



National Rural Infrastructure Development Agency
Ministry of Rural Development
Government of India



Pradhan Mantri
Gram Sadak Yojana

ADOPTING GREEN & NEW TECHNOLOGIES IN PMGSY



MAY, 2022



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ADOPTING GREEN and NEW TECHNOLOGIES IN PMGSY

INTRODUCTION

India has the second largest road network in the world. We have over 6.2 million km of roads. The administrative control of roads in India is divided as per the type of road and its geographical locations. The rural road is a state subject and within the state too, it is governed by several agencies such as Rural Development (RD), Panchayati Raj (PR), Rural Works Department (RWD), State Rural Road Development Agency (SRRDA), Public Works Department (PWD), Zilla Panchayat, Block Panchayat, Village Panchayat etc. The roads are primarily divided into following forms comprising different proportion:-

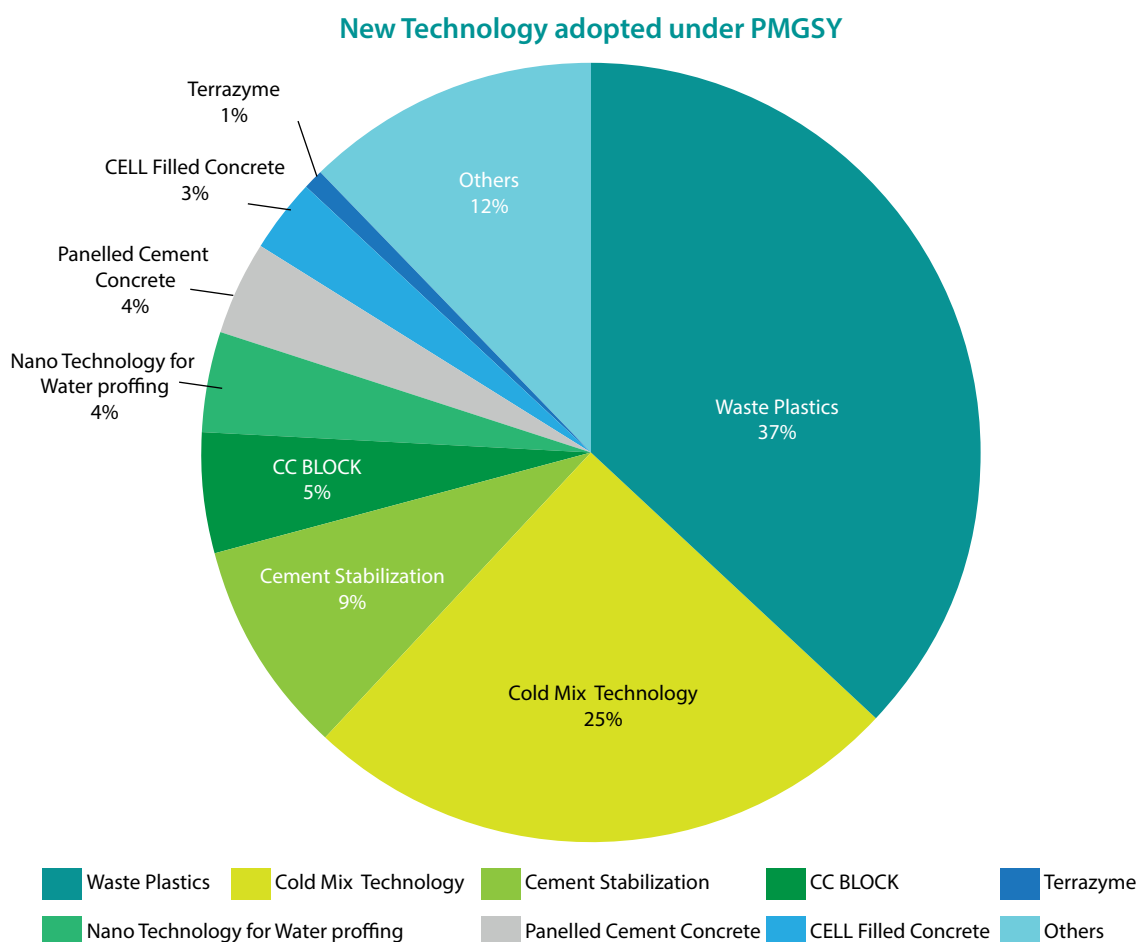
Category of Road Network	Percentage
National Highways	2.19%
State Highways	3.0%
Major District Roads	10.17%
Rural Roads	72.97%
Urban Roads & other Project Roads	11.67%

