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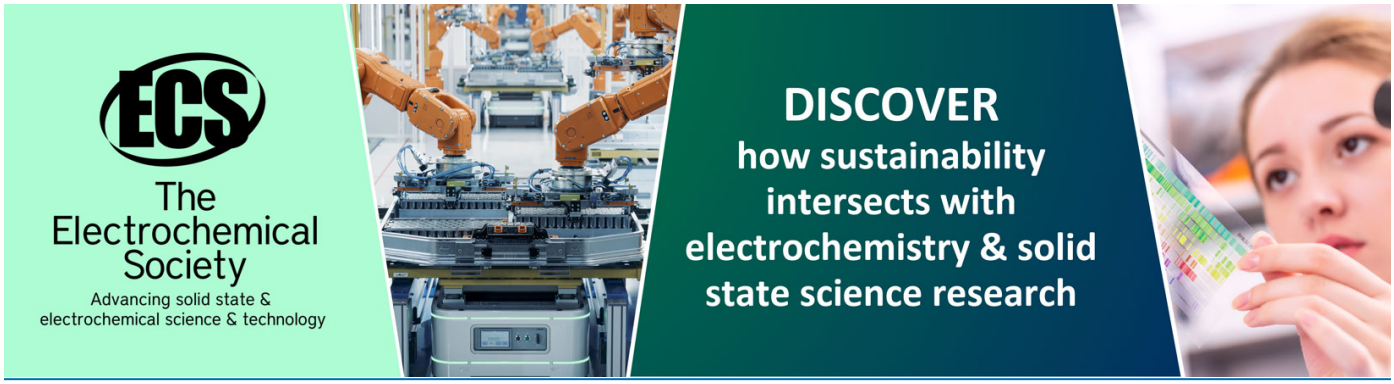

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Priority of road maintenance management based on halda reading range on NAASRA method

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Abstract. The road pavement, constantly experiencing stress-strain due to traffic load through it, can cause damage to the pavement. Therefore, early detection and repair of the damage will be able to prevent more severe damage that can develop into pavement failure. A road condition survey is one of the earliest attempts to detect the initial damage of a pavement. In this case the driving comfort is the most important part for the driver in assessing road conditions that are affected by the level of road surface roughness. To determine the level of roughness of the road, one of the methods developed is the measurement using the NAASRA method. In this method the roughness of the road is an accumulation of the average unevenness of the road, with the general setting on halda of 100 m. However, with this 100-meter setting, in some places the final value of the roughness value is too large or too small so that it will result in the priority of the road maintenance. This is what underlies roughness research by comparing halda settings at 50 m and 200 m different from the general settings above.This study uses the International Roughness Index (IRI) method in determining the level of road stability concerning driving discomfort. IRI score obtained from direct survey in field by using Roughometer-NAASRA.The final result shows that there is a significant difference between the reading of halda which is set at 100 m reading with halda set with 50 and 200 meter readings. This may lead to differences in handling priorities, which may impact on the sustainability of road network maintenance management (Sustainaible Road Management)

1. Introduction

Flexible pavement is a pavement consisting of several layers which become a unified layer which is responsible for carrying the load of vehicles passing over it, and can channel the load from the vehicle properly from the top layer to the underlying layer. As pavement layers, these structures are expected to serve traffic well, safely, and comfortably. But in fact some of the existing roads that can not meet those expectations. Currently, road pavement construction is not only required to serve high traffic and vehicle load, but also to pay attention to convenience (Sukirman, 1999)

Road users generally prefer the flatness or comfort of the road, so it is necessary to check the condition periodically. The inspection is intended to measure the unevenness of the road that can be used in the maintenance planning program or improvement so that service for road users can be improved. To know the level of road flatness, the method that now developed is the measurement of the flatness of the road using the method of NAASRA with Halda 100 m setting.

Based on the above, the background of technical analysis in analyzing the comparison of the value of road surface unevenness based on the NAASRA reading range which generally use the range of 100 m to other different ranges, ie in the range of 50 m and 200 m.

Assessment of pavement conditions is the most important aspect in terms of determining road maintenance and repairs. In order for roads to accommodate the needs of movement with a certain level of service it is necessary to make an effort to maintain the quality of road services, where one of its efforts is to revise the road surface condition. The value of these road conditions will be used as a reference to determine the type of revaluation program that must be done, whether it is an improvement program, regular maintenance, or routine maintenance.

