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

सत्यमेव जयते

Azadi Ka Amrit Mahotsav

Pradhan Mantri
Gram Sadak Yojana

Vision Document on NEW TECHNOLOGY INITIATIVES & GUIDELINES–2022

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This document is for wide dissemination amongst the stakeholders connected with construction and maintenance of Rural (low volume) Roads, such as PTAs/STAs, Engineers, Quality Monitors, Contractors, Field Supervisors etc.

ग्रामीण विकास मंत्रालय राष्ट्रीय
ग्रामीण अवसरंचना विकास एजेंसी
भारत सरकार

Azadi Ka Amrit Mahotsav

प्रधान मंत्री
ग्राम सड़क योजना

साध्वी निरंजन ज्योति
मा० राज्यमंत्री ग्रामीण विकास एवं उपभोक्ता मामले, खाद्य और सार्वजनिक वितरण मंत्रालय, भारत सरकार

श्री गिरिराज सिंह
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श्री फग्गन सिंह कुलस्ते
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के प्रेरणादायी और कुशल नेतृत्व एवं मार्गदर्शन में
प्रधान मंत्री ग्राम सड़क योजना का सफल क्रियान्वयन हो रहा है।

यह योजना देश की ग्रामीण आबादी को सड़क संपर्क
उपलब्ध करा कर उनके चहुंमुखी विकास में सहायक सिद्ध हो रही है।

इस प्रकार ग्रामीण विकास मंत्रालय राष्ट्र निर्माण
के क्षेत्र में उत्तरोत्तर प्रगति के पथ पर अग्रसर है और निरंतर सफलता की
नई ऊंचाइयों को छू रहा है।

नागेन्द्र नाथ सिन्हा, आई.ए.एस.
सचिव
NAGENDRA NATH SINHA, IAS
Secretary

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Message

Rural road connectivity is a key component of Rural Development for promoting access to economic and social services. Pradhan Mantri Gram Sadak Yojana (PMGSY) plays a vital role in this direction and the roads constructed under the programme are important part of the poverty reduction strategy. Their continued existence is absolutely essential to achieve the intended objective. Pradhan Mantri Gram Sadak Yojana (PMGSY) was launched in the year 2000 with an objective of providing all-weather road connectivity to all eligible unconnected habitations in rural areas of country.

Aiming to cover upgradation of existing selected rural roads based on their economic potential and their role in facilitating the growth of rural market centres and rural hubs, PMGSY-II and PMGSY-III schemes were launched in 2013 & 2019 respectively. In the last 21 years, more than 7 Lakh kms of rural roads have been constructed under the PMGSY. They have provided flip to the rural economy.

With a view to achieve optimal use of non-conventional materials and cost-effective environment friendly "Green Technologies" in the construction of PMGSY roads, the Ministry has fixed States specific targets for use of new Technologies in construction of PMGSY roads. Out of 112930 km road length sanctioned under new materials/green technologies, 69278 km road length has been constructed till 31st March, 2022.

Guidelines on Technology Initiatives under PMGSY were last issued in 2013 and as per those guidelines, States were to propose minimum 15 percent of proposed length under various new technologies/materials, setting up of entire eco-system including reduced Defect Liability Period, the need for use of technologies accredited and certified closure, capacity building of streamlining across the spectrum, documentation, development of digital tools for more informed navigation of new technologies/materials space. A need was felt to enhance the use of technology in PMGSY and rural roads. The current Vision document on New Technology Initiatives, 2022 emphasizes much increased use of new technologies/materials. I am sure this document on New Technology Vision 2022 will help promote effective use of various new technologies among the stakeholders, such as state government departments, consultants, field engineers, implementers etc in the field and, thereby, bring about greater economy, less impact on environment, higher citizen comfort and so on through them.

(Nagendra Nath Sinha)

Dr. Ashish Kumar Goel, IAS
Additional Secretary,
Ministry of Rural Development
& Director General, NRIDA
Government of India

FOREWORD

The Government of India, as a part of the poverty reduction strategy, launched the Pradhan Mantri Gram Sadak Yojana (PMGSY-I) on 25th December 2000 as a Centrally Sponsored Scheme to assist the states for construction of rural roads. The primary objective of the PMGSY was to provide all-weather road connectivity to the eligible unconnected habitations in the rural India. The mandate of PMGSY has been subsequently widened to include new interventions. PMGSY-II was launched in 2013, with a target to upgrade 50,000 km of the existing rural roads. Road Connectivity Project for Left Wing Extremism Affected Areas (RCPLWEA) was launched in 2016 for construction/upgradation of strategically important roads in the remote areas of the country. PMGSY-III was launched in 2019 for consolidation of 1,25,000 km through routes and major rural links connecting habitations to various socio-economic centres. Since inception till 31st March 2022, more than 7 lakh km road length has been completed under various verticals of PMGSY.

PMGSY has helped in better access of marketplace for the rural masses and generated employment in various forms. It has also helped in improving socio-economic condition of rural populace. An evaluation of Centrally Sponsored Schemes in Rural Development Sector, including Pradhan Mantri Gram Sadak Yojana was carried out by the Development Monitoring and Evaluation Office (DMEO) of NITI Aayog in 2020 and it was found that the scheme is well aligned with India's international goals and is seen to contribute to SDGs (Sustainable Development Goals) 2 & 9 as it addresses the issues of poverty, hunger and infrastructure for growth. Roads constructed under PMGSY have been observed to create positive impacts at the level of the household and community. Roads have impacted in increase access to market and livelihood opportunities, health and education facilities of people.

PMGSY has been pioneer in adopting new and green technologies in construction of rural roads. A new technology vision was formulated in 2013, and as a result more than 1 lakh km of roads have been sanctioned under PMGSY, which have adopted one or more new technologies. Recently, the adoption of new technology has seen an enhanced emphasis.

During the last three years i.e., 2019-20, 2020-21 and 2021-22, the road length completed using new materials/technologies is 8870, 11235 and 16038 km respectively, which shows an upward trend in the use of these materials/technologies. NITI Ayog has also recommended use of more new/green technology in PMGSY roads. Vision document on New Technology Initiatives, 2022 has been prepared to promote the use of these new innovative materials/technologies on a much larger scale.

This document has been prepared with contributions and suggestions of my NRIDA colleagues Shri B.C. Pradhan, Consultant Director (Technical), Dr. I.K. Pateriya, Director P-III, Shri Pradeep Agrawal, Director P-I, Shri Devinder Kumar, Director (P-II), Shri Satyendra Prasad, Joint Director (Technical), Shri Ashish Srivastava, Joint Director (Technical), Shri Sunil Kumar, Joint Director (P-III), Shri Navneet Kumar, Joint Director (P-I), Shri Pankaj Sharma, YCE, Shri Mohit Chauhan, YCE, Shri Arun Patel, YCE and Mohit Mathur, Assistant Manger.

I also acknowledge the immense contribution made by, Shri D.P. Gupta, DG (Retd.), MoRT&H, Shri S.K. Nirmal, Secretary General, IRC, Dr. B.P. Chandra Sekhar, Professor (Retd), Dr. U.K. Guruvittal, Chief Scientist, CRRI, Dr. A.K. Sarkar, Director, BITS, Pilani, Dr. U.K. Sahoo, IIT, Bhubneshwar and Shri M.K Gupta, E-in-C (Retd) without whose support and vital guidance, it would not have been possible for us to produce this document.

Finally, I am grateful to Hon'ble Minister, Rural Development, Shri Giriraj Singh for his tremendous encouragement and mentorship for adoption of new technologies in PMGSY. I am thankful to Hon'ble Ministers of State, Rural Development Sadhvi Niranjan Jyoti and Shri Faggan Singh Kulaste for their constant guidance. I am indebted to Shri Nagendra Nath Sinha, Secretary, Ministry of Rural Development for his invaluable support in developing a vision and strategy for adoption of new technologies and innovative approaches in PMGSY.

Contents

List of Annexures

Abbreviation

AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
ASTM	American Society for Testing and Materials
BOQ	Bill of Quantities
CD	Cross Drainage
CGBM	Cement Grouted Bituminous Macadam
CoE	Centres of Excellence
CRRI	Central Road Research Institute
DIY	Do It Yourself
DLP	Defects Liability Period
DPR	Detailed Project Report
EPC	Engineering Procurement and Construction
FDR	Full Depth Reclamations
GIS	Geographic Information System
GoI	Government of India
IAHE	Indian Academy of Highway Engineers
IAP	Integrated Action Plan
ICBP	Interlocking Concrete Pavement
IRC	Indian Roads Congress
LWE	Left Wing Extremism
MoRD	Ministry of Rural Development
MoRT&H	Ministry of Road Transport and Highways
MoU	Memorandum of Understanding
MSA	Million Standard Axles

NQM	National Quality Monitor
NRIDA	National Rural Infrastructure Development Agency
NTPC	National Thermal Power Corporation
OMMAS	Online Management, Monitoring and Accounting System
PIU	Programme Implementation Unit
PMGSY	Pradhan Mantri Gram Sadak Yojana
PQC	Pavement Quality Concrete
PR	Panchayati Raj
PTA	Principal Technical Agency
PWD	Public Works Department
QA&QC	Quality Assurance and Quality Control
QM	Quality Monitor (Includes both NQM and SQM)
R&D	Research and Development
RCCP	Roller Compacted Concrete Pavement
RCPLWEA	Road Connectivity Project on Left Wing Extremism Areas
RCTRC	Rural Connectivity Training and Research Centre
RD	Rural Development
RWD	Rural Works Department
SAC/EC	Standing Advisory Committee/Executive Committee
SENMaT	Scheme for Evaluating New Materials/Technologies
SQM	State Quality Monitor
SRRDA	State Rural Roads Development Agency
STA	State Technical Agency
ToR	Terms of Reference
TDDP	Technology Driven Demonstration Project
UT	Union Territory

1. Introduction

1.1. With more than 70% of the 1.3 billion of India's population living in rural areas, the economic growth and development of the country hinges on the development of rural areas. The access of rural population to the drivers of development is severely limited in the absence of proper rural connectivity. Rural roads not only provide physical connectivity to villages but also open up enormous possibilities by increasing access to economic opportunities, healthcare, education and other measures required for development. Thus, Rural Connectivity is a key factor in ensuring sustainable poverty reduction and integration of rural areas into the mainstream economic growth and social development. Good rural connectivity also plays an important part in improvement of rural governance.

