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Dated the 19th April, 1984

To

The Director General (Works), Central Public Works Department, D.G.B.R., All State/Union Territories Administrations Chief Engineers dealing with National Highways and Centrally sponsored Schemes

Sub : Quality Control on National Highways and other Centrally sponsored works

For any highway construction Quality Control is an important requirement for ensuring quality and for creating durable assets and National Highway works are no exception. In fact stringent Quality Control measures are warranted for those works since National Highways carry bulk of the country's passenger and freight traffic. Improved level of service of these highways will result in considerable savings in vehicle operating costs, and in favourable road user reaction and public opinion.

The need for effective Quality Control has been emphasized by the Ministry from time to time. An exclusive provision of 1% of cost is allowed in all works estimates of National Highway Projects. Financial support is also available for augmenting laboratory facilities and for setting up mobile testing laboratories. Guide lines regarding requisite tests, their frequency and acceptance criteria are available in Hand Book of Quality Control for construction of Roads and Runways (IRC Special Publication No. 11).

The impact of Quality Control on works, however, has not been felt the way it should have been primarily

because of lack of an uniform and effective implementation system. Examination and Evaluation of the systems prevailing in various States has led to favouring an in built system which places the responsibility for exercising Quality Control squarely on the staff executing the work. The Quality Control should be viewed based on this system, outlined in the subsequent paragraphs, may be adopted for implementation on all National Highway and Centrally aided works within a period of six months from the date of issue of this letter. Quality Control however, being a growing and dynamic process, the proposed system will have to be periodically evaluated based on the feed back information on its performance, for incorporating any modifications.

2. TESTING FACILITIES

Testing facilities should comprise of Laboratories at Central, Regional and Field levels. The Central laboratory located at headquarters will (a) provide testing facilities for tests of specialized nature (b) act as regional laboratory for works circle (s) at headquarters (c) act as the model laboratory for Research schemes in the State and Central sectors (d) bring out manuals for testing procedures. The Central laboratory headed by the Director, may have for quality control work, scientists from Geology, Chemistry and Physics disciplines. The list of suggested equipments to be provided in Central laboratory are available at Annex 1.

The Regional laboratories located at circle level will be headed by Executive Engineers (Quality Control) assisted by scientists from Geology, Physics and Chemistry disciplines. Regional laboratories will provide testing support to the (a) Engineers working in the circles and (b) Research teams from Central and State Highway R & D institutions. In addition they shall provide all facilities for training of all the Quality Control staff in the Region. The list of suggested equipments to be provided in Regional laboratories is given at Annex 2.

It is neither feasible nor advisable to send samples for routine tests all the way to the Regional laboratories and delay the work for want of test results. Setting up facilities for basic tests at the level of Junior Engineer/Engineering subordinate is therefore necessary. Some other equipments may have to be provided at Sub Divisional/Divisional level. A list of equipments suggested to be provided at Site/Sub Divisional/Divisional level can be seen at Annex 3.

3. NORMS FOR FREQUENCY OF TEST CHECK

In order to ensure attention on quality of work at all levels of supervision the following minimum frequencies of test check are recommended.

Field/Supervisory level	Percentage of prescribed tests to be performed/samples to be taken
1. Junior Engineer/Engineering subordinate	70%
2. Assistant Engineer/SDO/Deputy Engineer	20%
3. Executive Engineer	10%

4. QUALITY CONTROL ORGANISATION

The quality control organisation basically shall function directly under the Chief Engineer/Engineer-in-Chief. It shall be headed by a Director of suitable rank but not less than the Superintending Engineer and located at the Headquarters or the place where the Central Laboratory exists. The regional laboratories headed by the Executive Engineer shall be under his overall control. He shall deal with specific cases all policy matters, training of the staff etc. as broadly brought out in para 2 and in the Annexure 4.

The Quality Control Divisions headed by Executive Engineers may be created at each circle level. These should function under a dual control, primarily of the Superintending Engineer of the concerned circle for their day to day working and also under the Central Quality Control management for receiving guidelines to ensure uniformity throughout the state and for providing other technical support. The Executive Engineer (QC) will also be the incharge of Regional Laboratory. The functions of Quality Control Divisions are given at Annexure 5.

5. RECORDING OF TEST RESULTS

The samples of the suggested proformae for recording the test results for undermentioned items of the work are enclosed for adoption :

Road Works

- | | | |
|----------|---|---|
| 1) Q/R/1 | — | Characteristics of borrow materials |
| 2) Q/R/2 | — | Compaction characteristics of Earthwork/Gravel/Stabilized layers |
| 3) Q/R/3 | — | Characteristics of Aggregate/Binding Material/Screening for WBM (Surface, Base, and sub-base) |
| 4) Q/R/4 | — | Characteristics of bricks for sub base/base courses |

