International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 4 Issue 10 ǁ October. 2016 ǁ PP. 08-12

Functional Evaluation of Canal Bank Roads Using Merlin

Trinadh Varma Penumatsa[1], Dr. M.Jagapathi Raju[2], Dr. C.N.V.S.Reddy[3]
[1,2](Department Of Civil Engineering, S.R.K.R.Engineering College, Andhra University, India)
[3](Department Of Civil Engineering, Andhra University, India)

Abstract: Canal Bank Roads are Roads formed and developed on Banks of Canals or Drains. These Roads are observing premature failure in their performance. The Present Study Aims at Functional Evaluation of a Canal Bank Road. Using MERLIN (Machine for Evaluating Roughness using Low Cost Instrumentation.) From the study it is identified that the average IRI value of the study stretch is 3.65 m/km which indicates that the surface is in poor condition as per IRC:SP - 16
Keywords: Canal Bank Roads, Functional Evaluation, International Roughness Index, MERLIN.

I. INTRODUCTION

Road Transportation is playing a major role in the development of the Nation. India has a good number of rivers also which are useful in cultivating huge areas of land. In this process numbers of canals were constructed and the banks of canals are used as Inspection routes. Subsequently, Inspection routes were converted into major roads carrying a huge traffic (both passenger and goods). Deterioration of roads is one of the major causes of the pavement failure on the canal banks. The amount of Deterioration can be evaluated by observing the Roughness Index. Different studies have proven the importance of Roughness in surface condition, since it has a significant correlation with the pavement quality.

The Study Stretch is a Road link between Bhimavaram and Pippara of West Godavari District, Andhra Pradesh, India. This Road is almost along Canal or Drain. Performance of this road stretch is very poor which is resulting towards increasing travel times and Delay. Road Accidents are also more in this stretch. The Objectives of the Study are,

1. To Evaluate the International Roughness Index Value for the study stretch.
2. To Calibrate the MERLIN before using it for Evaluation Process
3. To Observe the average speed of Data collection using MERLIN
4. To Identify the present Condition of the Surface using IRC: SP 16.

II. LITERATURE REVIEW

2.1 Roughness Index:

Roughness is defined as irregularities in pavement surface that adversely affect ride quality, safety, vehicle maintenance and operating costs. Roughness is the factor that most influences users' evaluation when rating ride quality. This index had to be independent from equipment or techniques used to obtain the profile's geometry, and at the same time had to represent the full range of users' perceptions when driving an average vehicle at an average speed. The need for this index originated in the mid-eighties, giving rise to the concept, definition, and method for calculating the International Roughness Index (IRI).IRI is a statistical indicator of surface irregularity in road pavements. The real profile of a newly–built road represents a state defined by its IRI with an approximate range of 1.0–2.5 (m/km).

2.2 Roughness Measuring Instruments:

The Simplest type are the static road profile measuring devices such as the rod and level, which measure surface undulations at regular Intervals.Two devices which work on a similar principle but are semi-automated are the TRRL Abay beam and the modified dipstick profiler. With both of these instruments the surface undulations are measured from a static reference and data is fed directly into a microprocessor to do the necessary calculations. They produce high quality results but they are relatively slow in operation and expensive.

The second class of instrument is the dynamic profile measuring device such as the TRRL high speed Profilometer. In these instruments surface undulations are measured with respect to a moving platform equipped with some means of compensating for platform movement, so that the true road profile can be derived. This is then converted to roughness indices by automatic data processing. These devices can operate at high speeds and give good Quality results, but they are very expensive, they are not usually suitable for very rough roads and they have to be carefully maintained.

There are also the response-type road roughness measuring systems (RTRRMS). These measure the cumulative vertical movements of a wheel or axle with respect to the chassis of a vehicle as it travels along the road. In the case of a standard device such as the towed fifth wheel Bump Integrator (BI) the response is used directly as a roughness index. The vehicle-mounted BI however is much cheaper and can perform well as long as it is correctly used and is calibrated regularly.

MERLIN:

Fig: 1 Equipment for Measuring Roughness: MERLIN

The new instrument which has been developed is a venation of the static profile measuring device. It is a manually operated instrument which is wheeled along the road and measures surface undulations at regular intervals. Readings are easily taken and there is a graphical procedure for data analysis so that road roughness can be measured on a standard roughness scale without the need for complex calculation. Its particular attractions for use in the developing world are that it is robust, inexpensive simple to operate and easy to make and maintain.The device is called MERLIN which is an acronym for a Machine for Evaluating Roughness using Low-cost Instrumentation. It was designed on the basis of a computer simulation of its operation on road profiles measured in the International Road Roughness Experiment.

