A SIMPLE PAVEMENT MARKING MANAGEMENT SYSTEM APPICABLE TO SRI LANKAN HIGHWAY NETWORK

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Introduction

Pavement markings are very important highway asset group for road users, both drivers and pedestrians to enhance safety, efficiency and effectiveness of the roadway system. But, those pavement markings are deteriorated in stripping and fading due to various environment factors such as traffic, temperature, rain fall, etc. with reducing their effectiveness. Therefore, proper mechanism is essential to manage and maintain the pavement markings at due time period.

However, no proper mechanism is available to manage and maintain the pavement markings in Sri Lanka. In that context, this research was aimed to invent simple, but logical and efficient methodology to evaluate the appropriate repainting time of the pedestrian crossings.

Past researches had used retro-reflectometer, spectrophotometer, film thickness gauge, etc. for measuring amount of deterioration of pavement markings(1,2,3). But those methods are difficult to use in a country like Sri Lanka due to heavy expenditure. Therefore, this research introduces novel method to estimate the deterioration using computer based program.

Materials and Methodology

The methodology of this research consists of selecting a sample of pedestrian crossing, collecting data, define deterioration index, model development, define critical deterioration index and create pavement marking management system.

It was assumed that stripping is caused by mainly traffic and rain fall while fading is occurred due to temperature (sun light) and rain fall. Therefore, Average Daily Traffic (ADT), Annual Average Monthly Temperature (AAMT), Annual Average Monthly Rainfall (AAMR) and Last Painting Month (LPM) were selected as the parameters in data collection. Hence, different geographical areas have to be considered for sampling in order to obtain a variation among deterioration amount, age, traffic, temperature and rainfall condition.

Usually, the pavement surface is exposed at the pedestrian crossing's strips due to deterioration. This is one of the dominant parameter in the case of deterioration of pavement marking. If any instrument can detect how much pavement surface is exposed through certain strip, it can be used as a measurement for deterioration. In that sense, deterioration index method was

introduced and above concept was the basis behind this methodology.

Besides, method is based on computer program. In that, photographs of pedestrian crossings are taken from both sides of the road and pedestrian crossing strips are separated from photograph using crop option on image editing software such as Adobe Photoshop.

A computer program was created using image processing option on programming software of Visual Studio 2008. The certain separated strip has mainly two colors as yellow and non-yellow. The program detects every pixel in strip's photograph and captures the values of Red, Green and Blue (RGB) in each pixel. An equation was developed using RGB values as independent variable in program. Therefore, every pixel in separated strips must have finite value base on its RGB content. This equation was rearranged using trail and error method accordingly to give acceptable gap between those two colors. Using this gap, it was assigned range for yellow color. Then, program itself compares the value of the equation with this range and finds proportion of area with respect to each color. After that, program gives the percentage of non-yellowed area to entire area as an output. This percentage value is defined as **Deterioration Index (DI)**.

Regression analysis had been done using Mini-tab 11.0 to obtain satisfactory model relationship among

$DI = 1.8 - 3.92*10^{-8}*$

Where,

DI, Age in month, ADT, AAMT in ^0C and AAMR in mm.

The deterioration index between good and bad performance of pedestrian crossing is defined as the Critical Deterioration Index (CDI). Then, survey was carried out to find CDI using model photographs which contained different DI values. Both these modeled relationship and CDI were incorporated in to system for obtaining pedestrian crossing marking management system.

Results

The model relationship was obtained from regression analysis and it was done manually using different combination of parameters. The following equation 1 shows the better relationship between DI and other variable (R^2=94.8). Variation of the model equations values and actual values are closed to 45^0 line as shown in fig. 1.

Therefore, above regression equation can be used as model equation to estimate deterioration of pedestrian crossing.

The Critical Deterioration Index (CDI) was obtained from analyzing survey details and resulting CDI value is 55 when 85% of people can be seen well. Once the model equation was developed, Next Painting Month (NPM) can be found using CDI. The period in between LPM and NPM is defined as Safe Usage Time (SUT) of certain pedestrian crossing.

$C+0.682*Age+1.02*10^{-10}*C*Age^2$ (1)

$C = ADT*AAMT*AAMR$

SUT can be estimated using equation 1 by substituting CDI instead of DI. By introducing warning time period, the authorities were given the sufficient time to arrange the repainting activity. Finally develop statistical model is incorporated to a system to obtain a pedestrian crossing marking management system.

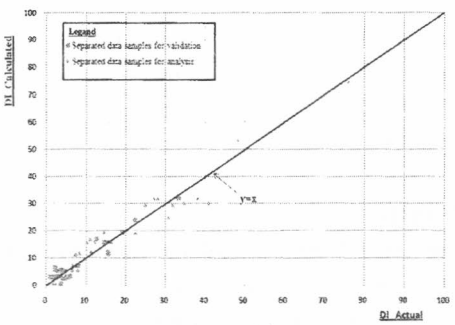

Figure 4.3: Variation of Calculated DI with Actual DI

Fig.1. Variation of calculated DI with actual DI

Discussion

The method used to measure deterioration in this research is very simple, economical and user-friendly. Therefore, this method can easily use anywhere to assess the pavement marking. When comparing actual **DI** values and predicted **DI** values, it is clear that the model equation has adequate accuracy for 67 number of data set. Thus, the model equation can be used to create the pedestrian crossing marking management system for Sri Lankan road network. Furthermore, it will be more accurate, if a higher number of data set is used. Since the model equation was developed using samples of inland area, system may have less accuracy for the coastal areas. Therefore, it is suggested that the system is only suitable for inland areas. Moreover, if the research is extended considering coastal influential factors, the model can be generalized to valid for the Whole Island.

Even though the critical visibility was not affected to model equation, it is affected to the system when calculating safe usage time in pedestrian crossing. But, the given **CDI** from survey is not given higher accuracy value with actual **CDI**, since human may have tendency to give wrong answer in such a survey. Therefore need the sophisticate method to find **CDI**, even it was not affected to model development.

References

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