

# Pavement Performance Evaluation of Roads Constructed using Zydex Nanotechnology under the Technology Demonstration Project of Namma Grama Namma Raste Yojane (NGNRY) - Post Monsoon

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**Abstract**— The main task of present evaluation work is to conduct pavement performance evaluation of roads which is constructed using Zydex nanotechnology under the technology demonstration project of Namma Grama Namma Raste Yojane (NGNRY) under KRRDA, in Chitradurga and Tumkur District in Karnataka. The purpose of the work is to conduct pavement performance studies on roads which consist of structural and functional evaluations and Geotechnical Investigation (Grain Size Analysis, Atterberg Limits and CBR). The road stretch is evaluated by MERLIN (Roughness evaluation) and pavement condition survey. Detailed survey has been carried out on roads. Road inventory survey includes visual observation, soil characteristics and shoulder condition survey. Severity of potholes, area of patching, cracking of bituminous layer, percentage of raveling, longitudinal depression, rut depth has been measured during condition survey of the pavement. The test were carried out on 5 different roads in Karnataka incorporated with zydex nano technology materials, all the roads were free from pavement distresses, structural conditions of the pavement was good and roughness value shows less significance on vehicle operation cost.

**Key words:** NGNRY, CBR, MERLIN, KRRDA

## I. INTRODUCTION

A good road network indicates the caliber of development of country. It enables social, economical, educational, and cultural development of a country. India has a road network of over 4,689,842 kilometers in 2013, the second most astronomically immense road network in the world. In India the roads are categorized as National Highways (NH), State Highways (SH), Major District Roads (MDR), Other District Roads (ODR) and Village Road (VR). Out of these ODR and VR are classified as rural roads.

About 68% of Indian population lives in six lakh villages, nearly 300 million people below the poverty line, 40% of the rural population is illiterate and at least 50% doesn't have access to clean drinking water, schools and primary health care facilities. Sufficient rural road transportation will improve these conditions. If a proper rural transport system had been provided, it would have functioned as a catalyst and efficient instrument for expediting rural development and establishing gregarious equity.

Rural roads are the tertiary road system in total road network which allots accessibility for the rural residences to market and other facility centers. Hence realizing the importance and value of rural road connectivity, the indian regime launched a program named "Pradhan Mantri Gram Sadak Yojana" (PMGSY) in December 2000, for the development of rural roads which serve as arteries of rural area.

The main task of present evaluation work is to conduct pavement performance evaluation of roads which is constructed using Zydex nanotechnology under the technology demonstration project of Namma Grama Namma Raste Yojane (NGNRY) under KRRDA, Government of Karnataka.

## II. STUDY AREA

THE STUDY AREAS SELECTED ARE:

- 1) Kethuhalli to T-05 of Tumkur Taluk, Tumkur district (3,44KM)
- 2) Pandarahalli to Godabanahal of Chitradurga Taluk, Chitradurga district (0.6KM)
- 3) Bennehalli to T-12 in Gubbi constituency, Gubbi Taluk, Tumkur district. (1.9 KM)
- 4) Bhanjarahatti to L-116 in C.N. Halli Taluk, Tumkur district (1,765 KM)
- 5) Hosur to L- 66 Road in Tiptur Taluk, Tumkur district (0.3 KM)

## III. OBJECTIVES OF THE PRESENT STUDY

Functional Evaluation of the chose roads extends by directing Pavement Condition Survey and by MERLIN.

To evaluate the structural condition of pavement by using Benkelman Beam Test and Axle load survey

To know the properties of soil in these roads extends by directing Geotechnical examination on the gathered soil sample

## IV. LITERATURE SURVEY

A. Faruqi M, Castillo L, Sai J. "State-of-the-Art Review of the Applications of Nanotechnology in Pavement Materials" 2013

The general target of this paper is to show a state-of-the-Art review of nano-science based standards to enhance the performance of transportation construction materials. The article is composed into six areas, to be specific utilizations of nanotechnology in rigid pavements, use of nanotechnology in asphalt pavements, use of nanotechnology in soils, money saving advantage, difficulties, and patterns to what's to come. They finally concluded that there are numerous attributes of nanotechnology that can be connected to pavement to give a superior execution. Be that as it may, fruitful nanotechnology application may require 5 or 10 years to be marketed. Future nanotechnology applications will lead to reduce maintenance costs, increase pavement lifespan, reduce accidents, and increase construction efficiency.

