

P 1. MEASUREMENT OF PAVEMENT ROUGHNESS IN ALBANIA ROAD NETWORK USING DIFFERENT EQUIPMENT

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ABSTRACT: The Albanian Road Authority (ARA), is an independent, public institution in Albania, whose purpose is to construct and maintain roads network. It belongs to the Ministry of Infrastructure and Energy and is the legal owner of the roads and has the authority to execute the construction of infrastructures on demand from the ministry. The national road network in Albania is 3945 km length. Based on the data provided by ARA, a segment of 1332 km is under the maintenance by WB project, and rest under the responsibility of ARA. All roughness data collected based on IRI (The International Roughness Index) but different equipment and application are used to evaluate pavement quality for the national roads network. This poster aims to assess the different equipment used on pavement data collection conditions and to make a comparison between them. All equipment has been used in recent years in some of the national road maintenance projects funded by the World Bank and ARA. Based on pavement roughness data collection verification through field survey and desk review, for all used equipment is confirmed that one of them fulfils all conditions without the need of buying other equipment.

Keywords: *Data collection equipment, comparison, roughness.*

1. INTRODUCTION

A large number of documents have been used to conduct this study. These documents belong to a long time from the years 2000 to 2020. The reviewed documents include various reports, contracts, and materials produced by both the client and the contractors. These contracts are part of various Albanian road network maintenance projects during these 20 years. The projects are funded by various donors and the Albanian government and are supervised by prestigious companies and studios in the field of road maintenance. The fact that different devices have been used in these projects for the same purpose is also the purpose of this study. This paper examines all the equipment used over the years for the maintenance of the Albanian road network, bringing a clear panorama of the possibility for the use and selection of the best of them.

2. MATERIAL AND METHOD

This paper focuses only on the comparison of different equipment that bases on a survey of pavement condition by the use of the International Roughness Index (IRI) (Sayers, M.W.; Karamihas, S.M. , 1998) (Christopher R. Bennett, et al., 2007). This equipment (Dynatest RSP 5051 MkIII, MiniROMDAS, PaveProf-V2, RoadLab_Pro) is used in the pavement data collection in several important projects in Albania for about 20 years. The results are compared to provide some recommendations and evaluations on the use and quality of equipment used in the quality of the pavement data collection.

Equipment descriptions

The equipment and applications used in this study are Dynatest RSP 5051 MkIII, MiniROMDAS, PaveProf-V2, RoadLab_Pro.

The Dynatest RSP 5051 Mk-III Road Surface Profilometer measures several indices and characteristics including the longitudinal profile, International Roughness Index (IRI), transverse profile, rutting, macrotexture, and geometrics (cross fall, gradient, and radius of curvature). The RSP has a unique "Stop & Go" functionality enabling the equipment to operate efficiently in urban areas, at traffic lights, stop signs, junctions and roundabouts, making it an ideal tool for data collection on both urban and rural networks. Dynatest RSP 5051 Mk III consists of a Windows-based control program installed on a laptop PC A Data Processing Unit (consisting of a single board computer and three lasers,

two accelerometers, and one camera (Anonymous, 2020 e). It used to collect road data on the entire Albanian road network by ARA. The equipment in 2009 updated by Dynatest experts.

Currently, the equipment is owned by ARSH. It is not used for the simple reason that the vehicle in which it is installed is intended only for this device and has a defect that has not yet been repaired. This has made it possible for ARA not to use it. At the same time, the staff trained for their use is no longer part of ARA.



Figure 6. Dynatest RSP 5051 Mk III

MiniROMDAS has been developed as a cost-effective and modular system designed to collect road and pavement data using any vehicle (Anonymous, 2014 a).

The MiniROMDAS equipment system is divided into three parts, as follows: 1. Z 250 Reference profiler, 2. Odometer 3. Roughness meter. The system needs to be calibrated before performing the data collection. To calibrate the roughness meter in ROMDAS systems normally are used two types of data. Those are bump integrator reading and roughness value, using the Z-250 reference profiler. Reference profile surveys are generally done for calibrating or validating a roughness measurement system (e.g. the ROMDAS bump integrator) (Anonymous, 2020 f) Z-250 reference profiler recommended to calibrated at the beginning in office, while odometer and roughness meter calibration must be carried out in the certified service of the company that purchased the device. Z250 is a Class 1 device (Christopher R. Bennett, et al., 2007) that collects high-accuracy profiles to calculate road roughness (IRI). MiniROMDAS was used to Monitoring and Supervision of the Four Output and Performance-Based Road Maintenance Contracts in Albania, which was a Pilot Project Funded by the Government of Albania and the World Bank for about 385 km data collection in Tirana, Kukes and Tropoja Districts in years 2009. Currently, the equipment is owned by ARSH but the staff trained for their use is not part of ARA



Figure 7. Z 250 Reference profiler

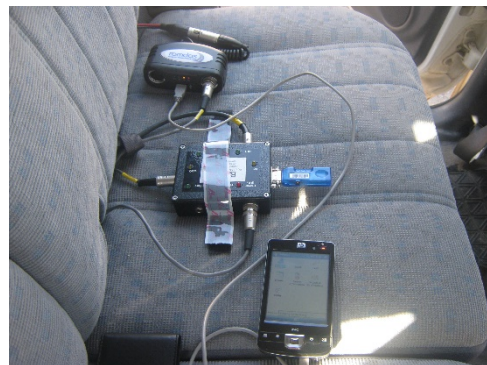


Figure 8. Assemble the MiniROMDAS

PaveProf V2 is a modular system that uses laser sensors to measure pavement profiles for applications such as highways and runways. It measures surface roughness, at highways speeds, and to international standards. The inherent flexibility, accuracy, and reliability of PaveProf V2, helps to deliver improved highway and runway surfaces and reduces the risk of accidents which can result from poor surface conditions (Anonymous, 2019 d). PaveProf V2 is a single laser and accelerometer system

used to collect road data on the Albanian road network in the frame of the World Bank Project Results Based Road Maintenance and Safety Project (RRMSP) on data collection in along the most of national road network. The objectives of the Results-Based Road Maintenance and Safety Project for Albania are to: (a) maintain the condition and improve the safety of the Borrower's primary road and primary-secondary road networks, and (b) strengthen sustainable and efficient road asset management and safety practices, for the benefit of road users (World Bank, 2015) .