- | | | | |
|----|-------|---|---|
| 5) | Q/R/5 | — | Aggregate Characteristics for Bituminous courses |
| 6) | Q/R/6 | — | Rate of spread of Binder, Aggregate and Bitumen content for Bituminous work |
| 7) | Q/R/7 | — | Temperature record for Bituminous work |
| 8) | Q/R/8 | — | Surface Evenness Record |

Bridge Works

- | | | | |
|-----|---------|---|--|
| 1. | Q/BR/1 | — | Coarse Aggregate for Concrete |
| 2. | Q/BR/2 | — | Water for Bridge Construction Works |
| 3. | Q/BR/3 | — | Fine aggregates for Concrete |
| 4. | Q/BR/4 | — | Cement Concrete |
| 5. | Q/BR/5 | — | Mortar for Masonry Work |
| 6. | Q/BR/6 | — | Stones/Blocks for masonry/Pitching work |
| 7. | Q/BR/7 | — | High Tensile Steel wire for Prestressed work |
| 8. | Q/BR/8 | — | Grout for Prestressed Concrete Work |
| 9. | Q/BR/9 | — | Steel for Bearings |
| 10. | Q/BR/10 | — | Neoprene Bearings |

The quality control Records in the prescribed proformae should be maintained in serially numbered registers, issued to personnel in charge of quality control tests on works in the same way as measurement books are issued. These registers should be presented with every third running bill. The payments of bills should thus be linked with assured quality of work.

6. TRAINING FOR QUALITY CONTROL

In order to bring awareness in the departmental officers and to bring them up to date in testing methods regular workshops on Quality Control should be held. These workshops should aim at the basic necessities like (a) Making participants aware of the specification requirements (b) Required Tests and Acceptance criteria (c) Frequency of testing (d) Methodology for conducting the Tests. The participants should thus be thoroughly imbued with all the aspects of (a) Quality Control system (b) Operation of the Regional Laboratory and the part these play in the construction process.

The persons employed for testing in laboratories should also be got trained through (a) CRRI or other R & D institutions (b) "on the job" training in the section where they are assigned. It should be the responsibility of Executive Engineer (QC) to see that new employee becomes familiar with all the prescribed test procedures and develops skill, care and accuracy in performing these tests. In order to ensure that proper testing procedures are being followed, each testing section should have a testing manual.

7. A true indication of a good Quality Control system is in obtaining accurate, reliable and repeatable test results, using standard methods and accurate equipment, instruments, and materials. A check system of proficiency testing and inspection of equipment and procedures can help in monitoring the Quality Control system, and in improving the same.

ANNEXURE 1**CONSOLIDATED LIST OF EQUIPMENT TO BE PROVIDED IN THE STATE CENTRAL LABORATORIES**

S. No.	Equipments	Number required
1	2	3
A.	General Equipment	
i)	High sensitivity proving ring— 100 kg.-Capacity	2
ii)	200 kg.-Capacity	2
iii)	500 kg.-Capacity	2
iv)	1000 kg.-Capacity	1
v)	2000 kg.-Capacity	1
2.	Dial Gauges	
i)	12 mm Travel	6
ii)	25 mm Travel	6
3.	Balances	
i)	7 kg. capacity-Accuracy 1 gm.	1
ii)	500 gm capacity-Accuracy. 001 gm.	2
iii)	Chemical Balance-100 gm. Accuracy 0.0001 gm.	1
iv)	Pan balance-5 kg. capacity	1
v)	Physical balance-.001 gm. accuracy-	2
vi)	Platform scale-Scwt. capacity	
4.	Ovens : Electrically operated, thermostatically controlled.	
i)	Upto 110 C-Sensitivity 1 C	
ii)	Size 24" × 16" × 14"	2

