

Maharashtra Rural Roads Development Association



सत्यमेव जयते

Chief Engineer

Pradhan Mantri Gram Sadak Yojana



e-mail : mh-ce@nic.in

Annasaheb Magar Buliding, 2nd floor, Market yard, Gate no-2 Pune – 411037.

☎ : 020-24262528

No.C.E./PMGSY/ 1844/2026

Date- 09/ 09/2026

To,

The Secretary,
Mukhya Mantri Gram Sadak Yojana
Rural Development Department
5th Floor, Bhandhkam Bhawan
Marzhan Street, Fort,
Mumbai- 400001

Sub: Publication of Green Road Vision Document on RDD Government of Maharashtra official website, ADB-RBL Loan-IND-4695.

Ref: Program Implementation Document (PID) vide table No. 10A.

With reference to above cited subject, it is submitted that, In Program Implementation Document (PID) as part of the activities under the ADB –RBL project, this office prepared the Green Roads Vision Document.

As per the requirement of the IVA certification, MRRDA is required to endorse the prepared Green Roads Vision document publish on its official website.

In view of the above, it is requested to kindly accord necessary approval/ endorsement and arrange for publication of this document on the official RDD website under the appropriate section, so as to comply with the requirements of the ADB- RBL Project and facilitate IVA certification.

The prepared document is enclosed herewith for kind perusal and necessary action please.

Encl : Green Road Vision Document.

(Sapna V. Koli)
Chief Engineer (PMGSY)
& MRRDA, Pune

Government of Maharashtra

No.MMGSY-2025/CR.No.377/Bandh-4
Rural Development Department
Government of Maharashtra
5th Floor, Bandhkam Bhavan,
Marzban Path, Fort, Mumbai -400001.
Date :26.05.2026

To,
Shri. Shiva Raju,
Project Officer,
Asian Development Bank (ADB)-(ID-4097),
4, San Martin Marg, Chanakyapuri
New Delhi - 110021.

Subject :- Publication of Green Road Vision Document 2026 for MRRDA ADB
RBL program. ADB Loan 4695.

Ref. :- Chief Engineer, PMGSY, Pune Letter No.CE/PMGSY/2086/2025,
Dt.19.08.2025, No.762/2026, Dt.16.04.2026 and No.980,
Dt.13.05.2026

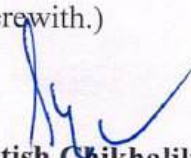
Respected Sir,

With reference to the Results-Based Lending (RBL) Program for the Maharashtra Rural Roads Development Association (MRRDA), this letter is to formally submit the "Green Road Vision Document 2026."

As per the established DLI Verification Protocol, specifically DLI 2 (b), the program requires the preparation, endorsement, and initiation of a Green Road Vision Document.

The document has been duly endorsed and is hereby officially published for implementation within the MRRDA framework.

We request you to take this submission on record for the purpose of DLI verification and subsequent disbursement processing. (Copy enclosed herewith.)


(Satish Chikhalikar)

Secretary (MMGSY) & CEO MRRDA,
Govt. of Maharashtra

Copy :-

1. Deputy Secretary (Bandhkam-4), RDD, Mantralaya, Mumbai
2. Chief Engineer, PMGSY, Pune.
3. Superintending Engineer, PMGSY, Amravati Region, Amravati.
4. Executive Engineer, PMGSY, Pune, Raigad, Parbhani and Gondia.
5. Select file (Bandhkam-4)

Maharashtra Rural Roads Development Association



Chief Engineer

Pradhan Mantri Gram Sadak Yojana



Annasaheb Magar Building, 2nd floor, Market yard, Gate no-2 Pune - 411037.

e-mail : mh-ee@nic.in

☎ : 020-24262528

No.C.E./PMGSY/2025

Date-19/08/2025

To,

Hon Secretary MMGSY
Maharashtra Rural Road Development Association
RDD, Govt of Maharashtra
5th Floor, Bandhakam Bhavan
25 Marzaban Street, Fort
Mumbai-01

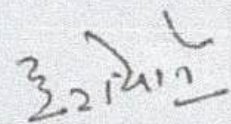
Sub- Publication of "Green Road Vision Document 2025" for MRRDA Asian Development Bank (ADB) Results-Based Lending (RBL) Program.

Ref - 1. This office letter No. CE/PMGSY/682/2025 dated 25/03/2025
2. SE, PMGSY Nagpur letter No. 940 dated 18/08/2025
3. DLI (1b) of ADB-RBL.

As per the Disbursement Linked Indicators (DLI) Verification Protocol of the ADB-RBL Programme, DLI (1b) is for the preparation, endorsement, and initiation of the Green Road Vision Document. In pursuance of this, and with reference to this office letter cited at Ref. 1, a committee was constituted under the Chairmanship of the Superintending Engineer, Nagpur, for the preparation of the said document.

Further, as per Ref. 2, the Superintending Engineer, Nagpur, has submitted the Green Road Vision Document. The document has been duly verified and is hereby forwarded for publication and submission to ADB.

Encl: Green Road Vision Document.


(Sambhaji S. Mane)
Chief Engineer (PMGSY)
& MRRDA, Pune

CC to: Superintending Engineer, Nagpur, for information.

Maharashtra Rural Roads Development Association



Chief Engineer

Pradhan Mantri Gram Sadak Yojana

Annasaheb Magar Buliding, 2nd floor, Market yard, Gate no-2 Pune - 411037.
e-mail : mh-ce@nic.in

No.C.E./PMGSY/ 762 /2026

Date- 16/04/2026

To,

Secretary,
Mukhya Mantri Gram Sadak Yojana,
Rural Development Department,
5th floor, Bandhakam Bhavan,
Fort, Mumbai.

Sub - Publication of "Green Road vision Document 2025" for
MRRDA ADB Result Based Lending (RBL) Program.

Ref - This office letter no. CE/PMGSY/2086/2025,
Dt. 19/08/2025.

As per the Disbursement Linked Indicator (DLI) and verification protocol of the ADB-RBL Program, DLI 2(b) pertains to the preparation, endorsement, and initiation of the Green Road Vision Document.

In this regard, the Green Road Vision Document has already been prepared and submitted for publication and onward submission to ADB. However, the publication of the document is still pending.

Therefore, it is requested to kindly take necessary action at the earliest to facilitate the publication of the document and its submission to ADB.

Encl. :- Green Road vision Document

(Sapna V Koli)
Chief Engineer,

Pradhan Mantri Gram Sadak Yojana
MRRDA, Pune

Copy :- Superintending Engineer, PMGSY, Nagpur Region, Nagpur for information.

Received
20/05/2026

Maharashtra Rural Roads Development Association



Chief Engineer

Pradhan Mantri Gram Sadak Yojana



Annasaheb Magar Buliding, 2nd floor, Market yard, Gate no-2 Pune - 411037.

e-mail : mh-ce@nic.in

☎ : 020-24262528

No.C.E./PMGSY/ 980 /2026

Date- 13/05/2026

To,

Secretary,
Mukhya Mantri Gram Sadak Yojana
Rural Development Department
Bandhakam Bhavan
25th Marzban Street,
Fort, Mumbai 400001.

Sub - Publication of Green Roads Vision document 2026 for MRRDA Asian
Development Bank- Result Based Lending (RBL) Program. ADB- Loan 4695.

Ref - ADB-RBL PID - Disbursement Linked Indicator (DLI) 2(b).

With reference to the above cited subject, the Asian Development Bank (ADB) assisted Results-Based Lending (RBL) Program for Maharashtra Roads Connectivity for Inclusive Growth includes Disbursement Linked Indicator (DLI) 2(b), which stipulates preparation and endorsement of the Green Roads Vision document for MRRDA Rural Roads.

