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Road quality service levels
and innovations to meet user expectations

Main Author:
- Prof. Dr. Eng. Eduardo E. Díaz García
  Telf: (53 7) 45 19 60
  E-mail: epot3@ceniai.inf.cu

Co-authors:
- Prof. Dr. Eng Luis Pérez Cid
- Prof. Dr. Eng. Luis E. Serrano Rodríguez
- Prof. Dr. Eng. Wigberto Sánchez González
- Eng. Emilia Fernández Sagol
- Eng. Francisco L. Marín González

Republic of CUBA

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SUMMARY

Studies and researches were initiated in 1986 in order to establish a suitable method of measuring the Service Quality of our roads.

The final results of the studies, which lasted over two years, were the following:

A. Design, national fabrication and the setting of simple and low cost measuring equipment (3) which were:

No.	Equipment	Type of measurement
1	Portable Pendulum (Diva)	Skip Resistance
2	Portable Texture	Frame Macro Texture
3	Ruler (3m)	Surface Regularity

B. Determination of the limit values of the parameters of the Service Quality selected and adjusted to the characteristics of locally fabricated equipment were:

Parameter of Quality	Limit Values
Coefficient of Skid Resistance (CFD)	≥ 0.33
Macro Texture	≥ 0.30 mm
International Index of Regularity (IRI)	≤ 4m/Km

C. Determination of the formula for calculating the Index of Security-Comfort was as follows:

$$ISC = 0.45E + 0.40D + 0.15G \qquad \text{(Formula 1)}$$

whereby:

E: Operational velocity Km/h
D: The values measured from CFD and from the Macro Texture, mm.
G: The results of longitudinal Surface Regularity, m/Km.

Based on this method, 300 Km of the National Interest Road Network was assessed in 1996 with the results indicating a low level of the Service Quality.

The economy, simplicity, accuracy and reliability of the result obtained from this method allow us to recommend its use in developing countries. In these cases we are capable of supplying more detail information by means of technical exchange or transfer of technology.

1. Preliminary data

Cuba does not have sufficient funds to keep in good operating condition its 17731 Km rural road network. Despite the low level of traffic circulation the number of deaths caused through road accidents in the year 2001 was 1061 persons, which represents an index of 7.0 deaths/10^8 vehicles-Km.

The frequency of road accidents in Cuba constitutes a quarter of the causes of deaths and is the primary cause of accidental deaths. In developed countries this index of deaths fluctuates between 1.0 – 2.0.

The scarcity of financial resources has not allowed Cuba to import measuring equipment for the Surface Characteristics of Roads (modern and costly) intended to determine the level of the Service Quality of our road network. These measurements are essential in the determination of corrective measures to be applied in roads in order to reduce to the least possible number of road accidents and their death consequences.

2. Methods of determining the Road Service Quality

As a result of this critical economic situation, for more than 10 years the Department of Road Engineering of the Higher Polytechnic Institute 'Jose Antonio Echeverria' (I.S.P.J.A.E) has initiated studies and researches to establish an appropriate method of determining the Service Quality of our roads using measuring equipment made at national level, simple and of low cost, together with parameters and formulas in correspondence with this equipment and specific conditions of our country.

2.1 About Measuring Equipment

Through these studies and researches, it was determined that measuring equipment which could be made in Cuba at low prices:

No.	Equipment	Type of measurement
1	Portable Pendulum (Diva)	Skip Resistance
2	Portable Texture	Frame Macro Texture
3	Ruler (3m)	Surface Regularity

Equipments with a total cost lesser than $ 500 USD

2.2 About the Service Quality Parameters and the Formula of the Index of Security-Comfort

Through these studies the limit values of the three parameters were fixed, which were measured to determine the Road Service Quality in such a way that these same parameters were compared with those from developed countries with up-to-date measuring equipment, and were as follows:

Parameter of Quality	Limit Values
Coefficient of Skid Resistance (CFD)	≥ 0.33
Macro Texture	≥ 0.30 mm
International Index of Regularity (IRI)	≤ 4m/Km

To determine the Road Service Quality at a global level a table was drawn to illustrate each category at different velocities of Operation. Thus an index for each velocity of operation (Vc) of Comfort-Security is used whenever appropriate and calculated for such road.

