CE 780A: Laboratory Course in Transportation Engineering (Semester: 2019-2020 II)
Lecture Notes

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Experiment 10: Estimation of Road Roughness Index

Reading Materials:
1) "*Pavement Roughness*", Section 14.3.1, from the reference book Principles of Transportation Engineering (Chakroborty & Das, 2018).
2) ASTM E1926 – 08: *Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements* (ASTM, 2015).
3) Sayers, M. W. (1995). On the Calculation of International Roughness Index from Longitudinal Road Profile. *Transportation Research Record, 1501*, 1-12.

Introduction

Road roughness is a critical parameter to determine rider quality and evaluating the road condition. Different indices have been developed to measure road roughness for a given longitudinal road profile. These include International Roughness Index (IRI), Present Serviceability Index (PSI), Profile Index (PI), etc. IRI is one of the most popular indices to measure road roughness developed by the World Bank in 1986, which is based on a quarter-car simulation model. Details of the methodology to calculate IRI based on the longitudinal profile of the road can be obtained from (Sayers, 1995).

This experiment involves determination of the longitudinal road profile of a given road segment using a profilograph, developed by the Central Road Research Institute (CRRI), shown in Figure 1. It comprises of a mobile trussed frame, four datum wheels which provide the plan of reference with respect to which the instrument, moves along the pavement surface during the test. The probing wheel undulates with the surface irregularities and the pen marker linked to probing wheel records the magnitude of the undulation on a graph sheet. The road roughness level is estimated using this equipment.

Figure 1. Profilograph used in the experiment

To obtain the road profile, horizontal and vertical calibration is required first. Vertical calibration can be done using wooden planks. Take at least 5 to 6 wooden planks of different heights. Place these planks at a uniform distance (say, 10 m on a smooth plane) and the corresponding undulation peaks can be recorded by the profilograph. The vertical calibration factor can be calculated using the known height of planks and the corresponding peak undulations observed in the profilograph.

Horizontal calibration can be done by marking points at a fixed interval (say 5 m) on the road stretch where the experiment is to be performed. When the profilometer passes over these points, it is noted on the graph. The corresponding distances recorded on graph for each 5 m interval can be used to calculate the horizontal calibration factor using least squares method.

Methodology

The experiment is performed in a 300-meter long stretch of a road (typically done in the NCC road in IIT Academic Area). A straight line is first marked on the road using ranging road, measuring tape, and line. Once the line is drawn, the profilograph is placed at the starting point and the test wheel is lowered to touch the starting point. The plotting arm is then aligned to the graph paper, linked to the probing wheel. The profilograph is then pulled at a low speed (typically 4-5 km/hr) along the line marked on the road. The corresponding reading for every 10 m interval is marked on the graph paper. These readings of profilograph at 10m interval is then used for horizontal calibration purpose. The vertical readings obtained at every 1 cm interval of the horizontal distance covered in the graph is then used to obtain the road roughness index, IRI, using the software ProVAL. (ProVAL, 2016). It uses the quarter-car model with the golden car parameters, as specified in the ASTM standards (ASTM, 2015). Determine the condition of the road using the IRI value obtained and discuss shortcomings, if any, in the methodology used to determine the road roughness in this experiment.

Bibliography

ASTM. (2015). *ASTM E1926 − 08: Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements.* PA, USA: ASTM International.

Chakroborty, P., & Das, A. (2018). *Principles of Transportation Engineering (Second Edition).* New Delhi: PHI Learning Private Limited.

ProVAL. (2016). Profile Viewing and Analysis Software (ProVal) User's Guide. Austin, Texas, USA: The Transtec Group.

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