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Theme :

Conducting analyses of the various control files follow-up and maintenance of Ouargla Airport since its inception

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In front of the jury composed of:

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University year: 2022/2023

إهداء

اهدي ثمرة جهودي إلى من أوصاني بهما الله

إلى من حملتني و وضعتني هنا إلى من كانت تسقني دعاء ينير دربي ووصلت إلى ما أنا عليه أمي

إلى من دعمني في مشواري الدراسي الذي جعلني اعرف معنى التحدي والمثابرة أبي

إلى قرة عيني إخوتي

وأخيرا وليس أخرا كل من مد لي يد العون وساعدني من قريب أو بعيد ولو بكلمة إلى كل من افتكره قلبي و لم يلفظه قلمي

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وأخيرا وليس أخرا كل من مد لي يد العون وساعدني من قريب أو بعيد

Nour El Houda CHELGHOUM

الشكر

بسم الله الرحمان الرحيم

وَقَالَ رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نِعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ وَعَلَى وَالِدَيَّ وَأَنْ أَعْمَلَ صَالِحًا تَرْضَاهُ وَأَدْخِلْنِي بِرَحْمَتِكَ فِي عِبَادِكَ الصَّالِحِينَ ﴿١٩﴾

النمل آية:١٩

بداية الحمد لله عز وجل الذي بنعمته تتم الصالحات وبعد نتقدم بأسمى عبارات الشكر للمشرف ب.سقاي سفيان الذي قدم لنا يد المساعدة والتوجيه طيلة فترة إعداد المذكرة كما نقدم الشكر إلى موظفي المخابر LEC وLTPS و موظفي الأشغال العمومي الذين تقاسموا معنا سطور هذا العمل إلى كل من كان له الفضل في مساعدتنا في انجاز هذا البحث من قريب أو بعيد.

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List of abbreviations

ACN: Aircraft classification number

PCN: Pavement classification number

mm: Millimeter

MN : Mega Newton

MPa: Mega Pascal

Kg: Kilogram

Km: Kilometer

Km/h: Kilometer per hour

m: Meter

Max: Maximum

min: Minimum

μ: Coefficient of friction

%: Percentage

C°: Degree Celsius

CBR: California Bearing Ratio

summary:

Keeping the facility in good operational condition is the first concern of operation and maintenance managers in private and public facilities, and the road network is one of the most complex facilities due to its huge size, and road networks are exposed to many factors that lead to the deterioration of their operational and construction condition with their age, so periodic maintenance must be followed to prolong the life of the road or therapeutic or radical maintenance ….Airport is an important part of the aeronautical infrastructure, has to meet high safety standards.The required level of safety can only be achieved by proper maintenance of all the elements composing an airport. ,Maintenance includes measures to keep or restore the operational function as well as measures ,to check and to evaluate the present function of an element. The basic components of maintenance are :(inspection ; servicing and repair) Inspection comprises all measures to check and evaluate the operating condition including Whenever inspection or servicing discovers deficiencies, repair measures have to be planned and carried out as soon as practicable. Repair can comprise minor or major work as, for instance, runway ,Our study aims to extend the life of the road and protect users , The method of study is to collect and analyze information.

Keywords: facility, degradation, maintenance cycle, airport, runway.

إجراء تحاليل لملفات الرقابة المختلفة متابعة وصيانة مطار ورقلة منذ إنشائه

ملخص – إن الحفاظ على المنشأة في حالة تشغيلية جيدة هو الشاغل الأول لمديري التشغيل والصيانة في المرافق الخاصة والعامة ، وتعد شبكة الطرق من أكثر المرافق تعقيدا نظرا لحجمها الضخم ، وتتعرض شبكات الطرق للعديد من العوامل التي تؤدي إلى تدهور حالتها التشغيلية والإنشائية مع عمرها ، لذلك يجب إتباع الصيانة الدورية لإطالة عمر الطريق أو الصيانة العلاجية أو الجذرية ....المطار جزء مهم من البنية التحتية للطيران, يجب أن تفي بمعايير السلامة العالية.لا يمكن تحقيق المستوى المطلوب من السلامة إلا من خلال الصيانة المناسبة لجميع العناصر المكونة للمطار . ، تشمل الصيانة تدابير للحفاظ على الوظيفة التشغيلية أو استعادتها بالإضافة إلى التدابير ، لفحص وتقييم الوظيفة الحالية لعنصر ما. المكونات الأساسية للصيانة هي: (التفتيش ; الصيانة والإصلاح) يشمل الفحص جميع التدابير لفحص وتقييم حالة التشغيل بما في ذلك عندما يكتشف الفحص أو الخدمة أوجه قصور، يجب تخطيط تدابير الإصلاح وتنفيذها في أقرب وقت ممكن عمليا. إصلاح يمكن أن تشمل عمل ثانوي أو كبير كما، على سبيل المثال، المدرج، وتهدف دراستنا لإطالة عمر الطريق وحماية المستخدمين، وطريقة الدراسة هي جمع وتحليل المعلومات.

الكلمات الدالة : المنشأة ، تدهور ، الصيانة الدورية ، المطار ، المدرج.

Analyse des différents dossiers de contrôle, de suivi et d'entretien de l'aéroport de Ouargla depuis sa création.

Résumé - Maintenir l'installation en bon état de fonctionnement est la première préoccupation des responsables de l'exploitation et de la maintenance des installations privées et publiques, et le réseau routier est l'une des installations les plus complexes en raison de sa taille énorme, et les réseaux routiers sont exposés à de nombreux facteurs qui conduisent à la détérioration de leur état de fonctionnement et de construction avec leur âge, de sorte qu'un entretien périodique doit être suivi pour prolonger la durée de vie de la route ou un entretien thérapeutique ou radical ....L'aéroport est une partie importante de l'infrastructure aéronautique, doit répondre à des normes de sécurité élevées. Le niveau de sécurité requis ne peut être atteint que par un bon entretien de tous les éléments composant un aéroport. , La maintenance comprend des mesures pour maintenir ou rétablir la fonction opérationnelle ainsi que des mesures pour vérifier et évaluer la fonction actuelle d'un élément. Les éléments de base de la maintenance sont: (inspection ; entretien et réparation) L'inspection comprend toutes les mesures visant à vérifier et à évaluer l'état de fonctionnement, y compris Lorsque l'inspection ou l'entretien découvre des déficiences, les mesures de réparation doivent être planifiées et effectuées dès que possible. La réparation peut comprendre des travaux mineurs ou majeurs comme, par exemple, la piste, Notre étude vise à prolonger la durée de vie de la route et à protéger les usagers, La méthode d'étude consiste à collecter et analyser des informations

Mots-clés : installation, dégradation, cycle de maintenance, aéroport, piste.

I.1 General Introduction

Airports are characterized by economic importance for all countries, as, like other sectors, the increase in passenger numbers means the revival of Tourism and trade, airports play a fundamental role in attracting direct and indirect economic and investment activities, and contribute to achieving development, and the development and development of airports has multiple economic effects, including the creation of various jobs for citizens, and the establishment of investment and commercial activities.

The development of airports from a technical point of view effectively contributes to the high index of economic, social, cultural and tourism development, as well as attention to the human wealth that manages it, the airport is an essential ground to connect the country with the cities of the world in a way that serves people and in all economic sectors, which must be characterized by its strategic location, and damage to the structure Aircraft, which entails material and moral losses.

