

अल्का उपाध्याय

अपर सचिव एवं महानिदेशक (एन आर आई डी ए)

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भारत सरकार

ग्रामीण विकास मंत्रालय

ग्रामीण विकास विभाग

कृषि भवन, नई दिल्ली-110001

Government of India

Ministry of Rural Development

Department of Rural Development

Krishi Bhawan, New Delhi-110001

No.NRRDA-P013(11)/1/2020-Dir(P-I) /

27th May, 2020

To,

The Chief Executive Officer of all States and UTs.

Sub: Ensuring Good Quality of Cement Concrete (CC) Pavements construction under PMGSY.

You might be aware that quality has been a singular feature of the Pradhan Mantri Gram Sadak Yojana (PMGSY) right from its inception. However, it has been observed in some cases that the quality of Cement Concrete Pavements is not as per specifications and certain deficiencies have been reported. I am writing this letter to draw your attention to the actions that are required to be taken on priority to ensure construction of good quality Cement Concrete Pavements under PMGSY.

2. Cement concrete pavements under PMGSY, are preferred on roads passing through habitations, where drainage of water is an issue. Cement Concrete Pavements are to be designed as per IRC:SP:62-2014 and Construction of Cement Concrete Pavements under PMGSY shall be carried out as per section 1501 of the MoRD Book of Specifications for Rural Roads- 2014, and Quality Assurance Handbook published by NRIDA. The necessary tests to be conducted before and during the progress of the work are given in table 1803.24 of the aforesaid Specifications for Rural Roads-2014. As a further safeguard, cores are to be cut after 28 days curing and tested before the acceptance of work and release of payment.
3. The procedure to be followed for acceptance of work and releasing payments is given in **Appendix-I**. The salient points to be observed while constructing plain cement concrete pavements to ensure quality and workmanship are given in **Appendix-II**.
4. Some of the States are using New Technologies like Roller Concrete Pavements, Cell Filled Concrete Pavements or Panelled Concrete Pavement. In all such cases also, the procedure specified in para 3 above, should be strictly adhered to, for ensuring good quality concrete pavements.
5. For compliance of above instructions, if required additional Core Cutting Machines may be procured. A consolidated proposal, of such requirements may be sent to NRIDA.
6. Programme Implementation Units (PIUs) may also be advised to ensure that Laboratory with requisite equipments, is established for the package, within 15 days from the start of the work and before start of the 'Trial Length of Cement Concrete Pavement' and the photographs of the same are uploaded on OMMAS.
7. You are requested to issue these instructions to concerned engineering officers, indicating that these shall be strictly followed, to ensure the quality of cement concrete pavements under PMGSY.

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Acceptance and Payment of work

Procedure to be followed for acceptance of work and release of payments is prescribed as under-

- A. Concrete mix design for cement content, w/c ratio and dosage of plasticizers for the specified design strength.
- B. The Contractor shall demonstrate the materials, Plant equipment and methods of construction that are proposed for concrete paving, by first constructing a trial length of slab, off road for at least 30 m length, with minimum 15 m on each day. Approval of the materials, plant equipment and construction methods for main work shall be given, when a trial length complies with the specification. The Contractor shall not proceed with normal working until the trial length has been approved.
- C. Four full depth cores of diameter at least 100 mm (2 cores for each day's work) will be cut by core cutting machine at 28 days. The core shall be tested as per IS: 516. The concrete in the work represented by the core test shall be considered acceptable if the average equivalent cube strength of the core is at least 85 percent of the cube strength (characteristic strength) of the grade of concrete specified for corresponding age and no individual core has strength less than 75 percent.
- D. Min. 6 cubes and 6 beams (3 each for 7 day and 28 day strength) per day should be prepared from the mix, being used for construction of Cement Concrete pavement. These should also be tested at specified age from date of casting.
- E. After 28 days of construction of the cement concrete pavement, a test will be carried out in the laboratory of the contractor or consultant or Program Implementation Unit Laboratory, in the presence of the Assistant Engineer/Assistant Manager and Junior Engineer/Sub Engineer himself, taking Core sample at a length of 500 meters each, with core cutter. Contractor's representatives may also be present at the time of cutting of core and its testing. If a single sample is taken (when the length of pavement is 500 m) then it will be taken from the center of the pavement. More than one sample (additional samples if required), will be taken from both sides from the center at a distance of 1.0 meter.
- F. Core shall be tested as per IS: 516.
- G. 28 days Compressive Strength assessed from the Core Sample, should not be less than 100 % Characteristic compressive strength, of the specified grade of concrete. M30 grade of Concrete has been specified for Pavements in PMGSY, hence the compressive strength should not be below 30 MPa. If 100% compressive strength is achieved after 28 days, then only the measurement of concrete work done should be recorded in the measurement book.

