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Effect of various Parameters on Performance of Rural roads Constructed under MPRRDA in Sagar District

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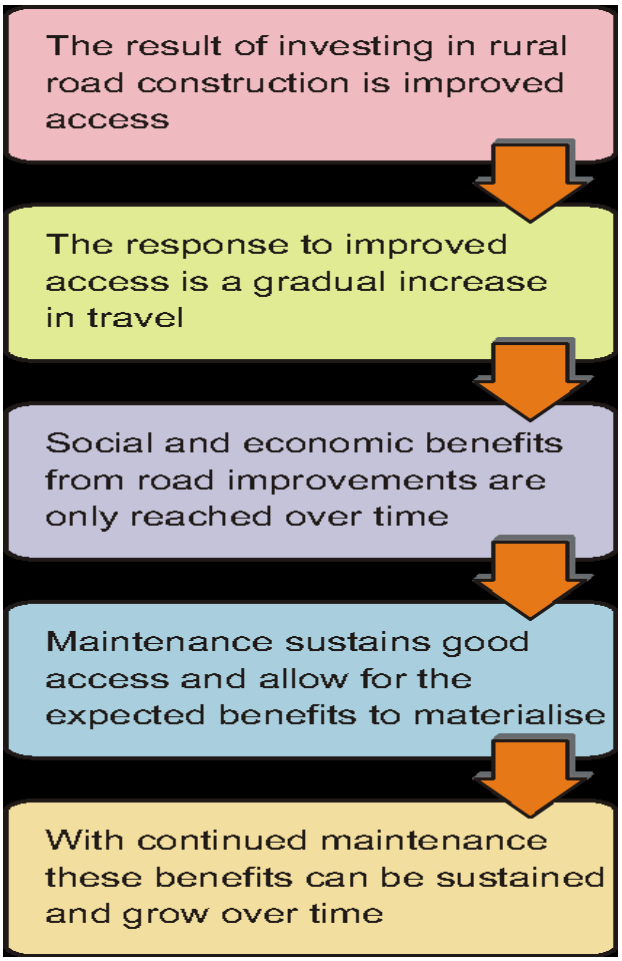
Abstract - *A wide range of government institutions are building rural roads in India. The Village Roads (VRs) and Other District Roads (ODRs), two categories of roads referred as Rural Roads, are normally under the jurisdiction of the Public Works Departments or Rural Development Departments within the State government administrations. There are also various agricultural marketing boards and similar agencies mandated to build and maintain rural roads. In addition, the Panchayati Raj Institutions at local government levels are in charge of some portions of the rural road network. Since December 2000, the Government of India has through the PMGSY embarked on a massive programme to provide connectivity to habitations through the rural road network across the country. The programme aimed to connect all habitations with a population of more than 500 inhabitants with all-weather roads in plains and 250 in hill states, desert areas and tribal areas. Rural road connectivity remains a highly important priority and as a result similar programmes are on-going in many states to connect smaller communities. The year 2013 saw the launch of PMGSY-II with the objective to consolidate the existing rural road network and upgradation of existing rural roads particularly that provide connectivity to rural growth centres and other critical rural business hubs. Maintenance of these roads is to be planned as area-based maintenance contracts. Considering the impressive results of these programmes, it is clear that this targeted focus on improving the quality of rural access has been extremely successful. The reasons for its success can to a large extent be credited to the effective management put in place to implement this programme, including key components such as establishing capable client organizations, streamlined procurement procedures, standardised technical designs, sound monitoring and quality assurance procedures and a regular and adequate flow of funds from central authorities down to project implementation levels*

Key Words: PMGSY, GSB, MPRRDA, AE

1. INTRODUCTION

For ensuring quality of work an appropriate technology must be adopted. In the context of rural roads, an appropriate technology implies an optimum blend of manual methods and mechanical equipment of adequate capacity which may also involve use of agricultural implements towed by tractor.



2. QUALITY CONTROL ASSURANCE

The Quality Control Register will be maintained in two Parts. The first Part will be Quality Control Register Record of Tests and the Second Part will be the Record of Abstract of Quality Control Tests and Non-Conformance Report Register. a. The first Part of the Register is the Register of all Quality Control Tests conducted by the person who is responsible for the basic Quality Control Testing; therefore, the first Part of the Register will be maintained by the person who is responsible for the basic Quality Control tests. If there is a provision of Quality Control by contractor in the Tender Document, the Quality Control Register will be issued to the contractor for every Road Work but if the responsibility of the basic Quality Control Tests is with the Department, the Register will be issued to the in-charge officer of the basic

Quality Control Testing of work not below the rank of Junior Engineer/sub Engineer.

