offset from Centre Line	m	16 R/S	12 R/S	17 R/S	10 R/S
	Layer No. or Level		(Sub Base + Base)			R/Side
	Depth of Hole	cm	14.5	15.0	14.5	14.5
Field Density	Wt.of Excavated Wet.Material from the hole	gm	11460	12380	11525	11895
	Bulk Specific Gravity of + 4.75 mm from Hole					
	Initial Wt. of Sand + Cone before Test	gm	13000	13000	13000	13000
	Residual Wt. of Sand + Cone after Test	gm.	3015	2450	2915	2695
	Wt. of Used Sand (Hole + Cone)	gm	9985	10550	10085	10305
	Wt. of Sand in Cone	gm	3699	3699	3699	3699
	Wt. of Sand in Hole	gm	6286	6851	6386	6606
	Unit Wt. of Sand	gm/cc	1.348	1.348	1.348	1.348
	Volume of Material from Hole	cc	4663.2	5082.3	4737.4	4900.6
	Wet Density of Material from Hole	gm/cc	2.458	2.436	2.433	2.427
Results	Container No.		Z	&	J	O
	Wt. of Wet Material + Container	gm	6565	8615	7765	5775
	Wt. of Dry Material + Container	gm	6385	8388	7591	5656
	Wt. of Container	gm	1098	1536	1540	1505
	Moisture Content of Material	%	3.4	3.3	2.9	2.9
	Dry Density of Material from Hole	gm/cc	2.377	2.358	2.364	2.359
	+#4 Material from Hole	%	51.8	53.1	57.3	58.1
	+#4 Material of Max Dry Density Material	%				
	Lab No. for Proctor		S-13	S-13	S-13	S-13
	Max Dry Density (T-180D)	gm/cc	2.351	2.351	2.351	2.351
	Adj; Max Dry Density (T-224)	gm/cc	2.351	2.351	2.351	2.351
	Optimum Moisture Content	%	4.2	4.2	4.2	4.2
	Compaction Obtained	%	101.1	100.3	100.6	100.3
	Compaction Reported	%	101.0	100.5	100.5	100.5
	Compaction Required	%	100	100	100	100
	Time of Test	Hrs	15:00	15:35	16:10	16:45
Remarks:		Pass/Fail	Pass	Pass	Pass.	Pass.

Tested By : Date : Checked By : Date :

TRRL Dynamic Cone Penetrometer — Data file : motor1

17/10/00

Site	Pakistan Motorway M1	Date	16/10/2000
Section no.	One	Start layer	Sub-grade
Test no.	1	Condition	Good compacted layer
Chainage	20+783	Zero error (mm)	0
Direction/lane	Right Side	Surf thick (mm)	0
Position/offset	20 m from C/L	Extens @ line	0

Blw	Rdng	Blw	Rdng	Blw	Rdng	Blw	Rdng	Blw	Rdng
1	29	11		21		31		41	
2	10 72	12		22		32		42	
3	20 108	13		23		33		43	
4	25 130	14		24		34		44	
5	30 146	15		25		35		45	
6	35 170	16		26		36		46	
7	40 190	17		27		37		47	
8	45 205	18		28		38		48	
9	50 215	19		29		39		49	
10	55 230	20		30		40		50	
51		61		71		81		91	
52		62		72		82		92	
53		63		73		83		93	
54		64		74		84		94	
55		65		75		85		95	
56		66		76		86		96	
57		67		77		87		97	
58		68		78		88		98	
59		69		79		89		99	
60		70		80		90		100	

E1 : 1.00 E2 : 2.00 E3 : 3.00 E4 : 8.00 EM : 0.80

Layer	Strength mm/blow	CBR	Thick mm	Depth mm
1	3.65	54	201	230

User defined equation - log10(CBR) = 2.4 - 1.18 * log10(STRENGTH)