2.4 Principle of Operation

The device has two feet and a probe, which rests on the road surface along the wheel track whose roughness, is to be measured. The feet are 1.8 meters apart and the probe lies mid-way between them. The device measures the vertical displacement between the road surface under the probe and the centre point of an imaginary line joining the two points where the road surface is in contact with the two feet. This displacement is known as the mid-chord deviation. If measurements are taken at successive intervals along a road, then the rougher the road surface the greater the variability of the displacements. By planning the displacements as a histogram on a Chart mounted on the Instrument, it is possible to measure their spread and this has been found to correlate well with road roughness as measured on standard roughness scales. The Merlin operates by using just one base length, the machine measures mid-chord deviations without the need for rod and level, the variability of the mid-chord deviations is determined graphically and very little calculation is involved to determine roughness.

2.5 Calibration Equations:

The Relation between MERLIN Scale, BI and the IRI scales are,For all Road Surfaces:

$IRI = 0.593 + 0.0471 D$

$42 > D > 312$ ($2.4 > IRI > 15.9$)

Where IRI is the Roughness in terms of the International Roughness Index and is measured in meters per Kilometer and D is the roughness terms of the MERLIN Scale and is measured in millimeters.

$BI = 0.983 + 47.5 D$

$42 > D > 312$ ($1.270 > BI > 16.750$)

Where BI is the Roughness measured by fifth wheel Bump Integrator towed at 32 kmph and is measured in millimeters per kilometer.

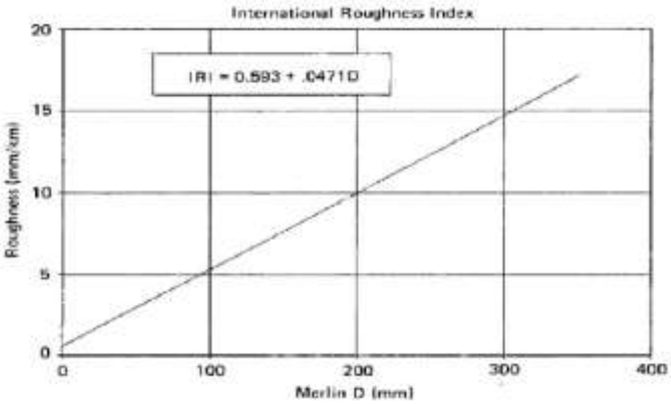

Fig.2 Relationship between IRI and D

IRC: SP – 16 provides the Maximum Permissible Roughness Values for different Conditions, the same value presented in Table 2.1

Table.1 Maximum Permissible Values of roughness (mm/km) for Road Surface (IRC :SP :16)

S.no	Type of Surface	Condition of Road Surface		
		Good	Average	Poor
1	Surface Dressing	<3500	3500 - 4500	>4500
2	Open Graded	<3000	3000 - 4000	>4000
3	Mix Seal Surfacing	<3000	3000 - 4000	>4000
4	Semi-Dense Bituminous Concrete	<2500	2500 - 3500	>3500
5	Bituminous Concrete	<2000	2000 - 3000	>3000
6	Cement Concrete	<2200	2200 - 3000	>3000

III. METHODOLOGY

Bhimavaram to Pippara (SH-42) road is one of the state highways where commercial traffic due to the heavy loads is increasing day by day due to agricultural and aquaculture needs. The main vehicles contributing to the heavy loads are Lorries and buses. Due to the generation of heavy moving loads the road is getting deteriorated. Like all other structures roads also deteriorate over time. Deterioration or road damage is primarily due to the accumulated damage from vehicles and more by overloaded and incorrectly loaded vehicles.

Another reason mainly contributing to the deterioration of this road is that the road is laid beside the canal and the Subgrade of this road is expansive soil. The Level of service of this road is determined by the International roughness index (IRI). Road roughness of Bhimavaram to Pippara road is determined by a low cost instrumentation i.e., MERLIN. It was conducted from a chainage of 3 km to 13 km from Bhimavaram towards Tadepalligudem. The Survey was done during February 2016. The MERLIN instrument was placed at 1m from the Road Edge in both Directions.

IV. DATA COLLECTION AND ANALYSIS:

4.1 Calibration:

Before use, the mechanical amplification of the arm should be checked using a small Calibration block typically 6 mm thick. Insertion of the block under the probe should move the pointer by 60 mm. For example, if the pointer moved 60 mm. then the value of D measured on the chart should be increased by a factor of 60/60.

The Road Roughness (IRI) is computed on the basis of MERLIN charts (Graphs). "D" value is calculated from each Graph and the values of D-Values are to be substitute in IRI equation.