1.1. Flexible Pavement Damage

In general, types of road damage can be divided into two categories:

1.1.1. Structural Damage

Structural damage is damage to the road structure, partly or wholly, causing pavement no longer able to support the traffic load. Therefore, it is necessary to strengthen the structure of the pavement by overlaying or repairing existing pavement layers.

1.1.2. Functional Damage

Functional damage is damage to the road surface which may cause disruption of the road function. This damage can be related to or not with structural damage. In functional damage, the pavement is still able to withstand the working load but does not provide the desired level of comfort and safety. For that the pavement surface layer should be treated for a good back surface.

In principle, the type of functional damage will reduce the level of comfort and safety of road users such as:

- Increases noise due to friction wheels and road surfaces
- Increase the risk of water splashing (water splashing) at the time of wet surface
- Raise the risk of slipping while crossing the bend, when the surface is wet
- Increases the risk of slipping when braking on wet or dry surfaces

Indications that point towards road damage, both functional damage and structural damage can vary that can be seen from the form and process of occurrence. Indications that arise on pavement surfaces may affect the roughness value of the pavement. Broadly speaking, damage to asphalt pavement can be grouped into four incident modes, namely: cracks, surface defects, deformations, and defects at the edge of the pavement

1.2. International Roughness Index (IRI)

International Roughness Index is a parameter used to determine the level of unevenness of the road surface. The Roughness parameter is presented in a scale depicting the unevenness of the pavement surface felt by the rider. The unevenness of the pavement surface is a function of the longitudinal and cross-sectional surface of the road.

The degree of unevenness of the road is one of the functional factors of a highly riding-quality pavement, where the technical indicator for assessing road surface performance is the IUD (International Roughness Index) value, The value of surface roughness is indicated as the cumulative length of the rising surface per unit length. The unevenness of the road surface is considered as a resultant condition of the pavement as a whole. If it is quite flat, then the road is considered good from the lower layer to the top layer of pavement and vice versa, (Hikmat Iskandar 2005).

IRI value is expressed in meters, from cumulative rise and fall of road surface per kilometer road length (m / km). If the value of IRI = 10 m / km, meaning the amount of amplitude (up and down) of the road surface of 10 m in each km of road length. The larger the IRI value, the worse the pavement surface.

1.3. Condition and Stability of the Road

Road conditions are a matter of great concern in determining road maintenance programs. According to the Department of Public Works of Director General of Highways (1992), road conditions can be classified as follows:

- The road with good condition is the road with a completely flat pavement surface, no waves and no surface damage.
- Medium-sized roads are roads with a moderate pavement surface, there are waves but no surface damage.
- Roads with lightly damaged conditions are roads with pavement surfaces beginning to wavy, there is surface damage and patching (less than 20% of the road area under review).
- Roads with heavily damaged conditions are roads with heavily damaged surfaces such as wavy, crocodile cracks, and large chips (20-60% of the roads under consideration) accompanied by damage to layers of foundation such as ambulances, sungkur and etc.

The definition of each term stability path is as follows:

- Steady Road Construction is a road with construction conditions inside a steady corridor which for handling only requires maintenance activities. The steady construction path set by Minimum Service Standards is a road in good and medium condition, where in this study used a limit of IRI <8 m / km.
- Unstable roads are roads with conditions outside the steady corridor which for minimum handling is the periodic maintenance and maximum upgrading of the road with the aim of adding value to the construction structure.

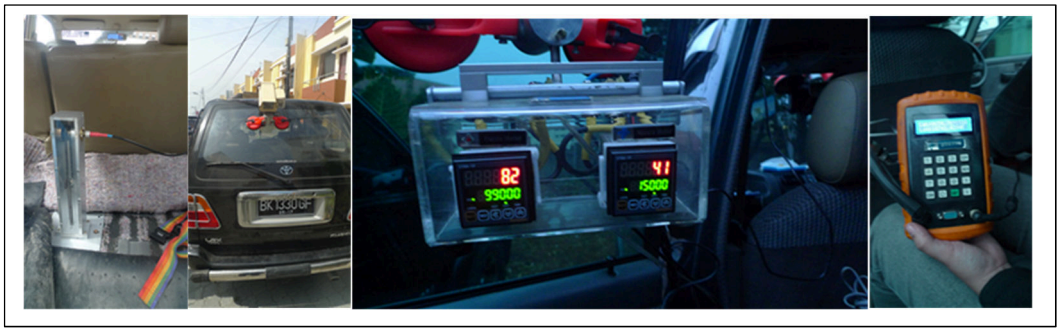
The Directorate General of Highways uses the International Roughness Index (IRI) parameter in determining the condition of road construction, which is divided into four groups. Below is shown Table 2 determining road condition conditions and handling requirements:

Table 1. Determination of roads condition and handling needs.