TRRL Dynamic Cone Penetrometer — Data file : motor3

17/10/00

Site	Pakistan Motorway M1	Date	16/10/2000
Section no.	One	Start layer	Sub-grade
Test no.	3	Condition	Good compacted layer
Chainage	20+850	Zero error (mm)	0
Direction/lane	Centre	Surf thick (mm)	0
Position/offset	C/L	Extens @ line	0

Blw	Rdng	Blw	Rdng	Blw	Rdng	Blw	Rdng	Blw	Rdng
1	23	11	160	21	260	31		41	
2	47	12	165	22		32		42	
3	65	13	175	23		33		43	
4	78	14	185	24		34		44	
5	92	15	195	25		35		45	
6	103	16	205	26		36		46	
7	115	17	220	27		37		47	
8	125	18	230	28		38		48	
9	138	19	240	29		39		49	
10	150	20	250	30		40		50	
51		61		71		81		91	
52		62		72		82		92	
53		63		73		83		93	
54		64		74		84		94	
55		65		75		85		95	
56		66		76		86		96	
57		67		77		87		97	
58		68		78		88		98	
59		69		79		89		99	
60		70		80		90		100	

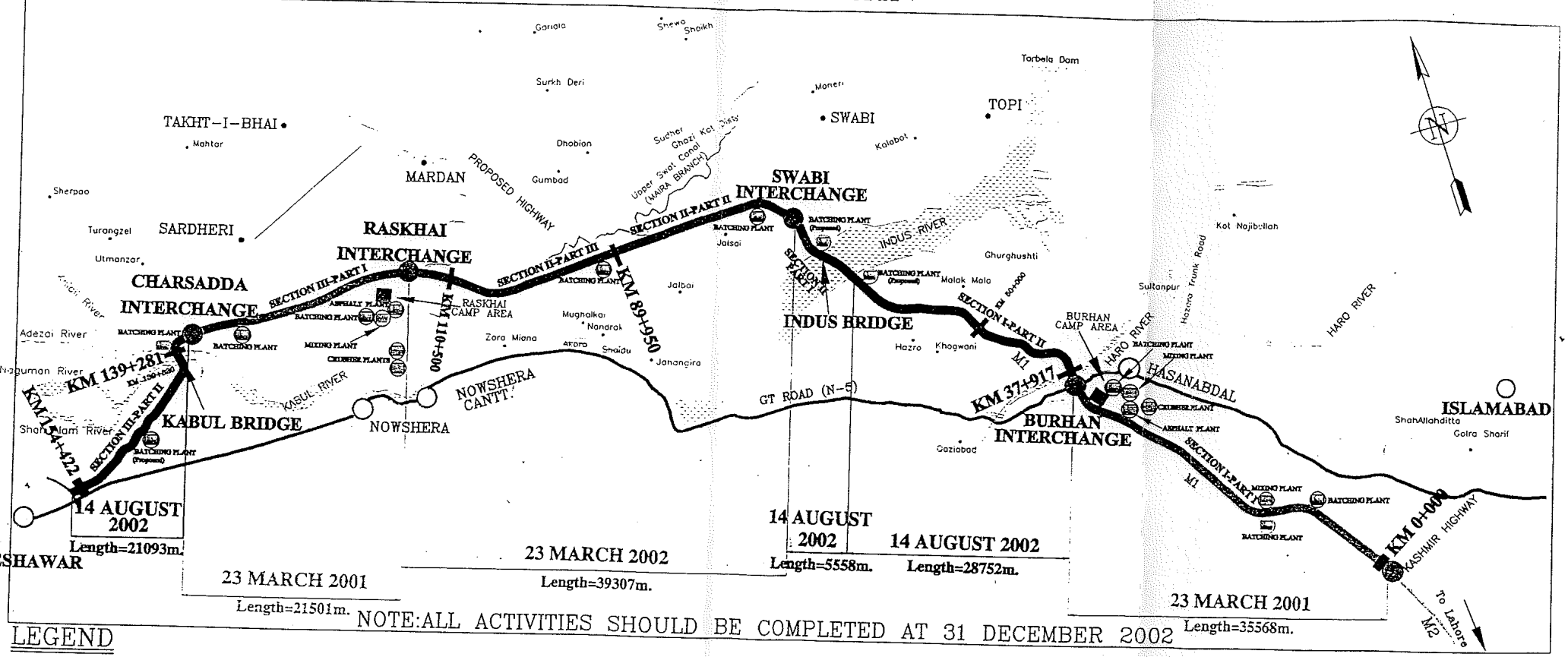
E1 : 1.00 E2 : 2.00 E3 : 3.00 E4 : 8.00 EM : 0.80