The condition of the road descends fro, excellent to very good , then good until it reaches a good condition . when the road reaches this conditions , remedial or radical maintenance is required , such as adding a layer of bottom to restore the road to its condition at the time of construction (excellent) any delay in maintenance this level (good) zill lead to a rapid deterioration of the road condition up to types the state of deterioration at the good level, and an exorbitant increase in maintenance costs of up to four or five times the cost if maintenance was carried out when the road was at a good level . therefore , it is necessary to carefully follow up on the condition of the road to determine the type of periodic maintenance it needs and the timing and type of road remedial maintenance

This study aims to present the method of monitoring, monitoring and maintenance of Ouargla airport, so our note is divided into the following chapters:

Chapter 1 we will talk about the generalities of the importance of Air Transport and positive air transport and air transport regulatory bodies and associations

Chapter 2 we will talk about Ouargla airport from the historical point of view, the technical card of the runway, the structures located in it and the deterioration that occurs to the runways

Chapter 3 we will talk about how to lift the deterioration and maintenance, and we will bring a realistic example of the control method

Problematic from the above

- How healthy are airports that know a high temperature range
- Evaluation of the flight platform at Ouargla airport
- Follow-up and maintenance of Ouargla airport since its inception

The purpose of the study

This study aims to know the technical, historical origin and ground characteristics of the runway of Ouargla airport and to know how to maintain it.

Chapter I

Generalities

I.2 Introduction

Connecting countries to each other depends heavily on airports, making their design a crucial aspect. The unification of aviation regulations, aircraft laws, runway and control towers is of paramount importance.

I.3 Definition of air transport

It is a type of transport that carries out passenger transportation or freight transportation from one location to another by air. Air transport is divided into two parts :

Civil Aviation "tourist" and "commercial"

Military aviation is under the guardianship of the Army Staff.

I.4 The necessity of air transportation

Air transport is a major contributor to global economic growth and social development , it creates jobs, facilitates trade and enables the arena and supports sustainable development around the world as the most important points can be summarized

I.5 Advantages of air transport

Represented by the following:

- To enable economic growth.
- The possibility of individual communication is maximized.
- How to support tourism
- The issue of job creation
- Support for Sustainable Development

I.6 Bodies and associations specialized in air transport

There have been bodies and associations for the purpose of organizing Air Transport (International, European, Arab organizations):

- The International Association of civil airports
- The International Civil Aviation Organization
- The International Transport Association
- The International Industries working group
- The Scientific Council of international airports

- The International Coordinating Council of space industry associations.
- The Civil Aviation Council of the Arab states
- The European Civil Aviation Commission
- The Association of Western European airports
- The Coordinating Council of airport associations

I.7 Classification of airports

Airports are classified by runway length according to the international aviation organization, the following table (I.01) shows:

Tableau (I.01) Classification of airports

runway length	Category
Biger thane 2550 m	A
2550 - 2150 m	B
2150 – 1800 m	C
1800 – 1500 m	D
1500 – 1280 m	E

I.8 TYPES OF PAVEMENT

Despite their specific characteristics, aeronautical pavements use the same materials as road pavements, subject to certain additional specifications but also to certain exclusions, guided by the nature of the soil and by local considerations as well as by the nature of the area to be built (runway, approaches to or extensions of the runway, taxiway, parking area) and by the traffic it is intended to accommodate. However, the type of pavement generally leads to the following prevailing in favour of road pavements:

I.8.1 Flexible pavements

The pavement structure consists solely of untreated materials or materials treated with hydrocarbon binders:

- The undeniable economic interest they offer for good quality subgrade, for runway extensions and approaches and for infrastructure dedicated to light aviation, given the relatively low pavement thicknesses corresponding to these different cases.
- Their suitability for phased reclamation.

I.8.2 Semi-rigid carriageways

A distinction is made between:

- The pavements comprising a base layer (and sometimes a foundation layer) treated with hydraulic binders (cement, granular slag)
- Pavements with a base layer and/or a gypsum sand foundation layer.

They are often found in arid regions.

I.8.3 Rigid pavements

Consisting of a set of cement concrete or prestressed concrete slabs, resting on a foundation also treated with hydraulic binders:

- The technical and economic advantages they offer for poor quality subfloors.
- Their suitability for parking areas subject to high punching forces and frequent hydrocarbon spills, as well as for the ends of runways from which certain types of military aircraft take off, where the inclination of the engines causes significant devastating thermal effects.
- Ensure continuity of slab support at joints.
- Helps to prevent freezing of the support soil and to prevent the rise of pumping fines at joints.

I.9 Information on the runway code

The runway code is determined by the following four basic factors

1) Type of pavement for determining 'ACN' Aircraft classification number and 'PCN' Pavement classification number:

	Code letter
• Rigid pavement	R
• Flexible pavement	F

2) Strength category of the foundation ground

A = High resistance: characterised by K = 150 MN/m3 and representing all K values above 120 MN/m3 for rigid pavements, and by CBR = 15 and representing all CBR values above 13 for flexible pavements.

B = Average strength: characterised by K = 80 MN/m3 and representing arange of K values from 60 to 120 MN/m3 for rigid pavements, and by CBR = 10 and representing a range of CBR values from 8 to 13 for flexible pavements.

C = Low strength: characterised by K = 40 MN/m3 and representinga range of K values from 25 to 60 MN/m3 for rigid pavements,and by CBR = 6 and representing a range of CBR values from4 to 8 for flexible pavements.

D = Ultra-low strength: characterised by K = 20 MN/m3 and representingall K values below 25 MN/m3 for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.

3) Maximum admissible tyre pressure category	Code letter
• Unlimited: no pressure limit	W
• High: pressure limited to 1.75 MPa	X
• Medium: pressure limited to 1.25 MPa	Y
• Low: pressure limited to 0.50 MPa	Z

4) Evaluation method

T = Technical assessment: specific study of pavement characteristics and use of pavement behavior pavement behaviour study techniques.

U = Assessment based on aircraft experience: knowledge of the specific type and weight of aircraft used regularly and which the pavement can support satisfactorily.

For example: PCN = 42 / F / A / X / U

Chapter II

Ouargla Airport

II.1 Definition of Ouargla airport 'Ain El beida'

Ain El Beida airport is located in the state of Ouargla in the south of the country, and it serves the city of Ouargla exactly in the municipality of Ain El beida. The airport was opened in 1982, and is under state ownership for military and civil use, and the airport is classified in the category of airports: C (according to the Algerian classification of airports) and operates locally. The following picture (II.01) shows the airport from above.

The critical aircraft is Boeing 737-800.

Figures (II.01) Airport of Ouargla

II.2 The location of the airport in relation to the city

The airport is located 7 km from the city of Ouargla on the right of National Road No. 49, the link between Ouargla and Hassi Messaoud at an altitude of 129 meters above sea level.

II.3 History of the airport

Ouargla airport was originally established in 1951 by the French occupation to control the area (mainly for military purposes), but it was closed in 1962 by the Algerian state and then in the eighties the airport was rehabilitated and developed, and it was reopened in 1982 under the name "Ouargla Ain El Beida International Airport".

Since then, the airport has been continuously expanded and modernized to meet the needs of air transport in Algeria and provide reliable and high-quality services for passengers and cargo.

II.4 Stages of development

The airport has gone through several stages

Prior to 1986 the airport consisted of:

- A main runway 01/19 with a length of 3000 m
- Taxiway
- five shoulder straps perpendicular to the axes of the runway and taxiway
- Taxi Track
- Car parking
- a parking area

After that, the airport infrastructure witnessed the implementation of extension works, which were carried out as part of the following operations :

A. Operation No. ND 5.527.3.262.130.01 entitled construction of a new runway at Ouargla airport

It was registered in 1986 and is related to the expansion of the airport by the construction of a new runway oriented 36/18 with a length of 3000 m , the ends of which are made of solid material (cement) 300 m each .