India is adopting new technologies day by day on a larger scale in construction of roads. Old technologies are used in construction involving certain specified construction materials which primarily involve usage of good quality soil and aggregate. The only reason that conventional technology holds good on to its users is its awareness among all. Thus, for the induction of new technology, its awareness and engineering advantages must be disseminated among various stake holders. The conventional technology has shown various drawbacks such as excessive use of natural resources, rapid depletion of aggregate, insufficient durability, poor riding quality, long hauls of construction material and excessive pollution, to mention a few.

In order to redress these challenges, it is need of the hour to adopt new/ innovative technologies in road sector in a big way. National Rural Infrastructure Development Agency (NRIDA) under Ministry of Rural Development (MoRD) has effectively initiated for promoting different newly developed technologies and in the process of achieving optimal use of such technology in building sustainable roads in cost effective manner while implementing construction/ upgradation of rural roads under PMGSY.

NEW TECHNOLOGIES IN PMGSY

- The roads in India are classified, based on construction technology/ material used as Flexible pavement, Rigid Pavement. The designs of different categories of roads are done as per specifications provided by prevailing Indian Roads Congress (IRC) Codes.
- The age long technologies involving certain specified construction material are used in construction. This method primarily involves good quality soil and aggregate. The only reason that conventional technology holds on to its users is mainly due to ease of understanding the conventional approach and awareness among all.
- Green, environment friendly and economically cheaper technologies are available which can create a permanent impact on our environment, as well as end the depletion of good quality conventional material which would ultimately minimize the damage to the environment due to emission of gasses like carbon dioxide and heavy suspended particles in the air and a way forward to Sustainable Development.
- A total length of 69278.06 km has been constructed till March 2022 using New Technologies under PMGSY.
- Under PMGSY-III, the States have been asked to propose at least 15% of the length of annual proposals under new and green technologies. In order to promote cost-effective and fast construction technologies and to achieve optimal use of non- conventional materials and cost- effective environment friendly “Green Technologies” in the construction of PMGSY-III roads, the prominent new technologies like use of waste plastic, cold mix technology, cell filled concrete, stabilization using cement and lime, nano technology, full depth reclamation (FDR) are in use. Using of new & green technologies has resulted not only in reduction of carbon footprint but also in savings of fuel and natural resources.



Green and New Technologies commonly being used under PMGSY are as under: -

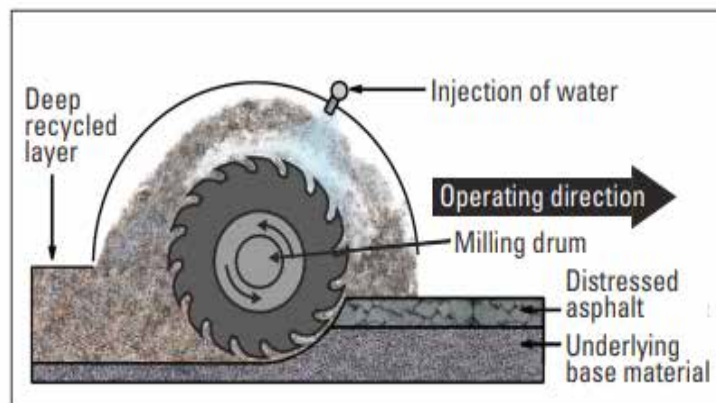
FULL DEPTH RECLAMATION TECHNOLOGY (FDR)

Full-depth reclamation of asphalt pavement is a rehabilitation method that involves recycling of the existing distressed bituminous layers of an existing asphalt pavement along with a predetermined thickness of the underlying granular (WBM, WMM and GSB) layer(s) into a new base layer. The FDR process begins with using a road reclaimer to pulverize an existing asphalt pavement layer and a portion of the underlying base, sub-base, and/or subgrade. Usually, the pulverized material is uniformly blended with an additional stabilizing material such as Portland cement or bituminous emulsion/foamed asphalt or other Commercial Chemical Stabilizers (CCS), to provide an upgraded, homogeneous material.