Layer	Strength mm/blow	CBR	Thick mm	Depth mm
Trans	4.80	39	24	47
1	2.24	97	213	260

User defined equation - log10(CBR) = 2.4 - 1.18 * log10(STRENGTH)

ISLAMABAD - PESHAWAR MOTORWAY (M1)

LAYOUT PLAN



NOTE:ALL ACTIVITIES SHOULD BE COMPLETED AT 31 DECEMBER 2002

LEGEND

- GT ROAD (N-5)
- RAILWAY TRACK
- INTERCHANGE
- RIVER / NALA

SECTION I	64.322
SECTION II	43.264
SECTION III	44.194

Kashmir Highway Interchange	0+000
Burhan Interchange	36+200
Swabi Interchange	70+350
Indus Bridge	65+280
Rashakai Interchange	112+100
Charsadda Interchange	133+600
Peshawar End Point	154+422
Kabul Bridge	139+551

BAYINDIR CONSTRUCTION INC.

bayindir
insaat

CONCRETE DELIVERY SLIP

BATCHING PLANT, BAYINDIR/~~HABIB RAFIQ~~

No. 21522 DATE 11/10/2022

LOCATION 37+015 KM W/T

NAME OF SUB-CONTRACTOR AKBOR

CLASS OF CONCRETE A QUANTITY 7.5 M3

PLATE NO EDJ-7114 MIXER NO. 66

DEPARTURE FROM BATCHING PLANT 12:40

120 M3

ARRIVAL TIME AT SITE 12:55 B. PLANT SUPERVISOR

DEPARTURE TIME FROM SITE 1325 Hrs NAME Azmat Ali

SIGNATURE

Checked By Monitoring Team.

