International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Analysis of Traffic for the Development of Existing Pavement Conditions - A Review

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Abstract: ***Roads are constructed to perform a service to the road user. In this context, the road needs to provide good traffic ability/possibility under all weather conditions with maximum comfort and at minimum cost and with the highest possible degree of safety. This is defined as the functional performance of the road. The functional performance includes aspects such as the riding quality, the skid resistance and the effective drainage of water from the pavement. The concepts of analysis period and design period require careful consideration during the pavement design phase. The analysis period is a planning period during which full reconstruction of the pavement is undesirable and is a function of the road category but is also frequently related to the roads' geometric life.***

Keywords: Analysis period, Design period, Functional performance

1. Introduction

All roads are designed with a finite life, usually defined by the traffic that the road can carry in terms of the cumulative number of equivalent standard axles. Once this design traffic has been carried, or as a result of premature distress caused by some environmental influence, the road usually needs to be rehabilitated. Prior to any rehabilitation design being carried out, it is necessary to fully assess and evaluate the condition of the road pavement and to identify the reasons for the distress. The time and resources required for these types of investigation are generally limited and costly and thus it is essential that the appropriate information be gathered and that it is presented in a systematic and complete manner.

Traffic flow pattern appears to be random in distribution, as it reflects people's motivation in terms of different composition of vehicles on different types of roads under varying environmental conditions.

The concepts of analysis period and design period require careful consideration during the pavement design phase. The analysis period is a planning period during which full reconstruction of the pavement is undesirable and is a function of the road category but is also frequently related to the roads' geometric life. Where the traffic situation on a road is likely to change considerably in the short term, a short analysis period will be used.

A. Typical pavement structures

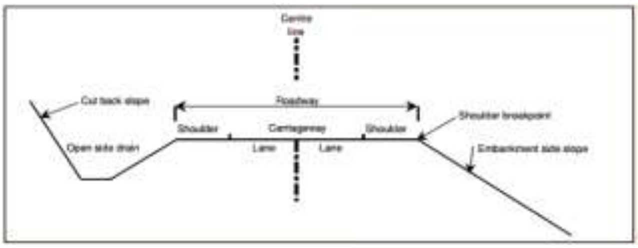

Figure 1: Cross section terms

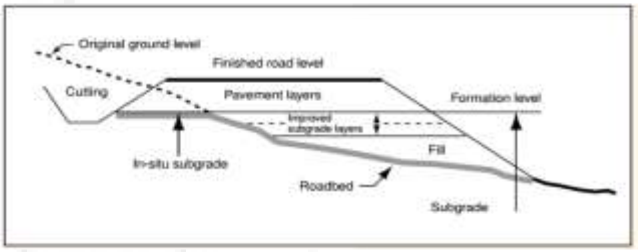

Figure 2: Cross section elements

B. Types of pavement distress

The structural failure of a pavement is usually manifested as rutting, cracking, ravelling and/or shear failure in the pavement. The process is often self-perpetuating in that the development of distress allows the ingress of water into the pavement exacerbating the conditions that may have initially led to the cracking.

The typical distress types associated with functional and structural performance are given as

Table 1: Typical distress types associated with performance

Performance	*Distress type*
Functional	1.Riding quality 2.Skid resistance 3.Surface drainage
Structural	1.Deformation 2.Cracking 3.Surface disintegration

C. Deformation

Deformation often results from subgrade and construction deficiencies and is frequently associated with culverts and embankments. Other typical forms of deformation include depressions and mounds, displacements, corrugations and undulations, all manifested as deviations of the road surface from a uniform flat condition and having a detrimental effect on the riding quality.

D. Cracking

Different forms of cracking can be due to different fundamental causes, so it is vital in the visual evaluation to identify the types of cracking.

1) Crocodile and Map cracking
2) Block cracking
3) Longitudinal cracking
4) Transverse cracking

E. Potholes and patching

Potholes are the result of loss of material from the base course once the surfacing has failed. Potholes are typically the result of pumping and loss of surfacing attributable to lack of maintenance. Potholes are distinguished from ravelling by being more than 150 mm in diameter and greater than 25 mm in depth.

F. Moisture & drainage

Excessive moisture in the pavement structure is generally the result of inadequate side-drainage, poor shoulders, unmaintained surface seals or a combination of these. High moisture contents in the pavement materials result in a decrease in the material strength and stiffness as well as the development of excess pore-water pressures under load. Both of these conditions can result in shear failure of the material at stresses lower than those designed for.

2. Planning and Selection of Appropriate Analysis

Prior to embarking on any pavement evaluation it is essential to understand the objective of the evaluation and to make use of evaluation techniques that will best achieve this objective.

1) Evaluation of experimental road sections
2) Failure investigations
3) Post-construction pavement audits.

A. Information Required

1) The original design
2) As-built records or completion data
3) Traffic information
4) Maintenance records
5) Data in the Road Management System.

B. Evaluation framework

As-built, historical, visual, and rutting and roughness data fulfil the minimum need. These are usually the data types in a road management system (RMS) that first identifies a possible need for a more comprehensive evaluation.

Initial assessment

The initial assessment will usually be based on an evaluation of significant changes in routine RMS survey data (e.g. visual distress, riding quality and rut depth) indicating onset of pavement deterioration.

Detailed assessment

The more detailed assessment will invariably include a comprehensive visual survey, rut depth measurements, a deflection survey, a Dynamic Cone Penetrometer (DCP) survey and test pitting and sampling.

C. Test frequency

Testing and sample collection is the most costly component of the field evaluation. It is essential to develop the pavement evaluation programme to obtain all the information necessary to carry out the rehabilitation design.

1) Roughness measurement
2) Pavement strength
3) Dynamic cone penetrometer (DCP)
4) Test pit profiling and sampling

Once all the field and laboratory data have been gathered, they should be compiled into a format that the rehabilitation design engineer can use with both confidence and minimal referral to the pavement evaluators. The data should be verified, validated and then presented in the required or a standard format.

3. Results and Discussion

A. Parameters obtained from analyses

Once the parameters have been tabulated, relevant ones can be compared with standard criteria for defining the need for any improvement or upgrading.

B. Sensitivity analyses

It is recommended that pavement analyses and rehabilitation designs should be based on a number of methods using a range of appropriate parameter values. The parameter values should reflect conditions that are expected to apply to seasons other than that during which field-testing was carried out (particularly if field work was carried out in a dry season). The reliability of parameters such as traffic and E-moduli should also be considered.

4. Conclusion

A through assessment of structural adequacy makes use of the following key evaluation activities.

1) Evaluations of the current types, severities, and extends of load related distresses and their progression overtime.
2) Evaluation of in situ materials samples via coring, removal of small section of pavements, visual examinations, and testing.
3) Analysis of pavement response to loading characteristics, as generated by deflection testing.
4) Estimating damage to the existing pavement structure and, thus the remaining life of the pavement.

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