Pavement Surface Unevenness - An Impact Study Using Romdas Mounted Vehicle

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Abstract **- This research paper explain about the Construction of Highways, Expressways now a days is achieved through an Application of the complicated software combined logarithmic valuation of the Results, Scrutinized through various level of check list. At different stages of protocol hierarchy for the construction of Expressway projects especially in the global tendering process the level of Engineering, procurement, construction, maintenance is at the epitome in consideration. As per IRC, it is Q-4 IRC:SP-057 per see to fulfil the objectivism. As in any part of the construction activity there are two parties involved i.e. client & contractor and the third which is most important, the one who is paying for the services rendered for the usage of construed subject. In specific for Highways, Expressways the ultimate purpose of all the vigilance, quality check is for the end- user i.e. the persons who are paying the Toll fees for plying. Here comes the important role of smoothness of the road surface, playing a vital role in reducing the vehicle operating cost, travel time. This can be just achieved by reducing the roughness, rutting as far as possible. As in Agra-Lucknow Expressway length 302 km. (approx) Contract Agreement settles at average BI/RI 1800 mm/km. As to check the roughness Index of the Road surface, I have focused only on ROMDAS equipment vehicle which is paramount in most modern technique in the execution of this test in India & Globally. In India CRRI has developed its *state of the Art* vehicle with the help of its European and Australian counter parts. We have conducted this test for determination of the International Roughness Index on the Entire stretch of the Agra-Lucknow Expressway as stated in our Contract Agreement for the study in the Road Roughness behaviour if any before and after Rainy Season. In this dissertation I have compiled the results of this test for the entire length of the Expressway. In this regard we have conducted two Pre-monsoon & one Post Monsoon testing of Road Roughness for the entire stretch of the Expressway. In furtherance taking all the data from the site being processed in the Labs of SRIINFOTECH, Hyderabad and COMPLETE INSTRUMENTATION SOLUTIONS, Gurgaon. Thus, producing results from the processed data and concluding it is a lengthy process to be done.**

Index Terms **- Construction of Highways, Expressway, protocol hierarchy, operating cost, modern technique.**

1.INTRODUCTION

Functional assessment of a road pavement is characterized by its geometric features and the surface characteristics. These characteristics are of paramount importance and must be adequate towards ensuring road user comfort and road safety, in addition to the reduction in wear and tear of the vehicles using the road and ultimately the reduce road user costs.

Pavement roughness is the result of either the built in irregularities due to construction defects/deficiencies or it may also appear on the road surface due to the consolidation or displacement of different materials placed within the pavement structure. The effect of roughness on various components making up the vehicle operating cost and the subsequent pavement maintenance costs are well established. Reduced travel speed, early and faster wear and tear of the vehicle's tires and machine parts, increased consumption of fuel and excessive strain on vehicle body and its components, faster deterioration of pavement structures, reduced life of vehicles etc. are some of the factors which are governed by the road roughness. Roughness also increases significantly the maintenance cost of both vehicles and pavements. It becomes clear, therefore, that pavement surface roughness is one of the main factors which needs to be given due attention by both engineers and planners. Pavement surface roughness is defined as the sum of deviations of the surface profile from a true planner surface with characteristics dimensions that affect vehicle dynamics, riding quality, dynamic loads and pavement drainage. This covers mainly the dimensions of longitudinal profile, transverse profile and crosslope.

In this paper section I contains the introduction, section II contains the literature review details, section III contains the details about methodologies, section IV describe the result and section V provide conclusion of this paper.

2.EQUIPMENT USED FOR MEASUREMENT OF ROADROUGHNESS

There are simple as well as sophisticated equipments, available worldwide, for measurements of both longitudinal and transverse profiles (unevenness) which differ from country. The measurements of road roughness, under this project, were under taken by Automated Road Survey System fitted with Laser Profilometer (which is a class -I equipment for the measurement of international roughness index (m/km) at highway speeds). Automated Road Survey System (ARSS) is based on the latest survey techniques utilizing Laser Profilometer, Global Positioning System and Video image processing tools etc. Using advanced equipment installed on the vehicles, these systems are capable of measurement of pavement surface roughness, rutting, road geometrics (gradient, horizontal curvature and cross slope), texture depth, GPS coordinates (X, Y, Z) viz. longitude, latitude & altitude. Using high resolution cameras installed on this vehicle, Right of way Videography and Pavement Surface Imaging is also possible.

