© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 08 Issue: 07 | July - September 2017
Paper is available at www.jrps.in | Email : info@jrps.in

COST EFFECTIVE TECHNOLOGY IN DESIGN OF PAVEMENTS FOR LOW TRAFFICKED ROADS

[1] Ashish Kumar Agrawal, [2] Ajit Singh

[1] Research Scholar, Department of Civil Engineering, CBS Group of Institutions
[2] Assistant Professor, Department of Civil Engineering, CBS Group of Institutions

ABSTRACT: Rajasthan, area wise (342,239 sq. km) is the biggest state of the country. It has a population of 68.6 million and located in the Western region. Rajasthan is lagging in many key socio-economic indicators and is one of the low income states. Rajasthan stands at 17th place out of 29 states of the country in terms of the Human Development Index. About 75 percent of the state's population is rural and mainly depends on agriculture for its livelihood. The state has good potential for growth in agriculture and agro-based industries, mining, minerals processing, tourism, handicrafts and cottage industries. The state's potential is underutilized due to inadequate road infrastructure and market linkages. The need for high quality road infrastructure is recognized to exploit the state's potential and resources. Rajasthan has a state road network of 193,017 km including 7,260 km National Highways (NH), 10,953 km State Highways (SH), 9,900 km Major District Roads (MDR), 25,033 km Other District Roads (ODR) and 139,871 km village roads (VR).

In recent years Rajasthan has made remarkable progress with developing its rural roads under PMGSY. The eligible criteria in PMGSY are to connect habitation of population up to 500 and for desert and tribal areas to connect habitation population up to 250. Initially the Rajasthan has adoped village as habitation due lack of population survey of each habitation of base year 2001. According to village connectivity the Rajasthan has achieved about 80% of total village as per census of 2001. As part of Innovative initiative In PMGSY, GoR selected 11 villages roads in 5 districts for construction of roads using new / Cost Effective Technology (CET), local available materials and environment friendly.

To meet the objective, the latest research work available in India and practices being followed in other countries have been studied / reviewed. To have a thorough understanding of structural and functional behaviors of each road, Scholar carried out site visits along all the project roads and collected technical data relating to traffic volume, type of soils, drainage & environmental conditions, engineering properties of locally available marginal material and industrial waste

which are required for introducing cost-effective technologies for road design and construction that are safe and environmentally friendly.

Scholar had meetings with stake holders to collect/discuss the local issues on project road, check availability of local material. Scholar had discussed the possible new technologies in CRRI for its suitability based on the laboratory test report of project road soil.

One of the problem along project roads was the poor soil condition. Soil is predominately Black Cotton (BC) type soil, having CBR <2% & PI>10 Specifically the availability of natural soil with CBR more than 5% was not available in the vicinity of the projects roads. Hence for enhancement of strength, in terms of CBR, of natural and locally available soil was found as first challenge or rather an opportunity to apply the cost effective and environmental friendly technology to make use of locally / natural soil for subgrade soil with higher CBR.

Keywords: New Technology in Pavement Design, Cost effective Technology CET, Flexible Pavement, Rigid Pavement, Soil Stabilization.

CET Technology 1: Use of Lime Sludge (Factory Waste) for stabilization of subgrade soil.

It was found that large quantity of Carbide Lime sludge is a byproduct of PVC manufacturing from Messrs. Shriram Vinyl & Chemical Industries, Kota. After draining of free water, the material is in a semi solid state and is very convenient for transportation. This factory waste has been recommended for enhancement of CBR of natural soil to upgrade it to meet the requirement of Subgrade layer. Lime sludge, waste from factory, is recommended for lime stabilization of subgrade soil. Certification from Factory for non-hazardous nature of the material is also established.

Consultant carried out laboratory testing of existing subgrade soil mixing with lime sludge and achieves a CBR of 15% by mixing 9% of lime Sludge by weight of soil. However as per Clause 403.2.3 of MoRD the laboratory CBR value shall be at least 1.5 times the minimum field value of CBR stipulate in the contract. Hence Consultant considered a CBR of 10% for design of pavement crust. Letter obtained from M/s. Shriram Vinyl & Chemical Industries, Kota is also attached for assurance of supply of waste material. Based on this analysis, it has been observed that there is a saving of 8% to 10% (depends on location of road) due to reduction in thickness of pavement crust by adopting above said lime (factory waste) stabilization.

Environmental Benefits & Cost-Effectiveness:

- Use of byproduct / Industrial Waste, which requires large area of precious land for disposal.
- Converting waste into wealth
- Preserving / saving the gradual depletion of natural resources
- Reduction in carbon emission
- Provides cost benefit in the rage of 8% to 10% on unit cost of stabilized soil.

CET Technology 2 : Use of Plastic Waste in Bituminous mix.

