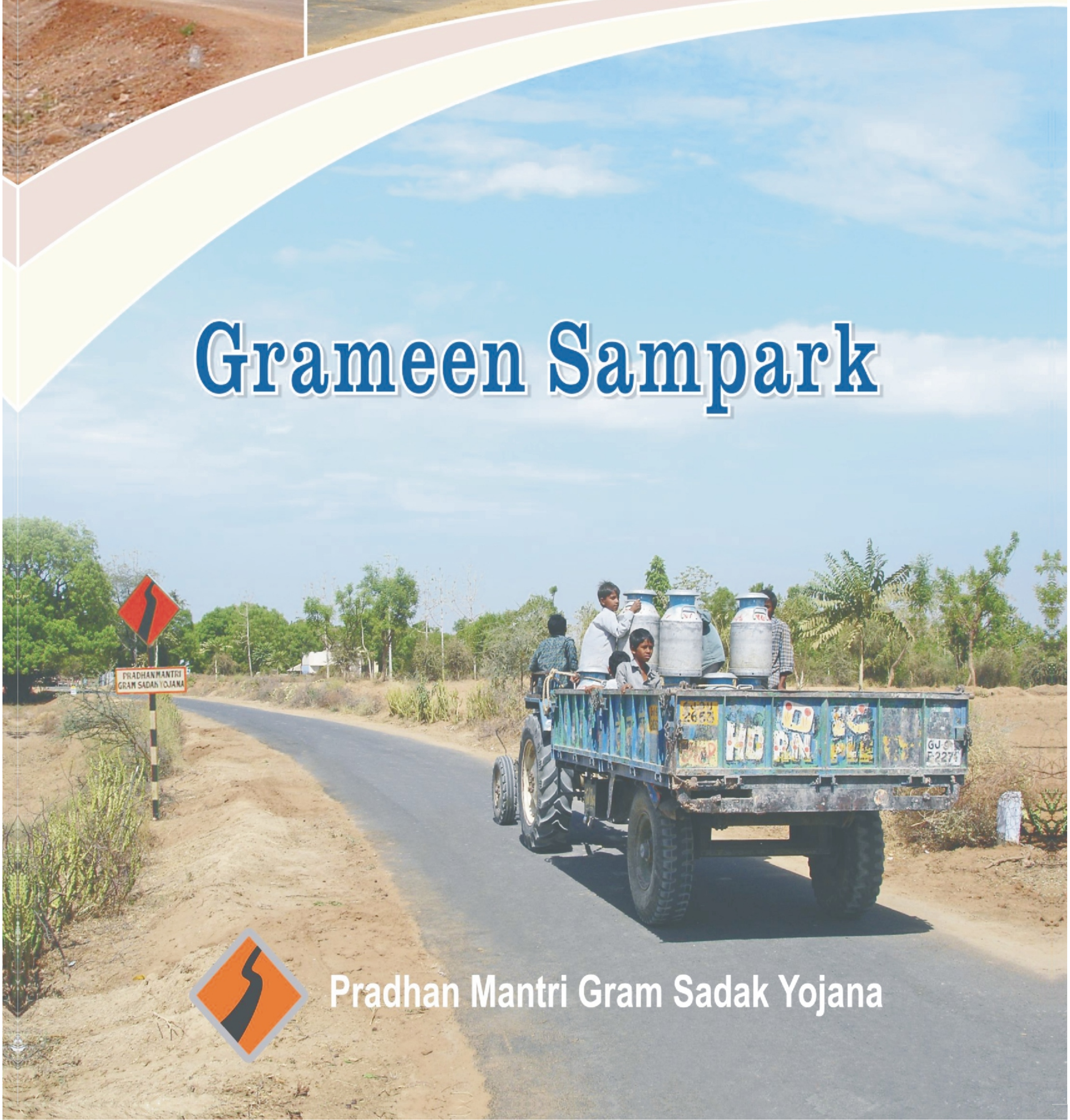
Grameen Sampark



Pradhan Mantri Gram Sadak Yojana

In this Issue

The National Rural Roads Development Agency (NRRDA) was established on 14th January, 2002 as the dedicated agency of the Ministry of Rural Development for the operational management of the rural roads programme - PMGSY

Grameen Sampark is a newsletter of the NRRDA containing items of topical interest. For official text or detailed information please contact NRRDA or visit the website.

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Note: Accepted articles may be condensed.

Editorial

Pradhan Mantri Gram Sadak Yojana has continued to play a critical role in sustained poverty alleviation by providing all weather connectivity to rural unconnected habitations since 2000. Under the scheme over 92 thousand habitations have been connected and 3.80 lac km of roads built including over 1.47 lac km length upgraded so far. The implementation of this massive Programme has not only posed several challenges but also thrown up huge opportunities to experiment and innovate in various spheres including Technology. Due to numerous infrastructure sector projects being implemented across the country, a major challenge is to judiciously conserve natural resources and innovate in the field of new, alternative and locally available construction materials. To meet these objectives consolidated guidelines (www.omms.nic.in/circulars) encompassing earlier developments have been issued to the States in May 2013 to undertake such proposals in a big way. Notably, mainstreaming of proven technologies, side by side with newly IRC accredited technologies has also been underscored to support these interventions for life-cycle based cost effective technologies. While a number of projects for use of soil stabilizers, liquid polymers, use of coir/jute etc. as geo-textiles, cell filled concrete and roller compacted concrete pavements have been undertaken, many more are in the pipeline. A Standing Advisory Committee has also been established in NRRDA besides a Technology cell to provide further encouragement to such efforts.

It is expected that SRRDAs would come forward to promote these technologies to overcome shortage of materials in road construction and successfully reduce concomitant carbon foot print.

I hope you would find this issue of Grameen Sampark engrossing and interesting as always.

Happy Reading.

(Rajesh Bhushan)

Acceptable Level of Roughness for Low Volume Rural Roads

Dr. U. C. Sahoo*

Rural roads usually carry low volume of traffic, but these roads play an important role in providing connectivity to remote habitations resulting in increased income and employment in rural areas. These roads are usually constructed as granular pavements with or without thin bituminous surfacing. Considering the vast network of existing rural roads, rationalization of the design approach can result in significant reduction in life cycle cost. In a mechanistic design approach, a performance criterion is usually developed, for which the terminal condition need to be established in terms of major performance indicators. In this paper, the acceptable value of roughness for rural roads has been identified taking into account the recommendations of various researchers, which may be used as a terminal condition for developing performance criterion for low volume rural roads.

Keywords: Rural Roads, terminal condition, performance criterion, riding quality, roughness

Rural roads in India comprise other district roads (ODR) and village roads (VR), which covers 80% of the total road network of the country. Presently, a large number of roads are being constructed under the Prime Minister's rural connectivity programme (PMGSY) with the objective of providing all-weather road connectivity to all the habitations with population more than 500. The roads being built under this programme are mostly granular pavements with thin bituminous surfacing. Pavement design of these roads are presently practiced as per the guidelines given in IRC:SP:72 (2007), IRC:SP:20 (2002), which do not refer to any mechanistic principles. A performance criterion needs to be established for rational design criterion of rural roads in India.

In mechanistic design methods, the relationship developed between the performance of pavements and design parameters is referred to as performance criterion. Performance criterion is generally developed considering a failure condition, which may be either structural or functional. While most of the mechanistic flexible pavement design methods consider the cracking of bound layers and rutting along the wheel paths as main distresses to be addressed, some design methods have different functional parameters such as Present Serviceability Index (PSI), roughness or other such indices that reflect the user's perspective. One of the difficult tasks associated in the development of performance criterion is defining the terminal condition of the pavement in terms of the performance indicators. Terminal condition may be described as unacceptable level of distress causing significant riding discomfort on a road surface.

Pavement surface roughness which reflects the user perspective is a simple parameter used to evaluate pavement performance. This is an important indicator of pavement performance as it directly affects the way in which pavements serve the travelling public. Rutting is the major mode of structural failure in granular pavements with thin bituminous surfacing. But, for thin bituminous surfaced roads, the pavement may actually fail by breakup of the thin surfacing before the terminal condition in terms of rutting is reached (Croney, 1972). Hence roughness should be considered to be a main

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parameter for defining the failure condition of such type of roads. In this paper, the acceptable value of roughness for rural roads has been defined based on recommendations of various researchers.

2. Terminal Condition

To develop a performance criterion for low volume roads, a terminal condition is required to be established. Terminal condition may be described as unacceptable level of distress causing significant riding discomfort on a road surface. Selection of appropriate parameter to describe the performance of the pavement is necessary for the development of a design approach.

In the case of low volume roads, the bituminous surfacing (for paved roads) is usually thin (less than 40 mm) and is not expected to contribute significantly to the structural capacity of the pavement (Pidwerbesky et al., 1997). Hence cracking of bituminous surfacing cannot be considered as a main mode of failure in such pavements. Rutting is the major mode of structural failure in granular pavements with thin bituminous surfacing. It develops mainly along the wheel tracks, and increases with cumulative application of commercial traffic. The strain induced in the subgrade by a moving wheel load is mostly elastic (recoverable). However, the accumulation of the irrecoverable part of strain leads to permanent deformation in subgrade. The permanent deformation in the subgrade and granular layers caused by repeated applications of wheel loads, manifests at the surface of pavement as rutting

Another simple parameter used to evaluate pavement performance is pavement surface roughness, which reflects the user perspective. This is an important indicator of pavement performance as it directly affects the way in which pavements serve the travelling public. The roughness of the road can be measured by different techniques and equipments resulting in different roughness indices; hence it is to be expressed in terms of International Roughness Index (IRI). Some design methods use parameters such as Present Serviceability Index (PSI), which uses parameters like rutting, cracking and patching etc. to quantify the riding quality of a road surface (AASHO, 1962).