B. Operation No. ND 5.527.3.262.130.02 to strengthen the existing infrastructure of Ouargla airport 1992 and related to :

- ➢ reinforcement of runway 01/19 between PK 0 and 2+662 with construction of the runway end in rigid material at threshold 19.
- ➢ reinforcement of Taixway and Taxi Track
- ➢ reinforcement and extension of the civil parking lot

- reinforcement of military parking lot

C. Operation No. ND 5.527.3.262.022.06 related to the completion of the strengthening of the infrastructure of Ouargla Airport May 1994 related to :

- Supporting director
- Taxi Track 1, 5, 6, 7 , 8

In 2007 , in order to address the deterioration of runway 01/19 and the Annex and the listing of 2007/02/19, the operation was carried out under the number DPTA/PSD/013/2007 related to the strengthening of infrastructure .

this poeration concerns :

1) reinforcement of the main runway 01 / 19 : 3000*45 m
2) strengthening of traffic lanes (taxiway) : 2644*25 m
3) reinforcement of the Taxi Track 1, 5, 6 7 : (385,497,471.5,250)*25 m
4) reinforcement of the Taxi Track 8 and 9 : 2*(250*25) m
5) strengthening and widening of the Brettellen9 : (1187*15)*2 m
6) reflection of the rigid part of the military parking lot : 354*16 m2
7) strengthening of intermediate demand(runway 18/36) : 4127.67 m2
8) extension of the plane parking : 119*100 m
9) extension of the Taxi Track 1 : 210 *25 m

The last one was in 2009, so it has been regularly maintained since 2000

II.5 Airport technical card (airport facilities and structures)

There are two runways 01/19 main and 36/18 secondary and the length of one runway is 3000 m with a width of 45 m

Dimensions of the civil parking area are 200*181 =36200 square meters

Dimensions of the military parking area 850*80= 68000 square meters

Length of lanes (taxiway and Taxi Track) :

Taxiway: 2632*25

Taxi Track : 1) 25*626.7 , 2) 25*450 , 3) 25*227 , 4)25*465 , 5) 25*250

II.6 The Buildings

Structures at the airport

- ENNA: National Aeronautics institution.
- EGSA: an institution that manages the interests of airport pilots.
- Air Algeria: Algerian Airlines.
- Border police.
- Naftal Foundation
- Customs
- Reception and Guidance Center

II.7 Runway layers and reinforcements

- Runway 18/36

The secondary runway with a length of 3000 m and a width of 45 m As shown in the following picture (II.2 ,II.3 ,II.4) and the Table (II.01)

Table (II.01) the components of the runway body 18/36

Threshold 36 South Threshold 18 Nort

Length (m)	300	2400	300
Achievement	1986		
Reinforcement	/		
Pavement consistency	-Backfill layer 20cm -Base layer in cement gravel 17cm - cement concrete in 37cm	-Subgrade in Tuf.........20cm -Foundation layer cement gravel....15cm -Base course in asphalt gravel.....12cm -Surface course in asphalt concrete.....08cm	-Backfill layer 20cm -Base layer in cement gravel 17cm - cement concrete in 37cm
PCN(2022)	65 F/A/W/T	49 F/A/W/T	65 F/A/W/T

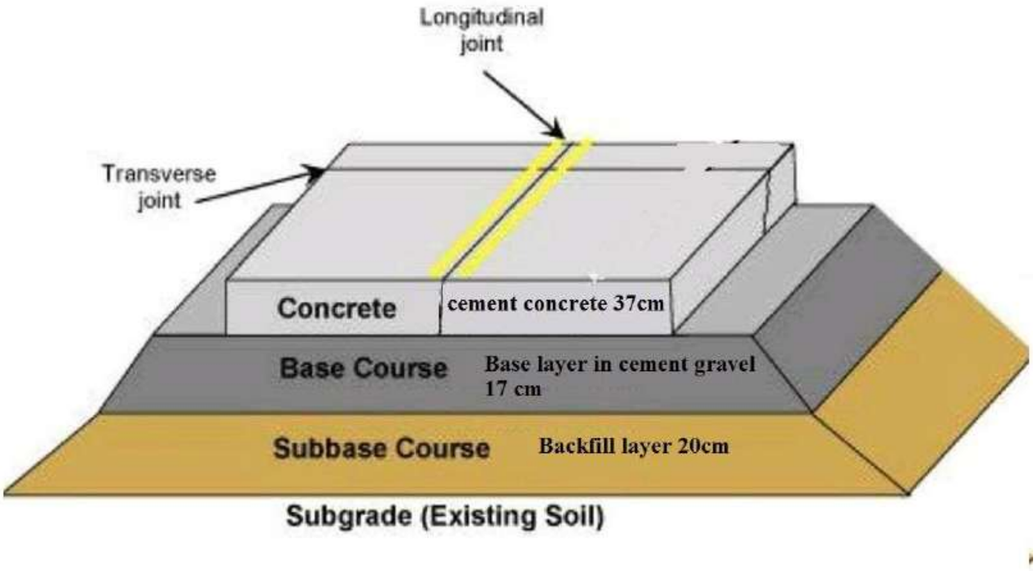


Figure (II.02) Rigid Pavement Layer

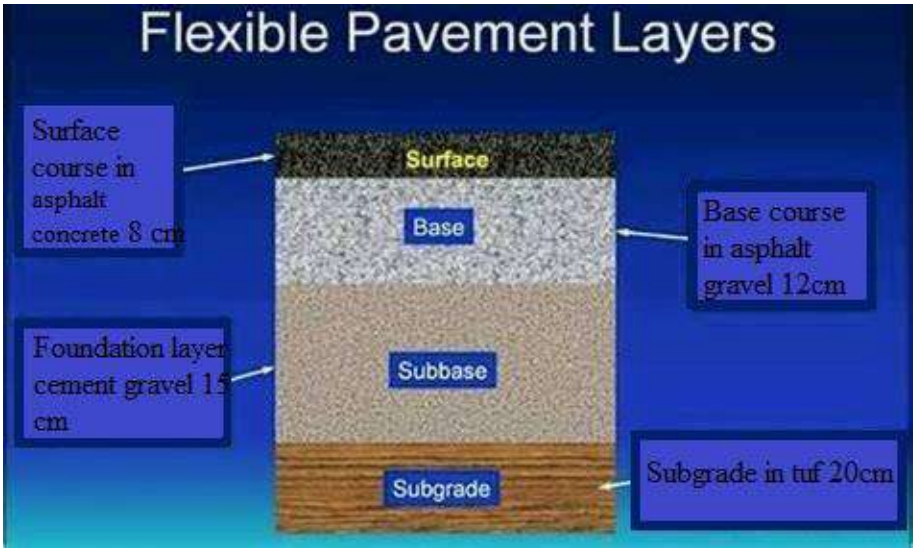


Figure (II.03) Flexible Pavement Layer 18/36

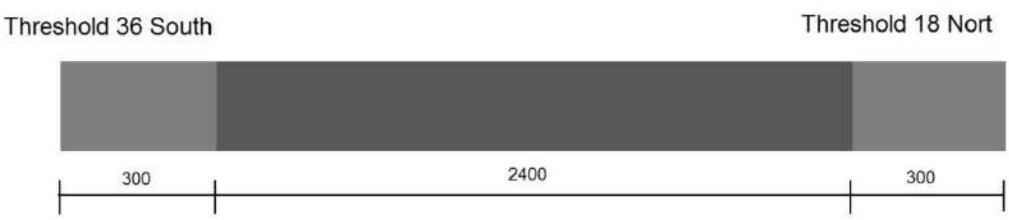


Figure (II.04) Runway18/36

- Runway 01/19

The main runway with a length of 3000 m and a width of 45 m As shown in the following picture (II.5 ,II.6) and the Table (II.02)

Table (II.02) The components of the runway body 01/19

Threshold 01 South   Threshold 19 Nort

Length(m)	0+000…..…300+000	0+300……….……1+300	1+300…………..….3+000
Achievement	1986	1951	
Reinforcement	/	1992+2010	
Pavement consistency	-Backfill layer 20cm -Base layer in GCim 17cm - cement concrete in 37cm	-Subgrade in tuf…...20cm -Foundation layer untreated gravel 15cm -base in asphalt gravel on 10cm -Surface course in asphalt concrete 13 cm	Subgrade in tuf 20 cm Foundation layer untreated gravel 15 cm base in asphalt gravel on 14cm Surface course in asphalt concrete 7 cm
PCN(2022)	45 F/A/W/T	62 F/A/W/T	62 F/A/W/T