Green Roads Vision document has prepared with reference of Disbursement Linked Indicator (DLI) 2(b). The document outlines the framework and strategic approach for development of climate-resilient, low-carbon, safe, inclusive, and environmentally sustainable rural road infrastructure.

Green Roads Vision document is enclosed herewith for kind perusal, and submitted for further necessary action please.

Encl - Green Roads Vision document

(Sapna V. Koli)
Chief Engineer (PMGSY)
& MRRDA, Pune



Dr. Chandrakant Pulkundwar
Secretary, Rural
Development and Panchayat
Raj Department



Government of
Maharashtra Rural
Development &
Panchayat Raj
Department

Message

On the lines of Pradhan Mantri Gram Sadak Yojana (PMGSY), the State Government launched Mukhya Mantri Gram Sadak Yojana (MMGSY) vide GR dated 28th October 2015 to provide all-weather connectivity to unconnected habitations (population ≥ 500) and to upgrade rural roads in poor condition. Initially, MMGSY aimed to upgrade 30,000 km of roads.

MMGSY-II was launched on 6th January 2022 with targeted upgradation of 10,000 km of rural roads. Further, the Cabinet (14th February 2024) approved an additional 7,000 km under the Research & Development Programme using Thin White Topping (TWT) technology. Subsequently, as per GR dated 16th March 2024, upgradation of 23,000 km of ODR and VR has been approved in phases. Under MMGSY Phase III, 23,000 km will be taken up phase wise 10,000 km in 2024–25 and the remaining in 2025–26 and 2026–27 (6,500 km per year), subject to fund availability.

Aligned with PMGSY guidelines and the Asian Development Bank's Green Roads Toolkit, emphasis is placed on adopting sustainable and cost-effective green technologies. The Green Road Vision Document, 2026 aims to promote wider use of innovative materials and technologies, ensuring improved road quality, environmental sustainability, and better outcomes for stakeholders and citizens and thereby bring out greater economy, less impact on environment, higher citizen comfort.



Mr. Satish Chikhalikar
Secretary (MMGSY) &
project Director



**Government of
Maharashtra Rural
Development &
Panchayat Raj
Department**

Forward

To improve rural connectivity and support development in trade, agriculture, health, education, economy, and social awareness (HDI), the Government of Maharashtra launched the Mukhya Mantri Gram Sadak Yojana (MMGSY) on 28th October 2015, based on the principles of the Government of India's Pradhan Mantri Gram Sadak Yojana (PMGSY).

PMGSY promotes the use of innovative technologies through the "Vision Document on New Technology Initiative & Guidelines-2022." In line with this, the Asian Development Bank (ADB) has introduced the "Maharashtra Green Road Connectivity for Inclusive Growth Program" under the Result Based Lending (RBL) initiative. As per DLI-1, MRRDA is required to prepare a Green Roads Vision Document and implement Green Road measures on a minimum of 860 km of roads under the program.

This document has been prepared with contributions from MRRDA officials including Mrs. Sapna Koli (Chief Engineer), Mr. Vishal Jawanjal, Superintending Engineer, Amravati Region; Mr. Satyashil Nagarare, Executive Engineer, Pune; Mrs. Sarika Desai, Executive Engineer, Raigad; Mr. Krushna Wagh, Executive Engineer, Parbhani; Mr. Ashish Awale, Executive Engineer, Gondia. Guidance and support from Hon'ble minister Jayakumar Gore, Hon'ble state minister Yogesh Kadam, and Hon'ble Secretary, Rural Development and Panchayat Raj Department Dr. Chandrakant Pulkundwar are gratefully acknowledged for promoting green and innovative technologies under MMGSY.

Contents

Sr. No	Topic	Page No.
1	Introduction	4
2	Challenges in Road Construction	7
3	Action Required for Green Road Technology	8
4	Emergence of New Technologies in Road Construction & their Acceptance.	10
5	Maharashtra Green Technology Vision 2025	12
6	Types of New Materials/Technologies and Guidance on their Adoption as per Green Technology Vision 2025	13
	6.1 Soil Stabilisation	13
	6.2 Full Depth Reclamation (FDR)	14
	6.3 White topping (Panelled Concrete)	17
	6.4 Cold Mix Technology	18
	6.5 Waste Plastic in the Bitumen Layer	20
	6.6 Fly Ash	22
	6.7 Coir Geosynthetics	23
	6.8 Geosynthetics	24
	6.9 Industrial Waste	26
	6.10 Road Side Rain Water Harvesting for Road Drainage and ground water recharge	27
	6.11 Bridge cum Bandhara	28
	6.12 Bamboo Crash Barrier	29
	6.13 Tree Plantation Along Rural Road.	30
7	Methodology	33
8	Guidelines for Adoption of New Technology	49
9	Training & Awareness	50
10	Available Guidelines	51

1. Introduction

The Government of Maharashtra (GOM) has identified 750 kilometers (km) of priority state roads and 2576.55 km of rural roads for immediate intervention to (i) address climate- and disaster-risk vulnerability; (ii) boost connectivity from farm to post-harvest centers, state transport services, educational institutions and medical facilities; (iii) enhance connectivity to business parks, processing and manufacturing zones, industrial clusters, multimodal logistics hubs and dry ports; (iv) promote districts with lagging multidimensional poverty; and (v) improve road safety

For rural roads under the RBL, the Maharashtra Rural Road Development Agency (MRRDA) is the Executing Agency (EA) under the overall supervision of the Program Director (Secretary) at the state level. A Program Management Unit (PMU) is already in place, headed by Chief Engineer (CE) as the Deputy Program Director (DPD), responsible for overall program implementation and safeguards. At the regional level (6 regions), the Superintendent Engineers (SE) act as Assistant Program Directors (APDs), responsible for the implementation of the program and safeguards in their respective regions. At the district level, 34 Program Implementation Units (PIUs) headed by Executive Engineers (EEs) will be responsible for implementing the program at the ground level.

Maharashtra's Road transport subsector to promote decarbonization pathways, climate resilience, disaster-risk preparedness, and road safety and asset management system maturation

The RBL program will demonstrate best practice in integrating climate and disaster risk and resilience with road asset management, with the objective to improve the overall condition and performance of the road network, minimize life

cycle costs, enhance road safety, enhance poverty reduction and provide satisfactory levels of service to road users.

Selected roads will boost farm-to-market connectivity, improve rural, intrastate, and interstate transport links, facilitate access for small-scale industries, and support Maharashtra's economic growth by fostering more inclusive connectivity.

accelerating progress in gender equality, building climate and disaster resilience and enhancing environmental sustainability, promoting rural development and food security, and strengthening governance and institutional capacity. The program will adopt a result-based lending approach and the outputs are Output 1: Climate and disaster-resilient and inclusive infrastructure and institutional systems established; Output 2: Maturity of road safety systems and institutional functions advanced; and Output 3: Asset management and maintenance systems strengthened and sustained.

The direct impact of the project will be triggered due to improved accessibility to various services such as to markets, health facilities, schools, and workplace, which in turn increases the income of the local residents including STs, and ultimately elevating their standard of living

Impacts of project are listed below.

- Improved roads will increase the competitiveness of the agriculture sector and improve rural socio-economic outcomes. Farmers will ensure transportation of their produce with minimum spoilage.
- Improved road network will provide for improved linkages between the village communities and urban center, which provides wider marketing facilities.
- Better connectivity and access to health, education and social services will enhance social outcomes and reduce the poverty of isolation and exclusion.

