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SURVEY OF PATHOLOGICAL MANIFESTATIONS OF BR-110 BY VISUAL ANALYSIS TECHNIQUE WITH MQV APPLICATION: CASE STUDY

LEVANTAMENTO DAS MANIFESTAÇÕES PATOLÓGICAS DA BR-110 PELA TÉCNICA DA ANÁLISE VISUAL COM APLICATIVO MQV: ESTUDO DE CASO

ESTUDIO DE MANIFESTACIONES PATOLÓGICAS EN LA BR-110 MEDIANTE LA TÉCNICA DE ANÁLISIS VISUAL CON LA APLICACIÓN MQV: ESTUDIO DE CASO

10.56238/edimpacto2025.063-001

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ABSTRACT

Technological development is advancing more and more in the field of Engineering, promoting the emergence of numerous applications aimed at assisting in the preparation of projects and data analysis with greater security, a greater degree of assertiveness and a faster workflow in its development. Among the various technologies, the mobile application Marcos Quilométricos Virtuales, developed for the paving sector by the National Department of Transport Infrastructure, stands out. In this perspective, this research aimed to perform a visual analysis of the existing pathologies in the stretch of BR-110, from km 51.00 to km 110.00, which connects the municipalities of Mossoró and Upanema, in Rio Grande do Norte, using the Virtual Kilometric Landmarks. To carry out this case study, the evaluation methodology proposed by the DNIT 005/2003 – TER standard was adopted. The results obtained showed the occurrence of 67 pathologies, with 27% prevailing the pans, indicating the need to implement actions to trigger the maintenance and recovery of the stretch. In addition, it was found that the Virtual Kilometer Milestones has excellent usability, generates georeferenced photographic records, provides greater agility in carrying out the survey in the field and does not require large investments.

Keywords: Auxiliary Applications. Pathological Manifestations. Road Networks.

RESUMO

O desenvolvimento tecnológico está avançando cada vez mais no ramo das Engenharias, promovendo o surgindo de inúmeros aplicativos destinados a auxiliar na elaboração de projetos e análise de dados com maior segurança, maior grau de assertividade e um fluxo de trabalho mais rápido em seu desenvolvimento. Dentre as diversas tecnologias, destaca-se o aplicativo mobile Marcos Quilométricos Virtuais, desenvolvido para o setor de pavimentação pelo Departamento Nacional de Infraestrutura de Transportes. Nesta perspectiva, esta pesquisa teve como objetivo realizar uma análise visual das patologias

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existentes no trecho da BR-110, do km 51,00 ao km 110,00, que interliga os municípios de Mossoró e Upanema, no Rio Grande do Norte, utilizando o Marcos Quilométricos Virtuais. Para realização deste estudo de caso, adotou-se a metodologia de avaliação proposta pela norma DNIT 005/2003 – TER. Os resultados obtidos demonstraram a ocorrência de 67 patologias, prevalecendo em 27% as panelas, indicando a necessidade de implementar ações para desencadear a manutenção e recuperação do trecho. Ademais, constatou-se que o Marcos Quilométricos Virtuais apresenta ótima usabilidade, gera registros fotográficos georreferenciados, proporciona maior agilidade na realização do levantamento em campo e não demanda grandes investimentos.

Palavras-chave: Aplicativos Auxiliares. Manifestações Patológicas. Malhas Viárias.

RESUMEN

El desarrollo tecnológico en el campo de la ingeniería avanza cada vez más, impulsando la aparición de numerosas aplicaciones diseñadas para facilitar el desarrollo de proyectos y el análisis de datos con mayor seguridad, precisión y agilización. Entre estas tecnologías, destaca la aplicación móvil "Marcadores Kilométricos Virtuales", desarrollada para el sector de la pavimentación por el Departamento Nacional de Infraestructura de Transporte. Con esto en mente, esta investigación tuvo como objetivo realizar un análisis visual de las patologías presentes en el tramo de la BR-110, del km 51 al km 110, que conecta los municipios de Mossoró y Upanema, en Rio Grande do Norte, utilizando los Marcadores Kilométricos Virtuales. Para llevar a cabo este estudio de caso, se adoptó la metodología de evaluación propuesta por la norma DNIT 005/2003 – TER. Los resultados demostraron la presencia de 67 patologías, con una prevalencia de baches del 27%, lo que indica la necesidad de implementar medidas para impulsar el mantenimiento y la restauración del tramo. Además, se observó que los Marcadores Kilométricos Virtuales ofrecen una excelente usabilidad, generan registros fotográficos georreferenciados, brindan mayor agilidad en los estudios de campo y no requieren una inversión significativa.

