EasyChair Preprint

№ 4295

Innovative Design and Construction Methodology in Road Construction/ Rehabilitation: Using Stabilization Technology with Cement and StabilRoad Additive in the State of Kerala - A Case Study

Srinivas Vallabhaneni, Col.Pratap Kumar Mohanty and Pavanaram Thirumalasetty

EasyChair preprints are intended for rapid dissemination of research results and are integrated with the rest of EasyChair.

September 29, 2020

Innovative Design and Construction Methodology in road construction/ Rehabilitation: Using Stabilization Technology with Cement and StabilRoad Additive in the state of Kerala - A Case Study

Mr.Srinivas Vallabhaneni, Director & CEO
Vishwa Samudra Engineering Pvt.Ltd, Hyderabad, Telangana state
srinivas@vishwasamudra.in
Mr.Col.Pratap Kumar Mohanty, Head-Techno Commercial
Vishwa Samudra Engineering Pvt.Ltd, Hyderabad, Telangana state,
pratapmohanty@vishwasamudra.in
Mr.Thirumalasetty Pavanaram, Sr.Manager-Designs
Vishwa Samudra Engineering Pvt.Ltd, Hyderabad, Telangana state
pavanram.t@vishwasamudra.in

ABSTRACT:

Innovation in Pavement design and road construction offers benefits in industry and community. The government is spending an excessive amount on road construction as well as maintenance, so there is also a need for the use of innovation to find methods that will be cost cutting. Conventional construction materials especially aggregate is becoming progressively scarce on account of environmental concerns as well as legal restrictions on quarrying, while the construction activity has expanded phenomenally. This conflict of interest has shifted focus from large-scale use of conventional aggregate to the use of local, recycled, and engineered marginal aggregates in construction. The present study establishes an innovative technology (In-situ soil stabilization / FDR with cement and StabilRoad additive) which is superior to conventional construction and provides Speedy, Cost-effective, Durable, Eco-friendly and maintenance free pavement besides minimising aggregate requirement and Green House Gas (GHG) emissions.

KEYWORDS:

StabilRoad, Full Depth Recycling, Stabilization,Eco-friendly Construction etc.

INTRODUCTION

In Pavement Design and Construction, there is an urgent need of economical and innovative Technology that provides sufficient strength and durability to pavement and reduces energy consumption and GHG emission. Presently, there is huge energy consumption and GHG emission in the extraction of pavement material, haulage, and pavement construction. Soil Stabilization / Full Depth Reclamation of existing pavement is an apt solution for obtaining sustainable pavement and mitigating the critical issues such as energy consumption and Air Pollution. Introducing Road Construction by Soil Stabilization / Full Depth Reclamation technology with StabilRaod additive, minimises Stone Aggregate significantly for preparation of Base / Sub-Base Layers.

The Cement is being used as a basic binder in Stabilisation since ages. But the limitations with cement when used in Cement-treated Base, is due to its high rigidity and Prone to shrinkage Cracks. Addition of “StabilRoad” to cement during stabilization modifies the

microstructure, enhances its binding property with Soil, & significantly retains the flexibility, which eliminates the risks of shrinkage cracks. Thus, it contributes to making the pavement long lasting, durable, and Maintenance Free.

Stabilroad Additive

The StabilRoad is a cement stabiliser, manufactured by B&K Industries UG & Co KG at Unterfohring, Germany and we have the exclusivity proprietory right to use the product in India. It is available in powder form; the texture is medium soft, and the colour is Greyish-White. It is made of 100% natural minerals with no synthetic chemicals. This product is already in use for nearly 20 years in several countries like Germany, Estonia, Netherlands, United Kingdom, United States, Poland, Austria, Switzerland, Brazil, Gabon, Guinea, Russia, South Korea etc. having different climate zones. VSE is using it in various projects like Airport, Ports, Roads in different aggressive environments with Gravel, Murom, Alluvial soils etc.

CASE STUDY

A stretch of 6 km length of Anayadi - Koodal road in Pathanamthitta District of Kerala was in dilapidated condition. All types of distresses like Pot Holes, Rutting, ravelling, etc were visible on the surface and the crust. The only possible conventional method for its rehabilitation was by Reconstruction from the Sub-Base. The rehabilitation would attract Time, heavy Cost, and discomfort to the users.

VSE got an opportunity to study the road condition and came out with the Cost-effective solution of rehabilitating this 6 kms long road stretch by Full Depth Reclamation. A detailed investigation was carriedout on existing road for a futuristic pavement design. Design Parameters and Recommended crust is mentioned in succeding paragaraphs.

Mix Design

The samples collected from the existing pavement were tested for its physical properties like Gradation, Atterberg limits and MDD and OMC in the laboratory. Based on the physical properties, mix design was carried out to evaluate the sufficient quantities of Cement and StabilRoad additive for stabilization to achieve the desired strength & durability criterias as per norms of Relevant IRC Codes. The desired strength was achieved at cement and additive quatnties of 40kg/sqm and 1.4 kg/sqm respectively for use during insitu FDR stabilization process.