- Road network will not only link the village communities to better markets, but also open up wider work opportunities in distant places. People can shuttle to distant work sites and towns and engage in construction, factories, business as well as domestic works.
- Improved road will also help people building strong institutional network with outside agencies. Essential and emergency services like schools, health center, public distribution system etc. can be availed faster.
- Increased frequency of interaction with outsiders will increase the awareness level of the people in the village with regard to their health and nutrition, living style, value of education and proper utilization of available resources.
- Interaction with the government, non-government and other development agents will help people gain new knowledge on improved farming, land development, development and maintenance of natural resources through the formation of various economic and social development groups.
- Road safety will help reduce the vulnerability of low-income households including the STs to the substantial shocks caused road crash fatalities and injuries.

2. Challenges in Road Construction

Road infrastructure plays a vital role in the sustainable growth and socio-economic development of the country. However, conventional road construction practices involve excessive use of natural resources, environmental degradation, pollution, and high maintenance costs. To address these challenges, there is a growing need to adopt sustainable and environment-friendly technologies in road construction.

The Ministry of Rural Development (MoRD) has been promoting the use of innovative and green technologies under PMGSY/MMGSY for construction of durable and cost-effective rural roads. In line with this approach, the Asian Development Bank (ADB) is implementing the “Maharashtra Green Roads Connectivity for Inclusive Growth Program” under the Result-Based Lending (RBL) initiative to promote climate-resilient, low-carbon, and sustainable rural connectivity across Maharashtra.

As per Disbursement Linked Indicator (DLI) No. 1 of the RBL program, preparation of a Green Roads Vision Document and implementation of green road measures over a minimum length of 860 km is mandatory.

3. Actions Required for Green Road technology

a. Eco-Friendly Road Design & Planning

Sustainable road development starts with thoughtful planning and design. Aligning road routes to avoid sensitive ecosystems, minimizing deforestation, and incorporating wildlife corridors and underpasses can help reduce habitat fragmentation and allow safe passage for animals. Sustainable drainage systems prevent erosion, control storm water runoff, and protect surrounding ecosystems.

b. Use of Sustainable Materials

The materials used in road construction have a significant impact on the environment. By recycling waste materials like fly ash, slag, and plastic waste, green road technology can reduce landfill waste and conserve natural resources. Porous asphalt helps prevent flooding by allowing water to percolate, and green concrete offers reduced carbon emissions and waste recycling opportunities.

c. Plantation and Afforestation

Tree planting along road sides is a key strategy to offset carbon emissions, improve air quality, and create green buffers for noise reduction. Using native and drought-resistant plant species ensures long-term sustainability, while afforestation efforts along roads help restore degraded ecosystems.

d. Pollution Control and Mitigation

Real-time air quality monitoring systems help reduce pollution by promoting cleaner driving habits and encouraging traffic management strategies that reduce congestion.

e. Green Construction Practices

Green roads prioritize low-emission construction techniques, employing machinery and vehicles that reduce carbon footprints. Advanced engineering techniques, such as tunneling and bridging, help minimize land disturbance and preserve natural landscapes.

f. Sustainable Pavement Technologies

The development of cold mix asphalt and warm mix asphalt has reduced energy consumption and emissions during road construction. Additionally, perpetual pavements—designed to last longer—reduce the need for frequent maintenance and resource consumption.

g. Incorporating Renewable Energy

Motivate and educate the people towards renewable energy sources such as solar and wind power can generate electricity. Solar energy farms and panels can provide a sustainable source of power, while wind energy may be harnessed in areas with favourable conditions.

4. Emergence of New Technologies in Road Construction & their Acceptance

There are several technologies which are already part of IRC code, standards, and specifications, but are not being adopted in the field although they are proven to be cost effective and have huge potential in reducing environmental damage and conserving natural resources. These technologies need to be adopted on a larger scale.

Major proven technologies considered useful for rural roads, with relevant Indian Roads Congress Specifications.

Codes/MoRD specifications are as under:

- (i) Soil stabilisation technologies:
Stabilisation of soil and granular material using cement, lime, fly ash – MoRD for Rural Roads-2014 and IRC:SP:89-2010. Stabilisation of soils and granular materials using various commercial chemical stabilisers- Guidelines for the Design of Stabilised Pavements – IRC:SP:89(Part-II)-2018.
- (ii) Improving properties of locally available materials and marginal materials, soft aggregates, brick aggregates etc. – MoRD Specifications for Rural Roads-2014.
- (iii) Use of fly ash in cement for concrete structures (culverts, bridges)/use of blended cement- MoRD Specifications for Rural Roads-2014.
- (iv) Guidelines for conventional and thin White topping- IRC: SP:76 -2015.
- (v) Cold mix technology using bitumen emulsions for bituminous wearing coat (premix carpet, surface dressing) –

IRC: SP: 100-2014 and MoRD Specifications for Rural Roads-2014.

- (vi) Use of bio-engineering measures including jute/bamboo matting for slope stabilisation, crib wall, terracing with locally available pine trees, bamboos, etc. in hilly areas-MoRD Specifications for Rural Roads-2014.
- (vii) Guidelines for use of Iron, Steel and Copper Slag in Construction of Rural Roads – IRC: SP: 121-2018.

MoRT&H has clarified that materials and technologies accredited by IRC and covered under IRC:SP:89 (Part-II), or for which standards/specifications of IRC, MoRT&H, AASHTO, ASTM, Euro Codes, or British Codes are available, shall be treated as approved technologies and will not require separate accreditation. The Defects Liability Period (DLP) for such works shall be at par with conventional road construction.

For new technologies/materials without approved codes or specifications, pilot implementation may be undertaken as Technology Driven Demonstration Projects (TDDP) on stretches up to 2 km under PMGSY, with performance evaluation through reputed technical institutes under a tripartite MoU arrangement.

5. Maharashtra Green Technology Vision 2025

5.1 Under MMGSY the following guidelines shall be applicable for surface course:

- (a) Compulsory use of waste plastic in at least 50% length out of the eligible proposed length involving Hot Mix process.
- (b) Cold Mix Technology shall be used in minimum 5% of the total eligible proposed length. The use of cold mix technology shall be prioritised in climatically suitable areas.

5.2 Under MMGSY the following guidelines shall be applicable for subgrade, sub base, base course:

- (a) At least 50% of the proposed road length shall be constructed using approved green technologies and sustainable materials.
- (b) All Cement Concrete roads shall preferably use Thin White Topping (Short Panel Concrete) or Cell Filled Concrete, while use of PQC shall be limited to exceptional cases only.
- (c) Full Depth Reclamation (FDR) with stabilization technology shall be preferred in areas where aggregate availability is poor or transportation cost is high.
- (d) Fly ash shall be utilized in CTB and embankment works near thermal power plants.
- (e) Slag shall be used in sub-base, base course, and embankments near steel plants.
- (f) Jute Geo-textiles, coir, and similar locally available materials shall be used for slope protection and subgrade improvement in suitable areas.

6. Types of New Materials/Technologies and Guidance on their Adoption as per Green Technology Vision 2025

Various technologies in use in MMGSY/PMGSY are described in brief below:

6.1. Soil Stabilisation

Soil Stabilization is the biological, chemical or mechanical modification of soil engineering properties. Stabilisation is the process of improving the engineering properties of the soil before construction. These properties include mechanical strength, permeability, compressibility, durability and plasticity. Stabilisation is done to improve the strength of the soil thus improving the load bearing capacity and the overall performance of the in-situ soils.

There are 3 main methods for soil stabilisation: Mechanical Stabilisation, Chemical Stabilisation and Polymer Stabilisation.

Mechanical stabilization consists of physical processes such as compacting or tamping with machineries including rollers or rammers. The mechanical soil stabilisation is also achieved by blending (adding or removing) different soil particles so as to obtain effective distribution of soil particle. These techniques are usually used for sub-base and base courses.

Chemical stabilisation of soils depends on the chemical reaction between the chemical/stabiliser used and the soil particle composition. These include Cement, Lime,

Magnesium Chloride, Bitumen Emulsion and Fly Ash among others.