Palabras clave: Aplicaciones Auxiliares. Manifestaciones Patológicas. Redes Viales.

1 INTRODUCTION

Engineering has been developing technologically more and more over the years years, investing in technological tools such as *software* for project development and developing applications to meet the various demands of the area. Therefore, several *software* and applications are constantly created, with the main objective of assisting in the preparation of projects and data analysis from various areas of engineering, promoting greater security and speed to the workflows developed by the Architecture, Engineering and Construction (AEC) industry.

Among the various applications developed to meet the demands of the Civil Engineering areas, the mobile application Virtual Kilometric Milestones (MQV) developed for the paving area by the National Department of Transport Infrastructure (DNIT) with the purpose of assisting and optimizing the tasks of the Local Units of DNIT stands out. In addition, it enables the development of photographic reports of field surveys, which are recorded with the date and time of the cell phone's GPS, with a validation code in the application itself, preventing fraud (AEDNIT, 2021).

It is notorious that the economic development of a country, region or city is totally interconnected to the existing road infrastructure in that place, since public transit routes allow the connection between regions, favoring the movement of goods. Therefore, it is necessary to understand the construction processes of the pavements, so that it helps in the longevity and safety of engineering works.

As the longevity of the performance of the road network is compromised by pathological manifestations, according to Silva (2008) and the DNIT 005/2003 – TER standard, the main pathological manifestations that can occur in flexible pavements are: cracks, fissures, pans, exudation, undulations, wear, slips, sinkings and patches. Durability depends not only on execution in compliance with regulatory aspects, but also on investments in maintenance (ROCHA *et al*., 2022).

Therefore, it is the responsibility of the Federal Government, through the DNIT, to supervise and invest in the correction of problems identified on federal highways. The population that uses

This road network also has the right to require the government to maintain it properly when it is deteriorated, since the poor state of conservation can increase the risk of accidents.

The stretch of BR-110 that goes from km 51.00 to km 110.00, connecting the municipalities of

Mossoró and Upanema in Rio Grande do Norte, in the year 2024 had a poor state of conservation and was on the list of stretches that the DNIT would open bidding for companies

to carry out the recovery and maintenance processes, becoming an ideal scenario to analyze the usability and technical feasibility of the MQV application for visual survey of the main pathological manifestations that occur in flexible pavements.

In this perspective, the present research aimed to survey the main pathologies present on BR-110, in the stretch that connects Mossoró to Upanema, in Rio Grande do Norte, using the application Virtual Kilometric Milestones (MQV) to record the pathologies present in the stretch that starts at km 51.00 and goes up to km 110.00. Identifying the positive points of using the MQV in the performance of visual analysis of stretches of road network.

2 THEORETICAL FRAMEWORK

2.1 CONSERVATION OF BRAZILIAN HIGHWAYS

The state of conservation of Brazilian highways plays an essential role in the socioeconomic development of the country, as it generates several positive impacts on various spheres of society. As the well-maintained road network brings advantages such as reduced transportation costs, investments and jobs to society. The National Transport Confederation (CNT, 2023) highlights that Brazilian infrastructure is a determining factor for the country's growth, since the Brazilian road network enables access to goods of all kinds, as well as the expansion of markets and the movement of vehicles with cargo and passengers throughout the country.

A road network with adequate conditions enables a regional integration of better quality, as well as stimulates commercial growth and tourism. The Brazilian road network is responsible for handling about 65% of cargo and 95% of passengers, that is, almost the entire logistics chain passes through Brazilian highways (CNT, 2023). Corroborating the data presented in 2023 by the National Transport Confederation, the National Road System (SNV) states that the Brazilian network has about 1.7 million kilometers of highways, 213.5 thousand of which are paved, representing 12.4% of the total length.

In view of the data presented, it is verified that the conservation of Brazilian highways is an imminent need for efficiency in the country's land transport, being relevant, according to Silva *et al.* (2020), the government will invest in the recovery and expansion of highways because it will provide several benefits, from road safety, in the prevention of possible accidents, as well as in the reduction of operating costs of passenger and cargo transport.