Roughness Level of Low Volume Rural Roads

The riding quality of a pavement surface depends on the roughness of the road and on the vehicle speed. On rural roads, a driver usually tolerates greater degree of road roughness because of the lower speeds at which vehicles usually travel compared to high speed facilities. The design speed for rural roads in India is 40 to 50 km/h (IRC:SP:20, 2002). The following paragraphs report some studies which recommended the roughness levels relevant for rural low volume roads.

Queensland Department of Main Roads (QDMR, 2000) uses the relationship given by Eq. 1, developed by Austroads between 'Single Track IRI' and NAASRA (National Association of Australian State Road Authorities) roughness (NRM).

$$NRM = -0.557 \times IRI^2 + 27.50 \times IRI - 3.47 \qquad \text{...... (1)}$$

Where:

NRM = NAASRA Roughness in counts per km

IRI= International Roughness Index in m/km

This agency has also proposed NRM thresholds for different ride quality levels for roads with different traffic intensities. The suggested NRM thresholds for low volume roads (with annual average daily traffic volume of less than 500 veh/day) are given in Table 2. The corresponding IRI threshold values using Eq. 1 are also given in Table 2.

Table 2: Ride quality thresholds for low volume roads (AADT < 500)

Descriptive Condition	NRM	Corresponding IRI (m/Km)
Exellent	< 80	< 3.25
Very Good	81-95	3.26-3.90
Good	96-130	3.91-5.50
Poor	131-180	5.51-8.00
Very Poor	> 180	> 8.00

Ahlin and Granlund (2002) established a relationship between road roughness, vehicle speed and human Whole Body Vibration (WBV). The relationship between comfortable vehicle speed (CVS) and IRI is given as Eq. 2. The value of 'n' in the equation is high for rural low volume roads, where the dominating roughness amplitudes have long wavelengths.

$$CVS = 80\left(\frac{IRI}{5}\right)^{\frac{2}{1-n}} \qquad \text{...... (2)}$$

The value of 'n' is about 2.5 for rural low volume roads. From Eq. 2, the IRI corresponding to a value of n = 2.5 and a comfortable vehicle speed of 40 km/h is 8.5. For a comfortable vehicle speed of 50 km/h, the corresponding IRI is 7.1.

Yu et al. (2006) proposed speed-related thresholds of roughness in terms of IRI for local streets as given in Table 3.

Table 3: IRI thresholds for roads with low design speed (Yu et al., 2006)

Ride Quality	IRI Thresholds for Different Speeds	
	50 km/h	40 km/h
Very Good	<2.28	<2.86
Good	2.28-3.59	2.86-4.49
Fair	2.60-5.54	4.50-5.69
Mediocre	4.55-6.25	5.70-8.08
Poor	>6.25	>8.08

Sahoo (2009) carried out riding quality study on selected rural road sections built under PMGSY by a panel of experts moving at a speed of 40 km/h. He suggested the threshold limits as given in Table 4 for different riding qualities applicable for rural roads.

Table 4: Riding Quality for Rural Roads (Sahoo, 2009)

Ride Quality	Roughness IRI (m.km)
Very Good	<4.0
Good	4.0-5.5
Fair	5.5-6.7
Poor	6.7-8.5
Very Poor	>8.5

Conclusions

Terminal distress condition leading to failure is an important consideration in developing performance criterion. Roughness of pavement surface is a simple and important indicator of pavement performance as it directly affects the way in which pavements serve the travelling public. Queensland Department of Main Roads (QDMR, 2000) reported very poor riding quality with an IRI value more than 8.0 for low volume roads in Australia. Ahlin and Granlund (2002) suggested acceptable roughness to be in the range of 7.1 to 8.5 for a comfortable vehicle speed of 50 to 40 km/h for rural roads. Yu et al. (2006) reported that the riding quality will be poor for 50 km/h on roads having an IRI more than 8.08. For a speed of 40 km/h, the corresponding IRI threshold is 6.25. Sahoo (2009) suggested roughness level of 8.5 IRI as very poor riding condition for rural roads. Hence, for rural roads in India which usually carry low traffic volume (less than 400 veh/day) and the design speed is between 40 to 50 km/h, an acceptable roughness of 8.0 to 8.5 IRI may be adopted for developing performance criterion for such roads.

References:

1. AASHO, (1962) "The AASHO Road Test, Report 5, Pavement Research," Highway Research Board Special Rep. No. 61E, American Association of State Highway Officials, Washington, D.C.

2. Ahlin, K. and Granlund N. O. J., (2002) "Relating Road Roughness and Vehicle Speeds to Human Whole Body Vibration and Exposure Limits," International Journal of Pavement Engineering, Vol. 3, No. 4, pp. 207–216.

3. Croney D., (1972) "Failure Criteria for Flexible Pavements," Proceedings of Third International Conference on Structural Design of the Asphalt Pavements, University of Michigan, Ann Arbor, Michigan, pp. 608-612.

4. IRC: SP: 20, (2002) "Rural Roads Manual," Indian Roads Congress, New Delhi, India.

5. Pidwerbesky, B. D, Steven, B. D. and Arnold, G., (1997) "Subgrade Strain Criterion for Limiting Rutting in Asphalt Pavements," Proceedings of Eighth International Conference on Asphalt Pavements, Seattle, Washington, pp. 1529-1544.

6. QDMR, (2000) "Pavement Roughness Condition Reporting," Asset Management Services, Queensland Department of Main Roads, Brisbane, Australia.

7. Sahoo, U. C. (2009) "Performance Evaluation of Low Volume Roads", Ph.D. Thesis, IIT Kharagpur, India.

8. Yu, J., Eddie, Y. J. C. and Yau, J. T., (2006) "Development of Speed-Related Ride Quality Thresholds using International Roughness Index," Transportation Research Record No. 1974, TRB, Washington, D.C., pp. 47–53.

Effective Public participation & role of PIU in Pradhan Mantri Gram Sadak Yojana

Case study of one work in Naxal affected area
District – Gondia in Maharashtra

Shri. S. S. Tekade*

Objective of PMGSY

Government of India has launched in 2000 ambitious programme of rural connectivity called PMGSY under which connectivity up to 250 populations in tribal area were to be achieved upto 2007 and also decided to take Up-gradation of roads under business plan approved in 2005 under **Bharat-Nirman.** Also considering the acute problem in Naxal affected area in 33 districts in India, the Govt. of India also has taken decision to sanction special programme for Naxal area reserving some percentage out of total programme fund of PMGSY. This scheme i.e. Pradhan Mantri Gram Sadak Yojana is centrally funded and technically administrated by State Govt. by creating an independent State Rural Road Development Association.

Sanction of Up-gradation Proposal - (Phase V)

In Gondia District of Maharashtra the village connectivity upto 250 population was already achieved by end of Phase IV, therefore Proposals for Up-gradation were approved by National Rural Road Development Agency in Phase V.

Project Proposals & Sanction

The DPR were prepared in house and normal provision of CD Works, RCW were made in DPR including strengthening of crust and black topping. The proposal was approved in July – 06. The tenders were invited in Aug-06 and agencies were fixed in Oct./Nov.-06.

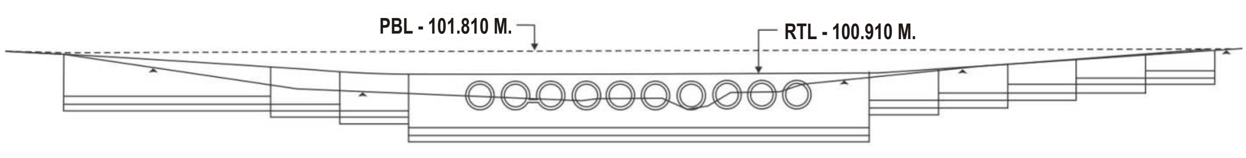
Case study of a work

Scope of Work

Road works of Dawk –Silapur–Fukkimeta VR-100 was sanctioned for Rs.78.48 lakhs. The DPR was consisting of 3 CD works and one RCW having 10 rows of 1000 MM dia pipe, alongwith strengthening & black topping of existing road. This road work alongwith other roads were started in full swing after of sanction of tenders.

Public agitation on taking of low level RCW at Km. 4/600.

The RCW having 10 rows of 1000 MM dia pipe clearing the OFL was proposed in DPR costing Rs. 10.76 lakhs. The proposed drawing of RCW is exhibited in **fig A.**



Originally Proposed Raised Causeway
(10 Rows of 1000MM Ø NP-3)
Fig. A

* National Quality Monitor

There is Major Irrigation Project on U/s. of the existing site of RCW. On many occasion when there is heavy rainfall in the catchments area of the dam it gets full storage and the excess water is discharged by opening gates causing heading of water at existing site of RCW which holds up the traffic for considerable time causing inconvenience to public.