The Second Part of the Register is the Record of abstract of the Tests conducted and Non-conformance reports; therefore, will be maintained by the site in charge officer not below the rank of Assistant Engineer. If the test results do not confirm to the prescribed limits, a Nonconformance Report (NCR) in the Format Prescribed in this Register will be issued to the Contractor.

Typical cross sections of rural roads under Malthone block of Sagar District

2.1 Horizontal alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings.

Table -1: Permitted Tolerance

Alignment	Plain & rolling terrain	Hilly terrain
Edges of carriageway	± 20 mm	± 30 mm
Edges of roadway	± 30 mm	± 50 mm

2.2 Embankment construction

Obtain materials (soil) for embankment from approved sources. Preference should be given to materials that are suitable and become available from nearby road excavation. For embankment over ground not capable of supporting equipment, successive loads of embankment materials should be spread in a uniformly distributed layer of adequate thickness to support the equipment and to construct the lower portion of the embankment.

Table 2 -: Dry Unit Weight for Embankment construction

	Types of work	Max. laboratory dry unit weight
1	Embankments not subject to flooding - Height up to 3m - Height more than 3m	 Not less than 14.4 kN/m^3 Not less than 15.2 kN/m^3
2	Embankments subject to flooding	Not less than 15.2 kN/m^3

2.3 Degree of Compactions

The embankment shall be compacted to satisfy the density requirements

Table -3: Compactions level

Types of works	Relative compactions as percentage of maximum laboratory dry density
Embankments	Not less than 97% of Standard Proctor Density
Sub grade	Not less than 100% of Standard proctor density
Expansive clays	Not less than 90% of Standard proctor Density

2.4 Granular Sub-Base (GSB)

Granular-Sub-base is often the main load-bearing layer of the pavement. Its role is to spread the load evenly over the subgrade. The materials used may be either unbound granular, or cement-bound. The quality of subbase is very important for the useful life of the road.

Table -4: Grading for Granular Subbase material

IS Sieve Designation	Per cent by Weight Passing the IS Sieve		
	Grading I	Grading II	Grading III
75 mm	100	--	--
53 mm	--	100	
26.5 mm	55-75	50-80	100
4.75 mm	10-30	15-35	25-45
0.075 mm (75 micron)	< 10	< 10	< 10

2.5 Base course

The **base course** or **basecourse** in pavements is a layer of material in an asphalt roadway, race track, riding arena, or sporting field. It is located under the surface layer consisting of the *wearing course* and sometimes an extra *binder course*. If there is a sub-base course, the base course is constructed directly above this layer. Otherwise, it is built directly on top of the subgrade. Typical base course thickness ranges from 100 to 150 millimetres (4 to 6 in) and is governed by underlying layer properties. Generally consisting of a specific type of construction aggregate, it is placed by means of attentive spreading and compacting to a minimum of 95% relative compaction, thus providing the stable foundation needed to support either additional layers of aggregates or the placement of an asphalt concrete wearing course which is applied directly on top of the base course.

Table -5: Grading for Base Course

IS Sieve desperation	Percent by Weight Passing IS Sieve		
	Grading A	Grading B	Grading C
53	100	--	--
37.5	97-100	100	--
26.5	--	97-100	100
19	67-81	--	97-100
9.5	--	56-70	67-79
4.75	33-47	39-53	47-59
425 µ	10-19	12-21	12-21
75 µ	4.0-8.0	4.0-8.0	4.0-8.0

2.6 Surface course

The wearing course is the upper layer in roadway, airfield, and dockyard construction. The term 'surface course' is sometimes used, however this term is slightly different as it can be used to describe very thin surface layers such as chip seal. In rigid pavements the upper layer is a Portland cement concrete slab. In flexible pavements, the upper layer consists of asphalt concrete, that is a construction aggregate with a bituminous binder. The wearing course is typically placed on the binder course which is then laid on the base course, which is normally placed on the subbase, which rests on the subgrade. There are various different types of flexible pavement wearing course, suitable for different situations. Stone mastic asphalt is a type of flexible pavement wearing course which is typically used for heavily trafficked roads.