Polymer soil stabilization refers to the addition of polymers to improve the physical & engineering properties of soils. Polymers tend to increase the strength of the soil through their interaction with clayey particles present in the soil. Many polymers currently used, tend to increase the water retention capability and the shear strength of the soil. Various chemicals/additives are available for the soil stabilization process.

The key advantages of soil-stabilization are as follows:

- Utilization of local and in situ materials
- Large number of waste materials can be utilized by increasing their strength
- Large savings in aggregate consumption
- Since locally available materials can be used and aggregate consumption is less, there can be savings in consumption and reductions in CO₂ emissions on account of transportation of material.

6.2. Full Depth Reclamation (FDR)

Full Depth Reclamation (FDR) involves recycling existing bituminous pavement and its underlying layers into a new base layer through a prescribed process which is pulverizing existing pavement (wearing course, base, and sub-base), blending with cementations agent, water, corrective aggregates (if needed) as per mix design to produce a cementations stabilized base. It is a sustainable technology for

pavement rehabilitation, cost effective alternative, and thinner surface course. It increases the structural capacity of new pavement by providing a stronger and more consistent base. FDR with cement saves money and reduces the carbon footprint of roadway construction projects by reducing mining, hauling, and disposal of basic construction materials. IRC has prepared guidelines for Pavement Recycling/Reclamation, Full Depth Recycling (IRC:120). NRIDA has published guidelines for FDR in May, 2022.





The key advantages of FDR are as follows:

- Pavement condition improvement – Long life pavement capable of carrying higher traffic loads, Vastly improved resilient modulus
- Environmental benefits – Use of in-situ materials, in a cost effective, environment friendly manner
- Sustainable technology for pavement rehabilitation, least cost alternative and thinner surface course.

6.3. White topping (Short Panelled Cement Concrete)

White Topping is a Portland Cement Concrete (PCC) overlay constructed over an existing bituminous road for rehabilitation and strengthening. As per IRC:SP:76-2008, thinner concrete pavements with short panels (1 m × 1 m to 1.5 m × 1.5 m) and thickness of 100–200 mm are suitable for village roads and urban streets. White Topping provides longer service life, improved durability, better riding quality, lower maintenance cost, and is particularly effective for roads with poor drainage conditions. (eg. Construction of Road Tal Amrori Dist. Gadchiroli)



6.4. Cold Mix Technology

Cold mix technology uses cationic bitumen emulsion instead of viscosity grade bitumen for construction of black top layer. This technology has much promise, particularly in the areas of cold climate and high-altitude areas, inside forests and other environmentally sensitive locations, etc., since it does not require setting up of hot mix plant for production of bituminous mix. It can also be adopted for projects where in lead distance for hot mix from plant to site is large or has obstructions. However, after admixing bituminous emulsion with aggregates of specified gradation, the cold mix cannot be transported over long distances, and hence mixing should always be carried out adjacent to or very near (within few hundred metres) to the laying location. Several agencies are manufacturing emulsions with and without foreign collaborations. This is an environment friendly technology and is not equipment intensive. This technology has been used on rural roads in a few states during the past few years with good results.

The life cycle assessment showed that the PM10 emission was 33% lower with the use of CMA compared to the HMA. In addition, 7% reduction in energy consumption was noticed with the use of CMA compared to HMA. This indicates that the CMA can significantly reduce the carbon footprint associated with the road construction activities. However, the implementation of the CMA may be taken at arid regions of India, where one may expect lesser annual rainfall as it was observed that CMA mixtures are sensitive to moisture damage. IRC has prepared guidelines for the Use of cold mix technology

in construction and Maintenance of roads using bitumen emulsion (IRC SP: 100-2014).

The key advantages of cold-mix asphalt are as follows:

- The technology reduces the energy requirement during constructions as it does not need additional heating nor does it require petroleum solvent to make it workable.
- It reduces local pollution as on-site burning of fuels is not required to prepare bituminous mix.
- Bitumen emulsions have the ability to coat damp aggregate surface, which eventually reduces the fuel requirements for heating and drying aggregates.
- Availability of various kinds of emulsions has led to development of new formulations, which satisfy certain design and construction requirements and help encourage the use of local available materials



(eg. MRL04-MSH 6 (Ganeshwadi) Patkhal to Dongargaon, Dist. Solapur)

6.5. Waste Plastic in the Bituminous Layer

Waste plastic can be used as a modifier for bituminous hot mixes. Specified types of waste plastics (refer to **IRC SP: 98-2020**) are available in plenty in urban areas. This needs to be processed to clean and bring waste plastic to proper gradation before mixing. This technology can be adopted all over India, to construct better quality bituminous wearing courses. It may be mentioned that during the past few years, several rural road projects have been undertaken with the use of plastic waste in bituminous works. Waste plastic is shredded & coated over aggregate & mixed with hot bitumen and the resulted mix is used for pavement construction. The advantages of Waste Plastic are that there is increased road strength (increased Marshall Stability Value), better resistance to water and water stagnation, increased binding and better bonding of the mix, increased load withstanding capacity and road life period is substantially increased.

It was observed that the environmental impact of Waste Plastic Road is marginally more compared to that of conventional road. The environmental benefit comparison has been done based on CO₂ equivalent emission at the stage of construction. IRC has prepared guidelines for the Use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Courses (**IRC SP: 98-2020**).

The following are the key advantages of the use of plastic waste in bitumen mixes:

- It increases the resistance to deformation.
- Plastic provides higher resistance to water-induced damages.

- It increases durability and enhances fatigue life.
- It provides improved stability and strength.
- It addresses the issue of disposal of waste plastic, thereby making the use of plastic environment friendly.



(eg Ranbambuli Wayangankarwadi Railway Station Road
Tal.Kudal)

6.6. Fly Ash

Fly ash is a fine residue of coal combustion in the Thermal Power Plants. Fly ash is an effective agent for chemical and/or mechanical stabilization of soils which enhances the soil density, water content, plasticity, and shear strength of soil. Fly ash eliminates the need for expensive borrow materials, expedites construction by improving excessively wet or unstable subgrade. By improving subgrade conditions, it promotes cost savings through reduction in the required pavement thickness and hence eliminates the need for more expensive natural aggregates in the pavement cross-section. Fly ash can also be used as cost-effective mineral filler in hot mix asphalt (HMA) paving applications. Where available locally, fly ash may cost less than other mineral fillers. Also, due to the lower specific gravity of fly ash, similar performance is obtained using less material by weight, further reducing the material cost of HMA. Mineral fillers increase the stiffness of the asphalt mortar matrix, improving the rutting resistance of pavements. Mineral fillers also help reduce the amount of asphalt drain down in the mix during construction, which improves durability of the mix by maintaining the amount of asphalt initially used in the mix. IRC has prepared the guidelines for the Stabilisation of soil and Granular Material using Cement, Lime, Fly Ash (IRC SP: 89-2010).



6.7. Coir Geosynthetics

Coir Geo textiles (CGT), a permeable fabric, natural, strong, highly durable, resistant to rots, moulds and moisture, free from any microbial attack, has finally been accepted as a good material for rural road construction. Coir Geotextile is produced using coir, which is made from the husk of a coconut. Among all the natural fibres available, coir fibre possesses high strength and low rate of degradation due to its high lignin content. It has been observed that CGT, when applied at the interface of subgrade and subbase, enhances the load bearing capacity of subgrade soil by performing the concurrent functions of separation, filtration, drainage and initial reinforcement within one or two season cycles. Use of CGT in road construction will intensify the utilization of the country's resource within its own geographical area and environment. Because it is a naturally occurring material, it can help save material for pavement construction while lowering the overall cost. The Indian coir business is a rural agro-based industry that employs over 7 lakh people in the country's key coconut-producing states. IS 15871-2009 provides the guidelines for the Use of geo-textiles, jute and coir technology in road pavements and associated works.