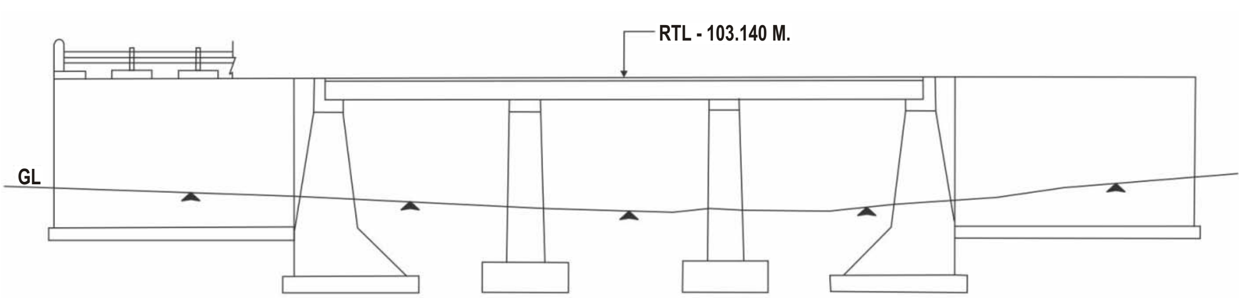
The local public and leaders were aware of this situation and they apprehended the problem of holding up of the traffic because of Low level causeway. Public representatives and Hon. Ex. President of Zilla Parishad had issued a notice that they will not allow the construction of Low level causeway at this site. They have submitted representation stating that there is necessity of bridge at this location because of discharge through dam. This issue was also raised in Legislature Assembly demanding bridge at this location and Hon. Minister has assured to take suitable action on the matter.

Remedial solution

The Superintending Engineer, Pradhan Mantri Gram Sadak Yojana has decided to resolve this issue by taking suitable decision in the matter. The site was inspected along with PIU. The detail instruction were issued to take trial pits at bridge location and study the catchments as well as observed OFL and level of water when the gates of dam are opened. The PIU was directed to modify the DPR of proposed RCW by Substituting submersible bridge.

The PIU has submitted the revised proposal giving water way calculation, foundation details and spanning arrangement and suggested open foundation. After careful study of DSD the modified proposal of construction of submersible minor bridge having 3 spans of 5 M was approved in place of RCW. The drawing is exhibited in **fig B.**

The Agency was requested to execute the work of Minor Bridge in Place of RCW by offering variation proposal as per tender conditions.



Constucted Submersible Minor Bridge
(3 Spans of 5 M. C/c)
Fig. B

The Agency had agreed to take up the work and completed the work within time.

The completed work is exhibited in Photos below

Financial Implication vis-à-vis public utility

There was overall excess of Rs. 5.00 lakhs which was accommodated in the overall saving and excess was regulated within scope as per the guidelines of NRRDA.

The R.T.L at bridge site which was earlier 100.910 was raised to 103.140 i.e. 2.23 Mtrs causing relief to about 40000 populations living in that vicinity causing them all weather approach to Taluka head quarter and also made it easy for Home Department for patrolling purpose in Naxal effected area. Now the public is very happy with this change and expressed their pleasures in implementation of PMGSY project.

Though apparently there is rise of level at bridge by only 2.23 M this has given great relief to rural population of about 40000 habitants in Naxal affected areas.

Conclusions

The PMGSY scheme is for connecting rural population. It has changed its role from new connectivity to Up-gradation and given relief to rural population with a vision to achieve the overall progress of rural India. The public is seen to be very happy to see the implementation of the scheme in given time limit and making all weather good quality roads sticking the standard and also caring for its maintenance.

The public can point out our lacuna in preparing DPR and bring to the notice of PIU for better results. If PIU desires and make a point to attend public demand and their say the scheme can be implemented in right spirit for passing all benefits to rural population. Any genuine mistake in preparing DPR can be corrected during execution within frame works of rules and guidelines issued by NRRDA.

The programme of PMGSY is well thought and systematically structured. There is need to adopt proper method of works depending upon the requirements of the situation. In many circumstances minor change in methodology can lead to lot of improvement. It is in the interest of all the stakeholders i.e. client, consultants and contractors to work in progressive and honest mind set free from old systems with such approach it is not difficult to achieve the goal objective in PMGSY works and contribute to realize the dream of prosperous and developed India.

Good Engineering Construction Practices for Bridges

Shri Ashit Kumar Jain *

Construction of bridges in hilly and remote areas has always been a challenge to the Civil Engineers. The paper consists of case study of several bridges which were constructed in the Northern and North –Eastern India at altitudes varying from 3000 Ft to 10000Ft. It is aimed to high light the importance of adherence of codal Provisions for various activities in bridge construction. Two important aspects of good Engineering construction practice for casting of superstructure and prestressing are discussed in this paper.

Bridges are designed for a life span of 100 years. In case the durability aspect is not kept in mind during the constructions of the bridges are likely to show distress well before the designed life. Two activities mainly pertaining to the construction of Super structure :

(a) Casting of Superstructure.

(b) Prestressing.

are discussed in the paper as these have a direct impact on the durability and serviceability of the bridge.

Casting of Super Structure UsingShuttering Vibrators

The case pertains to the construction of 110 m span bridge over river Sibokorang in Arunachal Pradesh in 1999.The GAD of the bridge is given below in Fig -1:

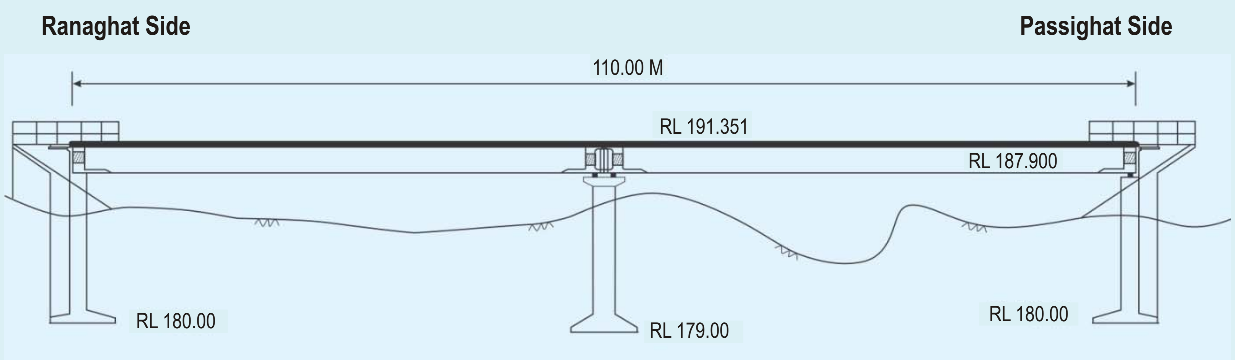


Fig. 1 : GAD OF SIBOKORANG BRIDGE

* Joint Director (Technical), NRRDA

The technical parameters of the bridge are as given below: Table II

State	:	Arunachal Pradesh
District	:	East Siang
Name of road and location	:	NH-52 at Km.37.650 Jonai - Ranaghat
Name of river	:	Sibokorong
Length of bridge	:	112.20 m
Span arrangement	:	Two span simply supported PSC box girder bridges each span 55.00 m 2.20 m gap slab in between box girder included webs.
Carriage way width	:	7.50 m
Soil classification	:	Soil mixed with boulders.
Scour depth considered in the design	:	19.185 m
Foundation	:	Open Foundation.
Foundation Dimension	:	7.00 m (Base Width) x 8.45 m
Depth of foundation	:	6.20 m
Type of structure	:	RCC
Type of bearing	:	Fixed and sliding type POT bearing inclined.
Super structure	:	PSC inclined box girder with 19 T13 systems.
Type of expansion joints	:	E80 Elastomeric Expansion joint
Wearing coat	:	RCC
Foot path	:	Not provided
Load classification	:	IRC class 70 R/AA
Date of commencement	:	21 Jul 1997
Date of completion	:	31 Mar 2001

The super structure had inclined webs and was to be prestressed with 19 T 13 Prestressing systems. As per Specifications for Roads and Bridge works, Ministry of Surface Transport clause No 2305.2, "the box section of super structure should be constructed with a minimum of one construction joint located in web below the fillet between the deck slab and web. If permitted by Engineer one additional construction joint may be permitted and this construction joint shall be located in the web above the fillet between the soffit slab and web" (i.e. maximum 2 Nos construction joints). Before this bridge was casted, this provision always looked very difficult to implement in hilly region, as in most of the cases the webs were casted in 1 to 1.5 m height there by providing 4 Nos construction joints instead of 2 Nos permitted as per codes.

The following Methodology was adopted for providing only 2 Nos construction joints as required by MoRTH / IRC provision

(a) For the first time shuttering / form vibrators were used in addition to the conventional needle vibrators.(Refer figure -02)

(b) The shuttering plates were modified in such a way to install the Shuttering / form vibrators. (Refer figure - 03)

(c) The concreting of Approx 1584 bags of cement was planned with three concrete mixers in a time frame of 48 hours continuous work.

(d) The shuttering plates were modified by welding an ISA 50X50X5 mm as shown in Fig -03 for attaching the shuttering vibrator.

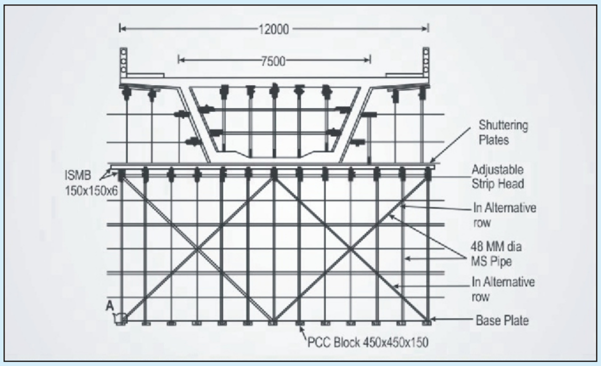
(e) A gang of 4 persons was trained for shifting of shuttering vibrators as show in Fig-04 to ensure proper compaction.

(f) The shuttering vibrators were shifted alternatively in the inner and outer side (Refer Fig -04) once the concrete was filled upto the bottom of the Deck level as shown in Fig- 05

(g) Superplastizer was also used to ensure that proper workability is achieved to avoid any honeycombing.