Some of the advantages of Full Depth Reclamation are as under:

- Most pavement distress can be treated satisfactorily.
- Cost effectiveness
- Early opening to traffic (Within 7-8 hours) of compaction
- Eliminates material disposal problem
- Results in conservation of natural resources
- Minimal air quality problem.
- Reduce carbon footprint

With the use of FDR technology, a strong cemented stabilized layer is produced, which behaves like a semi rigid pavement. Such pavements will behave in a satisfactory manner if they are laid on a uniformly compacted and structurally sound underneath layers. States such as Uttar Pradesh, Andhra Pradesh has used this technology on large scale for upgradation of Rural Roads.



WASTE PLASTIC

Waste plastic is shredded & coated over aggregate & mixed with hot bitumen and the resulted mix is used for pavement construction.

Some of the advantages of Waste Plastic are as under:

- Increased road strength (Increased Marshall Stability Value)
- Better resistance to water and water stagnation
- No stripping and have no potholes
- Increased binding and better bonding of the mix
- Increased load withstanding property
- Overall consumption of bitumen decreases
- Reduction in pores in aggregate and hence less rutting and ravelling
- Better soundness property
- Maintenance cost of the road is almost nil
- The Road life period is substantially increased

IRC code: IRC: SP:98-2013“ Guidelines for the use of waste plastic in Hot Bituminous mixes (dry process) in wearing courses”



Till date under PMGSY 25899.04 km of road length has been constructed using Waste Plastic all over the country, Madhya Pradesh has completed 8783.74 km which is the highest among all the States and UTs followed by Rajasthan and Chhattisgarh with the length 4646.29 km and 3090.67 km respectively completed using Waste Plastic.

COLD MIX

Cold Mix technology is field application of bituminous surfacing course using cold mix binders with the available IRC Specifications. In this technology heating of bitumen is not required resulting in saving in fuel and thereby saving of environment. By this process the construction activity will be faster. Cold mix technology is an impressive option to solve the problem of road connectivity in the states as various factors like rainfall, often delay in construction and maintenance of roads.

Some of the advantages of Cold Mix Technology are as under:

- 2-3 times faster progress using existing facilities at site without any extra investment in capacity building or equipment's.

- Green Technology: Non-polluting process, no heating, saves fuel and 90% energy efficient.
- Highly durable - contains anti-stripping properties, performing better than Hot Mix roads.
- All weather construction- during monsoons and cold winters on dry days.
- Local & semiskilled labour can execute the work.
- No chance of accident of labour

IRC code: IRC: SP:100-2014 "Use of cold mix technology in construction and Maintenance of roads using bitumen emulsion".



Till date under PMGSY 16987.84 km of road length has been constructed using Cold Mix all over the country, Odisha has completed 3933.20 km which is the highest among all the States and UTs followed by Uttarakhand and Assam with the length 1839.94 km and 1762.54 km respectively completed using Cold Mix Technology.

CEMENT STABILIZATION

- Construction of subbase/base course using locally available sub grade material adopting mechanical stabilization using cement as stabilizer.
- Cement stabilised base / subbase improves the strength, reduces the thickness of pavement ultimately proving to be economic.
- The hydrated products of cement bind the soil particles; the strength of the stabilised subbase/ base course depends upon the concentration of cement and the intimacy with which the soil particles are mixed with cement.

Advantages of CTB/CTB in Road Construction:

- The use of CTB/CTSB saves the material required for the construction of flexible pavement.
- The transportation charge, fuel consumption, machineries required is less for CTB/CTSB method than the traditional method. Hence the initial cost of construction is less for CTB/CTSB method.
- The CTB/CTSB is having more strength as compare to the traditional material. So, the maintenance work required for CTB/CTSB will be less. It will save the maintenance cost and affects the life cycle cost of the project.

IRC code: IRC: SP:89-2010 "Guidelines for Soil and Granular Material Stabilization using Cement, Lime & Fly Ash"



Till date under PMGSY 5887.09 km of road length has been constructed using Cement Stabilization all over the country, Jharkhand has completed 2959.39 km which is the highest among all the States and UTs followed by Odisha and Telangana with the length 1404.45 km and 459.86 km respectively completed using Cement Stabilization Technology.