1.2. The Government of India, as a part of the poverty reduction strategy, launched the Pradhan Mantri Gram Sadak Yojana (PMGSY-I) on 25th December 2000 for providing connectivity by way of all-weather roads to the eligible unconnected habitations as per core-network with a population of 500+ persons in plain areas. In respect of Special Category States/UTs, (i.e. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Himachal Pradesh, Jammu & Kashmir, Ladakh and Uttarakhand), the Desert Areas (as identified in the Desert Development Programme), the Tribal (Schedule V) areas and Selected Tribal and Backward Districts (as identified by the Ministry of Home Affairs and Planning Commission), the objective is to connect eligible unconnected habitations with a population of 250+ persons (Census 2001). For most intensive IAP blocks as identified by Ministry of Home Affairs the unconnected habitations with population 100+ (as per 2001 Census) is eligible to be covered under PMGSY. More than 99% habitations have been connected and PMGSY-I is targeted to be completed by September 2022.

1.3. Aiming to cover upgradation of existing selected rural roads based on their economic potential and their role in facilitating the growth of rural market centres and rural hubs, PMGSY II was launched in May 2013 and envisages consolidation of the existing Rural Road Network to improve its overall efficiency as a provider of transportation services for people, goods and services. A total of 49,885 km road length has been sanctioned under the Scheme and 47,170 km completed as on 31st March 2022.

1.4. The Government of India (GoI) approved the PMGSY III in 2019, which mainly focuses on the consolidation of existing Through routes and Major Rural Links that connect habitations to Gramin (i.e. rural) Agricultural Markets, Higher Secondary Schools and Hospitals. The target under PMGSY-III is to upgrade/consolidate 1.25 lakh kms with an expenditure of about Rs. 80,250 Crore. PMGSY-III heavily relies on technology for evidence based planning and selection of roads to be taken up under the scheme. The initial survey of rural facilities is conducted through the GEO-PMGSY app where geo-tagged photographs of facilities such as schools, hospitals are captured. The facilities data combined with the GIS based DRRP is then used to create "Trace Maps" which highlight routes which are commonly used by villages to access their basic necessities of agriculture, health, education

and administration. A total of 81,897 km road length has already been sanctioned to 17 States and 35,629 km road length completed till 31st March 2022.

1.5. Under Road Connectivity Project in Left Wing Extremism Affected Areas (RCPLWEA), which covers 44 districts in 9 states which are critical from security and communication points of view, the Ministry has so far sanctioned 10,901 km road length, against which 5,889 km road length has been completed till 31st March 2022. PMGSY-I & II are now targeted for completion by September 2022, RCPLWEA is targeted for completion by March 2023 and PMGSY-III is targeted for completion by March 2025.

2. Challenges in Road Construction

2.1. A country's march towards progress in sustainable growth and development is largely based on its infrastructure. Connectivity remains the most important ingredient for infrastructure improvement. Roads, the arteries of a Nation, bring rapid transformation along its path, changing socio-economic structure, demographics and environment. World over, roads have usually been built with little consideration of conservation of environment. It is our endeavour to save the fast-depleting natural resources with the use of alternate technologies in road construction in order to conserve our hills, forests and rivers. Many green and environment friendly technologies are now available which have the potential to reduce the intensity of impact on environment. These can also reduce the depletion of good quality conventional material. They can also minimize the damage to the environment due to emission of greenhouse gasses and heavy suspended particles in the air.

2.2. India has the second largest road network of 6.2 million km in the world. The administrative control of roads in India is distributed as per the type of road and their geographical locations. 'Rural roads' is a state subject as per Constitutional scheme of division of responsibilities and within the state too, rural roads are governed by many different agencies with nomenclature such as Rural Development (RD), Panchayati Raj (PR), Rural Works Department (RWD), Rural Engineering Department (RED), State Rural Road Development Agency (SRRDA), Public Works Department (PWD), Zilla Panchayat, Block Panchayat, Village Panchayat etc. The roads can primarily be divided into the following well understood categories:

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%

Source: Annual Report 2020-21 of MoRT&H.

2.3. India has started adopting new technologies on a large 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 conventional methodology of road construction has now shown to have various drawbacks such as excessive use of natural resources, rapid depletion of aggregate, in–sufficient durability leading to high maintenance, poor riding quality, long hauls of construction material and increased pollution. The only reason that conventional technology holds good on to its users is its awareness amongst all. Thus, for the induction of new technologies, their awareness and engineering advantages must be disseminated among various stakeholders. Various stakeholders also need to prepare for the transition of technology through multidimensional efforts viz. skilling, purchase of new plants and machineries, estimation of costs, testing facilities etc.

FIGURE 1: Destroying our valuable mountains for the quarrying of aggregate

FIGURE 2: Destroying our valuable mountains/ecosystem

2.4. During road construction, measures to protect the environment are usually inadequate. Excavated material is dumped without regard to environment and citizen concerns. Good soil is usually quarried leading to land degradation. Conventional road construction also draws heavily from natural resources available in hills and riverbeds thus threatening fragile eco system, and at times leading to destruction of those habitats and sometimes sacred natural features. There is insufficient awareness about emission of greenhouse gases during construction and there are neither adequate penalties for greenhouse gas emissions nor any provision of incentives to build 'greener' roads.

FIGURE 3: Destroying our hills

FIGURE 4: Destroying our environment

2.5 In order to meet these challenges, it is a need of the hour to adopt new/innovative technologies in the road sector in a big way. National Rural Infrastructure Development Agency (NRIDA) under Ministry of Rural Development (MoRD) has effectively initiated use, promotion of different newly developed technologies in rural roads. It has continuously been promoting increased use of such technologies in building sustainable roads in a cost effective manner under PMGSY.

3. 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.

3.1. Major proven technologies considered useful for rural roads, with relevant Indian Roads Congress Codes/MoRD specifications are as under:

(i) Soil stabilisation technologies:

- Stabilisation of soil and granular material using cement, lime, fly ash – MoRD Specifications 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) Roller compacted concrete pavement – IRC: SP:68-2005.

(v) Interlocking concrete block pavement – IRC: SP:63-2018.

(vi) Guidelines for conventional and thin Whitetopping- IRC: SP:76 -2015.

(vii) 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.

(viii) Use of Fly ash in Road Embankment – IRC: SP:58-2001 and MoRD Specifications for Rural Roads-2014.

(ix) Guidelines for the design and construction of low volume rural roads using jute geo-textiles, IRC: SP:126-2019.

(x) Guidelines for use of Geosynthetics in road pavement and associate works- IRC: SP: 59-2019.

(xi) Use of waste plastic in bituminous works – IRC: SP:98-2013.

(xii) 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.

(xiii) Use of crusher run macadam- MoRD Specifications for Rural Roads-2014.

(xiv) Use of Industrial wastes including quarry waste materials- MoRD Specifications for Rural Roads-2014.

(xv) Manual for design, construction and maintenance of Gravel Roads- IRC: SP:77-2008.

(xvi) Guidelines for use of Construction and Demolition Waste in Road Sector- IRC:121-2017.

(xvii) Guidelines for use of Iron, Steel and Copper Slag in Construction of Rural Roads – IRC: SP: 121-2018.

(xviii) Recommended practice for recycling of bituminous pavement -IRC:120-2015.

3.2 MoRT&H has issued an advisory on use of new/alternate materials & technologies in construction of highways to promote use of such new materials/technologies in construction and maintenance of National Highways for harnessing potential time and cost saving vide their letter RW/NH-33044/18/2020-S&R (P&B) dated 14th December 2020 (Annexure 1).

3.3 MoRT&H has clarified that any new alternate, material & technology that has been accredited by IRC, and falling under IRC: SP-89 (Part II), will not require further accreditation, and will henceforth fall under approved, alternate materials and technologies. For such approved, alternate, material and technology, the Defect Liability Period shall be at par with conventional/flexible pavement. The above-mentioned clarification of MoRT&H shall also be applicable in case of works proposed under PMGSY and defect liability period shall be 5 years at par with conventional methodology.

3.4 It is further clarified by MoRT&H that the material/technology for which Codes, Standards, Specifications, Guidelines etc. of IRC, MoRT&H, AASHTO, ASTM, Euro Code or British Codes are available shall not be treated as new/alternate material/technology and, as such, Defects Liability Period (DLP) of projects using such material/technology shall be at par with conventionally constructed pavement. The above-mentioned clarification of MoRT&H shall also be applicable in case of works proposed under PMGSY and defect liability period shall be 5 years at par with conventional methodology.

3.5 New materials/technologies, for which codes, standards, specifications, guidelines etc. of IRC/IRC accreditation, MoRT&H/MoRD, AASHTO, ASTM, Euro codes and British codes are not available, may be taken up on trial basis as a **Technology Driven Demonstration Project (TDDP)** with limited stretch (not more than 2 km) under PMGSY. For such materials/technologies, their first use may be considered as demonstration project with suitable safeguards/warranties from the industry and shall be appropriately selected in consultation with such technology or material developers/promoters. The performance evaluation of such new technology shall be carried out through a reputed technical institute by signing appropriate tripartite MoU among the PIU/SRRDA, the technical institute and the technology provider.

Since huge cost is involved in the construction of roads which can become a barrier in the development of new technology, therefore, in the spirit of Atmanirbhar Bharat, a special dispensation is being made to promote innovation in rural roads (PMGSY). In such cases, DLP shall be as per the warranty of the technology provider in mutual agreement with PIU/SRRDA and should not be less than 2 years.

3.6 Due to quantum jump in number of infrastructure projects being implemented in the country, an acute shortage of good quality aggregates is being faced for road works. For construction of low volume rural roads, it is possible to use locally available marginal materials and soft aggregates by suitably modifying them with addition of lime or cement or an additive other than or in addition to cement/lime or mechanical stabilisation depending upon their strength characteristics and other chemical properties (including water absorption, etc.).

3.7 Use of locally available materials and marginal materials, soft aggregates, brick aggregates etc., should begin with each state/PIU identifying different types of locally available materials which can be used in road works and conduct detailed laboratory tests on those materials to determine gradation, plasticity, compaction and strength characteristics. This will show best manner of using such materials, either as such without any further improvement or after stabilisation. Many a times, locally available materials can be greatly improved by mechanical stabilisation, but it depends on availability of materials and cost of processing. The type of additive stabiliser, if it is to be used, can be decided based on content of fines in soil. Gravel and sandy type materials can be stabilised using cement. Materials having higher percentage of fines (higher plasticity) can be stabilised using two stage treatment with lime and cement or any other set of stabilisers, as per IRC guidelines.