3.ANALYSIS AND PRESENTATION OF ROUGHNESS DATA

The Roughness data collected using ARSS Laser Profilometer has been collected and analyzed in terms of International Roughness Index (IRI), separately for each lane, for both direction of travel. The value of Roughness Index (RI), corresponding to each IRI value, using the standard conversion equation (RI = 630 (IRI)ˆ1.12, as per IRC:SP 16-2004) has also been calculated.

4. PLANNING A ROUGHNESS MEASUREMENT PROJECT

The plan of a venture for reviewing the harshness of a street organization should begin with an unmistakable comprehension of the goals to be accomplished from the estimation exertion. A considerable speculation of labor and cash can be devoured in a commonplace undertaking, hence it is alluring to plan the program cautiously. The actual plan is a blend cycle considering the undertaking objectives, the assets accessible, and the climate of the task. Maybe the most basic component in the plan is the determination of an unpleasantness estimation technique that is practicable, yet appropriately precise for the motivations behind the undertaking. This segment surveys the different estimation techniques accessible, characterized by how straightforwardly they measure harshness on a standard scale (Generally, the more straightforward strategies are likewise the most dependable). Also, it clarifies the sorts of blunders to be expected, and their significance to different sorts of estimation projects.

5.OVERVIEW OF THE IRI ROAD ROUGHNESS SCALE

To address particulars of unpleasantness estimation, or issues of precision, it is first important to characterize the harshness scale. In light of a legitimate concern for empowering utilization of a typical unpleasantness measure in all huge tasks all through the world, an International Roughness Index (IRI) has been chosen. The IRI is so-named in light of the fact that it was a result of the International Road Roughness Experiment (IRRE), led by research groups from Brazil, England, France, the United States, and Belgium to distinguish such a record. The IRRE was held in Brasilia, Brazil in 1982 [l] and involved the controlled estimation of street harshness for various streets under an assortment of conditions and by an assortment of instruments and techniques. The harshness scale chose as the IRI was the one that best fulfilled the models of being time-steady, movable, and pertinent, while likewise being promptly quantifiable by all professionals.

6.CLASS 4: SUBJECTIVE RATINGS AND UNCALIBRATED MEASURES

There are circumstances in which a harshness information base is required, however high precision isn't fundamental, or can't be managed. In any case, it is alluring to relate the actions to the IRI scale. In those cases, an abstract assessment including either a ride insight out and about or a visual examination could be utilized. Another chance is to utilize the estimations from an un-aligned instrument. Change of these perceptions to the IRI scale is restricted to a rough proportionality, which can best be set up by correlation with verbal or potentially pictorial Portrayals of streets related to their related IRI esteems, as depicted in Section 5.0. Basically, the assessments of equality are the alignment, but rough, and they might be viewed as "Adjustment by depiction." When these emotional assessments of unpleasantness are changed over to the IRI scale the goal is restricted to around six degrees of harshness with exactness going from 2 - 6 m/km (about 35%) on the IRI scale. (unpleasantness exactness, communicated either in outright units of m/km or as a rate, will by and large fluctuate with harshness level and surface sort.) Note that except if a legitimate adjustment by connection is utilized with a RTRRMS, it is absolutely impossible to interface the action to the standard scale. In this manner, an un-adjusted RTRRMS falls inside Class 4

7.DESCRIPTION OF METHOD

Class 1 and 2 estimations of the IRI must be acquired from a longitudinal profile of a street. A longitudinal profile is an upward segment along the wheeltrack, which shows the height of the surface as an element of longitudinal distance. The profile is portrayed by the arrangement of rise esteems, dispersed at close stretches along the wheeltrack. To sum up the hundreds or thousands of numbers that comprise a profile, an examination method is played out that ascertains the IRI as a solitary measurement evaluating the unpleasantness. The estimations are typically performed utilizing some type of advanced PC. A programmable pocket mini-computer can likewise be utilized, albeit the calculations are drawn-out and there is a higher potential for blunder. Virtually all microcomputers are reasonable for ascertaining IRI, and proposition the benefits of being modest, promptly accessible, and handily customized. Since the IRI applies to a specific wheelpath along the street, the people liable for estimating the profile ought to have an unmistakable thought of where the wheelpath is situated in the path. At whatever point rehashed measures are to be made utilizing static strategies, the wheelpath ought to be unmistakably set apart out and about surface with the goal that the different measures will be over a similar way. At the point when a high velocity profilometer is utilized in review work, the administrators ought to follow a steady practice for finding the profilometer horizontally in the voyaged path. Most estimations made with fast profilometers are made in either the focal point of the voyaged path, or in the two voyaged wheelpaths. By and large, the outcomes are not comparable besides on new streets and once in a while on Portland concrete cement (PCC) streets.