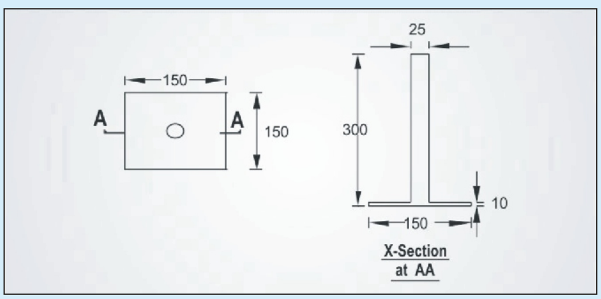
(h) Approx 75 labour per gang for 8 hrs works was planned so that the complete webs were casted in 48 hrs of continuous concreting.

The plan of the shuttering vibrators used is shown below:



View of Stagging & Shuttering for Super Structure

Fig. 2 : Shuttering Vibrator



Details of Base Plate

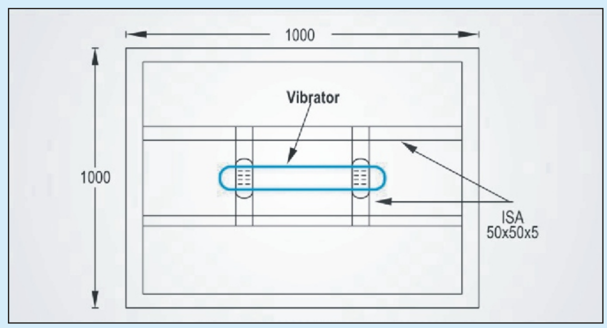
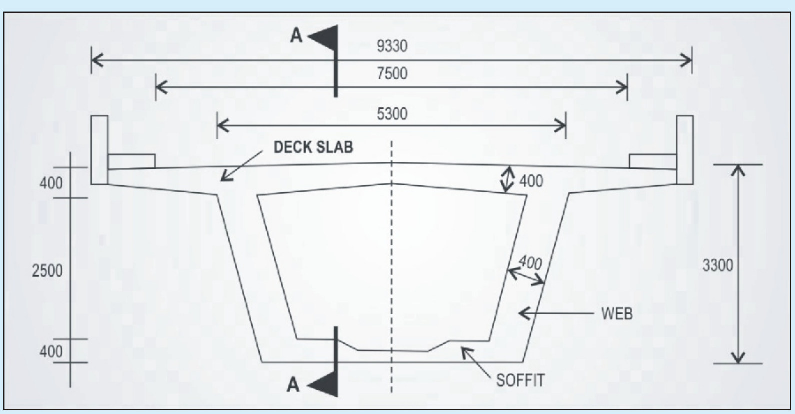


Fig. 3 : Detail of Shuttering Plates for Fixing Shuttering Vibrator



Cross-section of Super Structure

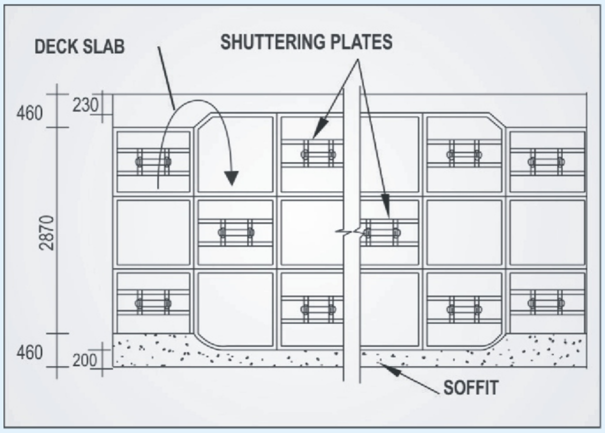
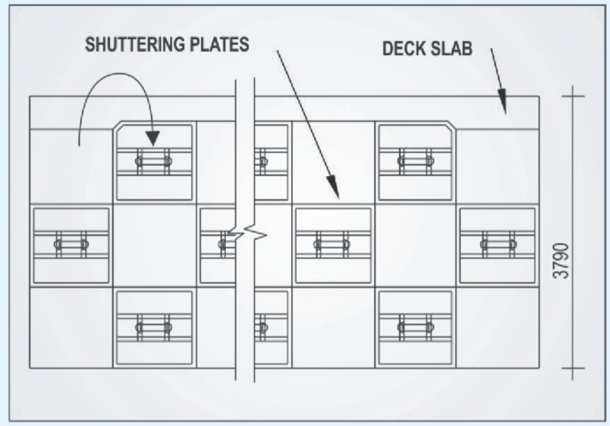


Fig 4 : Shuttering View - Innerside



Shuttering View - Outerside

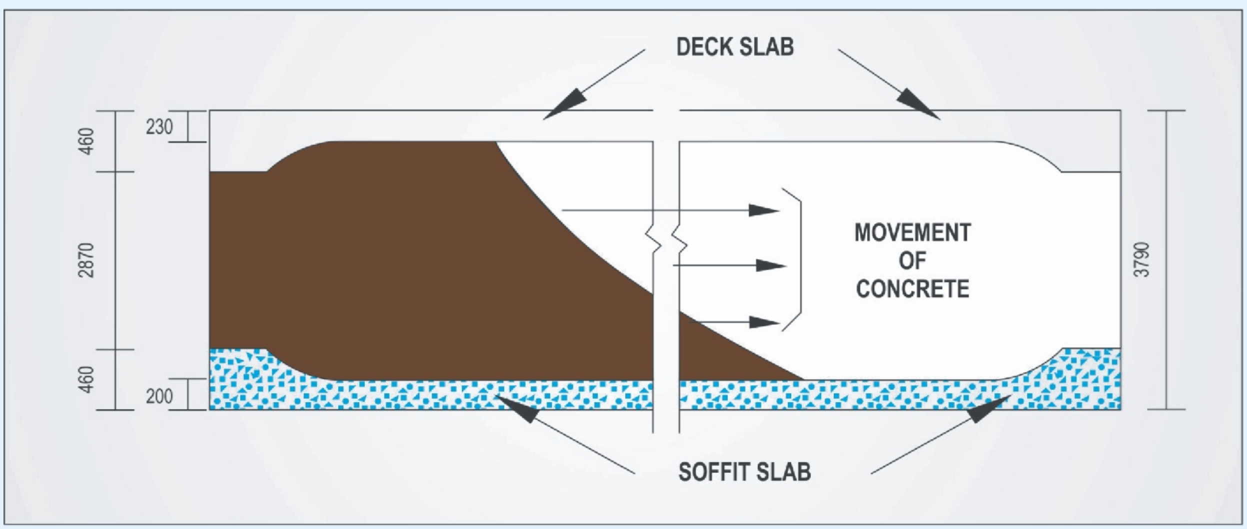


Fig 5 : View of Concrete Movement

(i) Casting of both webs was done as shown below in the plan in Figure 6

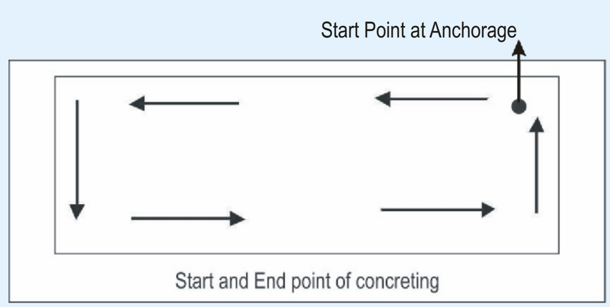


Fig 6 : Top View of box girder

Generally in the hills concreting for 24/36 hrs continuously is difficult as there is shortage of labour and modern Concrete Equipments like concreting pumps, shuttering vibrators etc are not available. Today we have good concrete weigh batch mixer and concrete pumps with the help of which the casting of super structure can be done by providing only two construction joints as per the IRC codal Provision.

Prestressing

In all Prestress concrete bridges prestressing is a very important activity as the serviceability of the bridge depends on this. Prestressing is a very sophisticated activity and an important aspect of bridge work which need to be given adequate attention by Engineers at site. Prestressing must be carried out in the presence and supervision of an experienced engineer only. A close interaction with the designer has to be maintained till initial few cables are completed successfully. Although the use of electric power pumps have helped in expediting the procedure but expert hands are required to apply the pressure steadily and to the extent required. We must remember the fact that the pre-stressing is like 'giving life to the structure to perform the function for which it is designed". Apart from the checks given in Specifications for Roads and Bridge works, Ministry of Surface Transport clause No 1807 and discussed as six cases below ,three important corrections are required to be applied before the discussion is taken by the Engineer to lock the cables. Most design consultant are silent about these correction .

Case I:The elongation has reached designed value but pressure has not reached. Generally most cases fall in this category, the pressure is increased toward targeted value in very small increment of say 5 Kg/cm^2, keeping a close watch on elongation which shall not exceed beyond 105% of targeted elongation. In case full pressure is achieved the prestressing of cable is considered completed else consider case II.

Case II:The elongation has reached 105% targeted elongation but pressure is below 100% target value but more than 95% targeted value.

In such case the prestressing is considered complete with the provision that deficient force due to all such cases would be provided in the dummy cable.

Case III:The elongation has reached 105% targeted elongation but pressure is below 95% target value.

In such case, the detailed parameters need to be investigated. This includes the area of the cables, efficiency of the jack, any unusual slip in the strands and design aspect also which may have error in assumption of friction value etc. The duct needs to be checked up for any unusual obstruction.

Case IV: The pressure value has reached design value but elongation has not reached.

In this case the pressure is increased up to 105% of the targeted pressure keeping the watch on the elongation, which shall reach to 100% of target elongation. In case it reaches 100% elongation value then the prestressing is considered completed.