	iii) Upto 400 F rotating type-Determination of loss on heating bitumen Sieves :	1
5.	i) B.S. Sieves-size-18" dia. 3", 2", 1½", ¾", 2"	1 set
	ii) B.S. Sieves-8" dia. 7, 14, 25, 36, 52, 72, 100, 170 & 200	1 set
6.	Sieve shaker capable of taking 8" and 12" dia. sieves-electrically operated with time switch assembly	1
7.	Proving Rings :	
	i) 400 lbs. capacity	1
	ii) 6000 lbs. capacity	1
	iii) 5 ton capacity	1
8.	Dial Guages :	
	i) 1" travel-.001" division	6
	ii) 2" travel-.001" division	6
9.	Load frame-5 ton capacity electrically operated with speed control	1
10.	200 ton compression testing machine	1
11.	Stop watches 1/5 sec. accuracy	3
12.	Glass ware	
13.	Miscellaneous	
14.	Hot plates 7" dia	
B.	Sub-Surface Investigations	
1.	Truck	1
*2.	Drilling Rig, upto 60 m depth	1
3.	Soil & rock drilling kit	1
4.	Vane Shear kit	3
*5.	Portable equipment for seismic survey (TERRASOOUT)	1
*6.	Stratometer for electrical resistivity survey	1
7.	Borehole Camera	1
*8.	Binosular type micro scope	1
*9.	Borehole deformation meter	1
10.	Static penetrometer equipment (10 tonnes)	1
11.	Hydraulic Jacks (30, 50, 100 and 200 tonnes)	1
12.	Undisturbed soil samplers (Dension & Piston Sampler)	1
13.	Plate load test equipment.	1
14.	Thin wall sampling tubes (100 & 50 mm. Dia. and 0.75 m long)	100 each type
15.	SPT Test equipment and static cone penetrometers.	3
	*Optional items depending on the requirements.	
C.	Soils.	
1.	Water Still	1
2.	Liquid Limit device and tools	
3.	Sampling pipette fitted with pressure and suction inlets, 10 ml. capacity	
4.	B.S. compaction apparatus (Proctor)	
5.	Modified AASHO compaction apparatus.	
6.	Sand Pouring cylinder with conical funnel and tap	
7.	Capillary water absorption test equipment	
8.	Sampling tins with lids 03" dia. X 21" ht. 1 lb. size-100 nos. and miscellaneous items like moisture tins etc.	
9.	PH meter.	
10.	Constant head & variable head permometer.	
11.	Unconfined compression test apparatus with a set of 4 proving ring and guages.	
12.	Lab. CBR test equipment. with 12 moulds	
13.	Field CBR test equipment.	
14.	Plate bearing test equipment with 12" dia. plate	
15.	Shear box test equipment	
16.	Triaxial compression test equipment	
17.	Consolidation test equipment.	
18.	5-ton capacity mechanical jack	
19.	Post hole augere 4" dia. with extensions and shelby tube for undisturbed sampling	
20.	Truck chassis capable of loading, upto 8 tons	
21.	Sample extractor frame with hydraulic jack hand operated	1
22.	Motorised unconfined compression testing machine	1
23.	Motorised direct shear operators with 12 rate of strain	1
24.	Triaxial testing equipment (Motorised) with 8 rates of feed and Assembly for lateral-pressure and pore pressure	1
25.	Tor Vans Apparatus	3
26.	Universal Automatic Compactor	1
27.	Core cutter	6
28.	Soil Lathe	1
29.	Vacuum pump	1
30.	Proctor needle, spring type	6
*31.	Consolidation test equipment	3

D.	Bitumen	
1.	Constant Temperature Bath	1
2.	Petrol gas generator (Laboratory model)	1
3.	Ring & Ball softening point apparatus.	
4.	(BRTA) Viscometer with 4 mm and 10 mm cups	
5.	Englor viscometer for emulsions	
6.	Red wood No. 1 and 2 viscometers	
7.	Penetrometer automatic type, adjustable weight arrangement, and needles	
8.	Soxhlet extraction apparatus type SJB 50.	
9.	Moisture determination apparatus with still (copper) and other accessories	
10.	Extraction thimbles 43 × 123 mm. size.	30
11.	Laboratory mixer 1/2 cft. capacity, electrically operated fitted with heating jacket	
12.	Ductility testing apparatus with variable speed gears complete with moulds	
13.	Moulds for Hubbard-Field stability test 6" × 2" dia.	
14.	Equipment for distillation of tars, cut-backs etc.	
15.	Hveem stabilometer	
16.	Marshall compaction apparatus	
E.	Rock Testing Equipment	
1.	Rock Sample height Gauge	1
2.	Rock Classification Hammer	1
3.	Portable Rock Tester	1
*4.	Field direct shear kit	1
F.	Concrete and structures	
1.	Water still	1
2.	Vicat needle apparatus for setting time test with plungers	
3.	Moulds	
	i) 4" × 4" × 20"	12
	ii) Cubical 6", 4", 2.78"	6 each size
4.	Lechat eller soundness testing apparatus	
5.	Air permeability apparatus	
6.	High frequency mortar cube vibrator.	
7.	Concrete mixer power driven 1 cft. capacity	1
	Concrete mixer power driven 5 cft. capacity	1
8.	Variable frequency and amplitude vibrating Table size 2" × 3" load 200 lbs.	
9.	Aggregate crushing test apparatus	
10.	Aggregate impact test apparatus	
11.	Los-angeles abrasion apparatus	
12.	Deval attrition apparatus.	
13.	Flexural attachment to compression testing machine	
14.	Concrete laboratory set up.	1
15.	Insitu concrete strength testing equipment, test hammer & Pachometer	1
16.	UTM for tension, compression and other tests	1
17.	Strain measuring equipment set.	1
G.	Equipment for Hydraulic Studies	
1.	Current meter	1
2.	Echo sounding equipment	1
H.	Road Testing Equipment	
1.	Benkelmen Beam	2
2.	Profile meter (hand towed)	2
*3.	British portable skid tester	4
*4.	Accelerated polishing machine	1
I.	Traffic Engineering	
*1.	Radar Speed meter	1
2.	Enoscope	1
*3.	Electronic Traffic counter	1
4.	Multi-bank event recorder	6
*5.	Multi-pen event recorder	1
6.	Time lapse photography camera and projector unit	1
J.	Terrain evaluation and photography	
*1.	Pocket stereoscope	2
*2.	Stereoscope with Parallax Bar	1
K.	Mobile laboratory	
*1.	Laboratory Truck	1
*2.	Equipment	1
L.	Special Research Equipment	
*1.	Equipment (individual items should be identified depending on actual needs).	1
M.	Quality Control Equipment in Field	
*1.	Equipment. (individual items to be identified depending on actual needs)	1
N.	Miscellaneous	
1.	Electronic Desk Calculator	1
*2.	Slide Projector	1