3.8 It is pertinent to point out that requisite laboratory investigations/characterisation should be carried out before adopting any new technology or materials. This would ensure the success of those technologies/materials and PIUs can engage STAs/PTAs or any other reputed institute for this assignment. Such investigations should be completed before preparation of DPRs so that technically sound DPRs can be prepared. Focus may, therefore, continue on promotion and encouragement of mainstreaming of such technologies, as this will maximize the use of locally available marginal materials and soft aggregates. This would result in not only reduction of the cost but also help protection of the environment by reducing carbon footprint during the process of construction.

4. New Technology Vision 2022

With a view to achieve optimal use of non-conventional materials and cost-effective environment friendly "Green Technologies" in the construction of PMGSY roads, the Ministry has fixed States specific targets for use of new Technologies in construction of PMGSY roads. As per 'Guidelines on Technology Initiatives under PMGSY, 2013', a target of 15 percent length of annual proposals by the State is to be proposed with use of new technologies/materials. This includes 10 percent length for mainstreaming of existing technologies for which relevant IRC codes and specifications are available. The other 5 per cent length is for technologies/materials where accreditation has been accorded by IRC or where although IRC has not accorded accreditation, however NRIDA has approved use of such technologies/materials on a trial basis. During the last three years i.e., 2019-20, 2020-21 and 2021-22, the road length completed using new materials/technologies is 8870, 11235 and 16038 kms respectively. There is clearly an upward trend in the use of new materials/technologies. An assessment conducted by NITI Ayog has also recommended substantially increased use of new/green technologies in PMGSY roads.

4.1. Hence forth, under New Technology Vision 2022, the following guidelines shall be applicable under PMGSY for surface course:

(a) Compulsory use of waste plastic in at least 70% length out of the eligible proposed length involving Hot Mix process.

(b) Universal use of Mechanized Surface Dressing (MSD) in T-1 to T-5 category of roads. From T-6 to T-8 category of roads, minimum 50% of length shall be taken under MSD. Surface Dressing can also be done with cold mix technology.

(c) Cold Mix Technology shall be used in minimum 25% of the total eligible proposed length. The use of cold mix technology shall be prioritised in climatically suitable areas.

4.2. In addition to above, the following guidelines shall be applicable for base course, sub-base course and sub-grade:

(a) At least 50% of length of the proposal shall be constructed utilizing new/green technologies/ materials as per para 3.3 and 3.4 hereinbefore.

(b) Each state shall promote two new innovations as per para 3.5 hereinbefore.

(c) 100% proposed length under Cement Concrete shall be constructed using thin Whitetopping (Panelled cement concrete) or Cell Filled Concrete. Only in exceptional cases Pavement Quality Concrete (PQC) shall be used.

(d) In cases where pavement cost is high due to factors, such as non-availability of aggregate, leading to high transportation cost or unacceptable quality parameters of aggregate, FDR shall be preferred as methodology of construction with advanced equipment and machineries by using stabilization technology so as to attain cost economy, better compaction, quality and durability.

(e) In areas near thermal power plants, fly ash shall be used in Cement Treated Base (CTB) and embankments in adequate quantity.

(f) In areas near steel plants, slag shall be used in subbase course, base course and embankments in adequate quantity.

(g) Construction and demolition (C&D) waste, duly processed, shall be used in subbase/base course in at least 10% of the proposals.

(h) Jute -Geo textile/Coir and similar such locally available materials shall be used for slope protection in hilly areas and other areas, where improvement of characteristics of sub-grade, embankments, shoulders etc. may be required.

5. Types of New Materials/Technologies and Guidance on their Adoption as per New Technology Vision (NTV) 2022

In order to promote cost-effective and fast construction technologies in the construction of rural roads, using new materials/waste materials/locally available materials, NRIDA has issued 'Guidelines on Technology Initiatives', in May 2013. Under the 2013 Vision, the States were advised to propose at least 10% of the length of annual proposals using any of the new technologies, for which specifications of Indian Roads Congress (IRC) are already available and an additional length of 5% of annual proposals with any of the new technologies for which specifications of Indian Roads Congress are not available, including materials accredited by IRC. Out of 1,12,930 km road length sanctioned under new/green technologies a total of 69,278 km road length has been constructed till 31st March 2022. State wise and technology wise details of road length sanctioned and constructed by using various types of new materials/green technologies till 31st March 2022 are given in **Annexure 2.**

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

5.1. 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.

Till 31st March 2022 under PMGSY, 4575 km of road length has been constructed by stabilizing soil all over the country.

5.2. 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 cementitious agent, water, corrective aggregates (if needed) as per mix design to produce a cementitious 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). In FY 2021-22, Ministry has sanctioned 695 roads of 5396 km length to the State of Uttar Pradesh under FDR. Moreover, a detailed guideline has been issued by NRIDA regarding use of FDR for rehabilitation of low volume rural roads under PMGSY.

5.3. Mechanized Surfacing Dressing (MSD)

Mechanized Surface Dressing (MSD) 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 also 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. Surface dressing as surfacing course can be used in all the proposed roads with traffic category T8 and less instead of Open Graded Pre-mix carpet so as to phase out the adoption of open graded Pre-mix carpet which is more prone to ingress of rainwater to the granular pavement layers and the main cause of early formation of potholes and patches. Now it has been decided to adopt 100% surface dressing in all the proposed roads having traffic category T1 to T5 and 50% in all the roads having traffic category from T6 to T8. IRC has prepared the guidelines for the Standard Specifications and Code of Practice for Design and Construction of Surface Dressing (IRC: 110-2005). Moreover, a detailed guideline has been issued by NRIDA regarding use of Surface Dressing in PMGSY roads. Till 31st March 2022 under PMGSY 949 km of road length has already been constructed using Surface dressing all over the country and much more length has been sanctioned, which is under implementation.

5.4. Whitetopping (Panelled Concrete)

Whitetopping is a Portland Cement Concrete (PCC) overlay that is constructed on top of an existing bituminous road. This overlay acts as a long-term alternative for the rehabilitation or structural strengthening of roads. The initial cost of the conventional concrete pavement is quite high because of higher thickness hence a new type of thinner concrete pavement with shorter panel size as per IRC: SP:76-2008 can be used in the construction of concrete pavements for village roads and city streets. Panels of size 0.5 m x 0.5 m to 1.5 m x 1.5 m with thickness from 100 mm to 150 mm are generally used. Whitetopping can provide better serviceability, longer service life, lower life-cycle cost, and improved safety over the conventional concrete pavement. This technology can emerge as a good long-term solution to the perpetual maintenance

problem of the roads with poor drainage. A detailed guideline has been issued by NRIDA regarding use of Whitetopping in PMGSY roads. Till 31st March 2022 under PMGSY 2513 km of road length has been constructed using Whitetopping/Panelled Cement Concrete all over the country.

5.5. 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.

NRIDA has sponsored a study to evaluate the performance of this technology to use in bituminous layers. Performance Evaluation on rural roads constructed using Cold Mix Asphalt (CMA) in surface layer were conducted by five institutes under the overall supervision of IIT Madras and this study took almost 18 months to complete. As per outcome of the study, the overall relative performance, cost of creation and operation, productivity, safety and environmental aspects, the CMA could be preferred over Hot Mix Asphalt (HMA) technology for low volume PMGSY roads. 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). Till 31st March 2022 under PMGSY 16,988 km of road length has been constructed using Cold Mix all over the country.

5.6. 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) 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.

NRIDA has sponsored a study to evaluate the performance of this technology to use in bituminous layers. The performance evaluation on rural roads constructed using Waste Plastic in Pre-Mix Carpet (PMC) was

conducted by seven institutes under the supervision of IIT Madras and this study took 18 months to complete. It was observed from the study that Waste Plastic roads have performed well in most zones across the country. The life cycle cost analysis (LCCA) carried out for waste plastic road and conventional road has shown a decrease in the overall life cycle cost of waste plastic road by 4.3 % compared to that of conventional road. However, 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 CO_2 equivalent emission at the stage of construction. Embodied Energy (MJ/km) and Embodied Carbon (Kg CO_2/kg) were calculated from material production and transportation.

However, this marginal increase in the cost is more than compensated by increase in the volume of the total mix, thereby resulting in less overall bitumen content, better performance and thus proving to be beneficial to environment overall by utilizing plastic waste. IRC has prepared guidelines for the Use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Courses (IRC SP: 98-2013). Till 31st March 2022 under PMGSY 25,904 km of road length has been constructed using Waste Plastic and approximately **10362 MT** of waste plastic has been utilized all over the country.

5.7. 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. The plastic cells act as both the form and reinforcement for the pavement. The plastic cells are made from reclaimed high-density polyethylene (HDPE) sheets of thickness 0.22 mm to about 0.25 mm. The strips can be heat-welded or stitched to form cells. Conventional pavement concrete with 28-day strength of 30 MPa with a slump of about 30 to 50 mm can fill up the cell. The Roller Compacted Concrete (RCC), as specified in clause 1502 of Specifications for Rural Roads, can also be used for filling up the plastic cells and compacted with a roller. The structural design of the pavement can be done by considering the rutting performance criteria used in the IRC guidelines for flexible pavements (IRC:37-2018) with an appropriate reliability level. An effective modulus of 2000 MPa is recommended for the cell-filled concrete layer.

This technology provides thinner concrete pavement by reducing the joints spacing to as small as 150 mm, thereby creating blocks of small size. Thus, the expansion or contraction joints are not required, and hence maintenance of joints is eliminated. Moreover, this technology uses recycled plastic and consumption of aggregates is reduced to almost 50% when compared to conventional CC pavements; leading to considerable savings in the cost of construction when compared to conventional CC pavement. Till 31st March 2022 under PMGSY 2,218 km of road length has been constructed using Cell-filled concrete all over the country.

5.8. 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).