Table -6: Grading for Surface Course

IS Sieve Designation	Per cent by Weight Passing IS Sieve
26.5 mm	100
19 mm	97-100
4.75 mm	41-71
425 µ	12-28
75 µ	9-16
Plasticity Index	4-10

2.7 Bitumen Hot Mix Plant

It has been brought to the notice of NRRDA that in a few States, the construction of Premix Carpet and Seal Coat is being done by manual means; the manual mixing of bitumen and stone chip is done over pans prepared by cutting empty bitumen drums in uncontrolled fire on high temperatures, which results in loss of properties of bitumen. The quality of such PMC and Seal Coat is not as per specifications and leads to poor riding surface which may result in rutting and pot hole formation within 1 to 2 years of its construction.

As per the provisions of para-508.1.3.4 of MoRD-Specifications for Rural Roads, August 2004, only for very small jobs the manual mixing has been allowed. As per item No.5.9 of MoRD-Standard Data Book for Analysis of Rural

Roads, September 2004, the analysis has been provided for construction by manual means and this provides for mixing of bitumen and chips in a small capacity hot mix plant, i.e., Mix all of 6/10 t capacity, however manual laying is permitted. It is clear that the manual mixing of bitumen and chips is not permitted in specifications for PMGSY roads. However, it seems that State Specifications were followed for the packages cleared in earlier years. Therefore; some States might still be permitting manual mixing. Construction of substandard work cannot be allowed even in packages which were cleared earlier on the basis of State Specifications. It has, accordingly, been decided that manual mixing of materials of PMC and Seal Coat should be prohibited with immediate effect and the States should ensure that the mixing of material for PMC and Premix Seal Coat is carried out in a hot mix plant as prescribed in item 508 of SDB irrespective of the provisions that might exist in State's own specifications for packages cleared before the current financial year.

me States verify the source of bitumen before allowing the use of bitumen in construction. Accordingly, submission of original bills and transit passes issued by the refinery which is supplying the bitumen to Contractor is made mandatory before allowing the use of bitumen in the construction. Bitumen is such a material in which there is considerable scope for spurious mixing of other liquids. As a result, in spite of provision of mandatory tests, it is difficult to ensure the quality and quantity of bitumen used.

States are therefore advised to consider **making mandatory the submission of original bills and transit passes issued by the refinery, before allowing use of the bitumen in the construction** of roads under PMGSY. The States may also evolve a mechanism to verify the release of bitumen to various Contractors through the refineries on a regular interval as a good construction practice.

2.8 Wet Mix Macadam (WMM)

This is new method where aggregate is mixed with water before laying and the wet mix is laid and then rolled. Wet mix roads are superior than WBM in all aspects. Wet Mix Macadam is a pavement layer wherein crushed graded aggregates and granular material, like, graded course sand arc mixed with water in mixing plant and rolled to a dense mass on a prepared surface. The mix may be spread either by a paver-finisher or motor grader It has many advantages over the WBM construction. These include superior gradation of aggregate, faster rate of construction, higher standard of densification that can be achieved, less consumption of water and stricter standards of quality achievable.

The specification can be adopted for sub-base and base courses. The work may be done in many layers. The thickness of an individual layer shall not be less than 75 mm and can be up to 2(X) mm suitable type of compacting equipment is used.

Typical elements of WMM plant

The surface to receive Wet Mix Macadam (WMM) shall be prepared as per sub-section 405. WMM shall be prepared in an approved mixing plant with mixing arrangements like the pug mill or pan type mixer of concrete batching plant. For small quantities of WMM, the Engineer may permit the use of concrete mixers. Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part 7) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. 3. Section-400 61 **Quality Assurance Handbook for Rural Roads**

Lateral confinement for WMM should be provided by laying material in adjoining shoulders along with the wet mix layer, refer Sub-section 407. Immediately upon mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub-base, in required quantities.

In no case should the material be dumped in heaps, directly on the area where it is to be laid. The mix may be spread either by a paver-finisher or motor grader. Thickness of a single compacted WMM layer shall not be less than 75 mm. When vibrating or other approved types of compacting

equipment are used, the compacted thickness of up to 200 mm may be adopted. The surface of aggregate shall be carefully checked with templates and all high or low spots should be remedied by removing/ adding aggregate as required. The thickness of layer shall be tested with depth blocks. No segregation of large and fine aggregates shall be allowed.