CC BLOCK

Interlocking Concrete Block Pavement (ICBP) is an environment-friendly and labour intensive paving technology which is widely applied in many countries to solve special-purpose paving problems. The block-paved surface consists of interlocking flat concrete blocks on coarse bedding sand, with fine sand between the blocks. Compared with asphalt pavements, ICBP has less good initial riding quality, skidding resistance usually at least as good and lower noise. Four main approaches have been adopted for designing ICBP worldwide. ICBP has a life of about 40 years, with repairs needed after 20 years.

Advantages of CC BLOCK Pavements

- Concrete paver blocks can be used at habitation areas on rural roads without diversion of the Traffic as the construction process is relatively faster.
- It gives a good aesthetic view as compared to cast in situ concrete roads.
- As regard of maintenance point is concern the damaged blocks can be easily replaced whereas in case of concrete roads the replacement of damaged concrete is difficult.

IRC code: IRC SP 063: "Guidelines for the Use of Interlocking Concrete Block Pavement"



Till date under PMGSY 3309.98 km of road length has been constructed using CC BLOCK pavement all over the country, Assam being the leader with 3027.59 km length completed.

PANELED CEMENT CONCRETE

- Concrete pavement appears to be the obvious solution for such locations where Bitumen pavements are subjected to adverse moisture conditions due to inadequate and clogged drainage resulting in heavy damage during every monsoon.
- Since the initial cost of the conventional concrete pavement is quite high because of higher thickness. A new type of thinner concrete pavement with shorter panel size similar to the white topping over bituminous pavements as per IRC:SP:76-2008(1) can be used in the construction of concrete pavements for village roads and city streets because of low flexural stresses caused by shorter panel sizes.
- Panels of size 0.5m x 0.5m to 1.5m x 1.5m with thickness from 50mm to 150mm.

Advantages of Panelled Cement Concrete Pavements

- Panelled concrete pavements can be a good alternative for reducing the cost of concrete pavements for built up areas, rural roads, bus bays etc.
- Stresses are reduced drastically in concrete pavements with panels of size 1.0 m x 1.0 m.
- If alternative route can be arranged, this type of pavement is very easy to construct with much higher durability than Mastic Asphalt surfaced bituminous pavement and serviceability expected to be same as conventional rigid pavement at much lower cost.
- This technology can be emerged to be a good and long-term solution to the perpetual maintenance problem of the roads with poor drainage



Till date under PMGSY 2513.39 km of road length has been constructed using Panelled Cement Concrete all over the country, Bihar has completed 768.64 km which is the highest among all the States and UTs followed by Odisha and West Bengal with the length 761.92 km and 518.20 km respectively completed using Panelled Cement Concrete.

CELL FILLED CONCRETE

- Cell-filled concrete pavement is the technology developed by IIT Kharagpur, which has proved to be a very promising solution for overloaded vehicles, inadequate drainage facilities, and waterlogging problems.
- Cell-filled concrete pavement consists of formwork of plastic cells over the compacted subgrade / sub-base, filled with concrete or stones.

Advantages of Cell Filled Concrete Pavements

- Use of recycled plastic.
- As the expansion or contraction joints are not required, and hence maintenance of joints is eliminated.
- The cost of construction is considerably reduced when compared to conventional cement concrete pavement.
- The consumption of aggregates is almost reduced to 50% when compared to normal CC pavements.
- If the individual block fails, it can be easily replaced without much effort and with the least cost.



Till date under PMGSY 2218.32 km of road length has been constructed using CELL Filled Concrete all over the country, Assam has completed 565.97 km which is the highest among all the States and UTs followed by Bihar and Rajasthan with the length 522.01 km and 327.53 km respectively completed using CELL Filled Concrete.

SURFACE DRESSING

Surface dressing is a simple, highly effective, and inexpensive road surface treatment if adequate care is taken in the planning and execution of the work. The process is used throughout the world for surfacing both medium and light traffic roads, and as a maintenance treatment for roads of all kinds.

Surface dressing comprises a thin film of binder, generally bitumen or tar, which is sprayed onto the road surface and then covered with a layer of stone chippings. The thin film of binder acts as a waterproofing seal preventing the entry of surface water into the road structure. The stone chippings protect this film of binder from damage by vehicle tyres, and form a durable, skid-resistant, and dust-free wearing surface. In some circumstances the process may be repeated to provide double or triple layers of chippings.