5.9. Slag

Steel slag, a by-product of steel making, is produced during the separation of the molten steel from impurities in steel-making furnaces. The slag occurs as a molten liquid melt and is a complex solution of silicates and oxides that solidifies upon cooling. Slag is a valuable raw material for preparation of macadam materials and mineral binders serving as a base for asphalt concrete mixtures and manufacturing of cement emulsions, which are widely used in road paving. Slag has a greater PSV (Polished Stone Value): i.e., greater resistance to wear. This is the result of its mineral composition. The consequences: less wear and longer road lifetimes. Roads constructed using Slag demonstrate reduced rutting. Moreover, Slag has micropores and therefore, it retains its adhesiveness with wear. In contrast, natural rock becomes smooth with wear—its surface becomes polished and slippery. As a result, tires can grip better on surfaces constructed using Slag, and this is particularly important on highways and on curves. Slag is harder and internally bound. Natural gravel does not have the same stability and load bearing capacity. As Slag is harder and more compact than natural rock, roads last longer. And as there is less wear, hence helps in reducing the carbon foot print. IRC has prepared the guidelines for use of Iron, Steel and Copper Slag in Construction of Rural Roads (IRC SP: 121-2018).

5.10. Warm Mix Technology

Warm Mix technologies allow production of bituminous mixes at a temperature 30-40°C lower than the hot mix using the same plant. These technologies reduce the viscosity of the bitumen with the use of additives (water-based, organic, chemical, or hybrids), so that aggregates can be coated at lower temperatures. Reducing the viscosity also makes the mixture easier to manipulate and compact at the lower temperature. Fuel consumption in warm-mix manufacturing is typically reduced by 20% as compared to hot-mix. In paving projects, the greater the temperature difference between the mix and the outside temperature, the faster the cooling of the mixture. Relative to hot-mix, warm-mix cools more slowly allowing it to be successfully placed at lower temperatures. Since faster cooling affects durability, cold ambient temperatures adversely affect hot-mix. As a result, warm mix extends the paving period and season. It also makes night paving more feasible. Additionally, it saves time in production as well as in surfacing roads.

5.11. 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 sub-grade and sub-base, 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. People in rural parts of coconut-producing states such as Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Telangana, Odisha, and others benefit from utilization of coir in road construction. IS 15871-2009 provides the guidelines for the Use of geo-textiles, jute and coir technology in road pavements and associated works. Till 31st March 2022 under PMGSY 1,061 km of road length has been constructed using Coir Geotextile all over the country.

5.12. Geosynthetics

Geosynthetics including geo-textiles perform various functions in a road pavement such as separation, filtration, drainage and reinforcement depending up on the type of geo-synthetic being used. Hence, choosing any particular type of geo-synthetic would first involve identification of improvement needed for the road pavement. Roads in problematic soil areas, such as black cotton soil or sites having drainage problem are often considered suitable for geo-synthetic usage. SRRDAs can take up promotion of polymeric geo-synthetics as well as agro-based geo-textiles such as Coir and Jute, in road pavements in areas where drainage is an issue, and also in areas where the soil properties need to be improved. Proper laboratory and field investigations are required to determine the causes of problems being faced in such problematic areas, and to identify the type of geo-synthetic/geo-textile needed. In this regard, PIUs should invariably consult STAs/PTAs as well as geo-synthetic manufacturers/suppliers before deciding on the type and correct manner of geo-synthetic material to be used.

Geo-cells are three-dimensional honeycombed cellular structures that form a confinement system when in-filled with compacted soil or marginal aggregates. The infill can be a non-cohesion material or recycled. This helps in constructing pavement structural layers using marginal and waste materials. The construction is cost effective because of reduced and economic usage of valuable natural resources (metal/aggregates, sand, cement, etc.). It saves cost as much as 30% for road construction and the time saving is as much as 50%. Also, it substantially reduces cost of maintenance by improving the longevity of the road/pavement.

As the Coir and Jute geo-textiles have proved to be effective in protection of slopes and the IRC State of Art Reports are available, these technologies should be used for protection of slopes and embankments. A few roads were constructed under PMGSY also, using Jute for improvement of poor sub-grade soils. Similarly, some roads have also been constructed using Coir in southern States of the country under different state government schemes. The IRC has published IRC SP 126: 2019 'Guidelines for the design and construction of low volume rural roads using Jute Geotextiles'. National Coir Board and National Jute Board can provide necessary technical support and ensure the availability of materials.

5.13. Bio-engineering Techniques

Bio-engineering measures can be adopted in hilly and mountainous terrain as a low-cost technique to prevent erosion of hill slope and to overcome the problem of shallow landslide. However, if the slip circle of landslide is deep seated or landslide is occurring due to inherent geological reasons, bio-engineering measures alone cannot be used as a remedy. In such cases, bio-engineering techniques can be a part of a package of engineering measures required against landslide hazard. Bio-engineering measures can be adopted to prevent erosion of bridge approach embankment side slopes if the height of embankment is more (above 3 m or so).

5.14. Cement Grouted Bituminous Macadam (CGBM)

CGBM is based on the concept of preparing a coarse aggregate skeleton structure which is then filled with cementitious grout material. CGBM consists of an open graded bituminous mix skeleton with 25-35% air voids such as bituminous macadam. Cementitious grout having sufficient fluidity flows under gravity to fill these voids. It enjoys the advantageous property of bituminous and concrete pavement. CGBM surfacing will be useful for pavements subjected to moisture damages and experiencing higher contact stresses.

5.15. Gabions

A gabion is a cage, or box filled with rocks, concrete, or sometimes sand and soil to make earth retaining structures. Gabions can be used for construction of toe walls/breast walls/retaining walls in place of masonry structure.

5.16. 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. Using industrial wastes depends on lead distance between the project and the concerned industry. Other factor would be cost of procurement (if any) for the waste material since some of these materials are sold by industries as by-products. 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. Mining and quarrying wastes often contain considerable amount of good quality rocks. But generally mining and quarrying wastes are heterogeneous in nature, which brings in uncertainty about their strength properties. Inspection and identification of borrow locations from where good quality rocky mining wastes, having adequate strength properties can be procured, would help their usage in pavement layers. Otherwise, they can be used for sub-grade improvement, stabilized pavement layer construction or for embankment. 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 or competent STAs/PTAs. As with any other locally available materials, laboratory investigations are needed to devise appropriate methodology and pavement layer wherein industrial wastes can be used.

5.17. Gravel Roads

Good quality gravel is available in different parts of the country. This gravel should be used as potential material for construction of very low volume rural roads. A few gravel roads can also be constructed as gravel sealed roads, where sealing can be done using bitumen emulsions or thin bituminous surfacing such as Surface Dressing. Gravel becomes the primary choice for construction of rural roads when total equivalent single axle load repetitions for the design life are less than 0.1 million standard axles (MSA). Gravel roads are not considered to be appropriate choice for wearing course when average daily traffic (ADT) exceeds 200 vehicles per day and also in hilly/mountainous terrain. In such locations having design traffic less than 0.1 MSA, surface dressing can be adopted as a wearing course over gravel base. Additionally, for forest areas,

and for providing connectivity to very small habitations, gravel roads, with or without thin bituminous sealing would be a suitable option. IRC SP:72 and IRC SP:77 provide details of gravel road design and construction. Though no performance data on sealing of gravel roads is available in India, many other countries such as South Africa and Australia are already using such gravel sealed roads on a large scale.

6. Guidelines for Adoption of New Technology

Based on experience gained during the preceding years on promoting use of new materials and technologies on rural roads under the PMGSY, the following guidelines shall apply henceforth:

6.1. One officer of the level of SE/EE/CE, with adequate experience and interest towards the use of new technologies, from each State be nominated as Nodal Officer, for promoting the use of new materials/ technologies and such Nodal Officers shall be provided special training. These nodal officers will then help in identifying potential technologies for application in the field and provide support to the PIUs entrusted with construction of such works.

6.2. Before preparation of annual proposals, in pre-DPR meeting with PTA/STAs, and PIUs, States shall identify probable list of roads or areas (locations/districts/blocks/geographies/landscapes) in which new technologies/materials can be adopted, considering availability of materials, viability of each technology and cost economics. DPRs of such road works should then be prepared in consultation with STAs.

6.3. The Detailed Project Reports (DPRs) for road works with any such technology initiative shall be prepared with due diligence after studying the properties of materials to be used and the requirements of technology. States may consider separately empanelling more experienced and well-equipped consultants for preparation of DPRs for such works. The reviews being carried out by the NRIDA may include progress on this front also as one of the key performance indicators of SRRDAs. The goal should be that in due course, these technologies become common - place in construction of rural roads all across the country. NRIDA is in the process of engaging various technical institutes in performance evaluation of new technologies. As the IRC specifications for most of these technologies are already available, States may also enter into MoU with STAs or PTAs or any other recognized government agency in consultation with NRIDA for performance monitoring of such roads, at local level and the expenditure on this may be met from R&D fund available with NRIDA. The State and STAs/PTAs may decide mutually the fees for performance monitoring at the time of entering into MoU. CRRI can be requested to provide guidance and coordination support in this exercise.

6.4. Special care would be required by the PIUs/Consultants in preparation of DPRs and by STAs/PTAs in scrutiny of DPRs using such materials/technologies. The materials proposed to be used need to be tested to suit the requirements of the project. Also, the traffic survey for such roads is to be carried out and design traffic needs to be projected with greater reliability.

6.5. In all such cases, the DPR of the work, using new materials/technologies, will be prepared after site inspection jointly by the DPR consultant, officer of Programme Implementation Unit and the State Technical Agency (or technical institute engaged for this purpose); after a detailed discussion regarding choice and suitability of new materials/technologies.

6.6 Special care would be required by the contractors for execution of works with such materials/ technologies. It will be necessary to incorporate such requirements in the Standard/Model Bidding Documents. The PTAs/STAs/Institution of Repute would also be required to support the PIUs initially in supervision of the works being executed with such materials/technologies and ensuring adequate quality control. CRRI and other institutes of academic excellence may be entrusted with the task of capacity building of the PIUs and STAs. NRIDA shall operationalise such support by the CRRI and other PTAs. It shall be the responsibility of the contractor/technical agency/technology provider to keep detailed documentation of the entire process right from DPR development till the completion of the work and performance during DLP.

6.7. Necessary modifications would also be made in the Bidding documents to incorporate the following provisions:

- For the technology-driven component of the work, the successful bidder has to enter into a joint venture agreement or MoU with the technology provider after award of the work and prior to signing of agreement, within the time specified for signing of such agreement to commence the work, in the said agreement/MoU the technology provider should clearly spell out the commitment for not increasing rate of the material within the stipulated period of completion which will become a part of the tender document.
- The selected bidder, i.e., the Contractor who is awarded such work component shall not be allowed to sub-contract the work.
- For such works, the specifications and construction methodology to be adopted shall be provided by the manufacturer/technology provider and will be included in the agreement/part of MoU as per consultation with the STA/technical institute.
- For such works, stage passing shall be mandatory, i.e., quality control checks must be undertaken before next layer is allowed to be laid.