6.8 Geosynthetics

Geosynthetics and geo-textiles are used in road pavements for separation, filtration, drainage, and reinforcement, particularly in problematic soil conditions such as black cotton soil and poor drainage areas. Under MMGSY/PMGSY, agro-based geo-textiles like coir and jute are recommended for subgrade improvement, slope protection, and embankment stabilization.

Geo-cells are honeycomb-shaped confinement systems filled with soil or marginal aggregates, enabling economical use of local and recycled materials. They can reduce construction cost by up to 30%, save construction time, and improve pavement durability.

IRC has also published IRC:SP:126-2019 for design and construction of low-volume rural roads using jute geo-textiles.





The key advantages of geo-synthetics are as follows:

- Geo-synthetics in road construction can help reduce the requirement of excavating and transporting the good soil and can help increase pavement life, which can indirectly reduce the CO2 emissions from road construction.
- Use of geo-synthetics can result in increased service life of flexible pavement
- Increase the allowable bearing capacity by 40%–50%.
- Increase the speed of construction due to quick installation and increase the possibility of construction to be completed in a shorter period.

6.9 Industrial Wastes

Many waste materials are available in different parts of the country such as Fly ash, Construction and Demolition (C&D) waste, Marble dust and Slurry, Mining and Quarrying Waste, Blast Furnace Slag, Steel Slag, Copper Slag, Zinc Slag, Rice Husk Ash, Phosphogypsum, Foundry Sand, etc. Use of such materials has already been demonstrated to be useful in various layers of road embankment and pavement. Utilisation of such materials is encouraged for converting waste to wealth and reducing environmental impact. Coal based thermal power stations and heavy industries are well distributed in different states of India, and hence there is ample scope for using such industrial wastes. It is further necessary to ensure that no harmful leachates are released subsequent to use of any industrial waste in road works. Environmental acceptability test results can be obtained from the respective industries and/or from reputed testing laboratories.

IRC:SP:121-2018 “Guidelines For Use Of Iron, Steel And Copper Slag In Construction Of Rural Roads.



6.10. Road side Rain water harvesting, for road drainage and ground water recharge

In the concept of rainwater harvesting from road, water is conveyed away from the roadways and this collected water is used to recharge ground water table in various ways. Such water conservation will give productive land and increase the agricultural yield of people in the vicinity. If rain water drains properly it will help for smooth traffic flow , minimise the road structure failure, avoid delay in travel time, decrease the expenditure on maintenance cost of road, decrease in vehicle maintenance cost, increase life of the road and reduce the possibility of accidents.

Indian Road Congress guidelines as per IRC: SP:50-2013 following standard operating procedure to be adopted for providing water harvesting

- The PIU and concern staff shall identify the location of rain water harvesting and artificial recharge along road side and shall include in DPR.
- The location and design of such standard (i.e diam./length of recharge shaft etc.) shall be based on the rainfall intensity and geo technical strata.
- It should be assure all the executing agencies before issuance of completion certificate that in water harvesting and artificial recharging arrangement have been provided by contractor and this are functional and recorded in completion certificate with location chainage.
- Periodic cleaning and maintenance of such structure /arrangements to ensure its proper functionality shall also be the part of maintenance.

6.11 Bridge Cum Bandhara

The Bridges are mainly constructed for crossing the rivers and other streams during monsoon period. They are therefore designed so as to have enough opening to enable water to flow conveniently and the obstruction caused by piers and other structures is minimum. Due to scarcity of water, it is necessary to save scarce natural resource like water to cater for drinking (human/animals) and irrigation needs besides other purposes. Thus, there is need to redesign the bridge structure so as to also serve as water storage structure. This dual purpose structure is Bridge cum Bandhara. The post monsoon flow specially the flow in the river after September is proposed to be used to create storage. This is a cost effective solution serving dual purpose of crossing the road over stream and providing gated or non gated structure to store water on upstream side. This also helps to recharge ground water table. Ministry of Road Transport & Highways has provided “Guidelines for Construction of a Bridge Cum Barrage structures on Roads serving dual purposes i.e. to cross the water body as well as to store water on upstream side” vide letter dated 18/04/2017.



6.12 Bamboo Crash Barrier

Bamboo Crash Barrier is a road safety item which is mainly prepared from bamboo as a basic raw material. It is a natural material which is cultivated at any place. It is eco-friendly material which helps to rebuild environment. Cultivation of bamboos involves farmers, labours & rural entrepreneurs promoting Socio Economic perspective. Bamboo is a sustainable material & absorbs 0.85 to 2.2 tons of carbon in 1 ton of bamboo plantation. The manufacturing of Bamboo Crash Barrier requires low energy consumption & cost effective. The Bamboo Crash Barrier is more flexible than conventional crash barrier which helps in saving several lives due to crashes at critical locations. The IRC has given accreditation to Bamboo crash barrier as new material vide letter dated 18/11/2022.



6.13 Tree Plantation along rural roads

- The plantation of trees along rural roads is to be confined to the available Right-of-Way. Roadside plantation will check deterioration of roads and will contribute to strengthening ecological balance and reducing global warming.
- In view of the limited space likely to be available along the PMGSY and other rural roads, only single row of plants would generally be provided.
- A spacing of 4 m to 6 m between tree plants may be adopted. In case block areas are available along the road side, the spacing grid of 3 m x 3 m may be adopted. Two rows of trees along rural roads may be provided where there is adequate Right-of-Way already available for two rows of trees.
- Trees should be planted minimum 0.5 meter beyond the toe of the roadway and as close to the edge of the Right-of-Way as possible so that they are not a safety hazard or affect the required sight distance.
- It should be borne in mind that for plantation, the strategy of using saplings of minimum 1.2 m height proves much more effective in reducing the mortality rate. The use of seedlings (less than 900 mm in height) shall be avoided in case of rural roads. The mortality of such seedlings along the road side is rather high.
- Sapling should be procured preferably from nursery of the forest department or any other Government Department. Only quality planting material should be used for plantation.
- The plantation should be maintained for a period of four years from the year of planting. Vacancy filling/replacement

should be carried out regularly from second year onwards. During initial stages of plantation, sometimes weeding and plant disease management will require regular attention.

- Shrubs and trees should be planted clear of roadside drains and other drainage structures so that their root system does not interfere with efficient working of the drainage facilities.
- IRC : 103 “Guidelines on Tree Plantation Along Rural Roads” are available for guidelines.

Typical cross-sections showing the location of trees on rural roads with different carriageway width and formation width are given

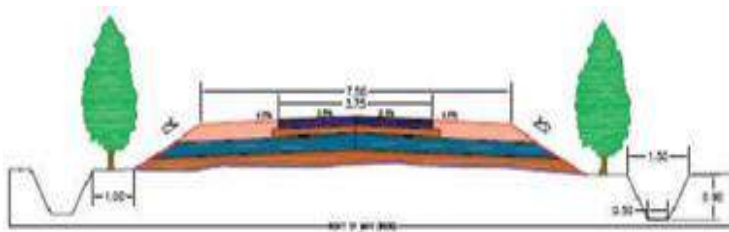


Fig. 1 Typical Cross-Section and Plan for Single Lane (3.75 m Carriageway) and 7.5 m Formation Width in Rural Area

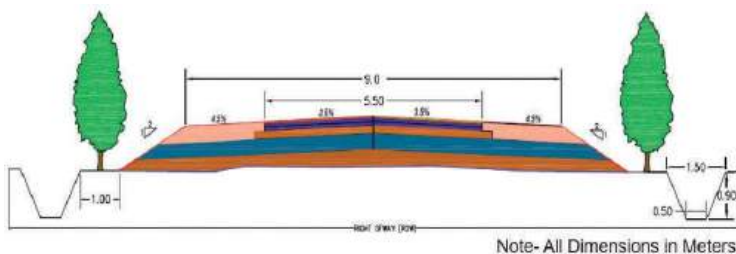


Fig. 2 Typical Cross-Section for Intermediate Lane (5.5 m Carriageway); with 9.0 m Formation Width in Rural Area

Tables list a few species, which can generally be planted throughout India for this purpose.