Advantages of Surface dressing Pavements

- One of the Cheapest Surfacing Technique
- One - third the cost of premix carpet
- Precoat stone chips with bitumen if black surface desired; marginal cost increase of Rs. 0.34 lakhs totalling Rs. 2.96 lakhs per km
- Highly effective in waterproofing the road
- Used successfully worldwide for low to medium traffic roads (US, Europe & Australia)

IRC code: IRC 110-2005 "Standard Specifications and Code of Practice for Design and Construction of Surface Dressing"



Till date under PMGSY 948.70km of road length has been constructed using Surface dressing all over the country, Odisha has completed 457.23km which is the highest among all the States and UTs followed by Jharkhand with the length 385.16km completed using Surface dressing.

TERRAZYME

TerraZyme is an environmentally friendly soil stabilizer used in the construction of road infrastructure. The product provides a tool for engineers to reduce the construction costs, while increasing the overall quality of road structures. TerraZyme is easy to use, not harmful to the environment or its users and guarantees a better and longer lasting road that has been accepted and appreciated WORLDWIDE.

The use of TerraZyme in the construction of base and sub-base structures removes the need for the use of a sand/gravel mix; soling or water bound macadam in the construction of road structures. The base and sub-base constructed with TerraZyme are built up immediately from the sub-grade level. Between the sub-grade and the asphalt or concrete layers, TerraZyme constructed structures have a much greater flexural strength and a higher CBR % than the conventional structures.

Advantages of Terrazyme

- Liquid Enzyme, making it very easy to use and apply
- Cuts construction cost by 10%-20%, approximately Rs. 2 Lakhs to Rs 10 Lakhs per km
- Up to 70% GSB and Aggregate material in roads constructed is reduced.
- Reduction in Carbon dioxide emissions attributable to 1Km of Road construction using TerraZyme is approx. 5.0 Tonnes
- Higher CBR and Modulus / higher road strength
- Lowers the maintenance cost by 30-50%
- Saves construction time by 50%
- Pavement thickness is reduced by 5-10% in phase of trials
- Environment friendly and bio-degradable product
- The product has been accredited by IRC

IRC Accreditation: Soil stabilizing material used in construction of roads

Date of Issuance of Accreditation Certificate: 03-Jul-2013 (re renewed on 29-Oct-2016, 29-Oct-2018 and 16-Apr-2021).



Till date under PMGSY 997.90km of road length has been constructed using Terrazyme all over the country, Andhra Pradesh has completed 257.51 km which is the highest among all the States followed by Chhattisgarh with the length 251.74 km completed using Terrazyme.

The following Publications has been issued by IRC for Low Volume roads:-

Sl. No.	Publication
1	IRC: SP-72-2015 "Guidelines for The Design of Flexible Pavements for Low Volume Rural Roads"
2	IRC: SP- 62 2014." Construction of Cement Concrete Roads for Low Volume Roads".
3	IRC: SP:98-2013 "Guidelines for the use of waste plastic in Hot Bituminous mixes (dry process) in wearing courses"
4	IRC SP 063: "Guidelines for the Use of Interlocking Concrete Block Pavement"
5	IRC: SP:100-2014 "Use of cold mix technology in construction and maintenance of roads using bitumen emulsion".
6	IRC 110-2005 "Standard Specifications and Code of Practice for Design and Construction of Surface Dressing"
7	IRC:44-2008 "Guidelines for Cement Concrete Mix Design for Pavement"
8	IRC: SP:89-2010 "Guidelines for Soil and Granular Material Stabilization using Cement, Lime & Fly Ash"
9	List of IRC Accredited New Materials (as on 31.01.2022)

The following Guidelines/ Manuals/Formats/template have been issued by NRIDA/ MORD for PMGSY roads:

1	Programme Guidelines for PMGSY I
2	Programme Guidelines for PMGSY II
3	Programme Guidelines for PMGSY III
4	Operations Manual "Pradhan Mantri Gram SadakYojana"
5	Standard Bidding Document
6	Model Bidding Document (WB)under Pradhan Mantri Gram SadakYojana (PMGSY)
7	Guide on Managing Maintenance of Rural Roads in India
8	Manual on Procurement and Contract Management for PMGSY Rural Road Projects
9	NQM and SQM Inspection formats
10	DPR template for PMGSY-III
11	Proforma C for scrutiny of DPRs of Road works
12	Online Management, Monitoring and Accounting System (OMMAS)



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