6.8. For execution of works utilizing these materials/technologies, it would be necessary to go in for appropriate and special equipment, particularly for stabilisation, recycling, widening of existing road pavement, etc. It is suggested that a separate group comprising some domain specialists and representatives of a few equipment manufacturers may deliberate over the requirements for such specialized equipment and identify the steps needed to facilitate execution of works by the contractors. The TOR for such a group may also include ensuring availability of low cost, good quality, light and portable equipment for construction of rural roads without compromise in quality. This will provide the much-needed support to small local contractors who may hesitate or are otherwise not in a financial position to invest heavily in purchase of equipment.

6.9 The bid document shall be reviewed to identify any additional requirements of special equipment and specialized technical personnel. Many states have been including such requirements in their SBDs, which is a good practice. Since these materials/technologies may not be in normal use by the contractors, it would be necessary to make arrangements for training their personnel (site engineers, construction workers and equipment operators). For this, dialogue with the contractors should be arranged. Initially, the support of equipment manufacturers or suppliers may be required to alert the PIUs and STAs and to provide technology management support including training.

6.10. During execution of works, it will be advisable to undertake documentation of procedures observed, quality control tests conducted and operation of equipment, etc., through videography of various activities so as to help in dissemination at other sites and to serve as training material. A detailed guideline regarding use of FDR for rehabilitation of low volume roads has been issued by NRIDA.

6.11. In case of some materials and technologies, the initial cost of construction may be higher than the cost of construction using traditional materials, though the new technology may prove to be more durable and may require lower maintenance. For such cases, the technology provider needs to furnish the track record of these technologies in respect of their performance with proper documentary evidence/ supporting documents/case studies.

6.12. It is necessary to build the capacity of second and third tier quality management systems, i.e., SQMs and NQMs, to support the execution of such technology demonstration works with quality. For this, workshops/conferences of selected NQMs and SQMs with the support of CRRI/PTAs/STAs/technology providers shall be organized for dissemination of the new technology amongst SQMs/NQMs.

Technology Driven Demonstration Projects

6.13. The PTA/STA/Technology provider may guide the PIU in preparation of analysis of rates based on the processes involved in execution of these items and considering identical items already available in Standard Data Book of MoRD, so that it becomes a standard BOQ item for incorporation into the project estimates. Rates of such items then may also be vetted by senior officers of SRRDA.

6.14. The Technology Provider shall, therefore, provide all technical support to the concerned PIU, STA and the executing contractor. Since there could be risk of failure of such technologies, some mechanism needs to be evolved for protection of the personnel belonging to PIUs and STAs and even contractors for their bonafide actions. This may also help in reducing/eliminating their resistance to take up such demonstration projects on ground. However, the quality control checks as per PMGSY guidelines should be rigidly adhered to. The type of tests and their frequency need to be specified by the technology provider at the time of preparation of DPR. The NRIDA may undertake a comprehensive dialogue with some of these industry entrepreneurs to identify the role and responsibility of each of the stakeholders (PIUs/STAs/PTAs/industry, contractor) in such demonstration projects. The **Box 1** gives an indicative matrix of roles of various stakeholders.

6.15. Another strategy that is warranted for such demonstration projects is to create a control section with conventional materials side by side. This will help in assessment of the cost-effectiveness of the technology being demonstrated. The control section should have the overall specifications (thickness and materials) as per IRC standards for rural roads. For all the technology demonstration projects, the control section may be of about 25 percent of road length Details of control section should be included in the DPR for such demonstration projects. Also, technical advice/consultation regarding control section may be taken from CRRI or other PTA to assess the value addition of industry product in terms of performance improvement, strength and durability.

6.16. With the help of technology provider/industry, the STA concerned, where demonstration has proved successful, should prepare the draft of specification and methodology of construction. NRIDA shall thereafter, get it vetted from the PTA/CRRI. On satisfactory performance of technology, NRIDA will take up the matter with IRC for preparation of Codes/Specifications for the technology.

6.17. The NRIDA will update the Quality Assurance Handbook so as to include additional tests and checks where needed and issue SOPs for Quality as and when required for implementation of these guidelines.

6.18. The DPRs for R&D and technology demonstration road projects shall include a section on 'Reduction in Carbon Footprint' as against the conventional method. The technology provider should indicate necessary information as part of DPR to work out the reduction in carbon footprint. Provision to this effect has been incorporated in the DPR Template 2019.

Box 1: Technology Driven Demonstration Projects

(Roles and Responsibility Matrix)

A. NRIDA

(i) Bear the cost of construction of the trial section as per PMGSY guidelines.

(ii) Consider and approve, the locations identified by SRRDAs for demonstration of technology in consultation with the SRRDA/STAs/PTAs/Technology Providers.

(iii) Obtain and negotiate warranty from the industry/technology providers.

(iv) Enter into agreement with the STA, as a partner in technology development process including post-construction periodic monitoring and performance evaluation.

(v) As facilitator, arbiter and dispute resolver amongst various stakeholders.

B. Industry/Technology Provider

(i) Provide value for money analysis of the product and warranty of performance to the NRIDA, SRRDA, PIU and contractors.

(ii) Technical backstopping of SRRDA/PIU and STA/PTA.

(iii) Training to be imparted to site engineers, equipment operators and construction workers of the contractors. Also provide stipend, if necessary, to workers and equipment operators for the period they are off site during training as per laid down rules and regulations.

(iv) Support the STAs/Technical Institution in supervision of the work being executed by the contractors.

(v) Assist the SRRDA in installation of performance monitoring instruments/equipment required, if any, at the time of execution of the work.

(vi) Join the STA and PIU in periodic monitoring and evaluation of performance, say every six months, after the road is open to traffic. Performance would be monitored for a period of two years.

C. SRRDA and PIU

(i) Bear the cost of construction of trial section as per PMGSY Guidelines.

(ii) Assist the NRIDA in finalizing the location of the demonstration project.

(iii) Enter into agreement with the STA, in preparation of project estimate, engage consultants for preparation of DPR, supervision during execution and periodic monitoring.

(iv) Enter into agreement with Technology provider/material supplier in preparation of project estimate, supervision during execution and rendering logistical support in periodic monitoring of performance of the road when it is open to the traffic.

(v) Oversight on the work of the STA and the contractors in this aspect.

(vi) Ensure installation of performance monitoring instruments, if any, during execution of demonstration projects.

(vii) Join the team of technology provider and STA in periodic monitoring of performance.

(viii) Ensure that such roads are properly designed for the traffic expected on them.

D. STA/PTA

(i) Enter into agreement with the NRIDA, as a turnkey partner in technology development process including preparation of project estimate, supervision and quality control during construction, and post-construction periodic monitoring of performance for a period of two years.

(ii) Expose its personnel to training by the industry/technology provider and experts.

(iii) Support the industry/technology provider in training of contractors' personnel (site engineers, equipment operators and construction workers).

(iv) Documentation of the procedures observed, methodology of construction, quality control tests conducted, operation of equipment and post-construction performance monitoring.

(v) Preparation of handouts/booklets for wider use of the technology and dissemination in consultation with NRIDA.

(vi) Development of specifications for the technology on successful trials for inclusion in codes, book of specifications by IRC in consultation with NRIDA.

7. Technology Development

7.1. The Highway Research Board of the IRC undertook an exercise to identify major thrust areas in the highway sector covering road pavements, bridges, geotechnical engineering, traffic engineering and safety related schemes. Huge investments are being made for rural roads under the PMGSY and other state level programmes and schemes. Some of the thrust areas considered useful and relevant for rural roads as noted below need special attention:

- Promoting recycling of pavements for up-gradation/rehabilitation projects – evolving guidelines and warrants for recycling.
- Evolving environmentally optimized and climate resilient design for rural roads.
- Evolving pavement performance prediction models for determining rate of deterioration of pavements with time, traffic and weather.
- Scope for composite construction technology in rural roads.
- Bridge construction technologies to achieve faster construction such as pre-casting technologies, steel superstructures etc. Also evolve standard designs for bridges on rural roads, along with standard drawings.
- Pre-cast technologies for small CD structures (culverts) and similarly pre-cast side drain system, along with standard drawings.
- Evolving cost-effective cross drainage structure designs by adopting precast components.
- Evolving low-cost erosion control and drainage measures.
- Evolving bio-engineering measures for improving slope stability in hilly areas.
- Evolving simple models for Asset Management System of rural roads.
- Evolving simple methods/technologies for maintenance of rural roads.
- Practical measures for enhancing safety on rural roads. Evolve typical design and layout of intersections.

7.2. There are number of academic and research institutions in the country who can be approached for these tasks. The academic and R&D institutions (STAs and PTAs) should also come forward for developing and evolving technologies suitable for their region considering the local requirements. NRIDA has provision for funding projects to different STAs/PTAs under R&D activities to get desired output in developing and evolving suitable technologies for rural roads and bridges. Apart from research and academic institutions, the PIUs and SRRDAs could also propose to NRIDA to have the research/studies conducted on new materials/technologies. The NRIDA/MoRD has already a mechanism in place for sponsoring of such kind of studies.

7.3. There is a need for a Pan India GIS database of location and strength characteristics of locally available road construction materials. The NRIDA had sponsored a pilot study in this direction wherein the CSIR-Central Road Research Institute (CRRI) had carried out a project on preparation of database of locally available materials for four districts (two districts each in Bihar and Madhya Pradesh). Under the New Technology Vision 2022 it is envisioned that this study will be extended to cover the entire country to locate potential locally available marginal material for their effective use. This can be jointly undertaken by the SRRDAs and STAs in each state under a research scheme with overall coordination and guidance from CRRI/NRIDA.

8. Preparation of Manuals/Handouts and Dissemination

8.1. CRRI will serve as key partner of MoRD in this entire effort. CRRI may also be entrusted with the task of preparation of Do It Yourself (DIY) field guides, Manuals and Handouts on the current technologies and accredited materials that have been proved as successful. The field guides should cover concept, materials, laboratory tests, methodology of construction, quality control requirements, the type of construction equipment and sample rate analysis using new materials/technologies. The CRRI can associate external experts including PTAs and STAs in this exercise. Manuals may also incorporate sections on Dos and Don'ts to alert the PIUs and contractors. A Core group of NRIDA officers and selected STAs, PTAs and CRRI has been constituted to steer this task and drafting of some. Do It Yourself (DIY) documents is already in progress.