The IRI scale and the MERLIN scale are related by the following equationFor all type of pavement surface:

IRI=0.593+0.0471D

42 > D > 312 (2.4> IRI > 15.9)

IRI= International Roughness Index in m/km

D=roughness in Merlin scale measured in mm

The length of road covered for 200 measurement/revolution of MERLIN:

= (26*π*2.54*200) / 100 = 415m

No. of Graphs or MERLIN Charts for 10km stretch obtained are:

= 12000 / 415 = 24

4.2 Observations and Analysis:

Type of Surface : Semi Dense Bituminous Concrete

Date of Survey: 23-02-2016 to 29-02-2016

Table: 2 Calculation of IRI Value based on D – Values observed using MERLIN

S.No	CHAINAGE		LHS		RHS			
	From	**To**	**D - Value**	**IRI, m/km**	**D - Value**	**IRI, m/km**	**LHS**	**RHS**
1	3.000	3.415	65	3.65	60	3.42		
2	3.415	3.830	58	3.32	71	3.94		
3	3.830	4.245	63	3.56	100	5.30		
4	4.245	4.660	76	4.17	80	4.36		
5	4.660	5.075	55	3.18	55	3.18		
6	5.075	5.490	57	3.28	55	3.18		
7	5.490	5.905	62	3.51	70	3.89		
8	5.905	6.320	62	3.51	57.5	3.30		
9	6.320	6.735	62	3.51	64	3.61		
10	6.735	7.150	63	3.56	85	4.60		
11	7.150	7.565	112	5.87	97.5	5.19		
12	7.565	7.980	80	4.36	86	4.64		
13	7.980	8.395	59	3.37	90	4.83		
14	8.395	8.810	52	3.04	49	2.90		
15	8.810	9.225	45	2.71	49	2.90		
16	9.225	9.640	52	3.04	67.5	3.77		
17	9.640	10.055	65	3.65	83	4.50		
18	10.055	10.470	41	2.52	55	3.18		
19	10.470	10.885	50	2.95	70	3.89		
20	10.885	11.300	75	4.13	79	4.31		
21	11.300	11.715	52	3.04	70	3.89		
22	11.715	12.130	46	2.76	50	2.95		
23	12.130	12.545	51	3.00	54.5	3.16		
24	12.545	12.960	42	2.57	74	4.08		
Average IRI- Value			LHS	3.43 m/km	RHS	3.87 m/km		
Overall Average IRI – Value			3.65 m/km					
Note:	IRI,m/km, Max. Permissible Value as per IRC: SP 16 for SDBC		<2500		2500 - 3500		>3500	

V. CONCLUSIONS

1. From Calibration of the Instrument it is verified that the Instrument was accurate as the Value obtained in calibration is 60/60.
2. The Surface layer is Semi Dense Bituminous Concrete.
3. The Average IRI- Value (When MERLIN placed on Left Hand Side of the Road) is 3.43 m/km which indicates that the Surface is in Average Condition as per IRC:SP-16
4. The Average IRI- Value (When MERLIN placed on Right Hand Side of the Road) is 3.87 m/km which indicates that the Surface is in Poor Condition as per IRC: SP-16
5. The Overall Average of IRI – Value is 3.65 m/km. which indicates that the Surface is in Poor Condition as per IRC:SP – 16
6. The Instrument is Easy to Handle and is very useful for Developing Countries for Functional Evaluation of the Roads.
7. The average rate of Evaluation using MERLIN is 3 km per Day

REFERENCES

[1]. Cundill, M.A. (1996). “The Merlin Road Roughness Machine: User Guide”, Research Report 229, Transport Research Laboratory (TRL), Berkshire, United Kingdom.

[2]. YusakO.Susilo, Hendarto and Bambang I. Siswosoebrotho, “The Comparison of Roughness measurement between NAASRA, ROMDAS and MERLIN devices for Road Maintenance Purposes”, Proceeding of the Eastern Asia Society for Transportation Studies, Vol.3, No.1, October, 2001

[3]. Sharath Kumar etal, “Pavement Evaluation Study of Road Stretches Constructed using Nanotechnology”, IJSRD, Vol.3, Issue 07, 2015.

[4]. J Rajendra Prasad etal, "Development of Relationship between Roughness(IRI) and Visible Surface Distresses: A Study on PMGSY Roads", Procedia of 2nd Conference of Transportation Research Group of India, Elsevier, 2013.
[5]. JyotiBiraj Das, "Development of a Low Cost Road Roughness measuring Device", NIT Rourkela, 212CE3054.
[6]. Modified Roughness Indicating Machine (AIM-570), Merlin Aimil Manual.
[7]. Guidelines for the Surface Evenness of Highway Pavements, IRC: SP: 16-2004 Code.