Soil Type	Recommended Botanical Name	Local Name
Normal Loamy	Albizia lebbeck	Kala Siris
Normal Loamy	Dalbergia sissoo	Shisham
Normal Loamy	Grevillea robusta	Silver Oak
Normal Loamy	Melia azedarach	Bakain
Waterlogged	Syzygium cumini	Jamun
Alkaline	Azadirachta indica	Neem

7. Methodology

7.1 FULL DEPTH RECLAMATION (FDR)

1. INTRODUCTION:

Rural roads carry agricultural traffic with heavy load and high tyre pressure. Rural roads carry agricultural traffic with heavy load and high tyre pressure. They are provided with thin bituminous surfacing (Carpet + Seal coat) which often fail under heavy, high-pressure vehicle loads, leading to cracking, rutting, and ravelling. These structural issues can't be solved by simply resurfacing with another bituminous layer. Full Depth Reclamation (FDR) recycles existing bituminous and granular layers to create a new, stabilized base layer. It is a cost-effective, sustainable method used for pavement rehabilitation, widening, and upgradation.

2. APPLICATION OF FDR TECHNOLOGY:

Adoption of FDR process can save between 20 to 30 percent in costs over alternative methods such as complete replacement of existing pavement. FDR can be a cost-effective rehabilitation strategy for a number of scenarios including the following:

- i. Flexural distresses in wheel lanes and Excessive patching (20 percent or more)
- ii. Asphalt distress due to low base failure (pavement condition index below 2 [poor condition])
- iii. Excessive rutting or alligator cracking in the asphalt surface

- iv. Need to widen the roadway; Need to increase structural design of the roadway
- v. Where the cost of overlaying granular material is high

IRC:SP:89 (Part II) soil stabilization guidelines recommend FSI $\leq 50\%$ for untreated soils under CTB or FDR. Thus FDR is not recommended when FSI $> 50\%$ due to risk of swelling damage.

3. BRIEF PROCESS:

Full-Depth Reclamation (FDR) recycles the distressed asphalt crust by pulverizing and blending it with stabilizers. This creates a strong, homogeneous base layer that performs like a semi-rigid pavement. Three different types of stabilization methods associated with FDR are as discussed below:

i. Mechanical stabilization (addition of aggregate)

Mechanical stabilization is mixing and densification of reclaimed materials with the addition of granular materials. It relies on particle interlocking between the pulverized mixture of existing crust and added aggregates. The pulverized mixture is compacted after mixing to the specified density.

ii. Chemical stabilization (addition of cement and stabilizing agent):

Chemical stabilization is carried out by mixing pulverized soil with chemical stabilizers to improve strength and durability of pavement layers. Commonly used additives include Terrasil, Zycobond, RBI Grade 81, Stabil Road, Enviortac, and Terrazyme. Use of these stabilizers shall be as per IRC:SP:89-2010 guidelines.

Material	Typical Application Rate	Unit	Remarks
Portland Cement	4–6% of dry pulverized material weight	% by weight	Finalized by lab mix design for target UCS (≥ 4.5 MPa after 7 days)
	15–20 kg/m ²	kg/m ²	For 200 mm layer at ~ 2.1 g/cc density; verify by canvas check
Lime	3–7% of dry soil	% by weight	Used for plasticity reduction and subgrade improvement
Fly Ash	8–20% (when used with lime or cement)	% by weight	Pozzolanic material; improves long-term strength
CKD (Cement Kiln Dust)	5–10%	% by weight	Alternative to cement/lime; source-specific reactivity
LKD (Lime Kiln Dust)	4–8%	% by weight	Often used for drying and improving marginal soils
Terrasil (Additive)	0.8% of total water used	L/m ³ of treated mix	Waterproofing additive; used with cement
Zycobond (Additive)	0.04% of dry pulverized material	kg/m ³	Enhances binding and performance in wet conditions
Water (for OMC)	6–12% (based on OMC of mix)	% by weight	Final rate from lab; adjust in field based on compaction

iii. Bituminous stabilization (addition of asphalt binder)

Bituminous stabilization can be achieved by mixing the pulverized asphalt pavement and subsurface materials with an emulsified asphalt or foamed (expanded) asphalt.

Type of FDR to be selected based on traffic shall be as follows:	
Low Volume Traffic (T1 - T4)	- Stabilization Mechanical
Moderate Volume Traffic (T5 - T7)	- Chemical Stabilization preferably Cement/CCS
High Volume Traffic (T8 & Above)	- Chemical + Bituminous
For T6 and above a 75 mm thick Crack Relief Layer (Granular layer is recommended.)	

Out of above methods; Cement stabilization FDR is widely recommended for PMGSY.

4. STEPS INVOLVED IN CONSTRUCTION OF FDR LAYER (Using CEMENT):

FDR with cement requires detailed pavement evaluation, implementation of established design practices and proper quality control during construction. The various steps involved are as follows;

4.1 Initial Survey & Testing

4.1.1 Pavement Condition Assessment

As per IRC:172-2017, initial assessment shall include:

- Visual inspection for potholes, rutting, cracking, and drainage condition
- Traffic assessment and pavement thickness evaluation
- Collection of road samples for subgrade testing
- Determination of CBR and moisture condition of existing pavement materials

4.1.2 Mix Design

As per IRC:172-2017, mix design shall include:

- Collection of representative samples at every 1 km
- Laboratory testing for Gradation, OMC, MDD, and UCS
- Trial mixes with different cement/stabilizer percentages
- Finalization of stabilizer type and dosage based on required strength and durability criteria

4.2 ACTUAL FDR PROCESS:

4.2.1 Pulverization of Existing Pavement

As per IRC:172-2017, existing pavement layers shall be pulverized using a reclaimer to the required depth (generally 150–250 mm) without disturbing the subgrade. Proper pulverization can be achieved by slower machine speed, replacement of worn mixer teeth, additional passes, and pre-wetting at OMC.

4.2.2 Mixing with Stabilizing Agent

Cement or stabilizing agents shall be spread uniformly over the pulverized layer and mixed thoroughly with water using a reclaimer. Proper blending, moisture content, and uniformity shall be ensured. Compaction should start within 30–60 minutes after mixing.

4.2.3 Shaping and Profiling of FDR

The mixed layer shall be shaped using a motor grader to achieve the required profile, camber, thickness, and smooth surface as per MoRD Clauses 401 & 403 and IRC:SP:89-2018 (Part-II).

4.2.4 Compaction

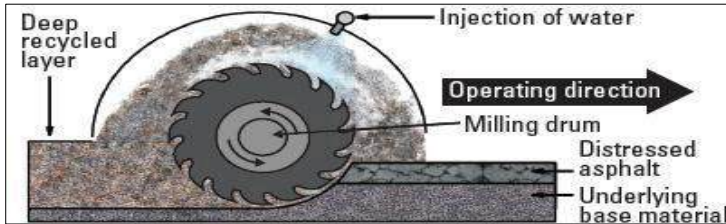
Compaction shall be carried out immediately after shaping using suitable rollers to achieve the required Maximum Dry Density (MDD). Moisture content shall be maintained during compaction, which should be completed within 2 hours of mixing.