H. If the 28 days Core Strength is below the characteristic compressive strength of the specified grade of concrete, then the concrete work done shall be rejected and no Payment for the work should be made.

I. Record of the Cube tests and also core tests done by the Assistant Engineer/Assistant Manager and Junior Engineer/Sub Engineer at 7 days and at 28 days should be maintained. This will be verified by the Executive Engineer/General Manager at the time of its 28-days Core Strength test.

J. The crushing strength of cylinders with height to diameter ratio between 1 and 2 may be corrected to a standard cylinder of height to diameter ratio of 2 by multiplying with the correction factor (f) obtained from the following equation:

$$f = 0.11 n + 0.78$$

Where,

f= correction factor

n= height to diameter ratio

K. Relation between Cube Crushing Strength and Cylindrical core tests will be as under-

Crushing strength of cubes = 1.25 x crushing strength of Cylindrical core, when the height to diameter ratio of the cylinder is 2.

L. Following acceptance criteria for distress/cracked slabs shall be strictly observed-

1. The length of Single crack in any panel shall be not more than 1500 mm, even though its depth is less than half of the slab depth.

2. The cumulative length of cracks with depth of crack less than half the depth of slab in a panel shall be not more than 2000 mm.

3. Slabs with cracks which are penetrating to more than half of the slab depth shall not be accepted. The same shall be removed and replaced by the contractor at his cost.

M. No additional payment shall be made for extra thickness of Pavement slab. Deficiency in thickness up to 5 mm and not more than three panels continuously can be considered within tolerance and full payment can be made.

Salient Points to be Observed while Constructing Plain Cement Concrete Pavements to ensure Quality and Workmanship

Construction of good cement concrete pavement will require Concrete which is laid following the laid down specifications and with good workmanship. Concrete, unlike steel, is prepared at site and therefore, attention is required to ensure its good quality. Good quality concrete implies a mix which has the right consistency in fresh state to allow compaction without requiring excessive effort and also which is cohesive enough to prevent segregation during transport and placement so that a homogeneous finished product is achieved. The hardened concrete must have the desired strength and durability. Therefore, to achieve a good cement concrete pavement, the following points need to be ensured.

- i. **Source of materials:** The contractor shall inform the engineer, sources of all materials to be used in the concrete work along with relevant test data sufficiently in advance and approval of engineer will be obtained at least 30 days before their use. The materials shall be tested by the contractor in accordance with Table 1803.24 of the Specifications for Rural Roads-2014 (**Annexure-I**).
- ii. **Mix Design-** Mix design based on laboratory trial mixes, using approved materials, is to be submitted for the approval of engineer at least 30 days before the paving of the trial length. The trial mixes shall be prepared in the presence of the engineer and the cubes shall be also be tested in his presence. The concrete mix shall be of minimum M30 grade and its design shall be based on the flexural strength of concrete as specified in the contract. The cement content should not be more than 425 kg nor less than 325 kg per cum of concrete, unless specified otherwise. If fly ash is used as a part replacement of cement, the cement content should not be less than 270 kg/cum and the maximum fly ash content will be limited to 30% of the weight of cementitious material.
- iii. **Workability-** The slump of concrete should be in the range 30mm \pm 10mm subject to adjustment based on ambient temperature, wind velocity and relative humidity. It shall not be more than 20 mm for hill roads.
- iv. **Water Cement Ratio-** The water cement ratio should be according to the mix design, not exceeding 0.50. Chemical admixture/ plasticizer can be used in prescribed quantity to achieve required workability.
- v. **Essential Machinery** – It is very important to ensure availability of necessary machinery and equipment at site to produce good concrete and to lay it properly to get a good cement concrete pavement. The list of equipment is placed at **Annexure-II**.
- vi. **Trial Length-** A trial length of road for at least 30 meter shall be constructed off road to demonstrate the proposed materials, plant, equipment and construction methodology,

before constructing the concrete pavement. It shall be constructed in two parts over a period of at least 02 separate working days with a minimum of 15 m on each day. Transverse and longitudinal joints of each type that are proposed in the main work shall be constructed and assessed. Four full depth cores of diameter at least 100 mm (2 cores for each day's work) will be cut by core cutting machine at 28 days. The core shall be tested as per IS: 516. The concrete in the work represented by the core test shall be considered acceptable if the average equivalent cube strength of the core is at least 85 percent of the cube strength (characteristic strength) of the grade of concrete specified for corresponding age and no individual core has strength less than 75 percent.