8. RESULT

8.1 Descriptive Evaluation Method

When Class 1, 2, or 3 methods for measuring roughness are not feasible, estimations of the roughness on the IRI scale can be made subjectively. This approach may be used in the initial stages of a project to develop approximate assessments of the roughness, or in situations where an RTRRMS is not available. The descriptions used can also serve to acquaint the practitioner with the IRI scale, helping to visualize the meaning of the IRI values and the road conditions associated with them.

8.2 Method.

The method provides adjective (and some quantitative) descriptions of the road surface conditions and ride sensations representative for several points on the IRI scale. These descriptions enable an observer traveling in a vehicle, and occasionally stopping to inspect the road, to recognize the conditions and to estimate the roughness. Photographs can be used effectively to support the method, but they can also be misleading because they tend to accentuate visual defects and minimize the shape or profile variations which relate most closely to roughness.

8.3 Description of the IRI scale.

The typical categories of road, surface shape defects, ride sensation, and typical travelling speed associated with each given roughness level. The observer is expected to use all these to make an objective assessment of the roughness of a road while travelling along it. The most objective description relates to the surface shape defects. Which are communicated as a scope of resistances under a 3-m straight-edge; these must be surveyed by common examination. Note that both the portrayals and the related IRI cover scopes of conditions at each level. This is vital on the grounds that the mixes of deformities and severities fluctuate generally, and on the grounds that asphalts at a similar unpleasantness level can have altogether different appearances. The scale in the figures goes from 0 to 24 mlkm IRI, as this is the reach that has been shrouded in the IRRE and in different ventures. The real scale can keep on evening more significant levels, in spite of the fact that unpleasantness is excessively serious to the point that voyaging such streets is inordinately difficult. In depicting benchmark levels of harshness, as done in the two figures, it is useful to utilize the accompanying descriptors:

8.3.1 Typical categories of road.

The roads are first divided into the two categories of paved and unpaved because of characteristic differences between the roughness on these two types. The descriptions further refer to the quality of the shape (i.e., longitudinal profile) which can be expected for each type and quality of construction. They include the quality of shape after construction, and the extent and types of deterioration.

8.3.2 Surface shape defects

Understand that harshness is connected uniquely to vertical changes in the level of the street in the wheel ways of the vehicle, and that the shallow appearance of the surfacing can now and again be misdirecting. Patches in the surfacing, or a coarse surface which brings about noisy tire commotion might misdirect the eyewitness to misjudge harshness. Then again, an imperfection free surface or a new reseal may delude the onlooker to belittle the harshness if the street is exceptionally lopsided. The onlooker should consequently become receptive to vertical surface inconsistencies. The attributes used to portray surface shape are:

- depressions:

dish-shaped hollows in the wheel paths with the surfacing in-place (by corollary, this includes humps of similar dimensions)

- corrugations:

regularly-spaced transverse depressions usually across the full lane width and with wavelengths in the range of 0.7 to 3.0 m (also termed wash boarding)

- potholes:

holes in the surface caused by disintegration and loss of material, with dimensions of more than 250 mm diameter and 50 mm depth.

The size is indicated by the maximum deviation under a 3-m-long straight-edge, e.g., 6-20 mm/3 m, similar to a construction tolerance. The frequency is given by:
"occasional" = 1 to 3 per 50 m in either wheel path
"moderate" = 3 to 5 per 50 m in either wheel path
"frequent" = more than 5 per 50 m in either wheel path

8.4 Travel speed.

This indicates common travelling speeds on dry, straight roads without traffic congestion, with due consideration of care for the vehicle and the comfort of the occupants.