4.2.5 Curing & Surface Preparation

As per IRC:172-2017, the stabilized layer shall be cured for a minimum of 7 days by maintaining adequate moisture and restricting traffic movement.

4.2.6 Bituminous Surfacing

After curing, the surface shall be cleaned and prepared for application of prime coat, tack coat, and bituminous layers such as OGPC, BM, or BC as per design requirements.



5. TRIAL STRETCH:

Before starting main work, construct a 100 m test strip to finalize moisture and stabilizer content, and confirm construction methodology. Evaluate the strip for required quality. Maintain detailed **trial records** and get approval from the authority before proceeding to full-length construction. If it fails Revise mix design or cement content, Adjust moisture or equipment settings and Repeat trial until specifications are met.

6. QUALITY CONTROL REQUIREMENTS:

The successful construction of FDR with cement relies on uniformity of pulverization, strength of compacted subgrade, cement content and moisture content and compaction of reclaimed layer.

7. ADVANTAGES OF FDR:

- i. Most pavement distress can be treated satisfactorily with desired strength requirement.
- ii. Significant structural improvements to the pavement crust (especially in base course).
- iii. Early opening to traffic as shortened construction schedule due to mechanized construction.
- iv. Cost effectiveness due to no/minimal use of additional costly granular material.
- v. Improves Riding Quality.
- vi. Use of locally available marginal material or minimal use of granular material (stone aggregate)
- vii. Eliminates material disposal problem as the existing materials are reclaimed and reused.
- viii. Results in conservation of natural resources, reduction in carbon footprint and air pollution.

8. LIMITATIONS OF FDR:

- i. Limited use in areas with higher rainfall and saturated sub grade where drainage system to direct water away from the pavement is not adequate. FDR is not recommended when FSI > 50% due to risk of swelling damage.
- ii. Unsuitable for High plasticity index (PI > 12) or clayey subgrades. It prevents proper pulverization and blending. Poor strength gain, excessive cracking, and shrink-swell problems.

- iii. Require Modern Pulverizing equipment so limits the use.
- iv. Requires strict time control. Delays may lead to Poor strength gain, excessive cracking, and shrink-swell problems.
- v. FDR is not recommended when FSI > 50% due to risk of swelling, damage.
- vi. For FDR, gradation should ensure a **well-graded mix**, with enough fines for binding and sufficient coarse content for strength. 100% shall pass through 53mm sieve. Table 1, Section 2.1.3 of the PMGSY FDR Booklet

9. Points to Remember While Executing FDR

Pre-Construction Stage

- Conduct pavement assessment, soil investigation, and laboratory mix design as per traffic requirements.
- Check subgrade properties such as Free Swell Index (<50%) and PI (<20%).
- Avoid FDR in waterlogged areas, high groundwater zones, and during monsoon season.
- Ensure proper gradation, identify underground utilities, and finalize stabilizer dosage before execution.

Pulverization

- Maintain uniform pulverization depth using calibrated reclaimers.
- Remove oversized particles, debris, and unmilled patches.
- Carry out work in short stretches (100–150 m) and avoid over-pulverization or rainy conditions.

Mixing with Stabilizing Agent

- Use fresh OPC/PPC cement as per approved mix design.
- Spread cement uniformly and maintain Optimum Moisture Content (OMC).
- Ensure proper mixing using recyclers and avoid dry pockets or clumps.
- Restrict traffic during mixing and ensure proper overlap at joints.

Shaping and Profiling

- Achieve proper camber, cross slope, alignment, and layer thickness using motor graders.
- Complete shaping within 2 hours of mixing to avoid premature setting.
- Ensure smooth surface finish and proper side drainage arrangement.

Compaction

- Start compaction immediately after shaping using suitable rollers.
- Achieve minimum required density (generally 98% MDD).
- Maintain proper moisture content and carry out regular field density tests.
- Restrict traffic on uncompacted layers.

Curing

- Begin curing immediately after compaction and continue for at least 7 days.
- Maintain adequate moisture using water spraying and protective covering.
- Prevent traffic movement and repair cracks during curing period.

Surface Preparation

- Ensure curing completion and required UCS strength before surfacing.
- Clean the surface and repair cracks or undulations.
- Apply primer/tack coat and provide granular layer where required by design.
- Maintain proper camber and avoid surfacing during rain or high humidity.

Relevant IRC Codes and Guideline:

- **IRC:120-2015** – Guidelines for Use of Cement Treated Base (CTB) in Road Pavements
- **IRC:SP:89-2018** – Guidelines for Soil and Granular Material Stabilization Using Cement, Lime and Fly Ash
- **IRC:SP:72-2015** – Guidelines for Design of Low Volume Rural Roads
- **IRC:37-2018** – Guidelines for the Design of Flexible Pavements
- **IRC:SP:20-2022** – Revised Rural Roads Manual
- **FDR Technology Booklet:** Published by NRIDA/MoRD year 2022

7.2 Short Slab Concrete Pavement

Introduction :

The Short Slab Concrete Pavement (SSCP) is a concrete pavement of low to medium thickness (100-200mm) laid over non-erodible bound base (like cement treated base or Dry-lean concrete) with small size of panels (1.0m x 1.0m to 1.5m x 1.5m) made by 1/3 to ¼ depth of groove cutting without any reinforcement or dowel bars.

Methodology

i) Approval of Materials, Plant & Equipment

Sources of materials, test reports, mix design, plant, and construction methodology shall be approved by the Engineer before commencement of work.

ii) Mix Design

Concrete mix design shall be as per IRC:44 or IS:10262. Minimum M40 grade concrete with flexural strength of 4.5 MPa at 28 days shall be used. Water-cement ratio should preferably be 0.30–0.38, and slump value around 30±10 mm.

iii) Trial Length

A trial stretch of 100 m × 3.75 m shall be constructed to verify materials, equipment, workmanship, and joint arrangements before actual execution.

iv) Batching & Mixing

All materials shall be proportioned by weigh batching plant and mixed uniformly to produce homogeneous concrete.

v) Separation Membrane

A 125-micron PVC sheet shall be placed between concrete slab and sub-base to act as separation membrane.

vi) Laying, Compaction & Finishing

Concrete shall be laid using fixed form paver, properly compacted using vibratory equipment, and finished to required level and smoothness.

vii) Surface Texturing

Surface texturing shall be done using steel/wire brush before concrete hardens to improve skid resistance.

viii) Curing

Curing shall start immediately after texturing using curing compound and wet hessian/jute mats for a minimum period of 14 days.

ix) Quality Control Tests

Cube and beam strength tests shall be carried out regularly to ensure required compressive and flexural strength.

x) Contraction Joint

Sawn contraction joints shall be provided at specified intervals to control cracking and relieve stresses.

xii) Longitudinal Joint

Longitudinal joints with tie bars shall be provided for pavements wider than 4.5 m or where widening is proposed.

xiii) Expansion Joint

Expansion joints with filler board and dowel bars shall be provided near bridges and culverts to accommodate slab movement.

xiv) 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.

7.3 Cold Mix Technology

Introduction

Cold Mix Technology is a sustainable and economical road construction method used under PMGSY for rural and low-volume roads. Unlike conventional hot mix, it uses bitumen emulsion mixed with aggregates at ambient temperature, eliminating the need for heating. This technology is suitable for remote areas, difficult terrains, and high rainfall regions.

Key Benefits

- Energy efficient and environment-friendly
- Lower greenhouse gas emissions
- Economical for rural roads
- Improved worker safety
- Easy transportation and storage of materials

Objective

To provide a standard methodology for construction of 20 mm Open Graded Premix Carpet (OGPC) using cold mix bitumen emulsion for durable and quality rural roads as per IRC:100-2015 and IRC:14-2018.