- vii. **Batching and mixing of materials-** All materials shall be proportioned by weight in an approved weigh batching plant of at least 0.2 cum capacity, having computer controlled weighing attachment. Cement shall be measured either by weight or by number of bags. Sample check of weight of bags should be done occasionally. The weight of all other materials shall be calculated on the basis of one or more full bags of cement. Water may be measured by volume. If volume batching of aggregates is permitted by engineer in small projects as a special case, separate measurement boxes, with handles, shall be provided for different aggregates.
- viii. **Separation Membrane-** A PVC sheet of 125 micron thickness should be laid between the sub base and cement concrete slab. Before placing the separation membrane, the sub-base shall be swept clean of all extraneous materials. It should be ensured that the plastic sheet is not folded or creased anywhere. Separation can also be provided by spraying VG 10 bitumen at the rate of 2 kg/m² and applying a light coat of sand passing 4.75 mm and retained on 2.36 mm sieves.
- ix. **Compaction Equipment-** Initial compaction is to be done using plate compactor. Final compaction using Vibrating Screeds (two numbers, one with straight bottom and the other with bottom as per cross profile) supplemented by Needle Vibrators in the corners and along side supports.
- x. **Texture-** Before the concrete becomes non-plastic, it is important to texture the surface with approved long handled steel or fibre brush.
- xi. **Curing-** After completion of the finishing operations, the surface shall be covered with wet hessian cloth (minimum of two layers), burlap or jute mats for 24 hours. This should be followed by complete wetting of the concrete by ponding or by using sprinklers, for 14 days. Thereafter 40 mm thick sand layer in wet condition should be kept, and not removed till 28 days. Exposed edges of the slab shall be banked with a substantial berm of earth.
- xii. **Cube test-** Minimum 6 cube moulds and 6 beam moulds should be filled for every 100 Cum concrete. Testing should necessarily be done for 3 cubes after 7 days and for 3 cubes for 28 days strength.
- xiii. **Contraction Joint-** The contraction joint shall consist of a mechanically sawn joint groove 3-5 mm wide and up to 1/4 or 1/3 depth of the slab or as per drawing. The sawn joints shall be cut as soon as the concrete has undergo initial hardening and is strong

enough to bear the weight of crew and the cutting machine. These joints shall be subsequently widened to 10 mm width and depth of 20 mm by appropriate saw to house sealant. These joints shall be spaced 2.5-3.75 m. However, the length of panel (in direction of traffic) shall not be less than the width of panel. The joints should be plugged on both the ends with pieces of synthetic tar felt to prevent ingress of water from median/shoulder.

- xiv. **Construction Joint-** Construction joints shall be butt joints and placed when concreting is completed after a day's work or is suspended for more than 30 minutes. Construction joint shall be provided at the location of contraction joint. The joint shall be widened to 10 mm width and 20 mm depth by saw cutting to house the joint sealing material. No emergency joint shall be allowed in less than 2 m distance of any preceding or succeeding joint position. The joints should be plugged on both the ends with pieces of synthetic tar felt to prevent ingress of water.
- xv. **Expansion Joint-** This type of joint is provided near bridge and culverts so as to separate the slab of the concrete road and the slab of the bridge or culvert. The joint shall be filled with a bitumen impregnated/ pre-moulded synthetic joint filler board. The board shall be 12 mm thick in case of slab culvers and 20 mm thick near bridges. Dowel bars shall be provided as per drawings. The joints should be plugged on both the ends with pieces of synthetic tar felt to prevent ingress of water.
- xvi. **Longitudinal Joint:** Longitudinal joints shall be provided for a pavement which is more than 4.5 m wide and tie bars shall be provided at mid depth of slab. The concreting of the entire width shall be done in one go and the joint should be saw cut. It shall initially be 3.5 mm wide and of depth equal to 1/3 rd of the depth of slab. After curing period is over, the joint shall be widened 6 to 8 mm, to a depth of 12-15 mm and sealed with hot poured bituminous sealant.
- xvii. **Joint Filling-** After minimum 28 days of casting the pavement, joint grooves at contraction/construction joints shall be widened to 10 mm width, to a depth of 18-20 mm. For longitudinal joint, grooves shall be 6-8 mm wide, to a depth of 12-15 mm. The grooves shall be sealed with hot poured bituminous sealant.
- xviii. **Quality Control and Tolerances-** Quality Control, tolerances for thickness, levels and strength shall conform to the requirements of Section 1803.24 of Specifications for Rural Roads- 2014 (**Annexure-I**).