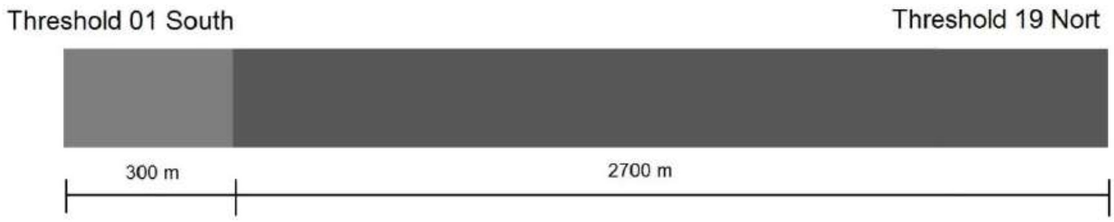


Figure (II.05) Runway 01/19

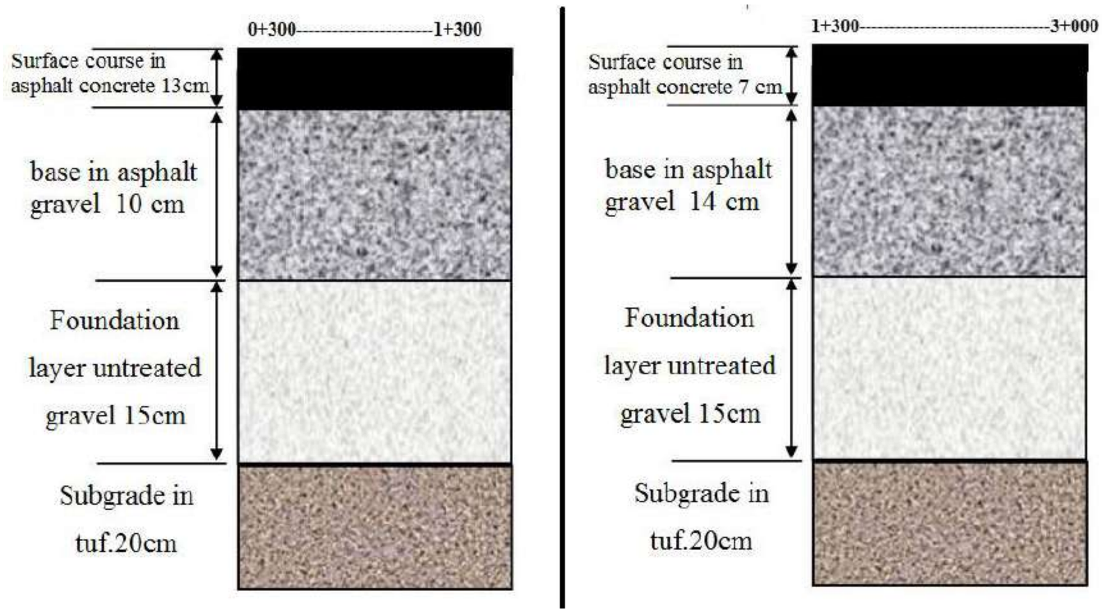


Figure (II.06) Flexible Pavement Layer 01/19

II.8 Lighting

At dusk or poor visibility conditions in the daytime, the lights can be clearer than the ground markings. In order for the lights to be clear in these Conditions or when visibility is poor at night, the intensity of its illumination should be appropriate. To obtain the require illumination intensity, it is usually necessary to direct the lights, and in these Case the Rings for holding the lights should be steerable depending on the operating needs. The runway lights must be considered as an integrated unit to ensure that the intensity of Lighting each of them is suitable for achieving the same goal. As shown in the Figure (II.07)

- Independent methods should be provided to control the intensity of illumination of the following groups of lights so that they can be operated at the necessary different lighting levels:

- Set the approach lights.

- Runway edge lights.

- Runway threshold lights.

- Runway End lights.

- Runway hub lights.

- Contact area lights on the runway.

- Corridor axis lights.

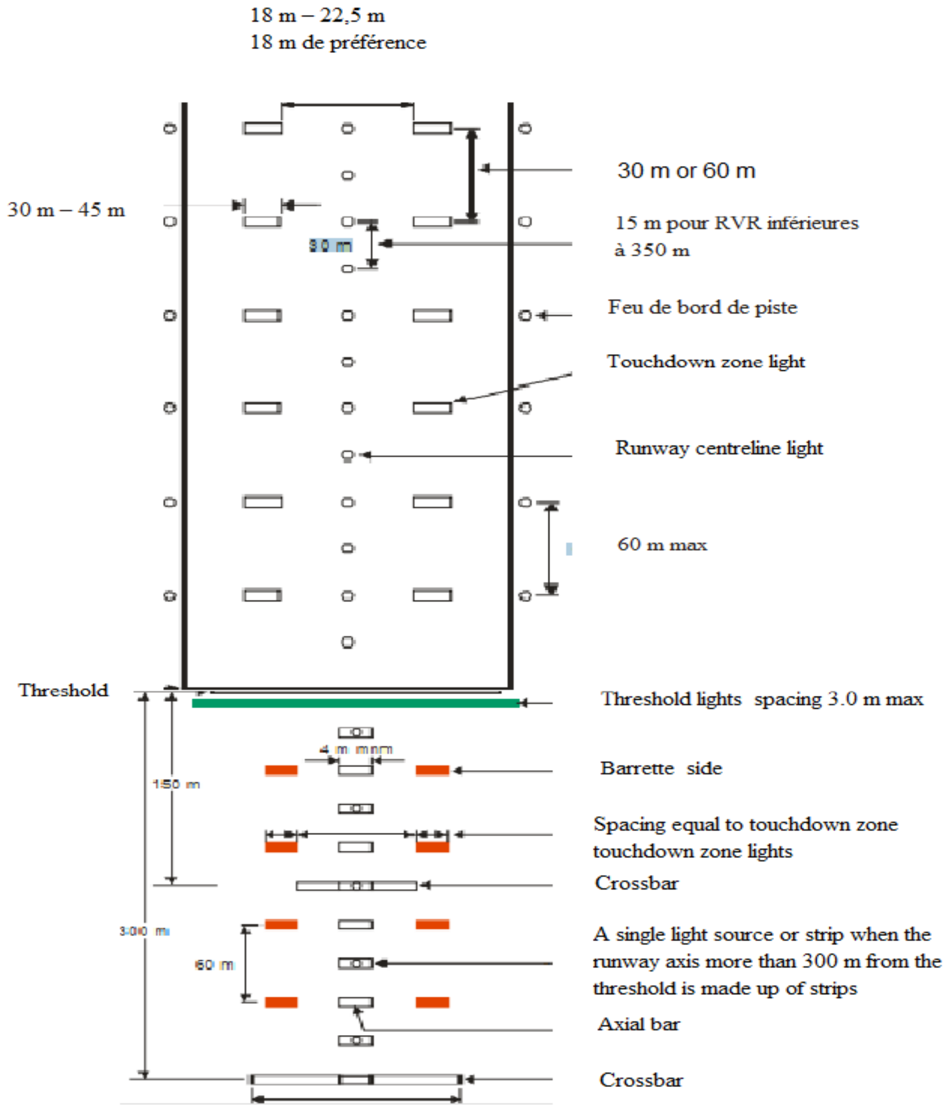


Figure (II.07) Distribution of lighting in the runway

II.9 Identify the problems that occur to the runway

Degradation occurring to the runway to diagnose damage to determine the solution:

II.9.1 Cracks

Cracks appear in the road in different forms Sometimes filling these cracks with liquid asphalt material is the most appropriate solutions, and other times this is necessary to remove all layers of asphalt and install a water drainage system or improve the foundation applied with cement before carrying out any surface maintenance work and therefore must know the causes of the cracks before carrying out repair work.