Design Parameters

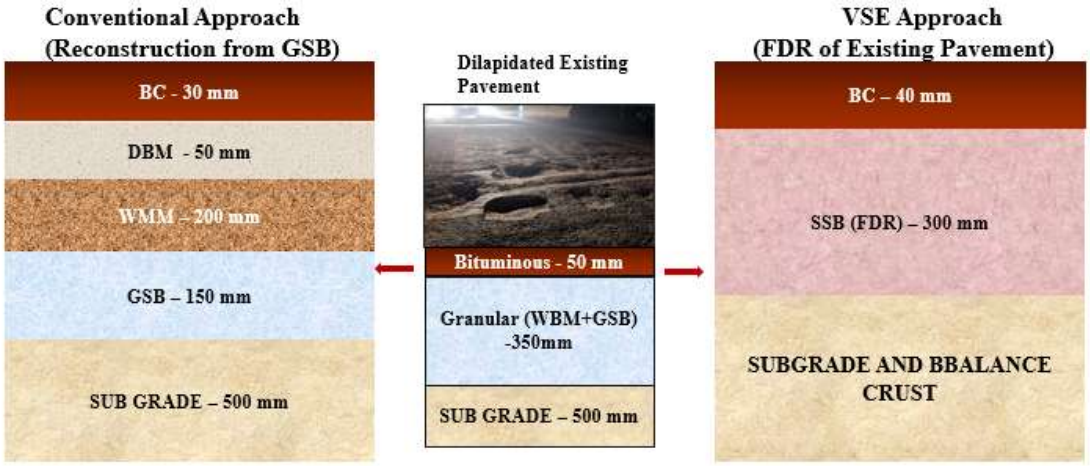
Existing crust of pavement: 400 mm.

Design Traffic: 5 Msa (As given by the Department)

Design CBR: 8% (As evaluated in the laboratory)

Carriageway Width : 6 m (Existing)

Design of flexible pavement based on conventional method vis-a-vis stabilized Base/Sub base layer is as follows:



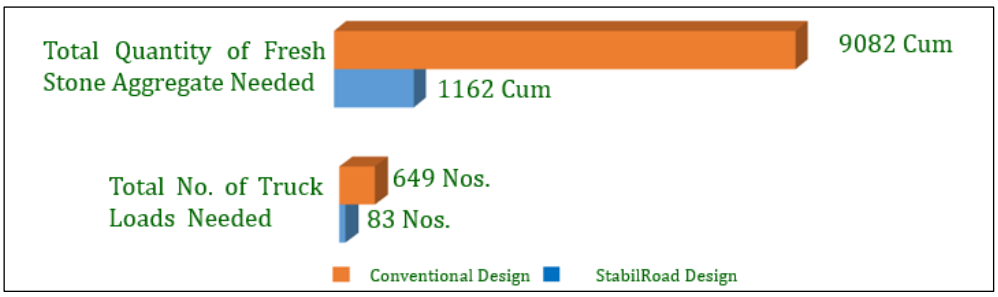
Construction Methodology:

The existing pavement surface was levelled to the desired profile /Gradient and over the prepared surface, desired quantity of Cement (40 kg/sqm) as per the Mix design was spread using Micro Processor Controlled Strew Master Cement Spreader and StabilRoad additive (1.4 kgs/sqm) was spread over the Cement. The existing pavement consisting of Granular material, Cement & StabilRoad, is then thoroughly pulverized using a Wirtgen Cold Recycler Machine WR 240, up to a depth of 300 mm while adding microprocessor - controlled water to achieve desired OMC. The surface is then compacted by a 20 MT pad foot HAMM Vibratory roller. After compaction, the surface is again graded to the desired camber & gradient using a Motor grader machine. The road surface is then Rolled with a tandem vibratoey roller to compact to the maximum density & followed by PTR Roller for further kneading and smooth finish. Then the surface was cured by sprinkling water and light traffic allowed after 6 – 8 hours. A Layer Bituminous Concrete of 40 mm thick wearing Course was laid over a thick Tack Coat and Prime Coat.

Few Pics of the Existing road and execution process are attached as **Annexure I**.