Scope

This SOP covers preparation, laying, and compaction of Cold Mix bituminous works for construction and maintenance of rural roads as per IRC:SP:100 and IS:8887.

References

- IRC:100-2015 – Use of Cold Mix Technology
- IRC:14-2018 – Guidelines for Rural Roads
- MoRD Specifications – Clause 511
- IS:8887 – Bitumen Emulsion Specifications
- IS:2386 – Aggregate Testing Methods
- IS:6241 – Stripping Value Test

7.4 Use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Courses

1. Introduction:

There is need for effective utilization of waste plastic in bituminous road construction, thereby contributing to effective waste management and enhancing the performance characteristics of bituminous mixes. This methodology for utilization of waste plastic in hot bituminous mixes (dry process) as per IRC SP 98:2020 is useful for achieving the goal of sustainable road construction practices by reducing CO₂ emissions.

2. Physical Properties of Plastic: Waste plastic must be cleaned, dried, and shredded to have plastic shred sizes ranging between 2.36 mm and 600 micron sieve with a maximum length of 2.36 mm and maximum width of 2.00 mm. Dust and other impurities should not exceed 1% (by weight of plastic).

3. Equipment's:

- Waste plastic collection and sorting facility.
- Shredding machine for waste plastic.
- Laboratory equipment for mix design and quality control tests (Marshall apparatus, etc.).

4. Collection and Processing of Waste Plastic

- Collection: Gather post-consumer plastic waste from authorized sources.
- Cleaning: Wash thoroughly to remove dirt and contaminants.
- Segregation: Remove all PVC, PET, and other prohibited plastics by visual inspection and flotation methods (PVC sinks in water; acceptable plastics float).

- Shredding: Shred the clean and dry plastic into small pieces conforming to the specified size (passing 2.36 mm sieve, retained on 600-micron sieve, maximum width 2 mm).
- Waste Plastic as per requirement can be procured from proper sources available near the work site.

5. Mix Design

- Plastic Content: Add waste plastic at 8% by weight of bitumen.
- Mix Type: Applicable for both thick surface course mixes viz. Bituminous Macadam (BM), Dense Bituminous Macadam (DBM) & Bituminous Concrete (BC) and thin surface course mixes viz. Semi Dense Bituminous Concrete (SDBC), Mix Seal Surfacing (MSS) & Open Graded Premix Carpet (PMC)

6. Mixing Process (Dry Process)

- Aggregate Heating: Heat aggregates in a central mixing plant to 140–175°C.
- Plastic Addition: Add shredded waste plastic to hot aggregates using a dosing system (e.g., through special arrangement at hot mix plant/ through conveyor belt with covered shed).
- Ensure uniform coating of aggregates with plastic. The duration of exposure of waste plastic to hot aggregates shall be 25 to 30 seconds. Do not heat plastic more than 180°C under any circumstances as it may emit harmful gases and may undergo thermal degradation at temperature higher than 180°C.
- Bitumen Addition: Add hot bitumen (temperature as per binder grade, generally 150–170°C) to the plastic-coated aggregates. Mix thoroughly for about 15 seconds to ensure uniformity.
- Mixing Equipment: Use central mixing plant (batch or drum mix) for better temperature and quality control.

8. Guidelines for Adoption of New Technology

Each State shall nominate a Nodal Officer of SE level for promotion and implementation of new technologies in rural roads.

- During DPR preparation, PIUs shall identify suitable roads/areas for adoption of green and innovative technologies based on material availability, feasibility, and cost effectiveness.
- DPRs shall be prepared with proper site investigation, traffic survey, laboratory testing, and technical evaluation of materials and technologies.
- Works using new technologies shall be jointly inspected by DPR consultants, PIU officers, and PMGSY authorities before finalization.
- Contractors shall follow approved specifications, methodology, and strict quality control during execution. Necessary provisions shall be incorporated in bidding documents.
- For technology-driven works, contractors shall enter into an MoU/Joint Venture with technology providers, and sub-contracting shall not be permitted.
- Specialized equipment, trained manpower, and technical support from institutes such as CRRI/PTAs/STAs shall be arranged for execution and capacity building.
- Proper documentation, videography, performance monitoring, and quality checks shall be maintained throughout construction and Defects Liability Period (DLP).
- Though some technologies may have higher initial cost, they may provide better durability and lower maintenance cost over the pavement life cycle.

9. Training and Awareness

- Most of the engineers, contractors and consultants are not aware of the advantages and necessity of adopting these technologies
- It is imperative to build capacity of various stakeholders in mainstreaming of existing/new technologies.
- Continuous skill enhancement of all the stakeholders is necessary for adoption and performance of various new technologies.
- Sufficient funds should be budgeted for conducting training and creating infrastructure for training facilities.
- MoRD should undertake dialogue with the equipment industry for undertaking development of low cost locally developed equipment and trainings of equipment operators, laboratory technicians and contractors.
- Regular workshops, conferences, colloquium in various regions of the country should be organised for demonstration of such technologies.
- Appropriate training to field engineers should be provided to interact with the gram panchayat office bearers/local public and convince them about the advantages of new technology, by addressing their apprehensions.

10. Available Guidelines

- IRC:SP:58-2001" Guidelines for Use of fly ash in road embankments".
- IRC : 60-1976 "Tentative guidelines for the use of lime-fly Ash concrete as pavement base or sub-base".
- IRC 068: 1976 "Tentative Guidelines on Cement-Fly Ash Concrete for Rigid Pavement Construction.
- IRC:SP:121-2018 "Guidelines For Use Of Iron, Steel And Copper Slag In Construction Of Rural Roads
- Use of Industrial wastes including quarry waste materials- MoRD Specifications for Rural Roads-2014.
- Guidelines for use of Construction and Demolition Waste in Road Sector- IRC:121-2017.
- Guidelines for use of Iron, Steel and Copper Slag in Construction of Rural Roads – IRC: SP: 121-2018.
- Recommended practice for recycling of bituminous pavement IRC:120-2015.
- IRC:SP:125-2019: Guidelines For Cement Grouted Bituminous Mix Surfacing for Urban Roads
- IRC:SP:140-2024- Guidelines for Design of Short Slab Concrete Pavements for Highways and Expressways
- IRC:SP-98"Guidelinesfor the use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Courses".
- Circular No. RW/NH-33044/24/2015-S&R (R) dated 26.11.2019 "Use of Waste Plastic in hot bituminous mixes in wearing courses(dry process) for construction of National Highways";
- Circular No. RW/NH-33044/24/2015-S&R (R) dated 27.08.2019 "Collection and Re-use of Waste Plastic :SwachhatahiSevaCampaign";
- Circular No. RW-NH- 33044/24/2015-S&R (R) dated 27.12.2016 and 09.11.2015 "Use of Plastic Waste in bituminous mixes in construction of National Highways".
- IRC:37"Guide lines for the Design o Flexible Pavements".
- IRC:SP:59"Guidelines for Use of Geo- synthetics in Road Pavements and Associated Works";
- IRC:113"Guidelines for the Design and Construction of Geo- synthetic Reinforced Embankments on Soft Subsoils".

- IRC:56 “Recommended Practices for Treatment of Embankment and Roadside Slopes for Erosion control”
- IRC:SP:58“Guidelines for Use of Fly Ash in Road Embankments”;
- IRC:44“Guidelinesfor Cement Concrete Mix Design for Pavements”;
- IRC:SP:89“Guidelines for Soil and Granular Material Stabilization Using Cement, Lime and Fly Ash”.
- IRC:SP-100“ Use of Cold Mix Technology in Construction and Maintenance of Roads Using Bitumen Emulsion”
- IRC:SP:76“Guidelines For Conventional and Thin White topping”
- IRC : 103 “Guidelines on Tee Plantation Along Rural Roads”