Case No V: The pressure has reached 105% of target pressure but elongation is more than 95% but less than 100% of target value.

In this case the available margin in the stress value of strands shall be examined and pressure may be increased beyond 105% value of as to reach the elongation to 100% target value. This aspect need to be kept in mind while designing and it is recommended that adequate margin must be kept in peak stress level of strands with respect to its limit stress value.

Case VI:The pressure has reached 105% target pressure but elongation is below 95% target value.

In such case the prestressing is abandoned and the matter is investigated.

Three important corrections are as under:

(a) Correction for modulus of elasticity:

Correction to elongation is required to be done in case there is any variation between the assumed modulus of elasticity (during design stage) and the actual Modulus Elasticity (as per the test results of the strands submitted at the time of supply) to the elongation to be done.

(b) Correction for area of strands:

Correction to Elongation is required to be done in case there is any variation between the area of strands (during design stage) and the actual area of strands (as per the test results of the strands submitted at the time of supply).

Given below in the table III are the design value and the detailed calculation for applying the above correction factors:

Table -3

S/NO	Item	Design Value	Actual value
1	Modulus of Elasticity (E)	$E_D = 2.1 \times 10^6$ Kg / cm^2	$E_A = 2.2 \times 10^5$ kg/cm^2
2	Area of Strands (A)	$A_D = 133.2$ cm^2	$A_A = 135$ cm^2
3	Elongation	$\Delta_D = 100$ mm	To be calculated

Elongation = (Force x Length) / (Area x E)

Force x length $= \Delta_D \times A_D \times E_D$

Modified elongation required $= \dfrac{\Delta_D \times A_D \times E_D}{A_A \times E_A}$

Modified elongation as per actual values: $\dfrac{100 \times 2.1 \times 10^6 \times 133.2}{2.2 \times 10^6 \times 135} =$ **94 mm**

This elongation is further required to be modified for the initial slackness as given under.

(c) Correction for initial slackness:

In case the prestressing results are recorded as per Appendix 1800/II of Specifications for Roads and Bridge works, Ministry of Surface Transport than the tables takes into account the initial slackness, however in case of any other method of recording is adopted the Elongation Vs Pressure graph for correction as per IS 1343 -1980 Code of practice for Prestressed Concrete should be applied by plotting a graph as per IS Clause no 12.2.1.3 as given under in figure 06:

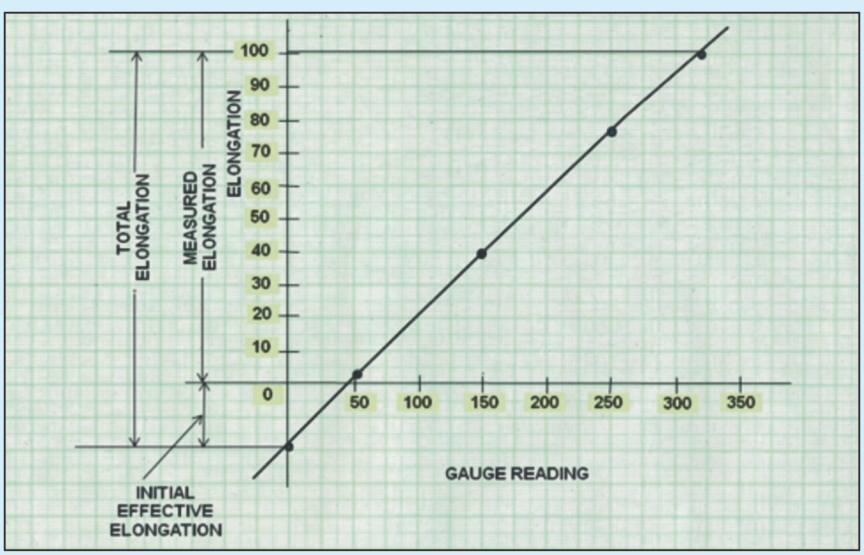


Fig 7: Elongation Vs Pressure

In the above case the slackness correction required is = 20 mm.

Total modified elongation required after applying slackness correction = 94 +20 =118 mm instead of 100 mm as given in the drawing.

In order to calculate the correction the Engineer has to plot the Elongation Vs Pressure graph as shown in fig - 06 as the stressing is in progress and thereafter calculate the modified elongation and then decide whether cables can be locked or not.

The above correction are required to be done before grouting so that the actual stress elongation behavior of the cables are known and any deficiency in elongation may be made up in the dummy cable after consulting the consultant.

In case the above correction is applied than only the checks on the above 6 cases mentioned by IRC can be applied in totality. The reasons why this correction should also be applied can be seen from the calculation given above.

Conclusion:

The purpose of discussing the case studies in this paper is to remove the short coming in the construction stages itself.

a) Joints in superstructure should be provided at the Soffit and Deck level only. It was observed that the webs are casted in lifts/ stages which acts as construction joints and guidelines issued by IRC are not followed.

b) Concreting should preferably be started from the anchorage as indicated in figure 06.

c) The correction for actual Modulus of elasticity (E) , Area of strands (a) and initial slackness need to accounted for before the cable are locked.

In case the above points are not taken into consideration at the construction stage, it may have adverse effects on the durability of the structure.

References:

i) Ministry of Surface Transport 'Specification for Road and Bridge works, Indian Roads Congress (Third edition).

ii) Indian Standard code of practice for Prestressed Concrete (First revision), IS: 1343 -1980.

iii) Indian Roads Congress Special publication 33 'Guidelines on supplemental measures for Design, detailing and durability of important bridge structures'.

Versatile Uses of Coir Geotextiles

Dr. K. Balan *

Geotextiles with natural fibres like coir, jute, sisal, hemp etc are used in Civil Engineering applications. Mainly they are used for erosion control applications. The main advantage of geotextiles with natural fibres is that they are ecofriendly and biodegradable. They can be successfully used in limited life applications of geotechnical engineering. This paper deals with the application of coir geotextiles in small height retaining walls and also for wave energy dissipation. Efficiency of coir geotextiles in both the application are discussed through model studies in the field and wave flume.

Use of natural fibres in construction can be traced back at least to the fifth and fourth millennia BC when dwellings were formed from mud-clay bricks reinforced with reeds or straw. Two of the earliest surviving examples of material strengthening by natural fibres are the ziggurat in the ancient city of Dur-Kurigatzu and the Great Wall of China (Jones, 1996). The Babylonians constructed the ziggurat some 3000 years ago using reeds in the forms of woven mats, laid in horizontal beds of sand or gravel at vertical spacings of between 0.5 and 2.0 m and plaited ropes, 100 mm in diameter, as reinforcement. It is believed that it was originally over 80 m high; even today it is 45 m tall. The Great Wall of China, completed during 200 BC, utilized tamarisk branches to reinforce mixtures of clay and gravel.

In 1926, the Highway Department in South Carolina undertook a series of tests, using woven cotton fabrics as a simple type of geotextile or geomembrane, to reduce cracking and raveling failure of roads was the first documented engineering use of natural fibres in Civil Engineering (Sarsby 2007). The application was similar to that of pavement fabric now a days used to prevent alligator cracking, i.e., to perform as a geomembrane than a geotextile. The high extensibility of the cotton fabric and its poor durability negated the slight improvement in road performance that the fabric produced.

Jute, coir and straw continue to be used extensively in erosion control products in the form of nets, meshes, blankets and reinforcement mats which are laid directly on the ground surface (Mandal, 1989; Rickson, 1994; Balan, 1995)

Geotechnical Applications of Coir Geotextiles

Polymeric geotextiles have long working lives, they are often used in practical situations where a geotextile is needed to be fully functional for a relatively short period of time, e.g., a separator layer beneath a temporary access road, or basal reinforcement of an embankment built on soft clay. The technical requirements of such fabrics could be satisfied by geotextiles with coir fibres. These are designed so that progressive loss of their capability with time is matched by improvement in the ground conditions with time (usually due to drainage and consolidation).

Coir geotextiles are used in the following areas in geotechnical engineering and which are successfully demonstrated and reported by the author elsewhere.

a) Management of surficial soil erosion in plain and slopes

b) Protection of banks of rivers/waterways

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c) Stabilisation of earthen embankments for highways, railways and flood control

d) Strengthening of road subgrades

e) Consolidation of soft soil through Prefrabricated Vertical Drains.

f) As a basal reinforcement and separation layer for embankments on soft soil

The basic concept behind the design of some of the above applications is as represented in Fig. 1, Fig. 2, Fig. 3 and Fig. 4. (Sarsby, 2007);