It is usually noted that cracks generally take the same shape when the causes are the same or at a certain stage of cracking, and the types of cracks are usually divided into the following:

- ✓ Flat fatigue cracks
- ✓ Roadside cracks
- ✓ Spacer cracks
- ✓ Reflective cracks
- ✓ Deflationary cracks
- ✓ Creep cracks

II.9.2 Dents:

Dents are usually formed as a result of a weakening of the underlying layer of the earth, where excessive compression or displacement occurs in the underlying layer of the Earth, or as a result of compression in the underlying layer . Such deformations may be accompanied by various cracks. The more it increases, the more dangerous it is, as water collects in it, and these deformations increase both with time. Among the most widespread types of dents are the following:

- Groove
- Ripples
- Crawl
- landing
- The bulges

1) Groove

Groove is the occurrence of compression in the form of channels in the tire path in the road surface, and it occurs as a result of compression of the road layers due to the weights of the vehicles. As shown in the Figure (II.08)

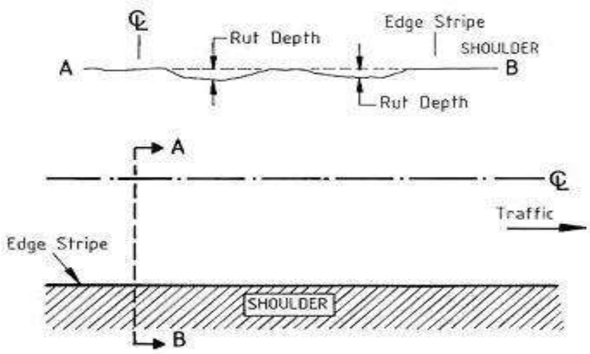


Figure (II.08): Picture for Groove

2) *Ripples*

Ripples are the movement of the asphalt layer to form a Landing and rise on the road surface in the direction of traffic. As shown in the Figure (II.09)

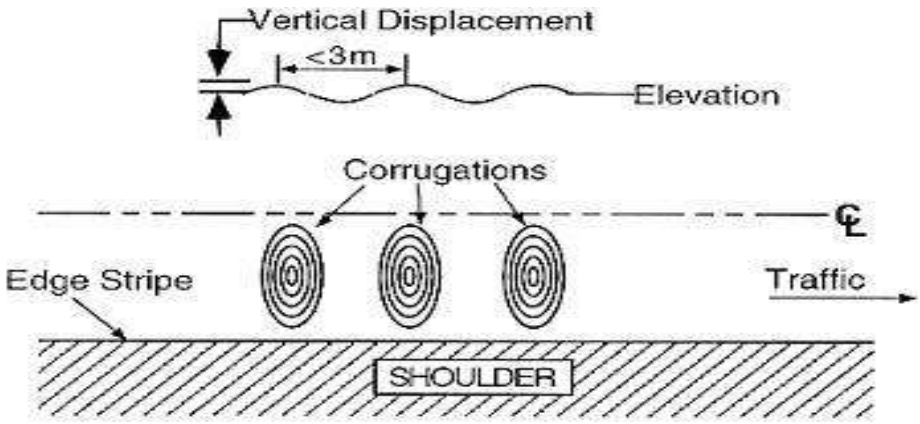


Figure (II.09) Picture for Ripples

3) *Crawling*

Creep is the rubbing of the asphalt surface layer and collecting it in the form of bulge in a specific area. As shown in the Figure (II.09)

Ripples and crawls usually appear in places where vehicles have to apply the brakes.

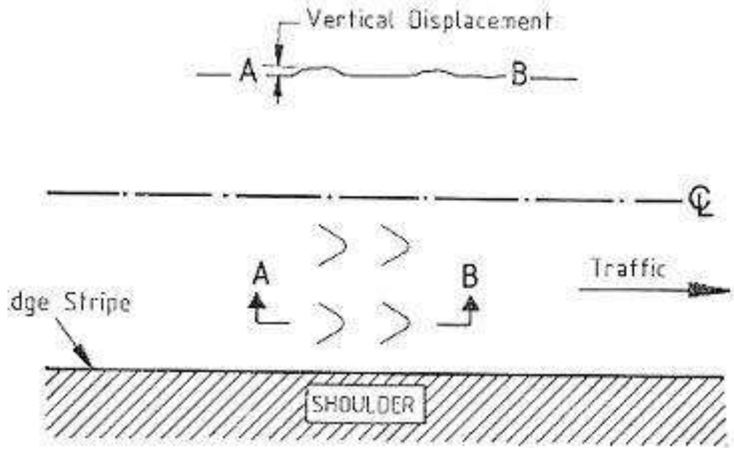


Figure (II.10): Picture for Crawling

4) Landing

Subsidence is usually confined to limited spaces and is sometimes accompanied by cracks. Water collects in the landing leading to general deterioration of the road and the formation of a danger zone for vehicles, which occurs as a result of the use of the road by heavy trucks heavier than the road is designed for, or as a result of poor construction. As shown in the Figure (II.10)

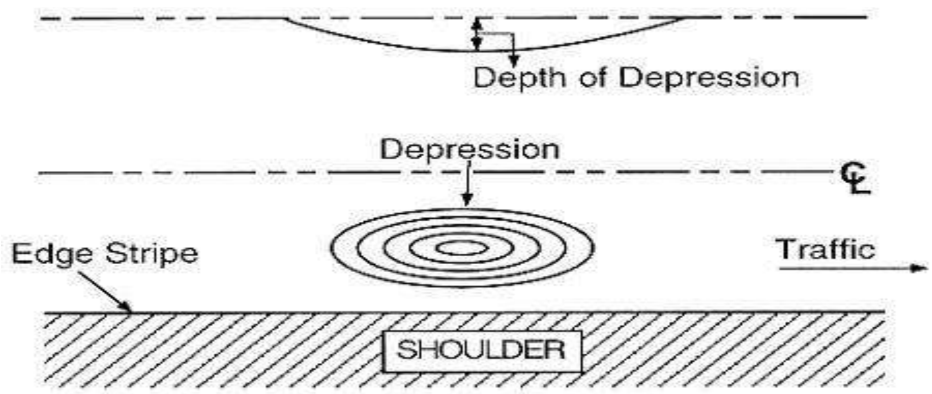


Figure (II.11): Picture for Landing

5) The bulges

Bulges usually occur in confined areas of the road surface and are in the form of an upper vertical displacement, bulges occur as a result of the bulging of one of the Constituent layers of the road. As shown in the Figure (II.11)

Repair is by removing loose material or improving the base layer.

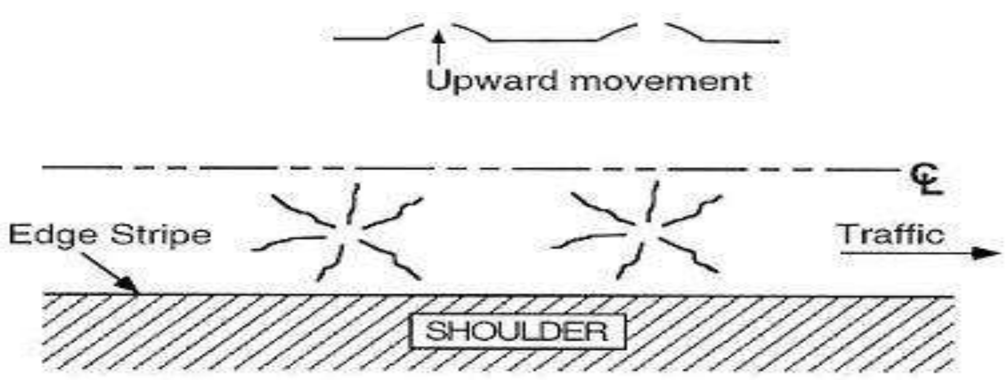


Figure (II.12): Picture for The bulges

II.9.3 Drilling

Potholes are formed in the asphalt layer and are of different sizes, and they are formed as a result of fragmentation that occurs in the pavement layer as a result of traffic .It is usually formed due to a weakness in the base layer as a result of a decrease in the percentage of asphalt in the asphalt mixture, a lack of thickness of the asphalt layer, an increase in fine gravel, or less, or poor water drainage and in the late stages of fatigue cracks . The temporary solution is to clean the pits and patch them with a pre-mixed asphalt mixture . The permanent solution is a deep patchwork. As shown in the Figure (II.12)