*3.	Camera	1
*4.	Photostat Machine	1

STATEMENT SHOWING THE RANGE OF ADDITIONAL EQUIPMENT PROPOSED BY SOME OF THE STATES FOR AUGMENTING THEIR CENTRAL LABORATORIES

S. No.	Discipline	Additional Equipment
1	2	3
1.	Soils	Dynamic cone penetrometer; soil lathe Flash shaker; Grimilaboratory blender; winkworth laboratory mixer; dieter's compaction apparatus; speedy moisture tester; conductivity bridge; Electrical earth pressure apparatus; sand equivalent test apparatus; soil density probe with utility scater; automatic compaction machine; platform vibrator with relative density kit; rotary high vacuum pump; Genco presso-vac pump; mechanical stirrer; mechanical mixer; shrinkage facior apparatus; protor needle; abbot's cylinder; calcimeter; soil centrifuge apparatus; sand equivalent test apparatus; vane shear apparatus; PVC meter.
2.	Bitumen	Distillation apparatus; electro-hydraulic kneading compactor; float test apparatus; settlement ratio apparatus; new model versa tester; higler speaker absorption meter; Barometer; Gilson testing screen and accessories; Kipp's apparatus; hydro-vapourising unit.
3.	Concrete & Bridges.	Prestressing bed; jack and other equipment concrete corling equipment; beam breaker concrete test hammer; twisting machine; universal testing machine; boring plant; supersonic tester; Acrow weighmore consistometer. drying shrinkage apparatus B.T.L. oven; muffle furnace; internal vibrator; shutter vibrator; masonry saw; briquette testing machine; K.C.P. tensile testing machine; fatigue tester; cold bend test; askamia vibrator;
4.	Aggregates	Dorry's attrition test; stewart's impact test; page impact test; jaw crusher slitting, grinding and polishing machine.
5.	Traffic	Electronic traffic counter; Electric speed meter; skyke's vehicle counter; enoscope wheel weigher; brake inspection decelerometer; instrument for tracing track width of curves; hand tally counter.
6.	Road Testing	Benkelmen beam; bump integrator; immersion tracking machine; skid resistance tester electronic roughness tester.
7.	Photographic/sound equipment.	Photometer; lux meter; recording camera; super cameras; enlarges; movie camera; sound projector; slide projector; epidioscope; amplifiers; photostat machine.
8.	Electric/Electronic and other miscellaneous equipment.	Polarising microscope; electronic weighing machine; generator; osoilloscope; vibration pick up; excitation amplifier; strain measuring bridge; oscolo script; G.K. Varistant; electronic calculator; duplicating machine; pallet trucks, mobile van; gas generator; electric tube furnace cassette tape recorder; refrigerator analytical and other preecision balances.

ANNEXURE 2

TESTING EQUIPMENT REQUIRED FOR SETTING OF REGIONAL LABORATORY

S. No.	Particulars of equipment	Nos. required
	I. GENERAL	
1.	Balances :	
	i) 7 kg to 10 kg capacity-semi-self indicating type-Accuracy 1 gm.	2
	ii) 500 gm capacity-semi-self indicating type-Accuracy. 001 gm.	2
	iii) Chemical Balance-100 gm capacity-Accuracy 0.0001 gm.	1
	iv) Pan Balance-5 kg capacity	3
	v) Physical Balance-.001 gm. accuracy.	3
	vi) Platform scale-300 kg capacity	1
2.	Ovens-Electrically operated, thermostatically controlled :	
	i) Upto 110°C-Sensitivity 1 C.	1
	ii) Upto 200°C-for determination on loss on heating bitumen.	1
3.	Sieves : as per I.S. 460-1962 :	
	i) I.S. Sieves-450 mm internal dia. of sizes 100 mm. 80 mm. 63 mm. 20 mm. 12.5 mm. 10 mm. 6.3 mm. 4.75 mm complete with lid and pan.	1 set
	ii) I.S. Sieves-200 mm internal dia (brass frame) consisting of 2.36 mm. 1.18 mm. 600 microns 425 microns. 300 microns, 212 microns, 150 microns, 90 microns and 75 microns with lid and pan.	1 set
4.	Sieve shaker capable of taking 200 mm and 300 mm dia. sieves-electrically operated with times switch assembly	1 No.
5.	Proving rings-complete with dia guage and calibration charts :	
	i) 250 kg capacity	2
	ii) 2000 kg capacity	2
	iii) 5 tonnes capacity	2