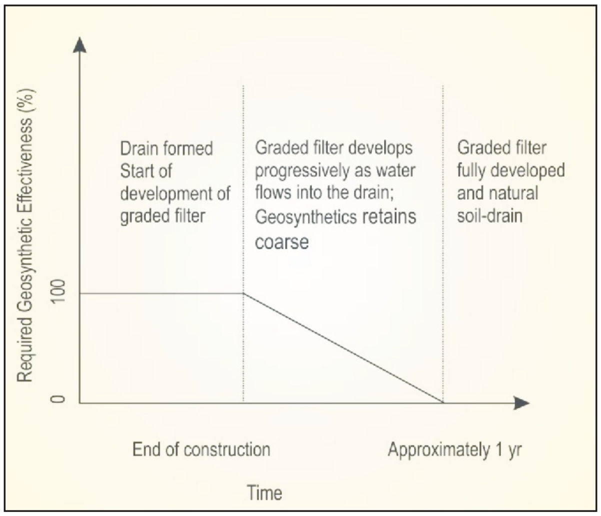


Fig. 1 Design life envelope for a filtration geosynthetic

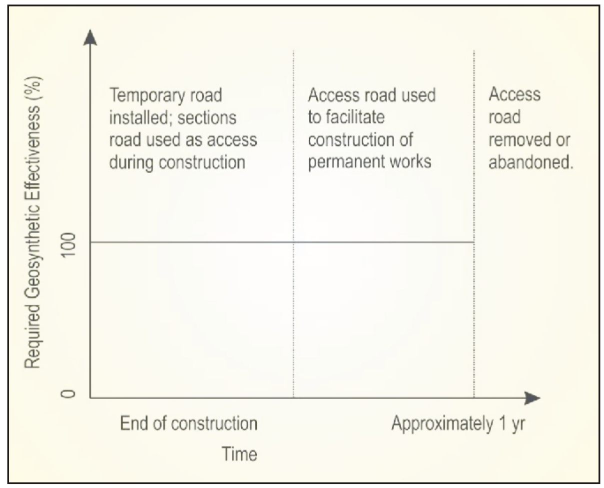


Fig. 2 Design life envelope for a separation geosynthetic

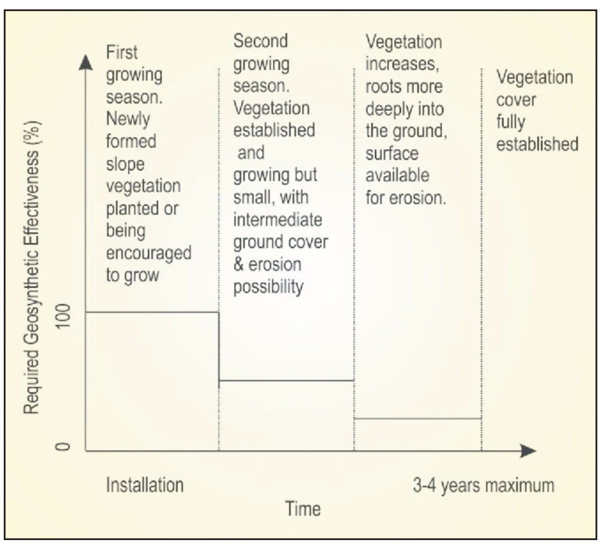


Fig. 3 Design life envelope for a erosion control geosynthetic

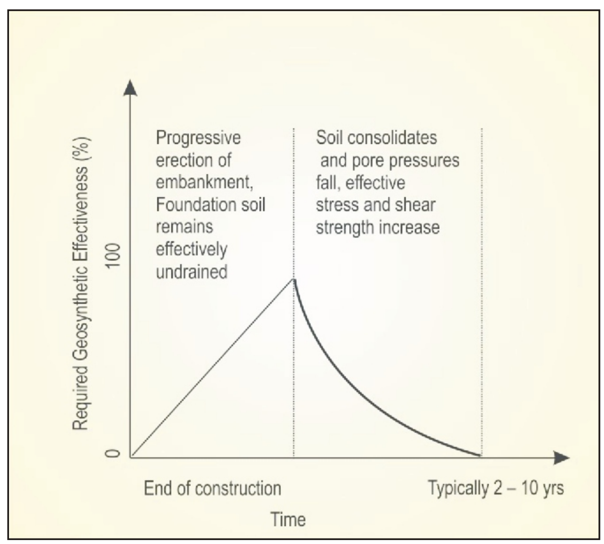


Fig. 4 Design life envelope for an embankment reinforcement geosynthetic

Coir Reinforced Retaining Wall

Proper design of gabion faced coir-bamboo reinforced retaining wall was made in such a way that the reinforcement gives a reduction in the size of gabion. This design was executed in the field trial. In a similar manner, coir -bamboo reinforced retaining wall with asbestos sheet as facing has been made near by the gabion faced retaining wall. The horizontal and vertical displacements of gabion faced retaining wall is discussed in detail, and also a comparison of the behaviour with that of asbestos faced retaining wall is made in the following sections (Balan et al., 2011).

Methodology Adopted

A coir reinforced retaining wall 10m long x 2m wide x 2m high was constructed using gabion as the facing. A similar retaining wall with thin panel (asbestos) as the facing was also constructed adjacent to the gabion facing retaining wall. The cross-sectional views of both the walls are presented in Figure 5. Woven coir geotextile in combination with bamboo stripes was used as the reinforcement in the retaining wall. The construction procedure adopted for both the walls were similar. The spacing and width of the reinforcement was decided based on standard design. The spacing of reinforcement for stability was obtained as 0.5m and 0.25 for gabion and thin panel wall respectively as per the design. Locally available lateritic soil at the site of construction was used as the backfill for the reinforced retaining walls. The optimum moisture content was 21% and maximum dry density 17 kN/m3. Gabion boxes of size 1m x 0.5m x 0.5m with diaphragm at the middle and with an extension of 0.3m at the base was used for the field study. The boxes were prepared by joining mesh panels of plan size 1.8m x 1m and 2m x 0.5m. The mesh panels were joined with the help of GI lacing wires.

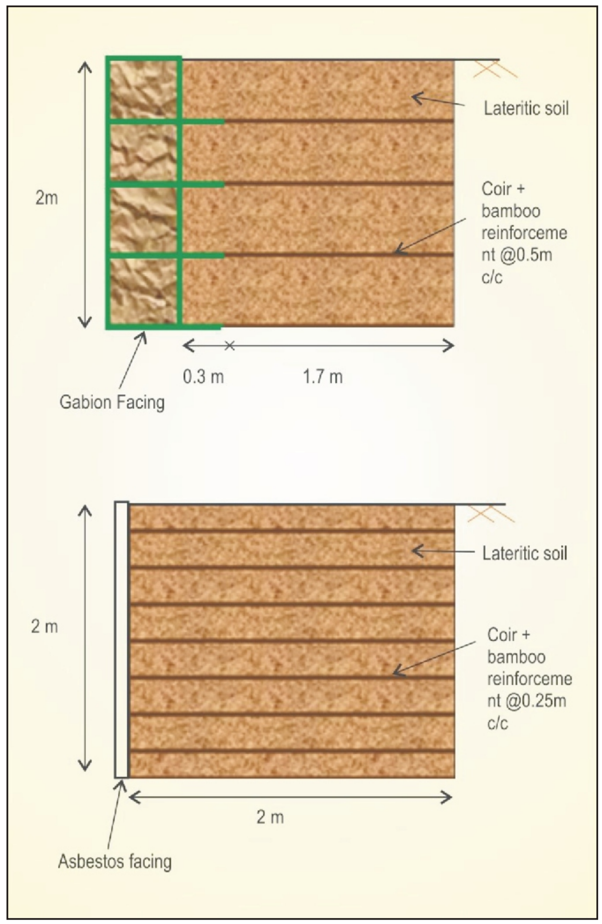


Fig. 5 Cross-sectional view of the coir reinforced wall with gabion facing and thin panel facing (asbestos).

The site for the construction of the retaining wall was cleared and levelled. Brick walls of size 2m length x 0.35m width x 2m height were constructed on either side to limit the length of the wall to 10m. The ground was leveled, compacted firm and the construction of the first layer was started. For the first layer, ten gabion boxes were placed in position. Adjacent boxes were tied together with the help of GI lacing wires. The gabion boxes were filled with coarse aggregate of 40mm size with a density of 15kN/m3. After the box was filled with coarse aggregate the top cover of each of the gabion box was placed in position and tied properly using GI wires.

After stitching the top cover of all the boxes in the first layer, the lowermost reinforcement was placed over the leveled surface behind the facing. For this, bamboo reapers were placed at a spacing of 40 cm in both the directions for the entire length and width of the wall. Adjacent bamboo reapers were tied together with the help of coir geotextile yarns. Coir geotextile of size 10m x 2m was laid on top of the bamboo and properly fixed in position by tying to the bamboo reapers at the bottom and to the extension of the base of gabion box. Non woven coir geotextile of size 10m x 0.5m was placed at the back face of gabion boxes to act as a filter medium. The first layer of backfill soil for a height of 0.5m was placed in four equal layers each of 15cm height. Each layer of soil was properly compacted by manual compaction. After completion of the first layer (0.50 m), the field density achieved was determined using core cutter. The field density was determined at three locations along the length, by taking soil sample near the two corners and at the centre of the wall.

Subsequent layers of gabion boxes are placed in staggered condition to avoid continuity of joints in the facing. Upper gabions were tied with the lower gabions using GI wires. The formation of the wall completed following the above sequence of construction. Figure 6 shows the placement of gabion boxes and laying of bamboo reapers for the second layer of retaining wall. The woven coir geotextile was laid on top of the bamboo as reinforcement and were tied properly as shown in Figure 7. The figure also shows the fixing of non woven coir geotextile as filter layer behind the gabion boxes. Figure 8 shows the front view of the completed gabion retaining wall.

Fig. 6. Placing of gabion boxes and laying of bamboo reapers for the second layer of retaining wall.

Fig. 7. Laying of woven coir geotextile as reinforcement and non-woven coir geotextile as filter

Fig. 8 Front view of the completed gabion facing retaining wall.

Performance of The Walls

The wall was completed in May 2011. The construction of the retaining wall was completed within a period of one week, before the arrival of monsoon season in Kerala. The area has gone through one monsoon season when heavy rainfall occurred. The horizontal and vertical deformation of the wall facing was determined at different locations along the length and height of the wall.

The horizontal deformation as normalized horizontal deformation against the height of the wall is shown in Figure 9. Variation of the normalized settlement of the wall at the bottommost layer of gabion is presented in Figure 10.