Significant material savings and Speedy Construction

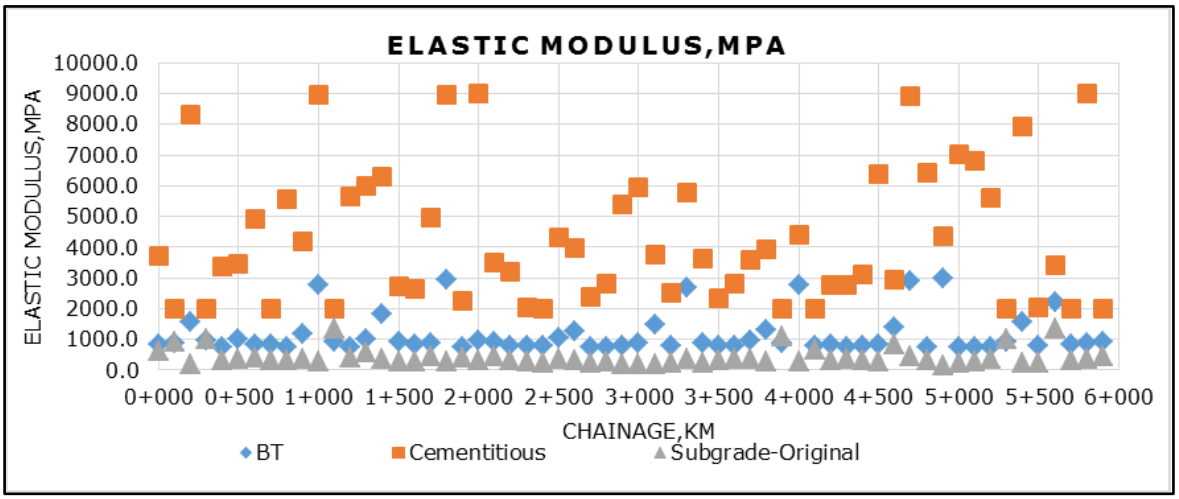
Comparative study based on this project shows a significant savings up to 85% material and reduced the GHG emissions with decrease of truck movements. The project was completed within a week. The comparison of conventional method of rehabilitation Visa-Vis FDR Stabilasation is as below.



Evaluation of Constructed Pavement

Construction of road work was completed in the month of Nov 2018. Inspections of road were carried out frequently to evaluate the condition and after construction performance. Road was found in good condition. No distress has appeared in the pavement.

During the last inspection of road in November 2019, Deflections were calculated using Falling Weight Deflectometer (FWD). Layer moduli were calculated using KGPBACK programme. Using these, moduli strains were calculated at the bottom of bituminous layer and at the top of sub grade using IIT Pave. Fatigue & rutting life were 198 msa & 528 msa respectively for 90% reliability against the designed traffic of 5 msa, which implies that the pavement has remaining life of more than 50 years of original design life.The results are as follows.



Back Calculated modulus value from the KGPBACK Progarm

Strain as per IIT Pave

CBR = 8	Et = Compression (BT Layer)	Fatigue Life = ****
	Et = 89.05 x 10-6 (Stabilized Base)	Fatigue Life = 198 msa
Msa = 5	EV = 221 x 10-6	Rutting Life= 528 msa

Apart from the FWD test, cores were extracted along the constructed road. The average Unconfined Compressive Strength (UCS) value of the cores for 7-days obtained as 6.66 MPa and it exceeds the minimum requirement of 4.5 MPa as per IRC SP 89:2018 (Part II) & IRC 37:2018. Durability test has been performed on the collected cores and weight loss of the core after 12 cycles is less than 14% as specified in IRC SP 89:2010.

CONCLUSION

The modulus of fresh WMM is 200 - 250 MPa, whereas of stabilized base with cement and StabilRoad additive achieved strength more than 2000 MPa. Thus, stabilized base provides a higher strength parameter in terms of modulus of resilience & in turn it leads to saving in

aggregate & saving of around 10% in cost. This technique is environment friendly as it consumes less aggregate, less energy & saves the natural resources. It was observed that even after 2 years, pavement was in very good condition with no sign of Fatigue and Rutting distress anywhere. The visiting officials of the Department have acknowledged the same during a recent joint visit to the above road. Thus the in-situ FDR of the damaged roads is a Revolutionary Ecofriendly Technology to reduce on use of fresh Aggregate and mitigate the construction discomfort to the road users.

Works In Hand: Presently we are executing the following prestigegious projects in India with this Soil Stabilization/FDR technology using Cement and Stabil Road additive

1. NHIDCL – Andaman & Nicoar Island
2. MoRTH – Bihar
3. GHIAL – Rehabilitation of Airfield Pavements in GMR Airport, Hyderabad

REFERENCES

IRC:37-2018: "Guidelines for The Design of Flexible Pavements".

IRC: SP: 89(Part I)-2010: "Guidelines for Soil and Granular Material Stabilization Using Fly ash & Lime".

IRC: SP:89(Part II)-2018: "Guidelines for The Design of Stabilized Pavements.

IRC:120 -2015: "Recommended Practice for Recycling of Bituminous Pavements".

IRC:115- 2014: "Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique".

Annexure 1: Photos during Execution, Evaluation test & Joint visit

Existing Damaged Road

StabilRoad Spreading

Recycling Cement, StabilRoad & Pavement

Pavement after Recycling

Compaction & Grading after Stabilization

Curing

Cleaning and applying bitumen emulsion

Finished Road

Extracted core From Stabilized Base

Pavement Strength Evaluation Test

Joint Site visit with Department officials