6.	Dial guage :	
i)	25mm travel-.01 mm/division	2 Nos
7.	Load frame-5 tonnes capacity electrically operated with speed control	1
8.	200 tonnes compression testing machine	1
9.	Stop watches 1/5 sec. accuracy	4
10.	Glassware Comprising of Brakers, Pipettes, dishes, measuring cylinders (100 to 1000 cc capacity) rods & funnels.	1 Doz. each
11.	Hot plates 200 mm dia (1 no 1500 watt)	2 Nos
12.	Enamel trays :	
i)	600 mm × 450 mm × 50 mm	6
ii)	450 mm × 300 mm × 40 mm	6
iii)	300 mm × 250 mm × 40 mm	6
iv)	Circular plates of 250 mm dia.	6

2. SOILS

1.	Water still	1 No.
2.	Liquid limit device with Casagrande and A.S.T.M. grooving tools and as per I.S. 2720-Part V-1970	2
3.	Sampling pipettes fitted with pressure and suction inlets, 10ml. capacity	—
4.	Compaction apparatus (Proctor) as per I.S. 2720 part VII-1974.	2
5.	Modified AASHO compaction apparatus as per I.S. 2720-Part VIII-1974.	1
6.	Sand pouring cylinder with conical funnel and tap and complete as per I.S. 2720 Part XXVIII-1974.	1 Doz.
7.	Sampling tins with lids 100 mm dia × 50 mm ht. ½ kg. capacity-and miscellaneous items like moisture tins, etc.	2 Doz.
8.	Unconfined compression test apparatus with a set of 4 springs and masks and complete as per I.S. 2720 Part X-1974.	1
9.	Lab C.B.R. test equipment for conducting CBR test as per I.S. 2720-Part XVI-1965 and consisting of following :	
i)	CBR moulds 150 mm dia-175 mm ht, complete with collar, base plate, etc.	
ii)	Tripod stands-for holding dial guage holder.	
iii)	C.B.R. plunger with settlement dial guage holder	
iv)	Surcharge weight 147mm dia-2.5 kg wt. with central hole.	
v)	Spacer discs 148mm dia., 47.7mm ht. with handle.	
vi)	Perforated plate (Brass)	
vii)	Soaking tank for accommodating 6 CBR moulds each	
10.	Field C.B.R. test equipment consisting of hand operated mechanical jack of 5 tonnes capacity, capable for sliding on I section fixable to truck chassis, proving ring of 2000 kg. capacity, extension pieces (of adjustable length upto 1 metre length), CBR Plunger, settlement dial guage holder, datum bar 254mm (10 in) dia. surcharge wt. with central hole (47.7mm dia) and 4.53 kg (10 lb)-nos. and 9.07 kg (20 lb)-2 nos. and one I-section of 1.25 metre length having arrangement of clamping to truck assis.	1 Set
11.	Plate bearing test equipment consisting of following items :	1 Set
i)	M.S. plates 254mm (1 in thick and dia 762 mm (30 in) 660 mm (26 in) 558 mm (22 in) 457 mm (18 in) 305 mm (12 in) 228 mm (9 in) and 154 mm (6 in).	
ii)	Hydraulic jack 20 tonnes capacity with remote control through flexible tubing of 2-3 metre length.	
iii)	Proving ring 25 tonnes capacity with dial guage and calibration chart.	
iv)	Ball bearing plates 25mm thick and 100 mm dia with centre groove.	
v)	Datum Bar 3 metre long with stand and dial guage clamps (2 nos.) with suitable attaching arrangements.	
12.	Standard Penetration test equipment	2 Nos.

3. BITUMEN

1.	Constant temperature bath for accommodating bitumen test specimen, electrically operated, and thermostatically controlled.	1
2.	Petrol gas generator (Laboratory model or any other alternative arrangement for heating of specimens in laboratory)	1
3.	Penetrometer automatic type, adjustable weight arrangement, and needles as per I.S. 1203-1958.	1
4.	Soxhlet extraction apparatus complete with extraction thimbles, etc.	1
5.	Laboratory mixer about .02 cu. metre capacity electrically operated fitted with heating jacket	1
6.	Hubbard-field stability test apparatus complete	1
7.	Marshall compaction apparatus as per ASTM 1559-62 T and complete with electrically operated loading unit, compaction pedestal bearing head assembly, dial micrometre and bracket for flow measurement, load transfer bar, specimen mould (4 in. dia) with base plate, collars, specimen extractor, compaction hammer 4.53 kg. (10 lb) × 457mm (18 in.) fall.	1
8.	Distant reading thermometers.	1

4. CONCRETE AND MATERIALS

1.	Water still	
2.	Vicat needle apparatus for setting time test with plungers, as per I.S. 269-1967.	1 No.
3.	Moulds :	
i)	100 mm × 100 mm × 500 mm	
ii)	Cubicals 150 mm, 100 mm (each size)	
4.	Air permeability apparatus	1 No.