Plastic waste is recommended as bitumen modifier; 8% by weigh of bitumen shall be replaced with plastic waste. Consultants have identified Messrs. K K Plastic Waste Management Ltd., as one of the major source to supply plastic waste. Though this technology is already approved / standardized by IRC, it is hardly being used in Rajasthan. It have also been confirmed that this technology, use of plastic waste in bituminous mix, has largely been used in Karnataka and Andhra Pradesh. The standards & specification for this activity is available in IRC SP 98 2013: Guidelines for the use of waste plastic in hot bituminous mixes. Sequence of activities are depicted by Figures. Based on this analysis, it has been observed that there is not significant saving by adopting above said plastic waste in bitumen mix as thickness of bituminous layer (s) is very less in rural / low trafficked roads. However, there is substantial benefit from environment point of view, as mentioned below.

Environmental benefits and Cost-effectiveness:

- Reduction in consumption of bitumen and gets replaced by waste plastic.
- Encourgae cleaning operations; an eyesore is removed from the public view, resulting in a cleaner, healtherir and safer town / villages.
- Rag pickers are paid; employment opportunities are created for a large number of people both directly and indirectly. *(Each rag-pickers earns around INR 400 per day)*
- When plastic are removed, what remain is organic waste which can be converted in to high quality organic manure for use of farmers.
- Food borne and water borne disease are reduced due to less accumulation of waste.

- Reduction in consumption of Bitumen by 8% to 10% and gives cost saving in the tune of 2% for Village roads where bituminous layers is quite thin.

CET Technology 3: Use of Plastic Cell-Filled Concrete Block Pavement

Most of the low volume village roads being constructed are flexible pavements provided with a thin bituminous surface. Quite often, these roads get damaged due to overloaded agricultural vehicles, inadequate drainage facility and water logging problems, and hence require early periodic maintenance. Also, in the absence of adequate fund and timely maintenance, the serviceably level of the roads deteriorates rapidly and most of the time, these roads gets converted into undulated-earth road.

The technology of Plastic Cell-filled Concrete Block Pavement (PCCBP) has proved to be very promising solution for the above mentioned issues. It provides long lasting concrete pavements at low initial cost which are almost maintenance free. It also generates employment opportunities in rural area. The technology and sequence of activity is depicted by Figures.

Advantages of PCCBP

- Use of recycle plastic
- Being a cement concrete pavement, relatively suitable for poor drainage
- The cost of construction is considerably reduced when compared to conventional cement concrete pavement; gives a saving around 50%.
- Due to high stiffness, the overall crust requirements gets reduced hence economical for low volume roads
- If the individual block fails, then it can be easily replaced without much effort and with least cost.

Disadvantages of PCCBP

- The preparation of the cells is cumbersome; cells get disturbed while placing the concrete and hence proper care is required.
- Consumption of labor is more, more labor oriented work
- Due to slow progress, the actual turn out of the men and machinery is less than the normal construction.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 08 Issue: 07 | July - September 2017
Paper is available at www.jrps.in | Email : info@jrps.in

RATIONAL FOR ADOPTING THE COST EFFECTIVE TECHNOLOGIES

Based on above mentioned advantages of Cost-Effective Technologies and their suitability for specific site conditions, the summary of the rational is as given below:

Rational for adopting the CETs

Sl. No.	Project Road Condition	Adopted Technology	Remarks
1	Where natural soil is Black Cotton (PI<10) and Low CBR (<5)	Factory Waste Lime : used in Subgrade	Used up to Economical leads
2	For all Bituminous Pavements	Plastic Waste in Bituminous Layers	Provides saving around 8% bitumen and betterment of Stripping Value.
3	Where non-built-up section (L<500m)	Cell Filled Cement Concrete	Bituminous Pavement is avoided due to water stagnation in builtup areas.

Conclusion :

Methodology and Specifications for the cost effective Technologies are developed and discussed in the Detailed thesis.

Reference:

Sr. No	Name of Document	Published By
1	Rural Road Manual- 2002 (IRC:SP-20)	Indian Roads Congress

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 08 Issue: 07 | July - September 2017
Paper is available at www.jrps.in | Email : info@jrps.in

2	Guidelines for Soil and Granular Material Stabilization using Cement, Lime and Fly Ash (IRC:SP:89-2010)	Indian Roads Congress
3	Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads (IRC:SP:2015)	Indian Roads Congress
4	Specifications for Rural Roads 2004	National Rural Roads development Agencies
5	Quality Assurance Handbook for Rural Roads, Vol 1&2	
6	Environmental Codes of Practices for Second Rural Roads Project	
7	A Guide to the Structural Design of bitumen-surfaced roads in tropical and sub-tropical countries (Overseas Road Note 31)	TRL, UK
8	Structural Design of flexible Pavements for Interurban and Rural Roads (TRH:1996)	DoT, Pretoria