Specifications for Rural Roads-2014: Tests on Plain Concrete Pavement**Table 1803.24.1** Tests prior to construction

The quality control tests and checks to be carried out during construction shall be as given in **Table 1800.48** of Specifications for Rural Roads- 2014.

SN	Type of Test	Frequency
i	Cement	
	(a) Setting time (IS: 4031, Part-5)	One test for 10 tonnes of cement (same brand & grade)
	(b) Soundness (IS: 4031, Part-3)	- do -
	(c) Compressive strength of mortar cube (IS: 4031, Part-6)	3 specimens for each lot
ii	Fine Aggregates	
	(a) Gradation (IS: 2386, Part-5)	3 samples for each source of supply
	(b) Deleterious constituents (IS: 2386, Part-2)	If in doubt, one test
	(c) Alkali silicate reactivity (IS: 2386, Part-7)	- do -
iii	Coarse Aggregates	
	(a) Gradation for PCC or RCC works	3 samples for each quarry source
	(b) Flakiness Index (IS: 2386, Part-1)	- do -
	(c) Deleterious constituents (IS: 2386, Part-2)	If in doubt, one test
	(d) Water absorption/content (IS: 2386, Part-3)	Once for each source of supply
	(e) Aggregate Impact Value (IS: 2386, Part-4)	One test per source of supply
	(f) Soundness (IS: 2386, Part-5) [if water absorption exceeds 2%]	- do -
	(g) Alkali Silica reactivity (IS: 2386, Part-7)	If in doubt, one test at approved test house
iv	Water	Once for each source, subsequently in case of doubt.
v	Admixture	
	• Chemical (for workability) (IS: 6925 & IS: 9103)	Manufacturer's certificate before procurement.
	• Mineral (Flyash) (IS: 3812)	- do -
vi	Dowel bars (plain steel) IS:432 (Part-I)	Tests on 3 samples to determine yield strength.
vii	• Premoulded Joint Filler (IS: 1838) or	Manufacturer's certificate.
	• Joint Sealing Compound (IS: 1834)	- do -

viii	Plants equipment and tools	As per contract.
ix	Concrete mix design for cement content, w/c ratio and dosage of plasticizers for the specified design strength.	To be approved by EE.
x	Granular Sub base	
	(a) Soil classification as per IS: 1498. - Wet Sieve Analysis, except for cohesion less soils - Liquid and Plastic Limits	Average of three tests from each source.
	(b) Combined Grading and Plasticity tests on materials from different sources, mixed in the design proportions. This shall be done when materials from more than one source are combined.	One test on the combined material for 500 m length of road or part thereof.
	(c) Proctor Compaction Test (IS: 2720, Part-7)	One test on the material from each source or on the combined material, as the case may be.
	(d) Wet Aggregate Impact Value Test (IS: 5640) where soft/marginal aggregates are used e.g. Laterite, Kankar, Brick Ballast etc.	One test from each source identified by the contractor.
	(e) CBR test (IS: 2720, Part-16) on representative sample compacted at 100% Proctor Dry Density)	One test per km length (average of a set of three specimens).
xi	Trial length	To be approved by EE before regular work.

1803.24.2 Tests during construction

The tests and checks to be carried out during construction shall be as given in **Table 1800.49** of Specifications for Rural Roads- 2014.