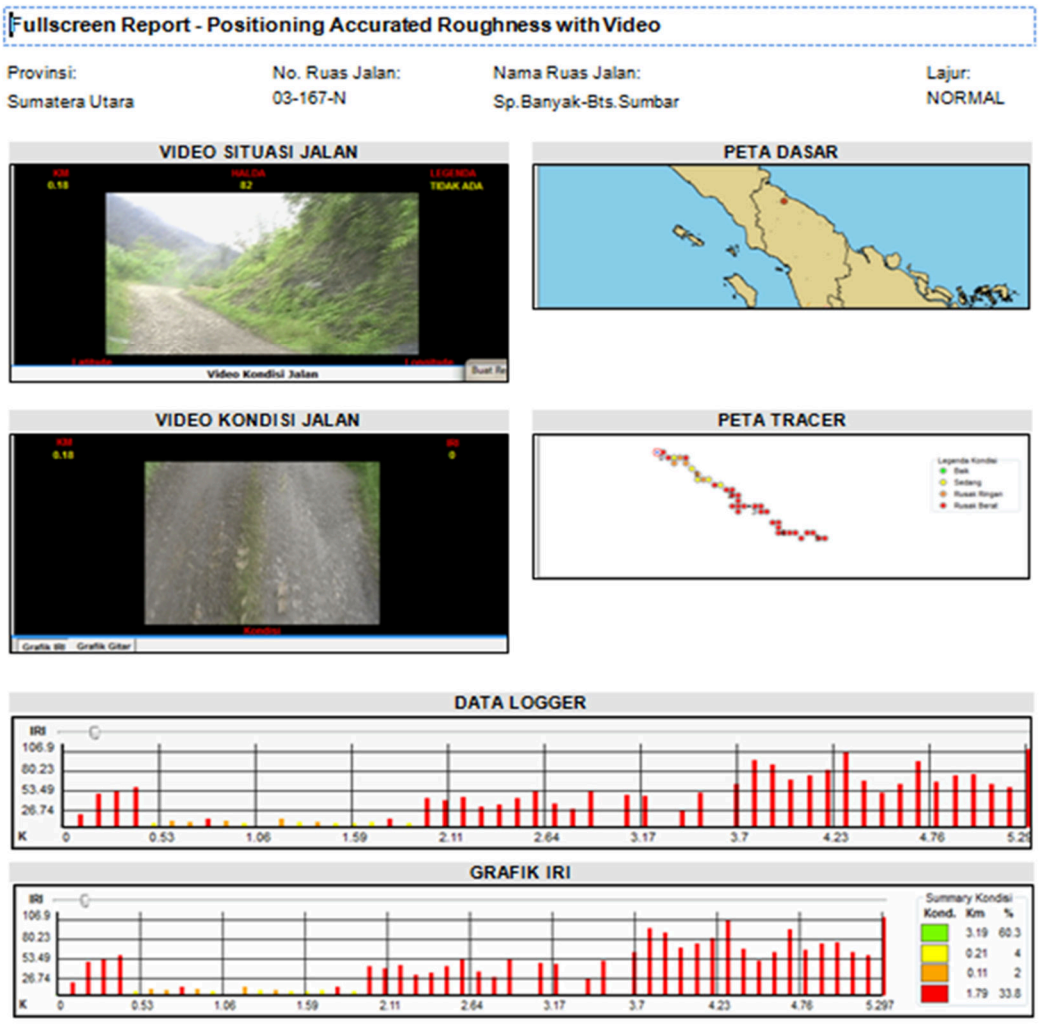
Road Condition	IRI (m/km)	Maintenance Program	Stability Term
Good	IRI avg. ≤ 4,0	Routine	Steady/Stable
Fair	4,1 ≤ IRI avg. ≤ 8,0	Periodic	Steady/Stable
Slightly damaged	8,1 ≤ IRI avg ≤ 12	Upgrading	Unsteady
Heavily damaged	IRI avg. > 12	Upgrading	Unsteady

2. Methodology

This study took a study on three national road segments in North Sumatra province with direct observation in the field (field survey), namely: Parapat - Tapanuli Utara regency borderline (10,000 km), Simalungun regency borderline - Silimbat Regency (34,000 km) and Silimbat –Tapanuli Utara regency borderline (11,000 km) so the total length of the roads under consideration is 55,000 km. Car and survey equipment used in this study can be seen in the picture below.