8.2. The draft of these Manuals and Handouts will be discussed at regional workshops with PIUs and STAs. At such workshops, other practicing professionals and domain experts could also be invited. Based on feedback, the drafts can then be finalized and printed. These documents will also be hosted on the PMGSY website for wider dissemination. The gist of these handouts can also be published in IRC journals.

8.3. These documents would be useful for dissemination of the technologies among the various stakeholders – road agencies, contractors, consultants, state technical agencies, etc. For this, regular workshops should be held at suitable intervals associating all the stakeholders involved in TDDPs. STAs/PIUs involved in TDDPs should present the details of such projects with the help of photographs and actual site videos for dissemination of technology.

8.4. Technical films on such TDDPs, covering various steps involved in selection of site, technology selection, material testing, design, DPR preparation, various aspects of construction, life cycle cost analysis, advantages of technology etc. should be prepared in sample cases for effective demonstration of new technology. Such films can then be used by training institutions for training of officers, consultants, contractor's personnel, supervisors etc. These films should also be made available on websites of NRIDA/SRRDAs.

8.5. In order to enhance the scope of adoption of New/innovative materials/technology in rural road works developed under PMGSY, there is a need to deliberate upon the adoption of Engineering Procurement and Construction (EPC) mode of bidding so that the prospective bidders, having exposure to such new technology works, can be given opportunity to adopt any proven technology in the awarded works at their own choice based on the specific site requirement without sacrificing the objectives of the project in terms of quality and durability. This may ensure cost economy and promote innovation.

8.6. For enhanced monitoring of works executed under new/green technologies, use of IT tools including use of drone camera should be explored which will be subsequently expanded to all the works irrespective of any methodology adopted in execution of PMGSY works.

8.7. During performance evaluation of new/green technology works by the STA/PTA and reputed technical institutes, students perusing M. Tech and Ph.D. shall be involved. Also, during the process of performance evaluation, life cycle cost analysis and comparison between the new/green technology and conventional technology should be undertaken.

9. Training and Awareness

9.1. It is imperative to build capacity of various stakeholders in mainstreaming of existing/new technologies. Some training programs have been organized in the past on various aspects of different new technologies, for engineers of different levels, State Technical Agencies (STAs) and Quality Monitors (QMs). Many of the officers trained for new technologies, might have retired or moved to other departments by concerned state governments. However, in the present setup, the aspect of imparting adequate training to the staff engaged in implementation of new technology works, right from senior level engineers, consultants, STAs, PIUs, contractors, supervisors down to workers at the ground level, needs to be emphasized.

9.2. Concerted efforts are needed to identify the capacity building and training needs at various levels to chalk out time bound programme for this purpose. Continuous skill enhancement of all the stakeholders is necessary for adoption and performance of various new technologies, based on appropriateness, cost economy, reduction in carbon emissions and reduced maintenance requirements etc. Though, many new technologies are being adopted by different states, however, most of the engineers, contractors and consultants are not aware of the advantages and necessity of adopting these technologies. Also, how a particular technology should be identified for implementation in a particular case, is not clear to many of the rural roads' engineers and contractors. Sufficient funds should be budgeted for conducting training and creating infrastructure for training facilities. Digital tools involving Artificial Intelligence (AI) and machine learning need to be developed which make it easy for various stakeholders to choose most appropriate matrix of materials and technologies for optimum outcomes in terms of economy, durability, less need for maintenance, riding comfort etc.

9.3. Training Needs

9.3.1. The training needs should be assessed for all stake holders. Refresher Courses (once in 5 years or earlier based on developments in R&D) should also be conducted. Each state should carry out comprehensive training need assessment for new technologies, which should then be aggregated at the national level for implementing a comprehensive and time bound action plan for capacity building on priority basis.

9.3.2. In many States, the PIUs consist of a large proportion of newly recruited personnel, or personnel from Departments with little or no experience in use of new technologies. The inability of PIUs in many States, particularly those with a large number of works, to supervise such works with proper quality control and project management for timely completion is a matter of great concern. Intensive training and orientation are to be ensured in such states.

9.3.3. Induction/orientation training of consultants should be built into their Hiring Contract. STAs would be the best suited institution for training of design as well as Project Implementation Consultants (PICs),

since STAs usually have adequate laboratory facilities and have expert technical resources which will be available for such trainings.

9.3.4. Training of Contractor and sub-contractor personnel is essential to address the problems mentioned above. In order to orient the Contractors for this initiative of implementation of various new technologies, Quality Control Workshops should be organised for the Contractors, so that they are aware of the quality requirements of the work and the need to invest in training their personnel.

9.3.5. Training only personnel of contractors with contracts of new technologies may also delay improvement in the larger universe of contractors. A two-level approach consisting of pre-scheduled training and certification of personnel of all registered contractors/sub-contractors (perhaps on a subsidized cost basis), followed by refresher and on-the-job training of personnel at work site and laboratory (as part of the contract conditions) would be the best approach for the long-term growth of the sector.

9.3.6. The on-the-job training should cover the skilled workmen, laboratory personnel as well as the engineers. The pre-scheduled training can easily be organized by the RCTRC/SIRD, since they would be covering almost the same subjects with PIU and Consultant personnel. The State would need to collaborate with a local ITI or Polytechnic for training of skilled workmen. Such teams need to be developed by the SRRDA using the SIRD or STA and it will add enormous value to knowledge development of contractor's personnel and workmen.

9.3.7. NRIDA has already developed a training module with training material on 'New Technologies in Rural Roads,' through Indian Academy of Highway Engineers (IAHE), Noida for STAs, QMs, engineers, consultants and contractors. This module can be further modified to include some more technologies which are not covered in it. Also, some other aspects of rate analysis, relevant equipment, process of bidding and performance evaluation can be updated based on the experience gained in the last few years. Further, new modules need to be developed for laboratory technicians, operators of equipment, skilled, semi-skilled and unskilled workers.

9.4. Institutions for Training

9.4.1. The CRRI may be the nodal agency for this purpose. CRRI and some other PTA institutions have been providing good support in training of engineers/STAs besides their R&D activities. IAHE, NIRD, STAs, NAC, IITs with other state level existing training institutions can provide support in this task.

9.4.2. NRIDA with the support of Asian Development Bank has established five Rural Connectivity Training and Research Centres (RCTRCs) in the states of Assam (Guwahati), Chhattisgarh (Raipur), Madhya Pradesh (Bhopal), Odisha (Bhubaneswar) and West Bengal (Kalyani, District Nadia). These institutions have good infrastructure and testing facilities. Some of these institutions have also signed MoUs with CRRI/IITs/foreign universities for training and research. As these are located in different regions, they can be utilised for region specific training requirements on new technologies and testing of materials during implementation. MoRD will provide relevant faculty for these institutions for implementation of training and R&D requirements and further development of these institutions as Centres of Excellence (CoE) for training and research in rural road sector.

9.4.3. Many other countries have already adopted new technologies and they conduct periodic conferences on long term performance of such technologies. These training institutions in the country will do well to collaborate with them in knowledge sharing.

9.5. Faculty

9.5.1. As many of these technologies are not yet very popular, including some modern equipment for implementation, testing and performance evaluation, there is acute shortage of faculty for providing training. However, as part of the efforts of NRIDA in last 6-7 years, many pilot projects have been implemented with various technologies for which master trainers at each state level were identified and trained. Some of them may be still available. Further, one or two master trainers for each of the technologies can be identified at state level and they can be provided training at CRRI/IAHE or PTA institutions.

9.5.2. In the last one decade, many faculty members have joined IITs/NITs who have earned Ph.D. in transportation engineering from many foreign universities. Many of them have good knowledge about these technologies and can help in this task of training. Further, the technology providers may be advised to suggest faculty for training on their commercially developed technologies. Accordingly, a directory of faculty will be prepared by the CRRI or NRIDA for enlisting outside support in preparation and delivery of training material for such technologies.

9.6. Experience Sharing

9.6.1. NRIDA has already created a module on OMMAS website for keeping a list of the projects sanctioned with different technologies in different states. This is helping the officers from different States with identical conditions for utilisation of technologies, after interaction and help from such PIUs. This module needs to be further updated to include the length and technology wise layer completion and their performance with age. Visits of PIUs/SRRDAs/PTAs/STAs/Contractors/Consultants should be arranged to good practice projects both within India and outside, to create awareness and raising their benchmark.

9.6.2. A separate module needs to be developed to keep record of such site visits to the demonstration projects and should be maintained on OMMAS website, along with the details of technology used.

9.6.3. In such an ambitious program of implementation of new technologies, possibility of few failures cannot be ruled out. A record of such failures may also be maintained with probable reasons of failure analysed by experts. This will help in learning from failures and avoiding similar mistakes in future.

9.7. Dialogue with Equipment Industry

9.7.1. NRIDA/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. Some of the manufacturers already have their own training centres, which can be utilized for training.

9.7.2. Conferences/colloquium - IRC has been organising regional conferences on adoption of various new technologies for the last several years. NRIDA/MoRD may also seek the support of contractor's organizations/technology providers to arrange regular workshops, conferences, colloquium with them in various regions of the country, for demonstration of such technologies involving STAs/PTAs/SRRDAs.

9.8. Social Acceptability and Public Awareness

9.8.1. It has been reported by many implementing agencies that there is a general reluctance about acceptance of new technology projects in the society, probably because of inadequate knowledge and awareness about the advantages of such technologies and fear of failure due to relatively thin layers or aesthetic appearance of the road surface such as in surface dressing. Citizen Information Boards with complete information about the project should be mandatorily put in place in all new technology projects. 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. Awards

10.1. A system of awards shall be instituted to recognize the contribution of:

- SRRDAs
- PIUs
- PTAs/STAs
- Contractors
- Technology Providers

In mainstreaming and up-scaling the innovative technologies in construction and maintenance of rural roads, annual awards for each of the above categories shall be offered to encourage the large-scale utilisation of such technologies. Such awards shall be given at the time of annual meetings of MoRD on recommendation of jury to be set up by the NRIDA.

10.2. MoRD/NRIDA shall also consider providing sponsorship to the officers of States/CRRI/PTAs/STAs for participation and publication of research papers in national/international events/workshops/ conferences for encouraging research and recognizing their contributions in such effort.