The PaveProf-V2 used to collect road data on the Albanian road network has been installed and calibrated directly by the manufacturer. Production company representatives have trained staff on data collection and processing. With the completion of the project in December 2021, the equipment becomes the property of ARA, which should take measures to train its staff.



Figure 9. PaveProf-V2

RoadLab_Pro, which is designed as a data collection tool for an engineer by the World Bank in collaboration with Beldor Center, SoftTeco, and Progress Analytics LLC. (<http://progressana.com>). The RoadLab_Pro app estimates the road roughness based on kinematic and GPS sensors in Smartphones. To use the app, the mobile device has to be placed on a stable surface, preferably mounted vertically and tightly to the vehicle windshield (Anonymous, 2016 b). With accelerometers on smartphones, this app evaluates road conditions, map road networks, detects major road bumps, and reports road safety hazards. Users can even upload a picture of potholes, black spots, or road accidents, etc. with a simple tag.

No training needed is required for running this app. All data collected can be emailed to the user address or uploaded to the Dropbox account when Wi-Fi is available.

“Technical Assistance for monitoring, communication and visibility of Transport Sector with Focus on Roads” (Anonymous, 2016 c) and “Regional and Local Roads Connectivity” (World Bank, 2018) are two Projects that used RoadLab_Pro on data collection of about 1500 km entire Albania national road network for both projects on years 2018-2019.

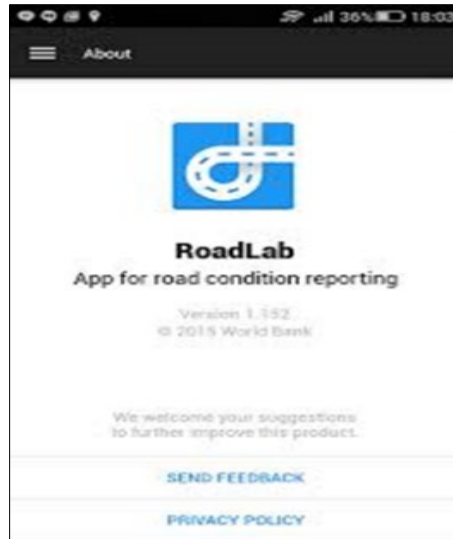


Figure 10. RoadLab_Pro

3. RESEARCH FINDINGS

There are many technologies for collecting data on the road. These range from low cost to high cost, and from very accurate measurements to approximations. The challenge is to choose the right technology given the needs of the data and the environment in which it will be used. The experience gained during this study makes clear some of the parameters that should be considered in the selection of equipment for data collection. In this paper, it is observed that different types of equipment collect data in different ways and with different qualities. The experience gained during this study makes clear some of the parameters that should be considered in the selection of equipment for data collection. In this paper, it is observed that different types of equipment collect data in different ways and with different qualities. Base on my experience and characteristics of each equipment, Table 1, represent details and scale levels for all of the equipment.

Table 3. Current state and characteristics of equipment

Issues	RSP 5051 Mk III	Mini ROMDAS	PaveProf-V2	RoadLab_Pro
Digital DMI	Yes	Yes	Yes	Yes
GPS	Yes	No	Yes	Yes
Video	Yes	No	No	No
WB Class	Class I	Class III	Class I	NA
IRI (data collected by)	3 lasers	Bump Integrator	1 laser	Bump Integrator
Data/ Speed	"Stop & Go"	10-100 km	7-115 km/h	> 15 km/h
Section length	10-100 m	only 100 m	10-100 m	only 100 m
Export data	5	5	5	5
Data format	xls; xlsb; erd; pro; dot; jpg	mdb	csv or erd	kmz, xlsx
Assembly/Installation	2	3	2	5
Operation & Maintenance	5	4	5	5
Calibration	2	3	2	No need
Data /Processing	5	4	5	5
Training needed	Yes	Yes	Yes	No
Availability today	use by ARA	NA	Use by contractor	Free

Scale Level
1. Very Difficult
2. Difficult
3. Moderate
4. Easy
5. Very Easy

4. CONCLUSIONS AND DISCUSSION

Regarding Assembly and Installation, Calibration, Operating Staff, Training, Data Collection Speed, Survey Reference Equipment, Maintenance, Cost of Equipment, and Comparability among them, it is up to managers to select which of the equipment response to the demands and needs of their road management systems. The decision to select the right equipment for road data collection is not only about the economic opportunity or quality of data collection but also with the vision of the manager

regarding the Road Assets Management System. In terms of what needs to be collected, roughness (IRI) is one of the key attributes used for road management and its quality is very important. If the data collected is complemented by Video- logging, managers can make sensible investment decisions. Based on pavement roughness data collection, verification through field survey and desk review, only for RSP 5051 Mark III is confirmed satisfactory level compliance with others used equipment. ARA needs to training staff and certifies them. The RSP 5051 Mark III equipment has been mounted in a vehicle that has been imported specifically for this purpose. ARA must maintenance and provide parts for this vehicle.

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