Picture 1. Car and survey equipment for roughness survey



Picture 2. Data acquisition, monitoring and presentation

3. Analysis and Discussion

From the data obtained, it can be seen in Table 2 that in the Halda 50 meter setting for the three national road segments, the length of the road segment with good condition is greater than the Halda setting at 100 and 200 meters, this is indicated by the length of the survey road Along 1200 m, 1600 m and 350 m.

However, in moderate, lightly damaged, and heavily damaged, there are variations that are not dominated in the halda settings, such as for road number 066. The length of the road with medium

road conditions will be produced by Halda 200 along 7800 m, followed by Halda 50 Along 6500 m, and last Halda 100 along 5300 m. This variation is also available for national roads 067 and 068.

The magnitude of the value of unevenness of the road under consideration is influenced by the value of NAASRA obtained at the time of the survey, where the greater the value of NAASRA produced, the greater the unevenness (IRI) of the road which will result in the condition of the road being damaged lightly and heavily damaged longer.

Table 2. Length of road based on physical condition of pavement

No Segment	Halda Setting	Road Length	Road Condition							
			Good (meter)	(%)	Fair (meter)	(%)	Slightly damaged (meter)	(%)	Heavily Damaged (meter)	(%)
066	Halda 50	10 Km	1200	12%	6500	65%	1650	16.50%	650	6.50%
	Halda 100		300	3%	5300	53%	3100	31%	1300	13%
	Halda 200		-	0%	7800	78%	2000	20%	200	2%
067	Halda 50	34 Km	1600	4.76%	24900	73.24%	5700	17%	1800	5%
	Halda 100		200	0.60%	25500	75%	7000	20.60%	1300	3.80%
	Halda 200		-	0%	28000	82.35%	4800	14.12%	1200	3.53%
068	Halda 50	11 Km	350	3.18%	5900	53.64%	4100	37.27%	650	5.91%
	Halda 100		200	1.20%	6800	61.80%	2900	27%	1100	10%
	Halda 200		-	0%	6000	54.55%	4400	40%	600	5.45%

Factors that cause NAASRA value to increase is; Quantity and location of the increasingly widespread type of asphalt damage, where in the absence of serious handling the level of quality of the road will decrease drastically, caused by daily traffic that weighs on national roads, which tend to be bypassed by heavy vehicles. This happens because the national road is the connecting road between the provincial capital that serves in fulfilling the need for goods and services for each region.

The basic thing that distinguishes the reading of this halda is the distance setting, which with a smaller distance then the quantity of asphalt damage that is covered will decrease, causing the acquisition of IRI value tends to decrease.

To achieve road conditions with smaller IRI values, the Halda settings that should be used are smaller because they will result in a more dominant stability (as seen on the 066 & 067 segments). This also can also be obtained with Halda 200 settings, but in providing good road conditions this Halda setting does not give results. Stability of road obtained solely only from the results of “fair” road conditions (Table 3).

Table 3. Percentage of road with stable/unstable condition

No Segment	Halda Setting	Road Length	Value of Road Stability/Stadyness			
			Stable		Unstable	
066	Halda 50	10 Km	77%	7700 m	23%	2300 m
	Halda 100		56%	5600 m	44%	4400 m
	Halda 200		78%	7800 m	22%	2200 m
067	Halda 50	34 Km	78%	26500 m	22%	7500 m
	Halda 100		75.6%	25700 m	24.4%	8300 m
	Halda 200		82.35%	28000 m	17.65%	6000 m
068	Halda 50	11 Km	56.82%	6250 m	43.18%	4750 m
	Halda 100		63%	7000 m	37%	4000 m
	Halda 200		54.55%	6000 m	45.45%	5000 m

From the above exposure was obtained an initial conclusion that the 50-meter Halda setting tends to be better than the Halda 200 meter setting. With the results of the steadiness obtained from both types of Halda settings, then the handling provided will be lower because the results obtained. This is in contrast to the Halda 100 setting process, which results in greater road inconsistency conditions, when viewed from the results then this setting will require extra handling compared to both 50 and 200 meter settings.

4. Result

To get better result that is relatively small value of IRI, hence setting halda 50 will be better use. But with a better level then the sensitivity of road handling will tend to be reduced. This is in contrast to the 100 meter halda setting which will result in IRI values that tend to be larger, but with the results obtained then the priority level of road handling will be much more to do.

With respect to the above conclusions, it can be concluded that the level of precision of road conditions is obtained from halda readings per 50 meters, but in terms of maintaining a sustainble road network maintenance program, maintenance programs based on road stability require early maintenance in order to keep more roads Which has steady conditions

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