The National Department of Transport Infrastructure (DNIT), aware of the importance of the recovery and maintenance of highways, prepared the Road Conservation Manual where it defines the conservation of the road network as a set of routine, periodic and

emergency operations carried out with the purpose of preserving the characteristics of the highways. technical and physical-operational standards of the highway system, in order to maintain the standards of the services executed (DNIT, 2005).

Conservation tasks are divided into five groups, consisting of three groups and two groups of activities that have relatively limited services, which may be assigned to conservation teams, according to their specific nature and purposes, these being according to the official terminology of DNIT (DNIT, 2005). Chart 1 presents these activities and their conceptual description.

Table 1

Conservation activities for Brazilian highways

Groups	**Concepts**
Routine Corrective Maintenance	It is the set of conservation operations that aims to repair or remedy a defect and restore the operation of the highway components, providing comfort and safety to users.
Periodic Preventive Conservation	It is the set of conservation operations, carried out periodically with the objective of avoiding the emergence or aggravation of defects; These are tasks required during the year, but whose frequency of execution depends on traffic, topography and climate. E.g.: pothole operation, crack closure, etc.
Emergency Conservation	It is the set of operations, which with the service or works necessary to repair, replace, rebuild or restore sections or structure of the highway, which have been sectioned, obstructed or damaged by an extraordinary, catastrophic event, causing the interruption of highway traffic.
Restoration	It is the set of operations intended to reestablish the perfect functioning of a specific or damaged asset, and to fully reestablish its original technical characteristics. It therefore involves a set of measures aimed at adapting the highway, on a permanent basis, to current and future traffic conditions, extending its life span.
Highway Improvements	It is the set of operations that add new characteristics to the existing highway, or modify the existing characteristics.

Source: DNIT (2005)

Rodrigues and Pinheiro (2023) state that pavements have a limited useful life and, therefore, they have a wide need to undergo conservation and maintenance actions. These actions ensure the safety and mobility of the population, and, in addition to the economic benefits, the preservation of highways contributes significantly to the prevention of accidents, ensuring greater safety in the transport of cargo and passengers.

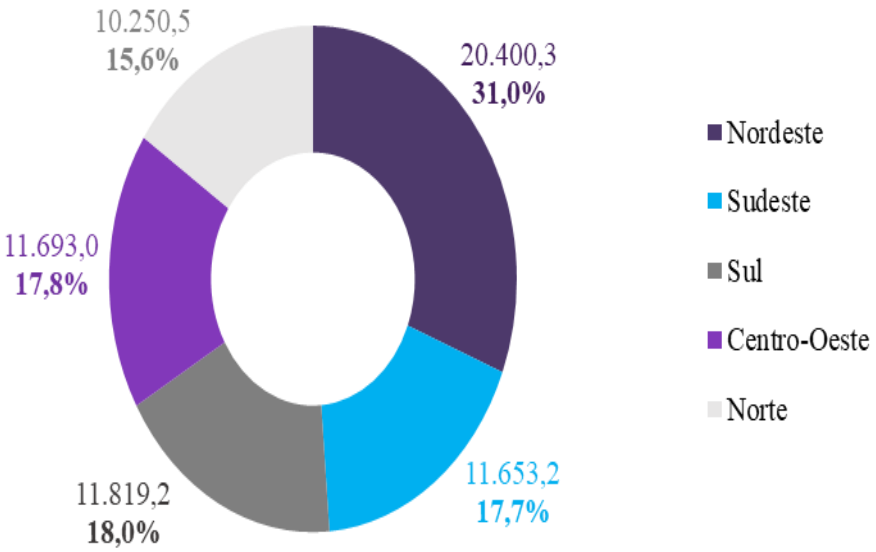
2.2 STATE OF THE HIGHWAYS THAT CROSS THE NORTHEAST REGION

The state of conservation of highways in the Northeast of Brazil is a constant challenge, which directly affects connectivity between states and regional development. Although there has been progress in infrastructure and growth in the road network, many highways still suffer from the state of conservation of the pavement, which directly compromises the quality of transport (CNT, 2023).

The National Transport Confederation points out that the Northeast region has the largest extension of the paved road network, containing 20.4 thousand kilometers, about 31% of the total network, and that these are in most of their extension in a state of conservation characterized as regular or poor, either by the quality of the pavement or by the signage (Figure 1).

