IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

STUDY AND ANALYSIS OF PAVEMENT CONDITION OF HIGHWAY BY USING NETWORK SURVEY VEHICLE (NSV)

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Abstract: This research introduces a novel method for collecting data on road distress. This distress collection is a critical component in determining future maintenance needs for existing roadway sections. The earlier way of finding various flaws in existing pavement, which is critical for identifying areas with the poorest road conditions, was visual inspection of the pavement. Distress detection was carried out on an existing flexible pavement segment of National Highway-53 in this paper. The state of the pavement has an impact on a variety of characteristics, including passenger comfort, safety, volatile organic compounds (VOC), vehicle speed and travel duration, emissions/pollution, and so on. With photographs and precise distance measurements, this Network Survey Vehicle gets highway pavement information such as roughness, rutting, cracking, ravelling, bleeding, texture depth, edge cracking, potholes, geometric data, and more at every place.

I. Introduction

Roads are the veins of a Country and they are being used day and night throughout the year. Hence it is necessary to keep them in up-to-date condition for safe and smooth movement of vehicles. The agencies involved in the construction and maintenance of highways always strive for it. But due to the continuous use and weather changes the condition of the highway and its riding quality may change. In the past years, the road rehabilitation strategies were defined based on the road condition survey done by walking through the entire project. In order to adequately plan the strategy, this procedure takes a long time. While preparing the same, it can take up to a year, and in the meantime, the quality of the road deteriorates, making a genuine picture impossible to portray. Also, because the data is collected manually, it moves at a much faster rate, and the impression of anxiety varies from person to person. In order to properly construct the road restoration strategy, it was critical to solve the problem and design a path ahead. The Network Survey Vehicle (NSV) is a next-generation State-of-the-Art technology that uses laser-based technology to assess road conditions.The NSV is vehicle which is a combination of laser profilometer, laser crack measurement system, transverse profile logger, GPS, camera, and odometer.

1.2 NSV (Network Survey Vehicle)

Network Survey Vehicle is an innovative technology to inspect the existing pavement surface and collecting pavement high resolution imagery data, cracking, roughness, rutting, raveling, bleeding, texture depth, edge cracking, potholes measurement with LCMS, accurate distance measurement with distance measurement unit fitted at rear wheel, etc.

Fig 1.1 - (a) Front view and Side view of a NSV

According to the manufacturer, the following are some of the general applications of NSV:

- Network and project level road and asset collection surveys
- Routine pavement monitoring surveys
- Roadside inventory and asset management
- Road geometry and mapping surveys
- Contractor quality control
- Road safety assessment
- Line marking reflectivity
- Airport runway inspections

The Network Survey Vehicle is built on the most up-to-date survey techniques, including the use of lasers, GPS, and video image processing technologies, among other things. The Survey Vehicle is used for automatic collection of road inventory and pavement condition related data required for Road Asset Management, Pavement Maintenance Management System and Road Safety Audit Related Studies.

A. Key features of Network Survey Vehicle System:

– High survey speeds up to 80 kmph
– Longitudinal (International Roughness Index) and Transverse profiling (Rut Depth) conforming to ASTM standards
– Pavement Texture in terms of Mean Profile Depth
– Slope, Cross-fall and Radius of curvature
– GPS Coordinates (X, Y, Z) viz. longitude, latitude & altitude using DGPS
– Video imaging for Roadside furniture / Road Asset
– Advanced data processing and reporting software
– Real time in-vehicle data acquisition software for display and collection of data from all parameters simultaneously
– Post processing software for data analysis and report preparation

2.AREA OF STUDY

The highway section between Nagpur and Amravati on NH 53 Starts from Chainage Km 0+000 to Km 3+000 is selected for this study. . The total length of study stretch is 3 km.

Latitude- 21°08'06.3111"N
Longitude- 79°02'45.2265"E
Altitude- 265.575

3.DATA ANALYSIS

Pavement condition survey carried out with Network Survey Vehicle. Network Survey Vehicle collected all distress data.