*B. Prof. A.A.Patel, Dhaval V. Lad "pavement evaluation by Benkelman beam of state highway section" 2014*

The point of the proposition has been structural evaluation of existing flexible pavement by Benkelman beam technique and discovers deflection of pavement. At that point after figure the thickness of overlay of flexible over flexible pavement according to IS standard

Flexible pavement deteriorating because of repeated application of vehicular burdens and because of the impact of climatic parameters. Structural evaluation of pavements is an important part of the pavement management. Hence they carried out a structural evaluation of SH 158 (waghodiya croosing limda) total length of the stretch is 11.7KM. In the structural evaluation of flexible pavement the pavement deflection is measured by the Benkelman Beam. Rebound deflection is used for overlay design. Also soil sample is taken at the site through at the pavement composition survey locations. Hence the soil tests that have to be conducted are Moisture content test (Standard Proctor test), in this present case they explain the weak spots of pavement by visual observing the cracks, rutting, patching, potholes. They also calculate the thickness of overlay of flexible over flexible pavement as per IS standards by using the deflection values of the pavement.

V. MATERIALS

In this present case the methodology adopted for construction of the road in above selected areas is nanotechnology and materials for different layers are terraprime, nanotac and zycosoil for primer coat, tack coat and bituminous layer respectively. Zycosoil is doped at 0.05 - 0.1% by weight of asphalt binder in the asphalt binder tank. Stir the asphalt binder

VI. METHODOLOGY

- The pavement performance evaluation includes an investigation of structural and functional behavior.
- Functional assessment is the one which is utilized to get the functional behavior of pavement over a timeframe which gives direct data about riding comfort and vehicle operation cost and so on. Pavement unevenness is carried out by MERLIN
- The structural evaluation may be classified in to two groups. Non- destructive test method and destructive method, Advantages of Nondestructive evaluations over destructive evaluation are Low cost ,Least disturbance to traffic ,No damage to pavements ,Sufficient number of measurements can be made to quantify variability In view of all the above advantages the nondestructive test method is adopted for the present work i.e. Benkelman Beam Deflectometer (BBD). To find the Vehicle Damage Factor (VDF) classified traffic volume survey is conducted, the information got from the structural assessment is utilized to regularly the structural condition of the current pavement to know the lingering life furthermore to design the overlay thickness required for the existence of the pavement.

VII. RESULT AND DISCUSSION

A. Benkelman Beam Deflection Studies

The flexible pavement acts as an elastic. Consequently deflection of the pavement under a wheel load will be elastic and accordingly on evacuation of the heap the deflected pavement structure will bounce back to the primary form. The magnitude of bounce back deflection because of expulsion of a standard wheel load is measured utilizing this basic hardware "Benkelman Beam".



Fig. 1: BBD Instrument

Sl no	Stretch name	Chainage	BBD value
1	Kethuhalli -T 05	3.44	0.777
2	Pandrahalli to godabanahalli	0.6	0.7
3	Bennehalli to T -12	1.95	0.552
4	Hosur to L-66	1.76	0.475
5	Banjarahatti to L -66	0.3	0.34

Table 1: BBD Results

The Benkelman Beam Deflection Studies were carried out on the above mentioned road stretches and test was conducted as Per IRC-81 1997. The observed average characteristic deflection value (Dc) for all the entire stretch is given in above table. So, from the observed values it can be concluded that the Relaying of the pavement is not warranted.