Figure 1

Percentage of the length of paved federal highways in 2023

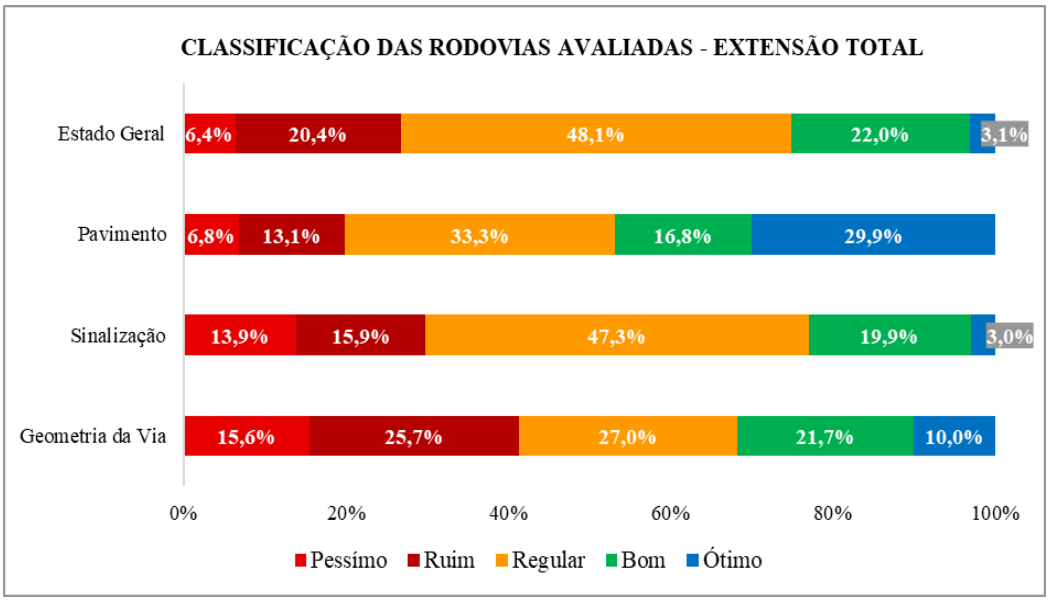


Source: Adapted from CNT (2023)

Figure 2 shows the situation of the highways in the Northeast, classified according to their state of conservation from the very bad level to the optimal level, showing percentages related to the general condition, pavement, signaling and geometry of the road.

Figure 2

Percentage of the length of paved federal highways in 2023



Source: Adapted from CNT (2023)

Rocha *et al.* (2022) state that Brazil has a major problem regarding the structure of flexible pavements, because they do not meet the necessary technical requirements, both in the structural competence of the layers and in the quality of the materials used in the coating. This fact leads to construction failures, consequently, causing a faster deformation process, which increases the expenses with repairs of these pavements so that they can achieve ideal traffic conditions. In the last survey, carried out in 2023, the Northeast region has a significant number of highways classified as very bad (Chart 2).

Table 1

Conservation activities for Brazilian highways

Ranking	Highways	Existing Overlays	UF	Region	Initial municipality	Final municipality	Jurisdiction	Management	Researched extension (km)	Extension scales	Overall rating
520	AM-010	BR-174	AM	North	Manaus	Itacoatiara	State	Public	254	More than 250 km up to 500 km	Lousy
519	PB-400		PB	Northeast	Cajazeiras	Conception	State	Public	102	More than 100 km to 250 km	Lousy
518	BR-364	BR-307	AC	North	Southern Cross	Acrelândia	Federal	Public	761	More than 500 km	Lousy
517	PE-096		PE	Northeast	Palmares	Barreiros	State	Public	50	Up to 100 km	Lousy
516	MA-106	BR-308	MA	Northeast	Governor Nunes Freire	Alcântara	State	Public	228	More than 100 km to 250 km	Lousy
515	PE-126		PE	Northeast	Palmares	Quipapá	State	Public	55	Up to 100 km	Lousy

514	AC-010		AC	North	Porto Acre	Rio Branco	State	Public	68	Up to 100 km	Lousy
513	AP-010		AP	North	Macapá	Mazagão	State	Public	70	Up to 100 km	Lousy
512	PA-263		PA	North	Goianésia Do Pará	Tucuruí	State	Public	73	Up to 100 km	Lousy
511	BR-174	BR-319	AM	North	President Figueiredo	Borba	Federal	Public	495	More than 250 km up to 500 km	Lousy
510	PE-177		PE	North east	Quipapá	Garanhuns	State	Public	55	Up to 100 km	Lousy
509	MA-006	BR-308	MA	North east	Cururupu	Pine	State	Public	98	Up to 100 km	Lousy

Source: Adapted from CNT (2023)

It can be seen in Chart 2 that, among the 12 (twelve) highways classified as very bad, 6 (six) of these belong to the Northeast region, demonstrating the need for greater investments related to road infrastructure, especially for this region, which faces challenges related to adequate paving, support infrastructure along the way, efficient signaling, structural limitations and lack of periodic maintenance.