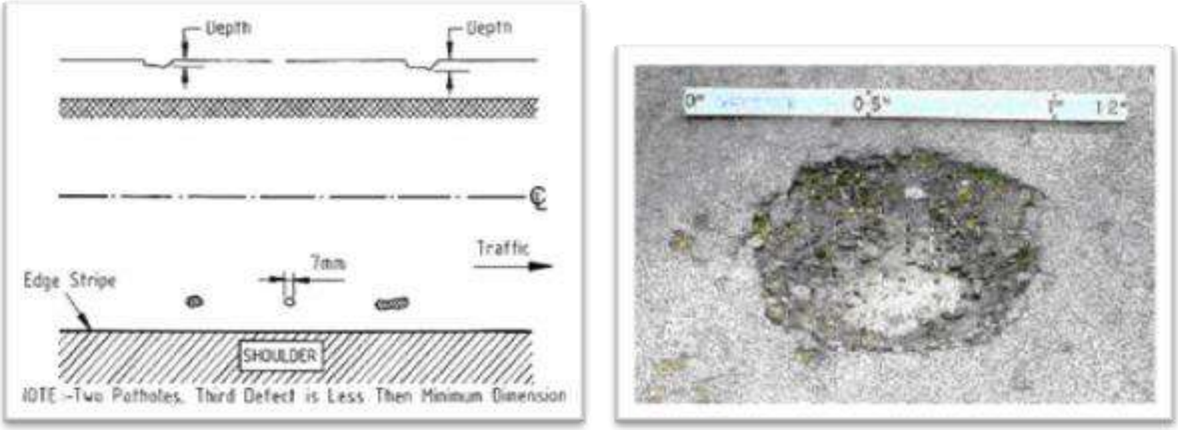


Figure (II.13): Picture for drilling

II.9.4 Corrosiveness

Wear is a constant loss of the asphalt surface layer of its constituent materials as a result of weather conditions or tire friction . Fine gravel usually flies first, leaving small spots and voids in the road surface, and with the continuous friction process, the pieces of coarse gravel begin to fly, leaving a high-rough asphalt surface . Volatilization occurs as a result of poorly constructed roads due to poor gravel quality, or due to improper mix design and spraying the road surface with a layer of asphalt emulsion in the initial stages of volatilization leads to stopping the volatilization process . However, sometimes it is necessary to treat the road surface by applying a layer of asphalt mortar, using asphalt cover mixed with fine gravel, or even laying a layer of hot asphalt mixture, depending on the state of volatilization and traffic volume

Figure (II.14) pavement in the time "corrosiveness"

II.9.5 Rubber layer

When aircraft land on the runway, the wheels are not in rotation, but begin to rotate after touching the runway, and due to the weight of the aircraft on them, the wheels lose a layer of rubber at each landing.

This layer adheres to the floor of the beginning of the runway, and with the increasing amount of rubber, the runway begins to lose friction, which may cause aircraft to slip, especially when it is wet with water, the airport authorities close the runway periodically for maintenance once or twice a week for a few hours to remove the rubber layer

Figure (II.15): Rubber layer

II.9.6 Roughness of the road

The runway loses its roughness over time and for several reasons, which leads to the failure of the bird's tires to stick to it, causing it to slip and the plane to exit the runway

II.9.7 PCN runway has changed over time :

The runway loses its ability to withstand weights over time, and the thoughtless use of the runway increases the speed of its deterioration

II.10 The types of frequent devices

Types of aircraft received by Ouargla airport

- ✓ ATR7-500, 600
- ✓ B737-600, 700, 800
- ✓ C130
- ✓ C295
- ✓ IL76, 78

- ✓ BE1900, 200
- ✓ B350

II.11 Average number of aircraft movements per month at the airport

We take the year 2018 to calculate the average aircraft movement at the airport, the table (II.03) shows more.

Table (II.03) movements in the Airport 2018

Month	January	February	March	Avril	May	Joan	Total
Number of traffic	388	349	390	345	360	316	2148
Month	July	August	September	October	November	December	/
Number of traffic	386	384	389	346	337	337	2179
/							4327

$$A = \frac{4327}{12} = 360.5$$

Average number of flights per month 361 Aircraft per month

II.12 COMPONENTS OF PAVEMENT MAINTENANCE MANAGEMENTSYSTEM

This diagram shows how to manage the maintenance of pavement

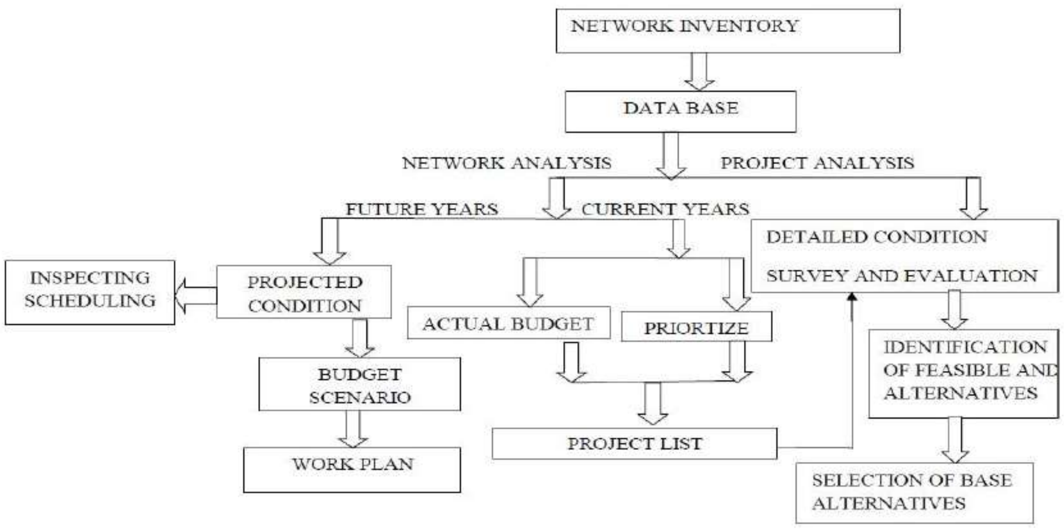


Figure (II.16): Components of pavement maintenance system

II.13 Major maintenance operations carried out on the runways

II.13.1 General maintenance

In general maintenance:

- Removing weeds from the edges of the runway
- Removed obstacles
- Cleaning the runway from sand in case of its presence
- Repainting runway marks

II.13.2 Maintenance of flexible pavements

The maintenance process is carried out according

Clogging of Cracks

Improve pavement roughness

Renovation of runway markings

Rubber Removed

II.13.3 Maintenance of rigid pavements

The maintenance process is carried out according to:

Partial or complete reconstruction of a slab

Fixing the spacers between the tiles

Chapter III

Maintenance

III.1 Introduction

The road network is exposed to many factors that lead to the deterioration of its operational and structural condition with increasing age, and this deterioration is slow at first the road life, then acceleration increases with increasing the road life, the road condition descends from excellent to very good, then to good until contact to good condition, and during this period the beginning of maintenance is a duty any delay in maintenance below this level will lead to deterioration of its condition The road is fast and reaches a weakening of the deteriorating condition at a good level and significantly increases the cost of maintenance and reaches four and five times the cost if fasting is done at the sites of a good level road, then it is necessary to follow the exact new cases to determine the type of periodic maintenance needed by the timing and type of remedial maintenance of roads .