B. Merlin Survey (Roughness Value)

Pavement surface unevenness implies on essential part on roughness index of the road which influences on riding comfort ability. Comfort ability refers back to the degree of safety provided to the vehicle occupants from uneven factors in the road surface. In this way, it is desirable over have a lower roughness index value for a superior riding quality of road users. Roughness is commonly described as an expression of abnormalities in the pavement surface which may be measured the usage of unique equipment"s like MERLIN, Bump integrator, Profilometer, and many others.



Fig. 2: Merlin Instrument

Sl no	Stretch name	Chainage	Merlin value
1	Kethuhalli –T 05	3.44	3.164
2	Pandrahalli to godabanahalli	0.6	2.71
3	Bennehalli to T -12	1.95	3.277
4	Hosur to L-66	1.76	3.304
5	Banjarahatti to L -66	0.3	3.418

Table 2: Merlin test results

The MERLIN survey was conducted on the above stretch and all the observed average International Roughness Index (IRI) value was found to be less than 3.5 m/km, Roughness Value has a less importance on vehicle operation cost.

### C. Pavement Condition Rating

Sl no	Stretch name	Chainage	PCI INDEX
1	Kethuhalli–T 05	3.44	5
2	Pandrahalli to godabanahalli	0.6	5
3	Bennehalli to T -12	1.95	5
4	Hosur to L-66	1.76	5
5	Banjarahatti to L -66	0.3	5

Table 3: PCI Index values

Defects	Range of Distress				
	>30	21-30	11-20	5-10	Less than 5
Cracking (%)	>30	21-30	11-20	5-10	Less than 5
Ravelling (%)	>30	11-30	6-10	1-5	0
Pothole (%)	>1	0.6-1.0	0.1-0.5	0.10	0
Shoving (%)	>1	0.6-1.0	0.1-0.5	0.10	0
Patch (%)	>30	16-30	6-15	2-5	Less than 2
Settlement and Depression (%)	>5	3-5	Up to 2	Up to 1	0
Rutting (mm)	>50	21-50	11-20	5-10	Less than 5
Rating	1	2	3	4	5
Condition	Very Poor	Poor	Fair	Good	Very Good

Table 3.4: Pavement Condition rating on Different Types of Defects

The Road stretch is in Good Condition. The surface is free from the distress such as Pot Holes, Ravelling, Edge Drop, Cracking, rutting and Longitudinal Depression during the time of survey.

### VIII. CONCLUSION

- 1) The traffic Survey was done for a period of 24 hours only. The total Traffic Count and Category of Vehicles are found out
- 2) The road surface has few minor patchworks, edge drop, rutting and ravelling at few places. Longitudinal depression is found in some stretches. The surface is free from distresses such as Pot Holes, Cracking in the entire road stretch during the time of survey. Are presented in terms of pavement condition rating T in Table-5.7.
- 3) The Benkelman Beam Deflection Studies were done on the previously mentioned stretches. The watched average characteristic deflection value (Dc) for the kethuhalli road was 0.777\* mm its quite high when compared with other stretches this is a direct result of heavy load catering on pavement and kethuhalli much prevailing to rainfall compare to other stretches, from the watched values it can be reasoned that the Relaying of the pavement is not justified.
  - a) \*The BBD values should not be taken as reference for the design of overlay. The characteristic deflection values are considered to understand the overall deflection characteristics of the pavement under a standard load. Since, the surface course is not a structural layer; it is only a functional layer.
- 4) The Axle load survey was done on the above stretches for a time of 24 Hours. The test was directed according to IRC SP-19 2001. The watched equivalent factor is appeared in Table-5.4 and from the watched results about it can be presumed that the vehicles are not over stacked.
- 5) The MERLIN study was directed on the above stretches and the watched average International Roughness Index (IRI) esteem was appeared Since, watched esteem is less than 3.0 m/km, Roughness Value has a less significance on vehicle operation cost. Roughness value indicates the unevenness of road surface

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