Continuous investments in infrastructure works and preventive maintenance programs raise the quality of highways and the safety of transport and passengers, meeting the growing demands of the roads that cross the northeastern region (RODRIGUES; PINHEIRO, 2023).

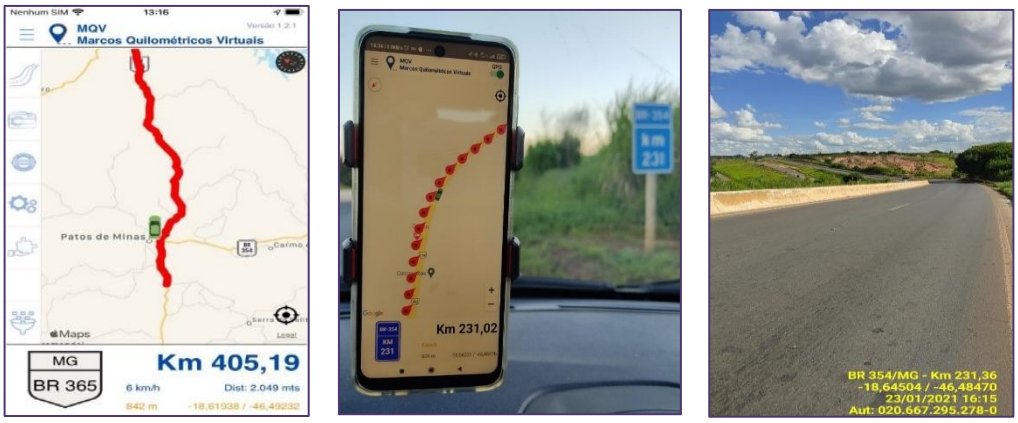
3 METHODOLOGY

The evaluation methodology adopted for the survey of pathologies followed the norm DNIT 005/2003 – TER, and the analysis of the results was carried out according to data tabulation proposed by Farias & Corrêa (2023). For data collection, the mobile application was used Virtual Kilometric Milestones (MQV), developed by DNIT's Transport Infrastructure analyst, Tiago Oliveira Moreira (AEDNIT, 2021).

The MQV's main objective is to identify the exact mileage of the highway referred to in the database of the National Road System (SNV), indirectly allowing georeferenced surveys. This is interconnected to the DNIT database, through *an Application Programming Interface* (API), which makes it possible to collect information on highways in the SNV (AEDNIT, 2021). Figure 3 shows the MQV interface.

Figure 3

Application interface (a), interface with kilometric milestone (b) and georeferenced photo with validation code (c)



(a) (b) (c)

Source: AEDNIT (2021)

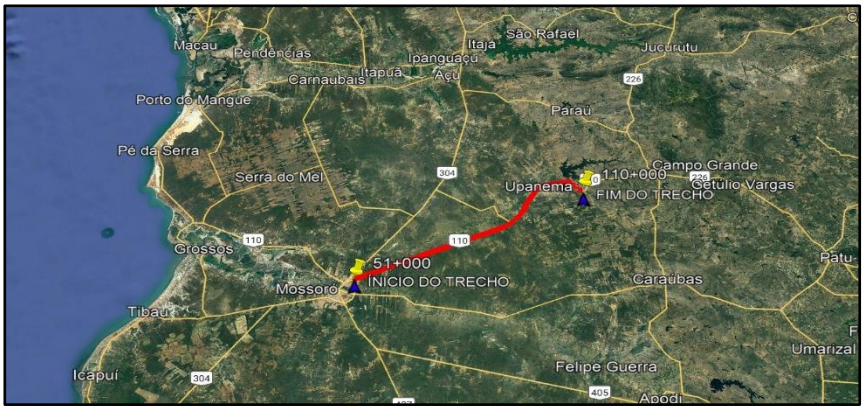
Currently, the application is available for download on Google's Play Store, for devices with an Android version, as well as on Apple's App Store, for users who have devices in the IOS version.