III.2 Definition of periodic maintenance

Maintenance and repair of airport buildings and facilities, take-off and landing runways and aircraft taxiways in accordance with internationally accepted standards, ensuring proper maintenance of buildings, facilities and other administrative units located within the airport yards and ensuring their use in accordance with safety standards

III.3 Importance of maintenance

Maintenance is carried out for many reasons, including

- Ensure security on Landing and take-off
- Extend the shelf life of the runway
- Taking into account the sensitivity of military aircraft and avoiding the scattering of gravel and forming a danger to them

III.4 Critical elements of runway preservation

We mention some of them

1. Determination of the monitoring method
2. Determining the cause of the problem
3. Identifying and applying the correct treatment(s)
4. Determining the correct time to do the needed work
5. Observing performance

III.5 Types of maintenance

III.5.1 Preventive maintenance

It is a strategy for surface treatments and Operations aimed at delaying progressive failure and reducing the need for Routine maintenance and service activities.

III.5.2 Corrective Maintenance

Corrective maintenance differs from preventive maintenance primarily in cost and timing. While preventive maintenance is performed when the pavement is still in good condition, corrective maintenance is performed when the pavement is in need of repair, and is therefore more costly.

performed after a deficiency occurs in Pavement, such as loss of friction , moderate to severe tearing, or Large-scale cracking

III.5.3 Emergency Maintenance

This maintenance activity may be performed during an emergency situation, such as when a blowout or severe pothole must be repaired immediately, generally for safety reasons, or to allow for traffic to use the roadway.

Emergency maintenance also describes those treatments that hold the surface together until a more extensive rehabilitation or reconstruction treatment can be accomplished.

When emergency maintenance is needed, some of the typical considerations for choosing a treatment method are no longer important. Cost may be the least important consideration, after safety and time of application are considered. Materials that may not be acceptable when used in preventive or corrective maintenance; activities, for cost or long-term performance reasons, may be highly acceptable when used in an emergency situation

III.6 Maintenance methods and equipment

III.6.1 Rubber layer

To remove the rubber layer, there are several ways to remove these residues, including using hot water under very high pressure to take off the rubber by force, this method is considered non-chemical and depends on water pressure only, another way is to use chemicals to dissolve these residues, then they are removed with ordinary water, and there is also a saving way is spraying sand strongly.

Figure (III.01): A device for removing the rubber layer with chemicals or hot water

Figure (III.02): A device for removing the rubber layer by strongly spraying sand

III.6.2 Cracks

The required equipment is provided on site before the start of work :

- Hand-or machine-operated coarse broom
- Emulsion asphalt spraying
- Small hand tools
- Rollers when needed
- A tool for straightening the asphalt layer when needed
- A carving tool or a mechanical router for cleaning cracks
- Air pump.

Working principle:

The cracks are cleaned of dust by an air pump or a broom

Cracks are clogged with pre-made asphalt emulsion

Removing and sculpting the damaged part and reshaping the asphalt layer

Deep patching: it consists of removing the asphalt layer and the foundation layers down to the natural earth layer and reshaping new layers.

III.7 Applied part

We went out to the airport to lift the deterioration, as part of the regular maintenance and we got these diseases:

Table (III.01) Table representing the degradation in pavements

Mesh Number Flexible Pavement			1	2	3	Mesh Number Rigid Pavement			1	2	3	4
1	flache	L	470	20	20	1	Oblique longitudinal transverse crack	L	1	1		1
		M						M				
		E						E				
2	Joint fissor	L	64	102	102	2	Corner crack	L	2	1	1	1
		M						M				
		E						E				
3	Gum depot (rubber)	L	160	170	170	3	Joint defect	L	1		1	
		M						M				
		E						E				

Applied work of the laboratory in reality

It was as follows

Within the framework of agreement No. 256/2012 concluded with the Department of Public Works in the state of Ouargla (D.T.P) on monitoring the behavior of Ouargla airport; the public works Laboratory in the South conducted this study and submitted a brief report on it.

Laboratory intervention can be summarized by the following steps:

- Measurement of roughness using a friction pendulum
- Completed 156 four-wheel drive deflection measurement tests at the level of the main runway 01/19 in 06 profiles ؛

- Completed 84 HWD deviation measurement tests at the taxi level on 06 profiles ؛
- Completion of 8 tests measuring deviations at HWD on the Taxi Track axis N ° = 8 and 9
- Data processing using the Elmod6 program ؛
- Tracking smoothness measurement
- Drafting of this report.

Visual inspection of the aerodrome pavements

Optical scanning consists in dividing the airport traffic zones into grids of the same surface with an area of (25 × 45) square meters.

In accordance with the recommendations of the S.T.B.A. catalogue, each degradation is listed using the following triplet of information: the type of degradation (twenty-two types used for flexible pavements, ten for rigid pavements)

- Type of decomposition: according to the above types.
- Level of severity: mild (L), medium (M) or high (E).
- The density of degradation in the mesh under consideration, measured by a characteristic surface characteristic of each type of degradation..

Table (III.02): All the deterioration that happens to the pavements

	Damage revealing a structural defect	Damage revealing a surface defect
Flexible pavement	Flache Rut Fatigue crack Deformation in W Swelling Differential settlement Upwelling Rising fines	Decoating - Burn Joint crack - Pothole Shrinkage crack - Pelade Damaged repair Contamination Gum deposit Punching Penetrant testing
Rigid pavement	Crack Fracture Corner crack Pumping Offset walk	Spalling Faiencing - chipping Degraded punctual repair Gasket defect (Joint defect) Gum deposit

A visual survey of the damage caused to the track during the walk was carried out. The purpose of this step is to assess the state of deterioration of the main path, identify the possible causes of this deterioration, which will help to propose the most appropriate solutions to the problems are Existing.

In our course, we observe light and medium cracks of several types of decomposition, presented in the form of articular cracks and dislocations, deterioration of various degrees is determined, the table above summarizes the amounts of cracks as well as their level of gravity:

Table (III.03): Severity of deterioration

Elevated(High)	Medium	light	Unity	Degradation
0	389	542	M^2	desenrobing
70	940	2546	D	Gumdeposition
0	18	0	M^2	Porous Enrobé
0	20	10	M	Fatigue crack
20	1989	422	M	Longitudinal joint crack
0	0	1	M^2	Parabolic cracks
2	1	3	D	Punctualrepair

From the results of the table note that most of the cracks are mild to medium degree articular cracks.

Calculation of the service index

The service indicator is a digital indicator that can take values between 0 (out-of-service route) and 100 (new route), and the service indicator is calculated using the SGBA program based on the visual record of damage to each network.

The runway Service Index is the average Service Index for each of the component links.

- IS Global :

Index calculated from the treatment of all the deteriorations encountered on the pavement. pavement, giving its overall condition.

- IS Structural :

Service index calculated from the treatment of structural deterioration encountered on the pavement.

to assess the condition of the pavement, revealing a bearing capacity defect.

- IS surface:

Service index calculated on the basis of surface deterioration encountered on the pavement.