5.	High frequency mortar cube vibrator	1 No.
6.	Concrete mixer power driven, 1 cu. ft. capacity	1 No.
7.	Variable frequency and amplitude vibrating table size 1 metre × 1 metre, as per I.S. 257-1963.	4
8.	Flakiness index test apparatus.	6
9.	Aggregate impact test apparatus as per I.S. 2386-Part IV-1963.	6
10.	Los-Angeles abrasion apparatus as per I.S. 2386 Part IV-1963.	1
11.	Flow table as per I.S. 712-1973.	4
12.	Equipment for slump test	4
13.	Equipment for the determination of specific gravity of fine and coarse aggregate as per I.S. 2386-Part III-1963.	4
14.	Flexural attachment to compression testing machine	2
15.	Core cutting machine.	1

5. CONTROL OF PROFILE AND SURFACE EVENNESS

1.	Survey level and staff	Set
2.	3 metre straight-edge and measuring edge	1 Set
3.	Unevenness indicator (optional)	1
4.	Camber templates Single lane 2 Double lane 2	
5.	Profilograph for checking pavement unevenness	1
6.	Automatic road unevenness recorder.	1

ANNEXURE 3

LIST OF TESTING EQUIPMENTS REQUIRED TO BE MAINTAINED AT DIVISION/SUB DIVISION/FIELD LEVEL

S. No.	Particulars	Divisional level	Requirement	
			Sub Divisional level	Field (each selection)
	(1) For testing soil			
1.1	Set of I.S. Sieves	1	—	1
1.2	Sand replacement equipment	—	—	2
1.3	Core Cutter	—	—	2 (Optional)
1.4	Field oven	—	—	2
1.5	Electric oven	1	—	—
1.6	Proctor Mould & hammer	1	1	—
1.7	Proctor needle	1	1	—
1.8	Balance	—	—	—
	(i) 5 to 7 kg.	1	—	1
	(ii) 500 grams	1	—	1
1.9	Pan Balance (15 kg)	1	—	1
1.10	Load frame for testing CBR (5 tonnes capacity)	1	1	—
1.11	CBR Moulds	—	—	9
1.12	Equipment for testing LL & PL	—	1	1
1.13	Speedy moisture meters	1	2	—
	(2) For Testing Aggregate			
2.1	Impact test equipment	1	1	1
2.2	Flakiness index testing equipment	1	1	1
	(3) For Testing concrete Mortar			
3.1	Slump cone & tamping rod Moulds	1	1	1
3.2	Moulds			
	i) 150 × 150 × 150 mm	—	3	12
	ii) 70 × 7 × 70.7 × 70.7	—	3	12
	iii) 50 × 50 × 50 mm	—	3	12
3.3	i) Proving ring for 1 ton	1	—	
	ii) Proving ring for 5 tons	1	—	
	(4) Bitumen			
4.1	Test trays	1	—	3
4.2	Thermometers	1	—	12
4.3	Spring balance	1	—	1

ANNEXURE 4

FUNCTIONS OF THE DIRECTOR QUALITY CONTROL

- i) To carry out the instructions of the Engineer-in-Chief/Chief Engineer regarding policy matter, work audit, arrange seminars and training programmes, help in nomination of the staff for outside training and as directed.
- ii) To issue guidelines to the regional Quality Control Executive Engineers and other staff from time to time.

- iii) To keep in touch with the latest developments on use of new materials, Quality Control methods and R & D activities in the State and elsewhere.
- iv) To frame and organise the training programmes for the new entrants and in-service staff.
- v) To analyse the reports received from the regional Quality Control Officers and issue necessary instructions to the officers concerned with the works.
- vi) To arrange closer association with Quality Control aspects in case of major projects for roads and bridges.

ANNEXURE 5

FUNCTIONS OF QUALITY CONTROL DIVISIONS

- i) To provide all assistance to the field officers for compliance of the instructions contained in the Circular connected with quality control.
- ii) Inspection works identified by Chief Engineer or Superintending Engineer concerned to ensure quality control.
- iii) To carry out tests on construction and road materials locally available and to suggest use of alternative materials.
- iv) To give suggestions for improving the quality at the site of work.
- v) To identify the various types of building and road construction materials available in a specified area or for the execution of a particular project. While doing so the desired properties of the material and also the economic viability of their use, should be kept in view.
- vi) To provide testing and investigation facilities to the field officers.
- vii) To educate and train the technical personnel engaged at construction sites for carrying out the field tests.

Q/R/1

TESTS OF COARSE AGGREGATES FOR CONCRETE

S. No.	Qty. Collected cum.	Gradation % Passing IS			Sieve size (mm)			Impact or crushing value %	Delete-rious consti-tuents. %	X Water absorption %	X Soundness	Checking AE EE		by SE	
		80	40	20	12.5	10	4.75					%	%		%
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Minimum

X — One test for each source of supply and subsequently when warranted by changes in Quality of aggregate.

Maximum

c — One test for every 50 cum of collection.