Slump :- 130 mm

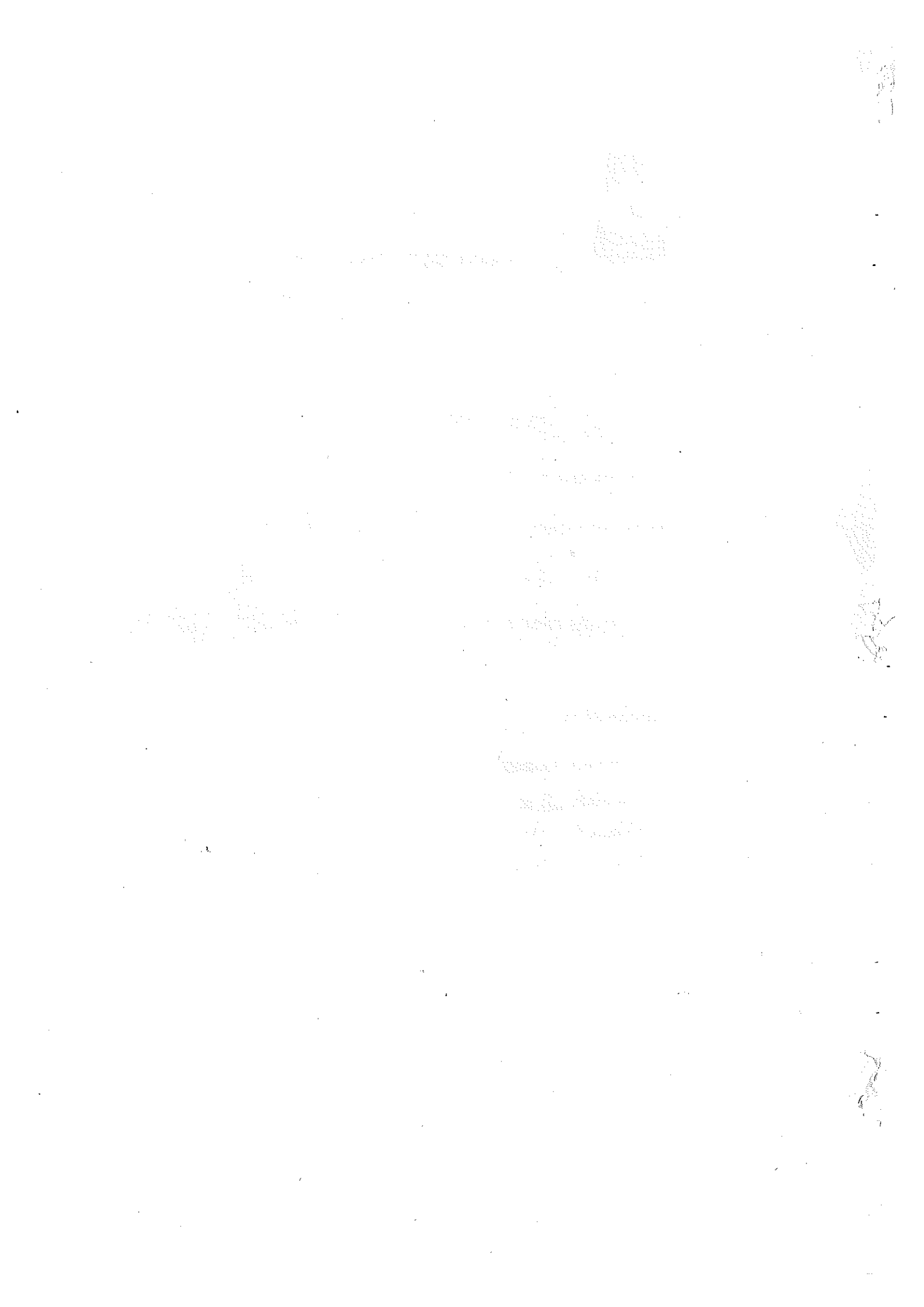
Temp :- 27°C.

cylinders - 12

RECEIVED BY

NAME A. Aziz

SIGNATURE



ASPHALT

Date Of Paving	Date Of Coring	Date Of Testing	Chainage	Layer No	Core Section LOCATION	Core ~~Location~~ Rep. CHAINAGE	PMC Core No	NTRC Core No	Marshall Density	Compaction %
15/9/2000	16/9/2000	17/9/2000	34+307~34+713 L/S	1	34+652.5 1.9m L/Edge	34+607~34+713	144	01	2.395	98.0
25/9/2000	26/9/2000	27/9/2000	34+315~34+705 L/S	2	34+664 5.4m L/Edge	34+614~34+705	201	01	2.396	98.0
28/9/2000	29/9/2000	30/9/2000	34+327~34+694 L/S	3	34+659.2 5.4m L/Edge	34+627~34+694	216	01	2.392	99.0
15/9/2000	16/9/2000	17/9/2000	34+339~34+706 R/S	1	34+569.5 .15m L/Edge	34+606~34+506	146	02	2.384	98.9
25/9/2000	26/9/2000	27/9/2000	34+697~34+384 R/S	2	34+528 1.9m L/Edge	34+599~34+499	203	02	2.392	97.0
28/9/2000	29/9/2000	30/9/2000	34+405~34+687 R/S	3	34+549.248 1.9m L/Edge	34+587~34+487	218	02	2.392	98.3
15/8/2000	16/8/2000	17/8/2000	33+500~33+930 R/S	1	33+867.1 .15m L/Edge	33+800~33+900	09	03	2.401	95.5
23/8/2000	24/8/2000	25/8/2000	33+591~33+929 R/S	2	33+800.7 5.4m L/Edge	33+792~33+892	27	03	2.388	99.6
14/9/2000	15/9/2000	16/9/2000	33+045~33+907 R/S	3	33+808.45 3.65m L/Edge	33+745~33+845	139	03	2.403	98.2
21/8/2000	22/8/2000	23/8/2000	33+912~33+100 L/S	1	33+282.982 1.9m L/Edge	33+200~33+300	17	04	2.425	99.1
24/8/2000	25/8/2000	26/8/2000	33+118~33+680 L/S	2	33+241.02 3.65 m L/Edge	33+280~33+180	36	04	2.386	97.0
13/9/2000	14/9/2000	15/9/2000	33+125~33+875 L/S	3	33+271 1.9m L/Edge	33+225~33+325	125	04	2.405	99.1