3.1 CHARACTERIZATION OF THE STUDY AREA

The study area was the stretch of BR-110 that connects the municipality of Mossoró to Upanema, in Rio Grande do Norte, from km 51.00 to km 110.00 (Figure 4).

Figure 4

Location of the stretch under analysis on BR-110



Source: Google Earth (2025)

The chosen stretch covers an extension of approximately 59 kilometers of highway, playing a fundamental role as a means of transporting cargo and passengers between the municipalities mentioned. According to data from the National Traffic Counting Plan, the

Annual Daily Average Volume (VMDa) recorded at the station at km 42.00, located in the city of Mossoró/RN, totaled a daily average of 4495 vehicles over 144 days (PNCT, 2022).

The high rate of ADVs can be attributed to the significant urban development in the city. In the last census, carried out in 2022, Mossoró/RN recorded a total population of 264,577 inhabitants in a territorial area of 2,099.334 km², according to IBGE data (2022). The local economy revolves around production and exports, with emphasis on irrigated fruit growing, especially melon production, the salt industry (the municipality being the largest salt producer in the country) and the expressive extraction of oil on land (PREFEITURA DE MOSSORÓ, 2024).

On the other hand, Upanema/RN has lower rates, with a population of 13,577 inhabitants and a territorial area of 873,140 km², according to IBGE data (2022). However, several exports travel along the stretch that connects Mossoró to Upanema, being essential the analysis of this traffic route, understanding the conditions and challenges faced in this stretch of highway.

4 FINDINGS

4.1 PATHOLOGIES FOUND IN THE STRETCH UNDER ANALYSIS ON BR-110

In the visual evaluation of the stretch of highway in question, using the MQV application, some of the pathologies defined by the DNIT 005/2003 – TER Standard were identified. These are presented in Table 2.

Table 2

Quantification of the pathological manifestations of the stretch under research

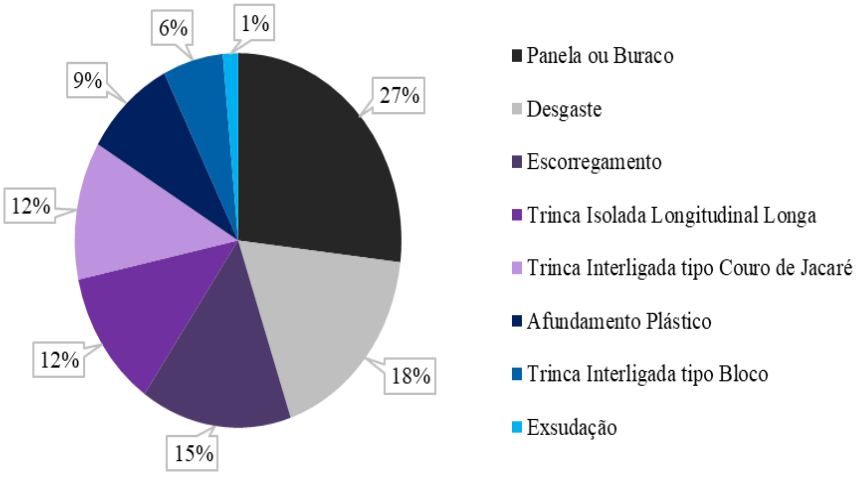
TYPE OF PATHOLOGY	QUANTITY
Pan or Hole	18
Wear	12
Slipping	10
Long Longitudinal Insulated Crack	8
Interconnected Crack Type Alligator Leather	8
Plastic Sinking	6
Interconnected Crack Type Block	4
Exudation	1
Σ (Total pathologies presented)	67

Source: Authors (2025)

In the excerpt evaluated, it was observed that the pathology with the highest percentage of occurrence (Figure 5) was pots or holes (27%), followed by wear (18%), and exudation was the pathology with the lowest occurrence (1%).

Figure 5

Percentage of pathologies quantified in Chart 2



Source: Authors (2025).

4.2 VISUAL PRESENTATION OF THE MAIN PATHOLOGIES IDENTIFIED BY THE MQV APPLICATION

4.2.1 Pot/Hole

Pans or potholes were the most frequent pathologies, having different sizes and depths, always requiring the driver's attention along the way to avoid accidents. Figure 6 illustrates one of the pans found on the analyzed pavement.