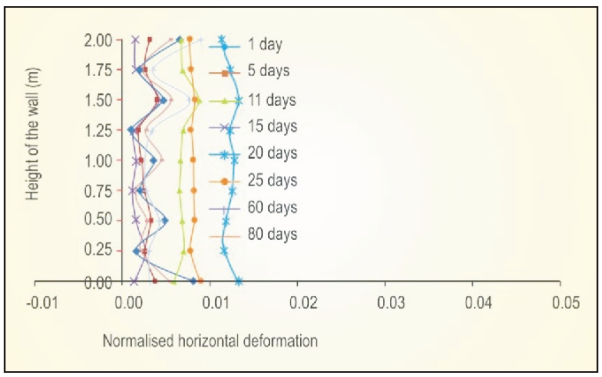


Fig. 9. Variation of horizontal deformation of the wall against height of the wall at the centre.

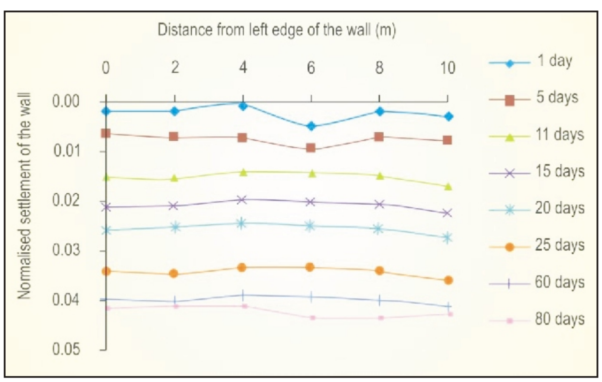


Fig. 10. Variation of normalised settlement of the wall at the bottommost layer (Section 1-1)

Both the wall are performing in good condition and the observations are still going on.

Conclusion

Coir Geotextiles are currently used for soil erosion control in embankments, or in mine waste dumps. The potential of its use in other non critical areas were explored. From the foregoing presentation it is observed that coir geotextiles have great potential in temporary retaining walls of low height.

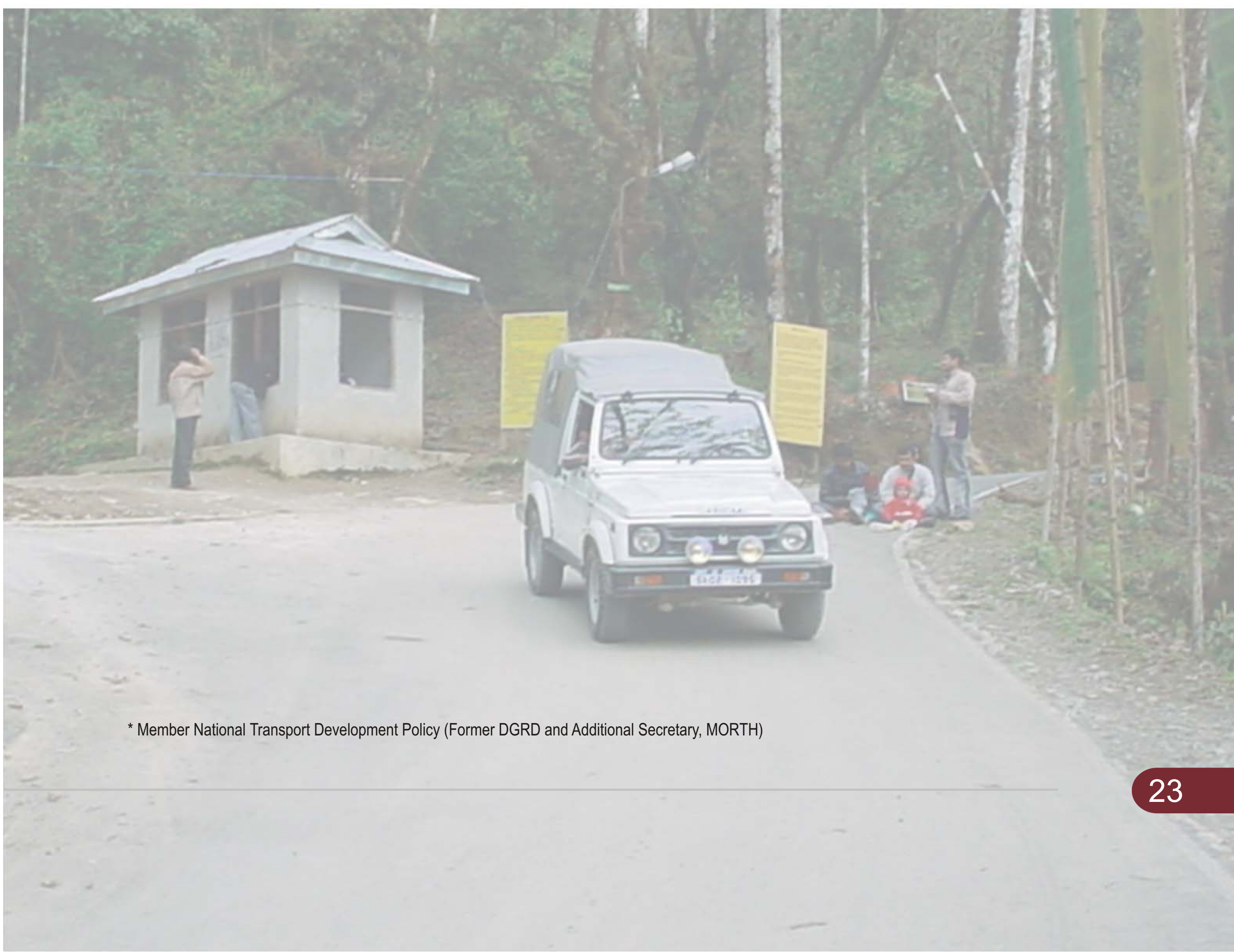
References

1. Balan, K, Jayasree, P.K, Beena, K. S, Anil K. R, and Sibi Joy, (2011), "Coir Reinforced Retaining Wall using Gabion Facing - A Case Study", Proceedings Geosynthetics India'11, Indian Chapter of International Geosynthetics Society, Chennai, pp 40 – 47.
2. Balan, K., (1995), "Studies on Engineering Behaviour and Uses of Geotextiles with Natural Fibre", Ph.D Thesis Submitted to Indian Institute of Technology, Delhi.
3. Jones, C.J.F.P., (1996),"Earth Reinforcement and Soil Structures", Thomas Telford, London.
4. Mandal,J. N., (1989), "Geojute", International Geotextile Soceity News, pp.12.
5. Prabisha P R, Prof. Jyothis Thomas, Dr. K. Balan,(2011), "Wave Energy Dissipation By Coco Logs", Proc. National Conference on Technological Trends (NCTT2011), College of Engineering Trivandrum.
6. Rickson,R. J., (1994), "Use of Natural fibres in soil erosion control matting", Proc. Of the Joint Conference of Pira International, Non wood fibres for industry, vol. 2, paper 27.
7. Sibi Joy, Dr. Balan, K. and Dr. Jayasree, P. K., (2011), "Model Study on coir reinforced retaining wall", Proc. National Conference on Technological Trends (NCTT2011), College of Engineering Trivandrum.
8. Sarsby, R. W., (2007), "Geosynthetics in Civil Engineering", The Textile Institute Woodhead Publishing Limited, England.

Preservation of Rural Road Assets

D. P. Gupta *

Rural roads being about 28 lakh km comprise over 85 percent of the total road network of around 33 lakh km and their being kept in serviceable condition is crucial to agricultural growth and for the benefits of access to social infrastructure not getting denied to our rural people. The PMGSY has provided the much-needed fillip to increase accessibility to villages/habitations in the hitherto low connectivity states and partially addressing the requirements of upgrading the existing rural road network for high connectivity states. It is a difficult task to assess the value of this vast rural asset due to classical problem faced in any aggregation. For instance, one can't compare cost of a rural road in steep hills of Arunachal Pradesh; with one in plains of Uttar Pradesh; of a road laid a few decades back with one laid recently. A broad assessment may, however, be made of current replacement value of the asset base that the rural road network surely represent. This is estimated at Rs. 4,25,000 crore as a ball park figure (Table 1 below).



* Member National Transport Development Policy (Former DGRD and Additional Secretary, MORTH)

Table 1: Replacement Value of the Rural Road Network (As on 1.4.2011)

S. No.	Particulars	Rough cost of replacement (Rs.lakh/km)	Estimated value (Rs. crore)
1.	PMGSY – 3,00,000 km	40.0	1,20,000
2.	Non-PMGSY		
	(a) Core network – 11,00,000 km	15.0	1,65,000
	(b) Non-core roads – 14,00,000 km	10.0	1,40,000
	Total – 28,00,000 km		4,25,000

While this is a broad assessment, there can be no two opinions that these are huge assets and deserve our serious attention. The numerous burdens invited by poor maintenance outweigh the regular cost of maintenance. These avoidable burdens are in the form of additional vehicle operation cost, much higher cost of rehabilitation, higher wear and tear and depreciation of vehicles, poor access to medical aid, education centres and markets besides loss of image of road agencies and erosion of asset base. The annual loss in asset base may be over Rs. 20,000 crore. We cannot afford to lose these assets.

Strategy Elements

On the maintenance front, situation varies across the states. The 13th Finance Commission has devolved Rs. 20,000 crore to States/UTs for state road maintenance over 4-year period 2011-12 to 2014-15. These would supplement the state budget allocations. At the core of strategy is political and administrative support to recognize importance of preservation of rural road assets. The State Governments should adopt a road maintenance policy covering rural roads. Unless the issue of maintenance is handled squarely, the value of rural road assets would not only diminish but would require huge costs to take any corrective action later.