12/10/2000

PAVEMENT SPECIFICATION REQUIREMENTS		SUBBASE (201)	AGGREGATE BASE (202)	ASPHALTIC BASE COURSE (203)	WEARING COURSE (305)
TYPE (COARSE/FINE)		A(COARSE)	A(COARSE)	B(FINE)	B(FINE)
MAXIMUM SIZE OF AGGREGATE		50mm	50mm	38mm	19mm
Aggregate Grading Requirement and Tolerances	50mm	100	100		
	38mm			100	
	25mm	60–100	70–95	75–90 (±5)	
	19mm			65–80 (±5)	100
	12.5mm			55–70 (±5)	75–90 (±5)
	9.5mm	40–70	30–65	45–60 (±5)	60–80 (±5)
	4.75mm	30–55	25–55	30–45 (±5)	40–60 (±5)
	2.36mm			15–35 (±3)	20–40 (±3)
	2.00mm	20–45	15–40		
	0.425mm	10–30	8–20		
	0.300mm			5–15 (±3)	5–15 (±3)
	0.075mm	5–15	2–8	2–7 (±1)	3–8 (±1)
Filler Requirements	4.75mm		85–100		
	0.150mm		10–30	100	100
	0.075mm			90	90
Grading Ratios	D60/D10 minimum	3	4		
	No. 200/No. 40 maximum	2/3			
	D15/D85 maximum (Subbase/Subgrade)	5			
Shape and Angularity Requirements	Crushed faces Min (+No.4 Seives)		%90 (two face)	%100 (two face) %80 (all faces)	%100 (two face) %80 (all faces)
	Crushed faces Min (–No.4 Seives)			%100	%100
	Flakiness and Elongation (+9.5mm sieve) Max		No laminated material	15	15
	Largest/Smallest Ratio (+No 4 Sieves) max				(%80) 2.5 (%95) 3
Plastic fines	Sand Equivalent minimum		50*	45	45
	Liquid Limit maximum	25	25	25	25
	Plasticity Index maximum	6	6	6	4
Abrasion & Soundness	L.A. Abrasion maximum	50	45	40	30
	Soundness maximum (Sudium Sulphate)		12	12	12
CBR	Bearing Ratio minimum	30 (%98 OPM)	80 (%100 OPM)		
Asphalt Mix Design	Grade of Asphalt Cement			40/50 ~ 60/70	40/50 ~ 60/70
	Number of blows			75	75
	Minimum Asphalt content (Pb)			3(±0.3)	3.5(±0.3)
	Stability minimum (Kg)			1200	1000
	Flow (mm)			2–3.5	2–3.5
	Air voilds (%)			5–9	5–8
	Void filled Bitumen (%)			55–65	65–75
	VMA minimum (%)			13	14
	Loss of stability maximum (%)			25	20
	Additive type			Cellulose fibers	N or S rubber
	Additive Dosage			0.2 ~ 0.25% of total mix	Natural 5% of bitumen
Layer Thickness	Minimum	75mm	75mm	50mm	35mm
	Maximum	150mm	150mm	100mm	60mm
Compaction	Minimum Percent Compaction	%100	%100	%97	%97

* Sand equivalent is minimum 30 for filler

PAVESPEC