Annexure 1

Advisory Issued by MoRT&H on use of New/Alternate Materials & Technologies

File No. RW/NH-33044/18/2020-S&R (P&B)
Government of India
Ministry of Road Transport & Highways
(S&R Zone)
No. 1, Parliament Street, Transport Bhavan, New Delhi-110001

Dated: 14th December, 2020

To,

1. The Chief Secretaries of all State Governments/UTs.
2. The Principal Secretaries/Secretaries of all States/UTs PWD dealing with National Highways, other centrally sponsored schemes and state schemes.
3. All Engineer-in-Chief and Chief Engineers of all States/UTs PWD dealing with National Highways, other centrally sponsored schemes and state schemes.
4. The Chairman, National Highways Authority of India (NHAI), G-5&6, Sector-10, Dwarka, New Delhi - 110075.
5. The Managing Director, National Highway Infrastructure Development Corporation Ltd., 3rd floor, PTI Building, Parliament Street, New Delhi - 110001.
6. Director General (Border Roads), Seema Sadak Bhawan, Ring Road, New Delhi - 110010.
7. All CE-ROs, ROs and ELOs of the Ministry

Subject: Use of New/alternative Material and Technology in construction of Highways

Madam/Sir,

1. It is felt necessary to consolidate various instructions of MoRTH, codal provisions and guidelines regarding cost effective new/alternative Material and Technology in highway construction to reduce construction cost.

2. IRC guidelines are available for use of Cement Treated Base (CTB), Cement Treated Sub-base (CTSB), Waste Plastic, Geo-Synthetics, Recycling, Fly-ash, modified Bitumen (CRMB, Polymer modified, Natural Rubber), Soil stabilization, etc. in highway construction. It is necessary to promote these materials/ technologies in construction and maintenance of National Highways for harnessing potential time and cost savings.

3. The details of these material/technology and relevant IRC Guidelines/MoRT&H circulars are summarized at Annexure I:

4. IRC has also accredited new materials/techniques/equipment/products. These may also be used as per the above Code/Guidelines/Circulars. The details of accredited material/technology are available on IRC website.

5. The standard EPC document issued by Ministry on 05.03.2019 specify Defects Liability Period ranging from 3 to 10 years for development and maintenance work, depending on the type of pavement, standalone bridge/tunnel, new/alternate material/technology used etc. Ministry's circular No. RW/NH-33044/10/2002/S&R (P&B) dated 21.08.2018 had also specified Defects Liability Period of 10 years for the stretches where new technology/material has been used/is proposed to be used.

6. As per Article 10.2 of the model document for EPC contract agreement, it is the responsibility of Authority's Engineer to review and approve the design and drawing prepared and submitted by contractor.

7. All ROs of Ministry/NHAI/NHIDCL & CEs of BRO are requested to use (i) new/alternative Material and Technology and (ii) locally available materials which are suitable and cheaply available in the area in Highway construction for better quality of construction, sustainability and cost and time savings.

8. DPR consultant shall furnish life cycle project cost comparison amongst the options using conventional material/technologies & with the use of new/alternative Material and Technology based on rate analysis as per Standard Data Book of the Ministry/market rate. DPR approving authority should ensure that such comparison has been done by the DPR Consultant and the new/alternative Material and Technology proposed by the DPR consultant is cost effective as well as environment friendly.

8.1 Bidding of the project will be taken up considering the cost determined by DPR consultant based on conventional material/technologies or new/alternative Material and Technology which is most economical to the Authority. It will not bar the contractor/concessionaire to use other new/alternate material/technology. The decision of use of appropriate material/technology will rest with the contractor/concessionaire subject to satisfactory compliance to the provisions of this circular.

8.2 In case use of such new/alternate material/technology by the contractor/concessionaire brings down the cost of construction/maintenance, provided it meets all other design/construction provisions as envisaged in the contract and stipulated in the Codes, Standards, Specifications, Guidelines etc. specified under schedule D, the Authority shall not revise the contract price nor ask the contractor to transfer the cost reduction benefit to the Authority.

8.3 **It is clarified that any new alternate, material & technology that has been accredited by IRC, and falling under IRC:SP-89 (Part II), will not require further accreditation, and will henceforth fall under approved, alternate, material and technologies. For such approved, alternate, material and technologies, the Defect Liability Period shall be at par with conventional/flexible pavement.**

9. "It is clarified that the material/technology for which Codes, Standards, Specifications, Guidelines etc. of IRC, MoRTH, AASHTO, ASTM, Euro Code and British Codes are available shall not be treated as new/alternate material/technology and, as such, Defects Liability Period (DLP) of projects using such material/technology shall not fall into the category corresponding to new material/technology. **Hence the defect liability period will be at par with conventional/flexible pavement.** The stretches where

new material/technology is used for which Codes, Standards, Specifications, Guidelines etc. of IRC, MoRTH, AASHTO, ASTM, Euro Code and British Codes, FHWA guidelines are not available, the project may be taken up on pilot basis and the Defects Liability Period of such projects shall be 10 years."

10. No separate approval from the Authority is required for using new/alternate Material/technology within the contract provisions. The Authority's Engineer/Independent Engineer shall also approve the design and drawing of all the new/alternate Materials proposed by contractor/concessionaire for which international standards such as AASHTO, ASTM, Euro Code and British Codes, FHWA guidelines are available.

11. If the use of alternative material/technology is not specifically covered in the Indian or International Standards as mentioned para 9 above, contractor/concessionaire would be permitted its use on certification by owners of similar projects regarding the continued successful performance of such materials, technologies, methods, procedures or processes for design life of the project as per Para 1.9 of Manual of two laning/four laning/six laning of IRC. In this regard, it is hereby clarified that usage in Indian condition shall not be insisted by the Authority's Engineer/Independent Engineer for the Material/Technology if certification by owners of similar projects regarding the continued successful performance of such materials are confirmed. The contractor/concessionaire will however be required to submit all quality assurance and quality control documents and demonstrate to the satisfaction of Authority's Engineer/Independent Engineer satisfactory performance of the pavement or structure using such material or technology. Authority may seek performance of the use of such material and technology through appropriate diplomatic channels. However, Defects Liability Period of such projects shall be 3 to 10 years (Varying subject to specific technologies) and approval shall be accorded at the level of Regional Officers or equivalent officers on recommendation of Authority's Engineer/ Independent Engineer.

12. IRC:SP: 112-2017 "Manual for Quality Control in Road and Bridge works" and various IRC Codes/MoRTH guidelines prescribe specifications and standards for design and construction of various proprietary items such as Geosynthetics. Contractor/concessionaire will ensure that the design parameters, warranty and other requirements are fulfilled by manufacturer(s) of such proprietary items as specified in applicable standards/guidelines. In addition, the contractor/concessionaire has to comply the documentation requirements from manufacturer/self, test on proprietary items as specified in IRC:SP:112-2017 "Manual for Quality Control in Road and Bridge works" and applicable standards/ guidelines.

13. ROs/EDs of Ministry/NHAI/NHIDCL & CEs of BRO (Kerala, Karnataka, Tamil Nadu, Puducherry, Andhra Pradesh) shall implement projects involving coir technology and ROs of Ministry/NHAI/NHIDCL & CEs of BRO (West Bengal, Odisha) shall invariably consider using jute technology wherever appropriate. A monthly report shall be submitted by all this ROs/EDs.

14. All ROs of Ministry/NHAI/NHIDCL & CEs of BRO are requested to submit quarterly reports indicating the number of projects and quantity of New/Alternative material used by them to the Ministry.

15. The contents of this circular may be brought to notice of all.

Yours faithfully,

(Jagat Narayan)
Superintending Engineer (S&R Zone)
For Director General (RD) & **SS**

File No. RW/NH-33044/18/2020-S&R (P&B)

Copy to:

1. All ROs/ELOs of MoRTH and all Technical Officers at MoRTH Headquarter.
2. Secretary General, Indian Roads Congress
3. Director, IAHE, NOIDA
4. PPS to Secretary (RTH), PPS to DG (RD) &SS, PS to AS&FA, PS to ADG- III
5. NIC-with request to upload on the Ministry's portal.

S. No.	Material/ Technology	Applications	IRC Code/Guidelines/IS Code	MoRT&H Circular
1.	Waste Plastic	Wearing Coat	**IRC:SP-98** "Guidelines for the use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Courses".	i. 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"; ii. Circular No. RW/NH-33044/24/2015-S&R (R) dated **27.08.2019** "Collection and Re-use of Waste Plastics: Swachhata hi Seva Campaign"; iii. 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".
2.	Cement Treated Granular Layer	In Base (CTB); In Sub-base (CTSB)	**IRC:37** "Guidelines for the Design of Flexible Pavements".	–

File No. RW/NH-33044/18/2020-S&R (P&B)

S. No.	Material/ Technology	Applications	IRC Code/Guidelines/IS Code	MoRT&H Circular
3.	Geo-Synthetics	i. Reinforcement in pavement ii. Slope-Protection iii. Separation, Filtration, Drainage and erosion control iv. Impermeable barrier/capillary cut off in waterlogged areas v. Stress relieving membranes and crack retarding layer.	i. **IRC:SP:59** "Guidelines for Use of Geo-synthetics in Road Pavements and Associated Works"; ii. **IRC:113** "Guidelines for the Design and Construction of Geo-synthetic Reinforced Embankments on Soft Subsoils". iii. **IRC:SP:48** "Hill Road Manual" iv. **IRC:56** "Recommended Practices for Treatment of Embankment and Roadside Slopes for Erosion control" v. **IRC:SP:106** "Engineering Guidelines on Landslide Mitigation for Indian Roads"	Circular No. 33044/64/2018-S&R (P&B) dated **16.07.2018** "Geo-Synthetics and their use in road construction".
4.	Recycling	i. Wearing Coat ii. Crust building	**IRC:120** "Recommended Practice for Recycling of Bituminous Pavements".	i. Circular No. RW/NH-33044/10/2002/S&R (R) dated **11.01.2018** "Guidelines for implementation of Hot in place Recycling technology for Periodic Renewal (PR) works"; ii. Circular No. RW-22012/01/2012-Mech dated **18.12.2012** "Use of Recycling technology for PR (Periodic Renewal) works on National Highways".