Refer following sample data-

Table 4.1- Lane Wise Roughness Distribution in Length (m)

Roughness Range	Severity	L1	L2	R1	R2
Less than 2.55	Good	2200	2000	2200	2400
2.55 - 3.30	Fair	500	900	600	400
More than 3.30	Poor	300	100	200	200
Total		3000	3000	3000	3000

Table 4.2- Crack Severity obtained

Rating	Condition	L1	L2	R1	R2
1	Very Poor	0	0	0	0
2	Poor	0	0	0	0
3	Fair	0	0	0	0
4	Good	300	500	100	400
5	Very Good	2700	2500	2900	2600

Table 4.3- Ravelling data obtained

Rating	Condition	L1	L2	R1	R2
1	Very Poor	0	0	0	0
2	Poor	0	0	0	0
3	Fair	300	300	0	0
4	Good	1400	1400	1600	1400
5	Very Good	1300	1300	1400	1600

Table 4.4- Pothole data obtained

Rating	Condition	L1	L2	R1	R2
1	Very Poor	0	0	0	0
2	Poor	0	0	0	0
3	Fair	200	400	0	0
4	Good	700	500	100	300
5	Very Good	2100	2100	2900	2700

The collected data from Network Survey Vehicle is analyzed with the help of Microsoft excel. After getting survey work done, decided criteria for rating to various distresses with respect to severity of each distress.

Table 4.5- Criteria for Classification of Pavement Sections

Distress	Pavement Condition-Rating
Crack area	Percent of pavement area affected by cracking, which is converted to the following rating scale: 1 - Very Poor (> 30%); 2 - Poor (21-30%); 3 - Fair (11-20%); 4 - Good (510%); 5 - Very Good (<5%)
Raveling	Percent of pavement area affected by ravelling, which is converted to the following rating scale: 1 - Very Poor (> 30%); 2 - Poor (11-30%); 3 - Fair (6-10%); 4 - Good (1-5%); 5 -Very Good (0%)
Pothole	No. Of potholes which is converted to the following rating scale: 1 - Very Poor (> 5); 2 - Poor (3-5); 3 - Fair (2); 4 - Good (1); 5 - Very Good (0)

4. COMPARATIVE ANALYSIS

Comparative analysis is done for the two main parameters which are considered while assessing the quality of the road that are namely roughness and cracking. The comparison is drawn between the traditional methods that were used for surveying with the NSV .

4.1 ROUGHNESS

Roughness measuring using a NSV - The International Roughness Index (IRI), Bump Integrator Roughness (BI) is used to define the characteristics of a longitudinal road profile and constitutes a standardized roughness measurement. IRI & BI is measured in meters per kilometer (m/km) & millimeters per kilometer (mm/km) respectively. Integrated into a NSV are two laser profilometers which calculate IRI. Any spikes in the roughness outputs will be excluded that may arise from rumble strips, speed breakers, expansion joints, cattle grids, railway crossings, bridge abutments etc. Automated checks in the data processing software are already incorporated to exclude any contribution to roughness from data collected below the minimum survey speed which is typically set at 5-30 kmph

Absolute profile instruments, Moving datum instruments,Vehical motion instrument are the traditional methods used to measure roughness.

4.2 CRACKING

Generally the cracks were classified through physical inspection and dimensions reported through physical measurements. The classification of six types of cracking crocodile, longitudinal, transverse, map, irregular and block. Another approach is to define it simply by location, namely wheel path cracking and non-wheel path cracking. Yet another is to refer directly to the mechanisms deduced to have caused the cracking, for example: fatigue, shrinkage, reflection, low-temperature, settlement, ageing; or alternatively, simply traffic-associated and non-traffic associated These have a high degree of commonality with many systems.

In a NSV cracking is classified as severity. Severity is a measure of the width of crack, usually represented by classes. In some classification systems, severity classes include both crack width and intensity. Severity is conveniently expressed as a percentage of the surfacing area over a defined unit such as a lane- or pavement width by a convenient sample length in the range of 100 to 1,000 m.

Intensity is expressed either as the total length of cracks in a unit area (m/m2) or as an average spacing of the cracks (considering cracking as a nominally square-grid network) - cracking within a fixed extent can become more intense as individual blocks of the surfacing break down into smaller blocks. Therefore measurement of cracking using an NSV is convenient as it has a standard procedure, less labor is required and provides an accurate reading.

5. CONCLUSION

The NSV survey is the latest advanced technology for assessment of road condition with high accuracy. In a very less interval of time the assessment of road can be done with very easy and high accuracy. This also enables to automatically Gro-tagging of the road condition parameters. It requires the highly skilled manpower for the data analysis. Total 3 km section is selected for study. NSV tests were conducted on these road segment to determine the pavement conditions of the existing pavement. Accordingly, with collected various distress data , distress rating allocated with respect to severity of destress to decide the type of pavement condition such as very poor to very good. After analyzing the collected data for all the parameters of the pavement we can conclude that the condition of the road is good. Hence it was good for use.

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