A broad framework of strategy elements is given in Figure 1:

Figure 1: Policy, Institutional, Funding and Implementation Elements for Road Maintenance

Policy Framework
(Political and Administrative Support)

Funding
- Sources
- Budgeting and allocations
- Expenditure

Institutional Arrangements
- Organisation and responsibilities
- Asset management
- Human resource development

Maintenance Implementation

Management
- Inventory and surveys
- Preparation of Annual plans
- Works and supervision

Delivery
- Contract procedures
- Contract documentation
- Contracting arrangements

Technology
- Resource utilisation
- Research and development
- Appropriate equipment

Control
- Monitoring
- Technical and financial auditing

Proposed Actions

The State governments should declare as a policy that rural roads would receive a dependable and adequate allocation of funds on a continuous basis to enable the road agencies to effectively plan and implement the maintenance programmes for the rural road network. Preferably, a single nodal agency would be identified and made responsible for this. Ideally, it could be SRRDAs or PWDs in the States.

For ensuring flow of funds, the States may consider setting up dedicated funds for maintenance by transferring funds from various sources – government budget, central grants recommended by the Finance Commission, additional levies like cess on agriculture produce, additional sales tax on petrol and diesel.

While PMGSY roads are being built/upgraded to proper engineering standards, much of the remaining rural road network is crying for improvement and upgradation and represents a serious backlog. Before any maintenance interventions on such roads, they have to be made maintainable. This requirement may be considered a plan activity.

Every State should create a well defined and thought out organizational structure within the road agency responsible for rural roads for maintenance planning and delivery both at the headquarter and PIU levels. A dedicated Road Maintenance Management Unit may be set up in each State and made responsible to develop a sound and rational Maintenance Management System for the entire rural road network.

For planning and prioritization of maintenance interventions, the model to be developed should be simple and demanding of only a few essential parameters so that it is robust and once developed, it is sustainable in the long run. It is now quite convenient to set up data base on GIS platform or such other IT-related softwares. The current stipulation of assessing Pavement Condition Index through visual inspection or assessing riding comfort through driving in a vehicle is adequate. In addition to condition, simple traffic counts can be undertaken to help in prioritization. Where traffic counts are not a feasible proposition, surrogates such as connectivity to school, mandi, medical centres can serve the purpose of judging relative importance of road. What is essential is to formulate an Annual Maintenance Plan (AMP) for the entire rural road network based on network condition and importance of road taking into consideration the Budget allocation. These AMPs should be formally got approved by the States High Level Standing Committee as is happening in case of PMGSY roads. Funds made available as per those plans and expenditure incurred should be subjected to both technical and financial audit to improve transparency and performance. A system of working out the replacement value of the rural road assets at the end of each financial year should also be introduced and put on website.

For delivery of maintenance, attention is required on three fronts:

(i) Evolving workable models of delivery of works of routine maintenance through gang labour where they exist and experimenting with system of community contracting, micro-enterprise which have proved successful in other countries facing similar situation. The assistance of UN-ILO can be sought as they have collected huge experience in Asian and African countries.

(ii) Creation of specialist contractors, small/medium size, to undertake works of periodic renewal of roads in a district or part thereof on a regular basis as per the AMPs.

(iii) Skill development of personnel of SRRDAs, other road agencies and the contractors.

Funds alone is not an issue. Maintenance delivery on the ground is a serious challenge in terms of visibility of outcome of tax-payer's money and improving image of the road agencies among the public and road users. The NRRDA may constitute a small group of technical experts to come out with a maintenance implementation framework which should lay down maintenance acceptance standards, kind of interventions and rectification measures needed for rural roads depending upon the nature of terrain and climate. Such a group may also provide guidance on realistic norms for maintenance of rural roads covering routine maintenance, periodic surface renewal, special repairs for cross-drainage works and other protective works and emergency maintenance (disaster management, landslides, storms, cyclones, etc.).

For higher categories of roads, projects are being implemented on PPP basis through private entrepreneurs on BOT (Toll) and BOT (Annuity) Models. This includes maintenance during the Concession Period covering a period of 15 to 20 years. Rural roads are low volume roads and would not be amenable to tolling. However, annuity models if structured properly, might attract some response. This concept can be developed in close dialogue with the private sector and then a few pilots tried out.

Foreign Visits and Training Programmes

Visit to CIRDAP, Dhaka, Bangladesh

A four member delegation led by Shri S. Vijay Kumar, Secretary, RD, Ministry of Rural Development, Government of India visited Centre for Integrated Rural Development for Asia and the Pacific, Dhaka during 3rd - 7th June, 2012. Constitution of delegation is as below:-

1. Shri S. Vijay Kumar, Secretary, Rural Development, Government of India.
2. Shri T. Vijay Kumar, Joint Secretary, (SGSY/ NRLM), Ministry of Rural Development, Government of India.
3. Dr. I.K. Pateriya, Director (Projects-II) & In charge (Director Technical), NRRDA, Ministry of Rural Development, Government of India.
4. Dr. V. Madhava Rao, Associate Prof. & Head, NIRD, Hyderabad.

The delegation visited the Ministry of Local Government Engineering Department, Government of Bangladesh, Building Resources Across Communities (BRAC) activities in Saver Village, met the representatives of Association for Social Advancement (ASA). The delegation also visited a few infrastructure projects of LGED namely Rural Roads, Primary School Buildings, Union Parishad Buildings and had discussions with the elected representatives of Union Parishad.

Dr. I.K. Pateriya also attended Bangladesh Country Team Workshop of World Bank and made a presentation on Online Management, Monitoring and Accounting System for transparency and effective management in PMGSY on 2nd June, 2012 at Dhaka, Bangladesh.

Senior Road Executive Programme at Birmingham University, U.K

A group of seven officers led by JS (RC) & DG, NRRDA attended two modules on Road Sector Reforms and Road Financing, of the Senior Road Executive Programme at Birmingham University from 18th -23rd June, 2012. Constitution of delegation is as below:-

1. Dr. Pramod Kumar Anand, Joint Secretary (RC) & DG, NRRDA
2. Shri J.C. Mohanty, Principal Secretary, Government of Rajasthan
3. Shri. Y.S. Dwivedi, Director (RC), Ministry of Rural Development, Government of India
4. Shri N.C. Solanki, Director (Projects-I), NRRDA
5. Shri A.A. Sagane, Chief Engineer, Government of Maharashtra

6. Shri C.P. Tongden, Chief Engineer, Government of Sikkim
7. Shri Sher Mohammad, Superintending Engineer, Government of Punjab

Subsequently another batch of six officers led by Shri S.R. Meena, Director (RC), Ministry of Rural Development, Government of India attended two modules on Road Safety and Road Maintenance Management, of the Senior Road Executive Programme at Birmingham University from 25th -30th June, 2012. Constitution of delegation is as below:-

1. Shri. S.R. Meena, Director (RC), Ministry of Rural Development, Government of India.
2. Shri B. Rajender, Secretary, RWD, Government of Bihar
3. Dr. I.K. Pateriya, Director (Technical), NRRDA
4. Shri Hiramath Mahesh, Chief Operating Officer, Government of Karnataka
5. Shri Abdul Hamid Sheikh, Chief Engineer, Kashmir, Government of J&K
6. Smt. Madhavi Vedula, Assistant Director (Technical), NRRDA

25th ARRB Conference, Perth, Australia

The 25th ARRB Conference was held in Perth, Western Australia from 23 - 26 September 2012. The Conference was endorsed by Austroads and Road Engineering Association of Asia and Australasia (REAAA).

National Rural Roads Development Agency (NRRDA) has deputed four member delegation headed by Secretary, Rural Development to attend this Conference. Constitution of delegation is as below:-

1. Shri S Vijay Kumar, Secretary, Rural Development.
2. Shri Jagdish Chander Sharma, Principal Secretary, PWD, Govt. of Himachal Pradesh.
3. Shri M.C. Boro, Commissioner-cum-Special Secretary, PWD, Govt. of Assam.
4. Shri N.C. Solanki, Director Projects-I, NRRDA.

Executive Seminar on Performance based Maintenance Contracting, Orlando, Florida (USA)

A delegation of six members led by JS (RC) & DG, NRRDA attended the Executive Seminar on Performance based Maintenance Contracting, at Orlando, Florida (USA) from 28th October to 6th November, 2012. Out of 6 members three officers also visited Washington from 25th -26th October, 2012 on the way to Orlando for sharing the experience of World Bank regarding best practises in rural road sector around the globe and to review the progress of World Bank Assisted Rural Roads Project-II. Constitution of delegation is as below:-

1. Dr. Pramod Kumar Anand, JS (RC) & DG, NRRDA
2. Shri Rajiv Kumar, Principal Secretary, Government of Uttar Pradesh
3. Shri S.N. Tripathi, Principal Secretary, Government of Odisha
4. Shri Prabha Kant Katare, Director (Projects-III), NRRDA
5. Shri P. Manoj Kumar, Director (RC), Ministry of Rura Development
6. Shri S.K. Agarwal, Chief Executive Officer, Government of Chhattisgarh

Training Programmes conducted during 2011-12 & 2012-13

S. No.	Programme	Nos. of Officers Trained	
		(2011-12)	(2012-2013)
1	Training Programmes at IAHE (National Level)	557	387
2	Training Programmes at CRRI (National Level)	217	295
3	Training Programmes at NIRD (National Level)	498	210
4	Training Programmes organized through World Bank (National Level)	68	374
5	Trainings & Workshops (National Level)	----	493
6	Training Programmes at SIRDs (State Level)	590	149
	Total	**1930**	**1908**


प्रधानमंत्री ग्राम सड़क योजना

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