File No. RW/NH-33044/18/2020-S&R (P&B)

S. No.	Material/ Technology	Applications	IRC Code/Guidelines/IS Code	MoRT&H Circular
5.	Fly-ash	i. Embankment ii. Cement Concrete iii. Stabilization	i. **IRC:SP:58** "Guidelines for Use of Fly Ash in Road Embankments"; ii. **IRC:44** "Guidelines for Cement Concrete Mix Design for Pavements"; iii. **IRC:SP:89** "Guidelines for Soil and Granular Material Stabilization Using Cement, Lime and Fly Ash".	i. Circular No. RW/ NH-33044/01/2019-S&R (P&B) dated **23.10.2020** "Use of Fly-ash in road/ flyover embankment construction on NH works"; ii. Circular No. RW/NH-35014/20/2017-H dated **07.01.2019** "MoU for offtake of Fly-ash from private power stations"; iii. Circular No. 24028/14/2018-H dated **27.08.2018** "Use of Fly-ash in road/flyover embankments construction".
6.	Modified Bitumen (CRMB, Polymer modified, Natural Rubber)	Wearing Coat	i. **IRC:SP:53** "Guidelines on Use of Modified Bitumen in Road Construction"; ii. **IRC:SP:107** "Guidelines for Gap Graded Wearing Course with Rubberised Bitumen-(Bitumen Rubber)".	i. Circular No. RW/ NH-35072/05/2018-S&R (P&B) dated **24.08.2018** "Use of Bitumen & Modified Bitumen in the construction of flexible pavements and their source of their procurement for National Highways Work"; ii. Circular No. RW/NH-33044/05/2016/S&R (R) dated **05.09.2016** and 28.03.2016 "Use of polymer/rubber modified bitumen on NHs and other centrally sponsored schemes";

S. No.	Material/ Technology	Applications	IRC Code/Guidelines/IS Code	MoRT&H Circular
				iii. Circular No. RW/ NH-33044/49/2015/ S&R(R) dated **18.02.2016** "Use of polymer/rubber modified bitumen on NHs and other centrally sponsored schemes"; iv. Circular No. RW/NH-33041/3/2001-S&R(R) dated **30.01.2012** "Use of bitumen/ modified bitumen for National Highway Works"; v. Circular No. 33041/3/2001-S&R (R) dated **19.07.2011** "Use of Modified Bitumen in BM/DBM layers for National Highway Works".
7.	Soil stabilization	Chemical Stabilization	**IRC:SP-89** (Part II) "Guidelines for the Design of Stabilized Pavements (Part-II)",	–
8.	Jute	Slope Stabilization	**IRC:56** "Recommended Practices for Treatment of Embankment and Roadside Slopes for Erosion Control"	–
9.	Coir	Slope Stabilization	**IRC:56** "Recommended Practices for Treatment of Embankment and Roadside Slopes for Erosion Control"	–
10.	Construction & Demolition Waste	i. Embankment ii. Granular Layer in flexible Pavement iii. Concrete Pavement	**IRC:121** "Guidelines for Use of Construction and Demolition Waste in Road Sector"	–

File No. RW/NH-33044/18/2020-S&R (P&B)

S. No.	Material/ Technology	Applications	IRC Code/Guidelines/IS Code	MoRT&H Circular
11.	Recycled Aggregate/ Slag Aggregate/ Bottom Fly Ash	i. Concrete ii. Granular Layer	**IS:383** "Coarse and Fine Aggregate for Concrete specifications"	Circular No. RW/NH-34066/09/2017-S&R(B) dated **21.07.2020** "Use of Manufactured Aggregates in National Highway Works".
12.	Stone Matrix Asphalt	Wearing Coat	**IRC:SP: 79** "Tentative Specifications for Stone Matrix sphalt"	Circular No. RW/NH-35072/05/2018-S&R(P&B) dated **24.08.2018** on"Use of Bitumen & Modified bitumen in the construction of flexible pavements and source of their procurement for National Highways works"
13.	Fibre reinforced concrete pavement	Road crust	**IRC:SP:46** "Guidelines for Design and Construction of Fibre Reinforced Concrete Pavements"	–
14.	Cold Mix Technologies	Wearing Coat	**IRC:SP-100** "Use of Cold Mix Technology in Construction and Maintenance of Roads Using Bitumen Emulsion"	–
15.	Open Graded Friction Courses	Wearing Coat for high rainfall areas	**IRC-129** "Specifications for Open-Graded Friction Course"	–
16.	Thin Whitetopping	Wearing Coat	**IRC:SP:76** "Guidelines for Conventional and Thin Whitetopping"	–
17.	Precast Pretensioned girders for bridges, Integral Bridges	Bridges	**IRC:SP:71** "Guidelines for Design and Construction of Precast Pretensioned Girders for Bridges"	–

Annexure 2

State Wise Road Length Sanctioned and Completed under New/Green Technology till March 2022

Length (in km)

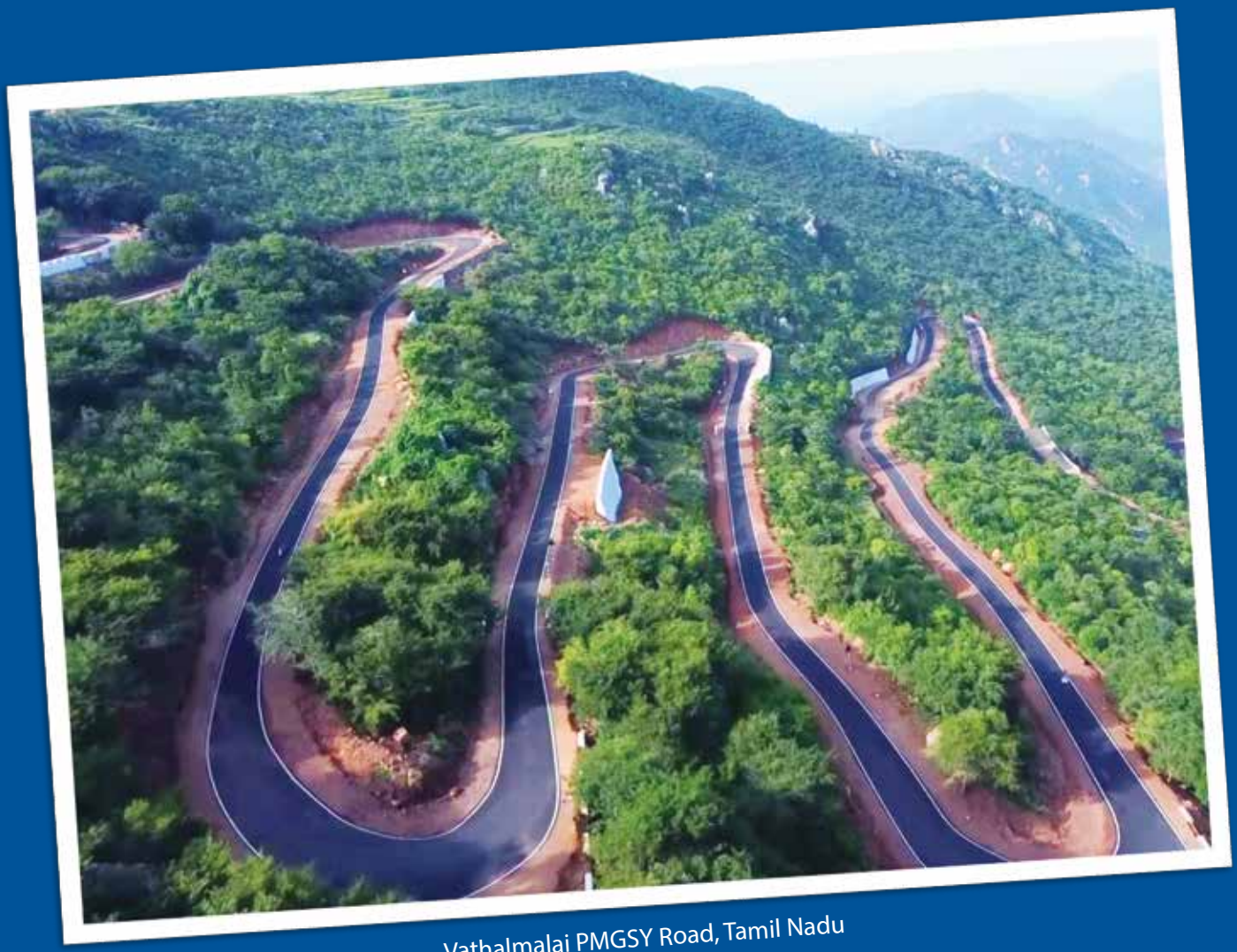
State	Road Length Sanctioned till March 2022	Road Length Completed
Andaman and Nicobar	118	25
Andhra Pradesh	1544	862
Arunachal Pradesh	2677	924
Assam	7680	6366
Bihar	7060	5459
Chhattisgarh	8089	4722
Gujarat	1532	592
Haryana	3232	2265
Himachal Pradesh	2176	1422
Jammu and Kashmir	1140	599
Jharkhand	5128	4949
Karnataka	1647	957
Kerala	1064	528
Ladakh	111	84
Madhya Pradesh	13671	9851
Maharashtra	2797	928
Manipur	1111	492
Meghalaya	2210	1086
Mizoram	729	264
Nagaland	675	355
Odisha	13438	7728

State	Road Length Sanctioned till March 2022	Road Length Completed
Pondicherry	50	–
Punjab	1010	453
Rajasthan	6376	5209
Sikkim	1132	444
Tamilnadu	3383	2334
Telangana	1801	795
Tripura	474	302
Uttar Pradesh	11835	3552
Uttarakhand	5261	2334
West Bengal	3778	3362
Grand Total	**112930**	**69243**

Technology wise Road Length Sanctioned and Completed under New/Green Technology till March 2022

Length (in km)

Technology	Road Length Sanctioned till March 2022	Road Length Completed
Waste Plastic	40130	25904
Cold Mix	25977	16955
Cell filled	3068	2218
Panelled CC	4831	2513
Terrazyme	1654	993
Nanotechnolgy/Nanotac	7777	3580
Coir/Jute/Geo- Textiles	1539	1061
RCCP (Roller Compacted Concrete Pavement)	1055	983
Cement Stabilization	10384	5887
Surface dressing	2816	949
Others	13699	8200
Total	**112930**	**69243**



Vathalmalai PMGSY Road, Tamil Nadu

Pradhan Mantri
Gram Sadak Yojana

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