Table 1

Vc Km/h	Categories of Comfort-Security Index				
	Critical	Bad	Regular	Good	Excellent
≥100	≤ 2.00	2.01 - 3.10	3.11 – 3.93	3.94 – 5.40	5.41 – 6.40
90	≤2.90	2.91 – 4.00	4.01 – 4.83	4.84 – 6.30	6.31 – 7.30
85	≤3.35	3.36 – 4.45	4.46 – 5.28	5.29 – 6.75	6.76 – 7.75
80	≤3.80	3.81 – 5.10	5.11 – 5.84	5.85 – 7.20	7.21 – 8.20
75	≤4.25	4.26 – 5.35	5.36 – 6.04	6.05 – 7.65	7.66 – 8.65
70	≤4.70	4.71 – 5.80	5.81 – 6.49	6.50 – 8.10	8.11 – 9.10
≤65	≤5.15	5.16 – 6.25	6.26 – 6.94	6.95 – 8.55	8.56 – 10.00

This table was drawn up using the formula below through the researches carried out for the conditions of the roads in Cuba:

$$ISC = 0.45E + 0.40D + 0.15G \qquad \text{(Formula 1)}$$

whereby:

E: Operational velocity, km/h
D: the values measured from CFD and from the macro texture, mm.
G: the results of longitudinal surface regularity, m/Km

The ranges established for different categories of Security–Comfort in each operational velocity in Table 1 were determined based on the linear distribution of the established parameters such as the maximum and minimum values of the Service Quality.

The economy, simplicity, accuracy and reliability of the result obtained from this method allow us to recommend its use in developing countries. In these cases we are capable of supplying more detail information by means of technical exchange or transfer of technology.

3. Measuring the Service Quality

To determine the Road Service Quality according to our method it is necessary to initially measure the three parameters indicated previously: CFD; Macro Texture and IRI. Comparing these results with the fixed limit values for each, the length of the road which does not comply with these values is determined and corrective measures are thereby employed to improve its Service Quality.

Through the application of the results of the three measurements in Formula 1 the index of Security-Comfort is calculated in the office. These results together with the operational velocity are then used to determine the category of the road utilising Table 1.

Since 1996 Cuba has been applying this method to determine the Service Quality in the National Interest Road Network, and 300 km have been inspected, being the results as follows:

A. The length of the roads which do not comply with the limit values established for each of the quality parameters, expressed in percentages, are as follows:

Parameters	%
Skip Resistance (CFD)	29
Micro Texture	26
Surface Regularity (IRI)	19

B. The distribution of the total length of these roads per category of the Security–Comfort expressed in percentages, are as follows:

Category	%
Critical	7
Bad	11
Regular	34
Good	43
Excellent	5

The figures indicate a low level in Service Quality of the roads of National Interest evaluated.

4. Measures to improve the Service Quality

The results from the three parameters of quality shown serve as a guide to define the type of improvements which should be applied to each specific road to increase its particular Service Quality.

In certain stretches of the roads evaluated within the categories of critical, bad or regular, the following traditional corrective measures have been principally applied.

- ❖ The surface spreading and compacting of the gravel to repair those stretches with an excess asphalt content on the surface.

- ❖ Adding a new layer of asphalt concrete over the existing one to correct the irregularities of the pavement and improve upon its anti-skidding characteristics.

- ❖ Surface planning of the existing pavements to eliminate the significant deformations and placing a new surface layer of hot asphalt concrete.

- ❖ Placing of new vertical and horizontal signs.

5. Program to Control the Service Quality

In the National Interest Road Network, controlled by National Road Centre, Ministry of Transport, a visual inspection of the surface characteristics is carried out every three years. This is achieved with the aid of the reference guide (Damage Catalogue) which permits the identification and classification of the scale of the damage, in turn indicating the type of maintenance and repair in accordance with the priorities and available economic resources.

When the results of visual inspection give inadequate values as far as this road network is concerned, causing shortcomings in the integrity of road security and comfort a more detailed study is required using the method described in this National Report.

6. Other aspects related to the Road Service Quality in Cuba

In almost all the roads in the country, the hourly intensities of traffic flow are low in comparison to the value which the wide transverse sections of the highway can support. For this reason, the phenomenon of traffic congestion is infrequent and thus the maintenance and repairs are implemented during the day without causing disturbances nor delays.

The delay in application of results obtained from the studies and researches of the Road Service Quality was due to the fact that the work was paralysed during severe economic crisis confronting Cuba for the period of 1990 – 1994, as a consequence of the disappearance of Socialism in countries of Eastern Europe.