8.5 Calibration

To adjust to the scale, the eyewitness should turn out to be completely acquainted with the remarkable components of each set of depictions above. This could be known as a "alignment by portrayal." The last legitimacy of such an adjustment relies upon how well the depictions are attached to actual provisions of the street surface. Whenever the situation allows, it is a significant acquaintance for the onlooker with be driven over a couple of segments which cover a wide scope of unpleasantness and for which the IRI is known from actual estimations. On the off chance that the vehicle to be utilized for the overview is totally different in wheelbase or suspension qualities from a fair size traveler vehicle car, exceptional consideration ought to be taken to change: the ride depictions utilized. Ideally, this ought to be finished by "alignment" on a couple of truly estimated segments. On the other hand, it tends to be finished by common investigations and cautious. Examination of the shape measures with the descriptors.

8.6 Data processing Riding Quality

Board evaluations of riding quality have been executed in many spots previously. Traveler spectators r a t e the riding nature of street areas on a subjective scale from amazing to exceptionally poor (closed), regularly evaluated on a size of 5 to 0. Generally, this is connected to the Serviceability Index (PSI) fostered a t the AASHO Road Test or a Ride Comfort Index. The PSI scale is restricted in that it was produced for streets of moderately excellent, in contrast with a portion of the less fortunate streets shrouded in the IRRE and delegate of conditions in less created nations. Accordingly the PSI scale, as traditionally utilized in the United States, just covers the low harshness end of the I R I scale. Information relating PSI to IRI and other target harshness measures are scant and conflicting, due to some extent to the various techniques that are utilized by various offices for assessing PSI.

Table 2 PRE-MONSOON 2020

LHS ROUGHNESS SUMMARY				
Chainage (Km)		IRI Average (m/km)	Average BI (mm/km)	Event
Start	End			
0+000	1	2.02	1383.5	FLYOVER
1	2	1.96	1335	VUP
2	3	1.91	1298.33	VUP
3	4	1.84	1247.67	PUP
4	5	1.88	1275	PUP
5	6	1.84	1244	PUP
6	7	1.9	1289	VUP
7	8	1.83	1238.33	PUP
8	9	1.78	1204.67	
9	10	1.92	1306.67	VUP, PUP
10	11	1.85	1254.67	PUP
11	12	1.84	1250.67	PUP
12	13	1.79	1206.67	PUP
13	14	1.92	1310.33	MNB
14	15	1.79	1211	VUP, PUP
15	16	1.83	1238.33	PUP, PUP
16	17	2.01	1375.33	VUP
17	18	1.81	1222.67	PUP
18	19	1.99	1364.33	PUP
19	20	2	1371.67	PUP, VUP
20	21	1.91	1301.33	PUP
21	22			PUP, TOLL PLAZA, VUP
22	23	2	1373	
23	24	1.99	1362	PUP
24	25	2.17	1502.33	VUP, PUP
25	26	2.14	1475.67	PUP, PUP
26	27	1.98	1351	PUP
27	28	1.79	1210.67	VUP, PUP
28	29	1.78	1196.67	PUP
29	30	1.92	1309	PUP
30	31	1.84	1243	PUP
31	32	1.8	1221	PUP
32	33	1.82	1233.33	
33	34	1.98	1353	PUP, VUP
34	35	1.89	1287.67	
35	36	1.85	1257.33	PUP
36	37	2.27	1583	VUP
37	38	2.71	1924	MJB
38	39	2.65	1876	
39	40	2.67	1888.67	VUP
40	41	2.76	1966.33	PUP, VUP
41	42	2.67	1893	PUP
42	43	2.61	1843	
43	44	2.83	2026	VUP, PUP
44	45	2.52	1776.67	
45	46	2.27	1574	PUP
46	47	2.48	1746.33	PUP, VUP
47	48	2.68	1900.67	PUP
48	49	2.51	1769.67	PUP
49	50	2.79	1987.33	
50	51	2.72	1937	PUP
51	52	3.22	2332	PUP, VUP
52	53	2.93	2106.33	MNB
53	54	2.97	2135.33	VUP, VUP
54	55	2.51	1766.33	
55	56	2.54	1791.67	MNB
56	56+200	2.85	2040.67	

9.CONCLUSION

The quadrant as we have seen from the wide range of result of the IRI/RI the class-I category vehicle involving the ROMDAS equipment has been very precise for the output of result in comparison to the other former technologies.

In any ongoing or in finalization of payment of contractor specially in state of Uttar Pradesh viz. in construction of green field Expressway the finalization of agreement is entirely based on pavement surface unevenness report.

The importance of performing this test one feel that client is satisfied either in EPC/ BOT/ HAM/ PPP projects before opening it to for the public usage.

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