Figure 6

Pan accompanied by "Alligator Leather" type crack

Source: Authors (2025)

Figure 6 shows that pathologies do not always occur in isolation, because traffic, together with the action of other triggering agents, such as rainwater, initiates the disintegration of part of the coating forming the pans and, thus, promotes surface irregularities and, with the increase in traffic intensity in the first irregularities, results in a chain of effects.

According to DNIT (2006b) and Rodrigues et al. (2008), the main causes of pans are: damage to the coating caused by fatigue cracks; action of rainwater through infiltration; disaggregation of the coating on the surface of the pavement, which occurred due to traffic in points with more fragility; poor adhesion between the asphalt coating and the lower layer, and flaws in the executed project.

The analysis in Figure 6 refers to the occurrence of pathology of cavities with small depths, indicating correction with a superficial patch, which should occur cleaning the cavity after making a rectangular cut in the area that holds the pathology and removing the accumulated water, if present (RODRIGUES et al., 2008). Subsequently, the affected area must be filled with PMF (Cold Pre-Mixed), as governed by the current DNIT standard (DNER-ES 390/99), followed by compaction with a vibrating plate to ensure long-lasting adhesion with the other layers. For cases where pans or holes have reached the lower layers (base and sub-base), deep patching is recommended as a form of DNIT correction (DNER-ES 390/99).

4.2.2 Wear and tear

Along the way, some areas with wear on the pavement were noticed, and the occurrence of detachment of bituminous material in relation to the underlying layer was evident, as shown in Figure 7.

Figure 7

Wear

Source: Authors (2025)

Pavement wear is a constant pathology on federal highways caused by the volatilization and oxidation of asphalt, resulting from the constant action of vehicles and weathering; construction of the pavement in bad weather conditions; localized deficiency of asphalt binder due to the clogging of the nozzles or incorrect adjustment of the spreader bar, and the presence of water inside the coating, causing the detachment of the bituminous film (DNIT, 2006b; SILVA, 2008).

There are effective measures to remedy wear on the pavement, according to Bernucci et al. (2023), the most used solution is the application of cold asphalt micro-sheath in accordance with the procedures described by the DNIT 035/2018 - ES standard. The application of this compound aims to homogeneously improve the pavement's rolling layer.

4.2.3 Slippage

Some points of the studied section showed slippage of the bearing layer on the edges of the pavement (Figure 8).

Figure 8

Bituminous Coating Slippage

Source: Authors (2025)

According to DNIT (2006b) and Rodrigues et al. (2008), the incidence of slips on the edge of the pavement may occur due to some factors, such as: poor dosage of the asphalt mixture; excess binder, generating high humidity from the coating to the lower layers; inadequate compaction of the asphalt mixtures or the upper portion of the base layer, and plastic deformation of the coating due to the influence of high temperatures.

Rodrigues et al. (2008) present as a corrective measure for this pathology the cutting and removal of the coating by means of cold milling, following the procedures imposed by the DNIT 159/2011 - ES standard and, subsequently, the application of asphalt mud mixture, according to DNIT 150/2010 - ES specifications.

4.2.4 Long Longitudinal Insulated Crack

Long longitudinal cracks were found at some points along the pavement (Figure 9).

Figure 9

Bituminous Coating Slippage

Source: Authors (2025)

According to DNIT (2005) and Rodrigues et al. (2008), the appearance of these longitudinal cracks occurs due to these factors, such as: poorly executed construction joint; inadequate connection between the layers launched in sequence to form traffic lanes; emergence of settlements in the layers below the coating; contraction or expansion of the coating due to the technical gradient, or aging of the asphalt, and concentration of stresses in the vicinity where the crack manifested.

The correction of isolated cracks can be performed by sealing the cracks with asphalt emulsion and sand or stone dust in the entire affected area (DNIT, 2005). The application of the asphalt material is carried out manually, ensuring that all cracks are properly covered to prevent penetration into the lower layers, subsequently, sand or stone dust is distributed and leveled over the upper layer of the pavement using a roller (DNIT, 2005).

4.2.5 Interlocking Crack Type Alligator Leather

Another pathology existing in the analyzed pavement was the "alligator leather" type crack, identified in some isolated points during the journey (Figure 10) and in conjunction with pans (Figure 6).