After the mix is laid to proper thickness, grade and cross fall/ camber, the same shall be uniformly compacted with a suitable roller. Rolling shall be continued till the density achieved is at least 100% of the maximum dry density as per IS:2720 (Part 7). If the surface irregularity of WMM course exceeds the permissible tolerances, the full thickness of layer shall be scarified over the affected area, reshaped by adding premixed material or removed and replaced with fresh premixed material as applicable and re-compacted. The area treated in this manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and un-graded materials or fines. After final compaction of WMM, the road shall be allowed to dry for at least 24 hours. Preferably no vehicular traffic should be allowed on the finished WMM surface till it has dried and the wearing course has been laid.

Table -7: Grading for Granular Subbase material

Test	Sub-Base	Base	Surfacing
Aggregate impact value	Less than 50	Less than 40	Less than 30
Flakiness Index	Less than 30	Less than 25	Less than 20
Soundness test -Loss with Sodium Sulphate	Less than 12%	Less than 12%	Less than 12%
-Loss with Magnesium Sulphate	Less than 18%	Less than 18%	Less than 18%

Table -8: Observed Grading for Granular Subbase material

Test	Sub-Base	Base	Surfacing
Aggregate impact value	55%	35%	25%
Flakiness Index	35%	40%	10%
Soundness test -Loss with Sodium Sulphate	8%	16%	09%

Table – 9 Grading requirements of coarse aggregate for WBM

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
1	**90 mm to 45 mm**	**125 mm 90 mm 63 mm 45 mm 22.4 mm**	**100 90-100 25-60 0-15 0-5**
2	**63 mm to 45 mm**	**90 mm 63 mm 53 mm 45 mm 22.4 mm**	**100 90-100 25-75 0-15 0-5**
3	**53 mm to 22.4mm**	**63 mm 53 mm 45 mm 22.4 mm 11.2 mm**	**100 90-100 65-90 0-10 0-5**

2.9 Flexible Pavement on Expansive soil

The amount of lime required for stabilization of the soil, should be determined on the basis of mix design to achieve the required CBR value. The thickness of any layer to be treated shall be 100 mm when compacted. The maximum thickness shall be 200 mm provided the plant is accepted by the Engineer. Lime may be mixed with the prepared material either in slurry form or dry state as approved by the Engineer. The top of windrowed material may be flattened or slightly trenched to receive the lime. The distance to which lime is to be spread upon the prepared material ahead of mixing operation shall be determined by the Engineer for which trial runs are advisable. It is good practice to pre-condition the soil by addition of 2% lime in the first instance and leaving it overnight before adding the moisture content of soil-lime mix at compaction shall be within (±) 2% of optimum moisture content determined on the basis of IS:2720 (Part 7). Immediately after spreading, grading and levelling of the mixed material, compaction shall be carried out. During rolling, the surface shall be checked for grade and camber. A density of at least 100% of the maximum dry density of the material, as determined in accordance with IS:2720 (Part 7) shall be achieved. The sub-base shall be cured by moist curing with water for a period of 7 days after which subsequent pavement courses shall be laid to prevent the surface from drying out and becoming friable.

3. CONCLUSION

PMGSY has succeeded in providing connectivity to some of the most deserving habitations although the pace of implementation in most of the selected States is rather slow. Selection of these road works seem to be justified, unless one

gives a high weightage to the opportunity cost in terms of road works forgone in other Districts/other States. All the implementing States have designated an implementing agency as the nodal agency. All the selected implementing States have more or less adhered to the PMGSY guidelines as far as selection of habitations, project proposals and clearance are concerned. Quality of PMGSY roads has been found to be generally good. PMGSY roads provide connectivity to important places such as School/College, Market Centre, and Block Office etc. It has improved the accessibility of beneficiary villagers and resulted in higher income in the form of better price for agricultural produce, new employment avenues etc. The cost of providing connectivity for some of the habitations in States like Himachal Pradesh is very high due to difficult terrain. But for PMGSY, no road would have been taken up in these sparsely populated habitations However, what is important is that not only both the phases of PMGSY are efficiently completed within prescribed time targets by overcoming the problems/constraints faced from time to time but the learning experiences of the past are also always kept in view. Further, it is hoped that by the end of Tenth Five Year Plan, all unconnected villages/habitations will be actually connected through the construction of all-weather surfaced roads so that vast chunk of India's population living in rural areas also enjoys the fruits of development.

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