SN	Tests/check	Frequency
i	Subgrade	
	(a) Placement Moisture (IS: 2720, Part-2) where facility for oven drying is not available, any of the following quick test methods can be used: - Sand Bath Method - Rapid Moisture Method	At least 3 tests daily (well spread over the day's work)

	(b) in situ Density Measurements (IS: 2720, Part-28) [each layer]	At least 3 tests daily (well spread over the day's work) - Average of 3 tests results shall not be less than the specified degree of compaction. - Individual test values of the degree of compaction obtained shall not be less than 1% of the specified value of degree of compaction. (For example, for the specified 100% Proctor Density, the individual test value shall not be less than 99% of Proctor Density and the average of the three (or more) tests carried out in a day shall not be less than 100% Proctor Density).
	(c) Thickness of subgrade layer	At random
ii	Sub-base	
	(a) Wet Sieve Analysis (IS: 2720, Part-4) on the GSB material combined in the design proportions from various sources.	At least one test to be carried out daily.
	(b) Liquid and Plastic Limit tests (IS: 2720, Part-5)	- do -
	(c) Placement Moisture Content (IS: 2720, Part-2)	At least 3 tests to be carried out daily, well spread over the day's work
	(d) In situ Density measurements (IS: 2720, Part-28)	- do -
	(e) Thickness of compacted layer	At random
iii	Gradation and moisture content of aggregate for CC pavement	Minimum once per day
iv	Concrete workability (Slump cone test IS:1199)	One test per 3 cum of concrete at paving site or one test for each dumper laid at plant site.
v	Strength of concrete (IS: 516)	Min. 6 cubes and 6 beams (3 each for 7 day and 28 day strength) per day.
vi	Straightness of side forms (steel) (For paralleling and possible settlement and securing position before concreting)	To be checked daily.
vii	Size, spacing, paralleling of dowel bars and location of different joints	To be checked prior to casting of concrete at the location.
viii	Batching and Mixing of materials	Check for measurements and proper mixing
ix	Hot/Cold weather concreting including compaction	Checks regularly
x	Compaction equipment (Needle, Screed and Plate vibrators)	For continuous working and standby arrangement
xi	Separation membrane (thickness and laying)	Prior to laying of pavement concrete

xii	Levels and Alignment	
	(a) Level tolerance	To be checked for each day's work regularly
	(b) Surface Regularity (Transverse and Longitudinal including camber/cross slope)	- do -
	(c) Width of pavement and position of paving edges	To be checked for each ay's work regularly at grid points
	(d) Pavement thickness	To be checked for each day's work
	(e) Alignment of joints	- do -
	(f) Depth of Dowel bars	- do -
	(g) Texturing and Edging	- do -

1501.11.2-Specifications for Rural Roads-2014: List of Plants, equipment and tools

1. Two tilting type drum mixers of at least 0.2 cum/0.4 cum capacity with computer controlled weigh batcher for intake of materials. The number of mixers to be employed in a project shall be decided on the basis of the size of the project. One additional stand-by unit shall be kept at site.
2. Vibrating screeds of appropriate length so that the same can be supported on the side forms for tamping and compacting pavement surface. These are moved on the levelled side forms to achieve the required smoothness, grade and surface regularity. One screed vibrator shall have straight bottom for use on super-elevation and the other one will have specified parabolic camber.
3. Two needle vibrators, with one stand-by.
4. Plate compactor.
5. Core Cutting machine for cutting Cores of Concrete of Minimum 100 mm diameter and depth from 100 mm to 250 mm.
6. Wooden tamper 100 mm x 100 mm x 125 mm size with mild steel shoe at bottom.
7. Concrete saw cutter for cutting initial contraction joints and subsequent widening, in a continuously constructed lane.
8. Hand held sprayer for applying liquid curing compound with at least 10-20 litres capacity container/tank to be used where there is acute scarcity of water.
9. Texturing brooms of steel wires brush of adequate length.
10. One straight edge of 3 m length for routine checking, an additional master straight edge.
11. Graduated wedge.
12. Appropriate tools for sealing joints as per IRC: 57.
13. Fixed side forms measuring at least 100-150 m length.
14. Stop-end and start-end made of steel or wooden section.
15. Appropriate number of wheel barrows and iron pans.
16. Adequate number of spades, shovels and rakes.
17. Pump to clean the holes/grooves of joints.
18. Epoxy gun for filling holes with epoxy, if any, expansion joints are needed near existing bridges/culverts.
19. Two sets of bulk head stop-end made of iron sheet in two halves with half diameter circular holes in each half to hold the dowel bars and with adequate clamps to hold the assembly together.