Q/R/2

TESTS OF WATER FOR BRIDGE CONSTRUCTION WORKS

S. No.	Date	Source	O. I Normal Nao H, to Neutralise 200 ml of sample (ml)	O. I Normal Hcl to neutralise 200 ml of sample (ml)	Organic %	Inorganic %	% SOLIDS IN WATER	
							Sulphates %	Alkali Chloride %

Minimum

x One test for each source of water or subsequently when warranted by change in quality.

Q/Br/3

TESTS OF FINE AGGREGATES FOR CONCRETE

S. No.	Qty. Applied	% passing		I.S. 2.36	GRAD-ATION				Deleterious constituents %	Bulking %	Silt contents %
		10	4.75		Sieve size 1.18	600 m	(mm) 300 m	150 m			
1	2	3	4	5	6	7	8	9	10	11	12
									1		
									2		
									3		
									4		

Minimum

x One test for 50 cum of supply

Q/Br/4

TESTS FOR CEMENT CONCRETE

S. No.	Date	Location in the structure	Qty. (cum)	Workability Slump/Compaction factor Vee bee Value	Compressive Strength After 7 days					Compressive Strength After 28 days					Checked by		
					Sample Nos.					Sample Nos.					AE %	EE %	SE %
					I	II	III	IV	V	I	II	III	IV	V			

x Minimum. Ten samples per 60 cum of concrete.

Q/Br/5

TESTS OF MORTAR FOR MASONRY WORK

S. No.	Qty. cum	Location in structure	Compressive Strength After 7 days				Strength (kg/cm ²) After 28 days				AE %	Checking	
			I	II	III	IV	I	II	III	IV		EE %	SE %
1	2	3	4	5	6	7	8	9	10	11			

Minimum Six Samples per 20 Cum of Masonry work.

Q/Br/6

TESTS OF STONE/BRICK FOR MASONRY/PITCHING WORK

S. No.	Date	Quantity Supplied cum	Compressive Strength Kg/Cm ²	Water Absorption %	Efflors cence %	For Bricks Only		For Pitching stone weight per unit kg	Specific Gravity	Checking		
						-Warp Cm/Cu	Dimension Cm			AE %	EE %	SE %
1	2	3	4	5	6	7	8	9	10			

x For Bricks minimum one test per 10,000 nos.

e Once for each source and subsequently when warranted. due to change in quality

K All stores to be checked.

3100/14

Q/Br/7

TESTS FOR H.T. WIRE FOR PRESTRESSED WORK

S. No.	Quantity	UTS Kg/mm ²	Tolerances %	Proof Strength at 20% Strain. Kg/mm ²	Checking for AE %	EE %	SE %
1	2	3	4	5	6	7	8

Q/Br/8

TESTS FOR GPANT FOR P.C.C. WORK

Sl. No.	Date	Quantity	Location in Structure	Bleeding %	Compressive I Sample	Strength II Sample	Kg/Cm ² III Sample	Checking AE %	EE %	SE %
1	2	3	4	5	6	7	8	9	10	11

Q/Br/9

TESTS FOR STEEL BEARINGS

S. No.	TOLERANCES IN (mm)									
	Diameter of Rollers and all convex surfaces	Diameter of all concave surfaces mm	Height of Components mm	Base Plate Length mm	Width mm	MC on deviation on rolling/rocking/ sliding surfaces M	Checking AE %	EE %	SE %	
1	2	3	4	5	6	7	8	9	10	

Q/Br/10

TESTS FOR NEOPRENE BEARINGS

Sl. No.	Date	Identifications	Durometer Hardness (pts)	Ultimate Tensile Strain %	Tensile Strength kg/Cm ²	Adhesion to metal kg/Cm ²	Ozone resistance for 20% Strain	Length mm	Tolerances Width mm	Total Thickness of single layer mm	Thickness mm
1	2	3	4	5	6	7	8	9	10	11	12

CHARACTERISTICS OF BORROW MATERIAL

Sl. No.	Location of borrow area	Km. in which material is used	Sand content %	4.75 mm	GRADING					P.I. value %	Proctor Density gm/cc	CBR %	Delete-rious content	Natural Moisture content.	Lab compacted soil Den	Moist-ure cont-ent	Recom-ended by JE AE SDO EE					
					passing 600 mic	200 mic	150 mic	75 mic	10								11	12	13	14	15	16
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

TEST FREQUENCY : for gradation, Plasticity Index and standard Proctor test 1 test per 8000 m³
 CBR (on a set of 3 specimens) one test per 3000 m³
 Deleterious constituents — as required.
 Natural Moisture content — one test per 250 m³ of soil.

COMPACTION CHARACTERISTICS EARTHWORK/GRAVEL/MURUM

Q/R/2

S. No.	KM	Layer no	Lab fr-om bottom.	Lab OMC	Lab DD	LOCATION WITHIN KILOMETRES																																Recorded	Remarks
						MC	DD	Ref	0 to .1		.1 to .2		.2 to .3		.3 to .4		.4 to .5		.5 to .6		.6 to .7		.7 to .8		.8 to .9		.9 to 1												
									by	JE	AE	EE																											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	

LEGEND —

Ref : Reference of observation sheet number (page) and observation No.
 MC : Percentage moisture content at the time of compaction,
 DD : Dry Density achieved in gm/cc.
 %C : Percentage Compaction.