Figure 10

Bituminous coating slippage

Source: Authors (2025)

According to DNIT (2005) and Rodrigues et al. (2008), the interconnected cracks that hold the appearance of alligator leather arise due to some factors, such as: contraction of the asphalt layer due to temperature variation; the material that constitutes the coating has low viscosity; constant deformations caused by traffic loads, and low thickness of the coating layer.

Rodrigues et al. (2008) suggests milling the damaged pavement in a rectangular shape, following the guidelines of the DNIT 159/2011 - ES standard and, sequentially, recommends the execution of a patch, depending on the depth that the pathology has reached. For cases where adjacent layers show deterioration, it is necessary to remove the damaged material to improve these layers.

4.2.6 Plastic Sinking

Some places in the studied section presented subsidence, all of them having upheaval on the edge of the pavement, characterized as plastic subsidence. The example of this type of sinking is shown in Figure 11.

Figure 11

Plastic sinking

Source: Authors (2025)

Plastic sinkings are identified by depressions on the surface of the pavement, and can be generated due to some aspects, such as: plastic deformation of the upper and/or adjacent layer, which can even affect the subgrade; excessive action of traffic loads; poor soil compaction, and deficiency in the dosage of the asphalt mixture (Bernucci et al. (2008); DNIT, 2006b; SILVA, 2008).

In agreement with Farias & Corrêa (2023), the main alternative to solve this pathology would be to carry out surface milling of the pavement, correcting the sinkings greater than 20mm in the wheel tracks, then executing a new coating in CBUQ, according to the regulations of the DNIT 159/2011 - ES and DNIT 031/2006 - ES standards, respectively. The execution by milling is carried out on average with a thickness of 40mm, applying the blasting of compressed air to clean the milled area. Next, the bonding painting and filling of the milled surface in CBUQ is carried out.

4.2.7 Interconnected Block Type Crack

In some regions of the stretch, the emergence of interconnected block-like cracks was detected, as shown in Figure 12.

Figure 12

Interconnected block cracks

Source: Authors (2025)

The appearance of cracks in block shapes occurs as a result, according to DNIT (2005) and Rodrigues et al. (2008), of the following aspects: contraction of the coating material, due to temperature variation; considerable loss of the characteristics of the asphalt binder; fragility in the tensile strength of the asphalt mixture; Union of transverse and longitudinal cracks in cement-based coatings.

Rodrigues et al. (2008) states that the corrections for this pathology would be the sealing of cracks with asphalt mud, following the recommendations of the DNIT 150/2010 – ES standard, and in situations where the rejuvenation of the pavement is not sufficient, milling in the affected area is indicated, followed by the execution of a deep patch.

4.2.8 Exudation

The presence of asphalt exudation was identified, as can be seen in Figure 13.

Figure 13

Exudation

Source: Authors (2025)

According to DNIT (2005) and Silva (2008), the presence of exudation in the asphalt arises due to some factors, such as: poor dosage of the asphalt mixture, generating high content of bituminous binder and/or low void index, presenting a shiny appearance on the pavement; the temperature of the binder higher than that established at the time of mixing, causing the expansion of the asphalt and the irreversible filling of the voids between the particles, and the incidence of loads can cause an increase in the densification of the mixture in the wheel tracks, intensifying the exudation in the pavement.

The solution for this type of pathology is to combat it with pebbles, manually applying the aggregate on the exuded area, in order to reestablish the non-slip conditions of the pavement surface (DNIT, 2005). It is recommended that the service be carried out on a day with high temperatures or with previously heated aggregate.

5 FINAL CONSIDERATIONS

With this analysis, it is concluded that:

- The prevailing conditions on federal highways in the Northeast, especially in the stretches that connect cities in the interior of the state of Rio Grande do Norte, are in a critical state of conservation. A fact that triggers the need for periodic repairs of the respective stretches analyzed or the implementation of new pavements.
- The stretch of BR-110, which connects the municipality of Mossoró to Upanema, in Rio Grande do Norte, presented several pathologies in the period of the field survey

(August and September 2023), disturbances that indicate that the essential functions of the pavement were not being properly met.

- Regarding the use of the MQV (Virtual Kilometric Landmarks) mobile application, it was found that it has adequate functionality and efficiency for this type of study, as it makes it possible to generate photographic records of the pathologies existing on the highway georeferenced in a simplified way because it has an easy-to-use interface, requiring only a smartphone. In addition, it does not require large investments in obtaining visual analysis reports of the state of conservation of the road networks and facilitates the identification of various geographical characteristics of the pavement under analysis.

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