TEST FREQUENCY : 1-2 tests per 1000 m² of compacted layer each of 150 mm thick.

Note : Use separate sheet for compaction of gravel and other sub base layers.

CHARACTERISTICS OF AGGREGATE/BINDING MATERIAL/SCREENING FOR WBM,
 SURFACE, BASES & SUB-BASE COURSE

S No.	LO- CA- TI- ON, KM/M	Layer Number from bottom	Type of aggregate	Grading % Passing through IS Sieve														Aggregate Ref impact value % Ref		Flakiness Index % Ref		
				100 mm	80 mm	63 mm	50 mm	40 mm	20 mm	12.5 mm	10 mm	6.3 mm	4.75 mm	600 mic	300 mic	150 mic	75 mic	19	20	21	22	23
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Screening LL PI Ref			PI value of Binding Material % Ref.		Recorded by JE AE EE			Remarks
24	25	26	27	28	29	30	31	32

TEST FREQUENCY — Grading, Impact value, Flakiness index, Screening PI Value.

one test for 200 m³ of material
 one test for 25 m³ of material
 one test for 250 m³ of material

BRICK CHARACTERISTICS FOR SUB-BASE AND BASE COURSE

Q/R/4

S. No.	Location Km/m	Layer number from bottom	Water absorption										Compressive strength.									
			0 to .2 %	.2 to .4 %	.4 to .6 %	.6 to .8 %	.8 to 1.0 %	0. to .2 %	.2 to .4 %	.4 to .6 %	.6 to .8 %	.8 to 1 %	Ref kg/cm ²	Ref kg/cm ²	Ref kg/cm ²	Ref kg/cm ²	Ref kg/cm ²	Ref kg/cm ²	Ref kg/cm ²	Ref kg/cm ²	Ref kg/cm ²	Ref kg/cm ²
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Recorded by JE AE EE
 24 25 26

Remarks.
 27

TEST FREQUENCY : 5 bricks to be tested for crushing strength and water absorption for every 5000 bricks.

AGGREGATE CHARACTERISTICS FOR BITUMINOUS COURSES

Q/R/5

S No.	Location Km/m	Type of aggregate	Gradation % passing through IS Sieve												Aggregate		Flakiness	
			20 mm	12.5 mm	10 mm	6.3 mm	4.75 mm	2.36 mm	1.7 mm	600 mic	300 mic	180 mic	150 mic	75 mic	Ref value %	impact Ref	Index %	Index
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 20

Water absorption		Stripping value		Recorded by			Remarks
%	Ref	%	Ref	JE	AE	EE	
21	22	23	24	25	26	27	28

TEST FREQUENCY : Gradation. 1 test for 25 m³ of material
Impact value, Flakiness Index, water absorption,
Stripping value 1 Test for 50 m³ of material.

RATE OF SPREAD OF BINDER, AGGREGATE & BITUMEN CONTENT FOR BITUMINOUS WORK

Q/R/6

S No:	Km/m	TEST RESULTS																																									
		0 to .1			.1 to .2			.2 to .3			.3 to .4			.4 to .5			.5 to .6			.6 to .7			.7 to .8			.8 to .9			.9 to 1.0														
		BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref	BA	Bc	Ref									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42		

Recorded by			Remarks
JE	AE	EE	
43	44	45	46

LEGEND: B = Rate of spread of binder for surface painting or tack coat.
A = Spread of aggregate for surface painting or premix work.
Bc = Bituminous contents of premix work.

TEST FREQUENCY : for B 1 test per 500 m² of surface.
for A 1 test per 500 m² of surface
for Bc 2 tests per day

TEMPERATURE RECORD FOR BITUMEN WORK

Q/R/7

S No.	Date	Km/m	Time con- tinuous minimum half hourly.	TEMPERATURE					Recorded by			Remarks
				TA	TB	TM	TL	TR	JE	AE	EE	
1	2	3	4	5	6	7	8	9	10	11	12	13

LEGEND: TA = Temperature of Aggregate.
 TB = Temperature of Bitumen at the time of tack coat.
 TM = Temperature of Mix.
 TL = Temperature while laying the Mix.
 TR = Temperature while rolling.

TEST FREQUENCY: The temperature is to be taken regularly at an interval of half an hour.

SURFACE EVENNESS RECORD

Q/R/8

S. No.	Date	Location Km/m	Stage of work	GRADE					CAMBER		Recorded by			Remarks
				at .6 left	from edge	at .6 right	from edge	Left	Centre	Right	JE	AE	EE	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

NOTE : This test is to be done regularly along with the progress of work at different stages starting from sub base to B/T surface.