To assess the surface condition of the pavement Table (III.04) shows pavement condition for each service index:

Table (III.04): the pavement condition for each service index range

Service coefficient in %	Service Level
0-10	Out of service (bad)
10-25	Verybad
25-40	Bad
40-55	Acceptable
55-70	medium
70-85	Good
85-100	Very good

For the main runway 01/19 of the Ouargla aerodrome the service indices for each mesh are distributed as follows in the table (III.05):

Table (III.05): the service for each mesh For the main runway 01/19

Number of parts	Service Level
0	Out of service (bad)
0	Very bad
0	Bad
0	Acceptable
0	medium
57	Good
78	Very good
135	Total

Total (track average) = 84

Structural (track average) = 99.85

Surface (average runway) = 84.04

Interpretation of the results:

To qualify the condition of the pier and in order to justify the strengthening or non-strengthening of the airport, it is necessary to go through the following flow chart, which is considered a general principle of the management system:

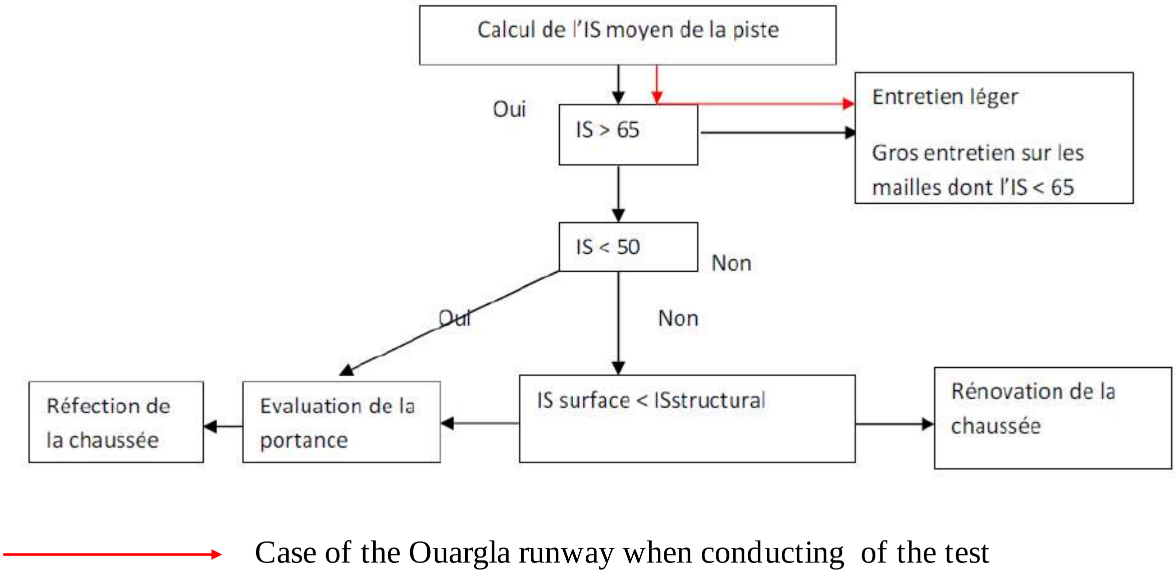


Figure (III.03): Qualify the condition of pavement

From the interpretation of the results of the service indicators, note that route will require light maintenance

LIFT MEASUREMENT

Description of the HWD acquisition device (heavyweight deflection meter)

The HWD is a non-destructive Tester designed to reproduce the load corresponding to the wheel of an airplane or a vehicle on the road, by impacting the disc in contact with the pavement.

HWD is designed to measure the basin of deviations caused by the fall of the mass applied to a plate (from a diameter of 30 cm). It consists of a Trailer trailer carrying The nine weight bearing elements Geophones and control system Automation, acquisition and processing From the information included in Towing cart. After a stay for the trailer to the right of the point Measure, the mass is released from the height which can vary from 2 to 40 cm Variable power from 30 to 260 KN.

The drop height and the applied force are fixed according to the nature of the structure tested. The load is transmitted by a spring whose constant rigidity makes it possible adjust the charging time. The nine sensors (one of them is in the center of the plate) record the longitudinal deformation at a distance of approximately 1.8 m from the point of application of the load. For road structures, the load characteristics are adjusted to obtain a pulse with duration of 25-30 ms. HWD can be used on flexible, semi rigid or rigid sidewalks. The Figure (III.04) shows more.

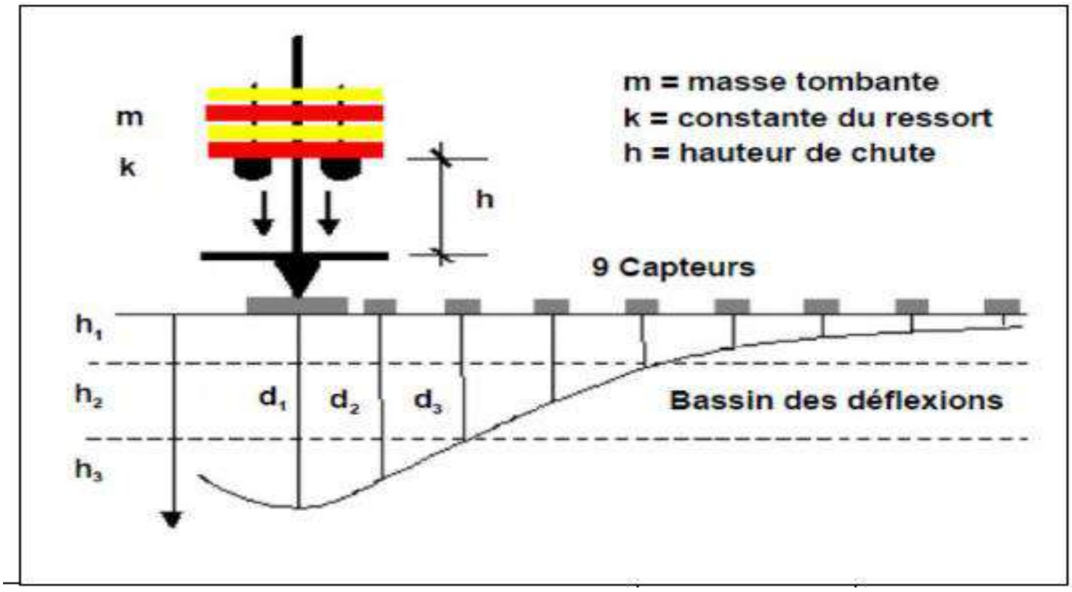


Figure (III.04) The HWD acquisition device (Heavy Weight Deflectometer)

Intervention plan

During the tests, the car is frozen and the tests are generally carried out in the path of the outer wheels on the right. The specific information of the project such as the location of the site, tests, configuration of geophones, frequency of tests should be specified and separated in advance with the project manager. The various commands necessary for conducting tests are executed from inside the car by a computer connected to the acquisition system. The duration of the test is a few minutes, and more than 100 measurement points can be made per working day. The table below summarizes the number of profiles made on the runway, runway and runway ramps 8 and 9.

Main runway 01/19

Table (III.06): Lift measurement Main runway 01/19

Number of points	Interval of measurement in m	Position/axis In ml	Domain	Profile
44	60	3.5	Runway	Profile 3.5 D
44	60	3.5		Profile 3.5 G
22	120	06.5		Profile 06.5 D
22	120	06.5		Profile 06.5 G
12	240	12		Profile 12 D
12	240	12		Profile 12 G
156	Total important points			

Taxiway

Table (III.07): Lift measurement Taxiaway

Number of points	Interval of measurement in m	Position/axis In ml	Auscultatedarea	Profile
23	120	3.5	taxiway	Profile 3.5 D
23	120	3.5		Profile 3.5 G
12	240	06.5		Profile 06.5 D
12	240	06.5		Profile 06.5 G
07	480	12		Profile 12 D
07	480	12		Profile 12 G
84	Total important points			

Taxi Track 8 and 9

Table (III.08): Taxi Track 8 and 9

Number of points	Interval of measurement in m	Position/axis In ml	Auscultated area	Profile
05	30	0	Taxi Track	Taxi Track 8
03	30	0		Taxi Track 9
08	Total important points			

Measurement of deflections

Pavement deflection is the term used to describe the movement (vertical displacement measured at the surface) of the pavement under a load. measured at the surface) of the pavement under a load. Deflection is defined in units of length. This measured parameter is used to assess the bearing capacity of the pavement, as expressed by therein for cement and PCN calculations.

The deflections recorded in a database correspond to 02 successive dropsof a 700 kg weight at two different drop heights. The second fall will be taken into data analysis stages. The deflections recorded are presented resented in tabular and graphical form

Interpretation of results

Main runway deflections

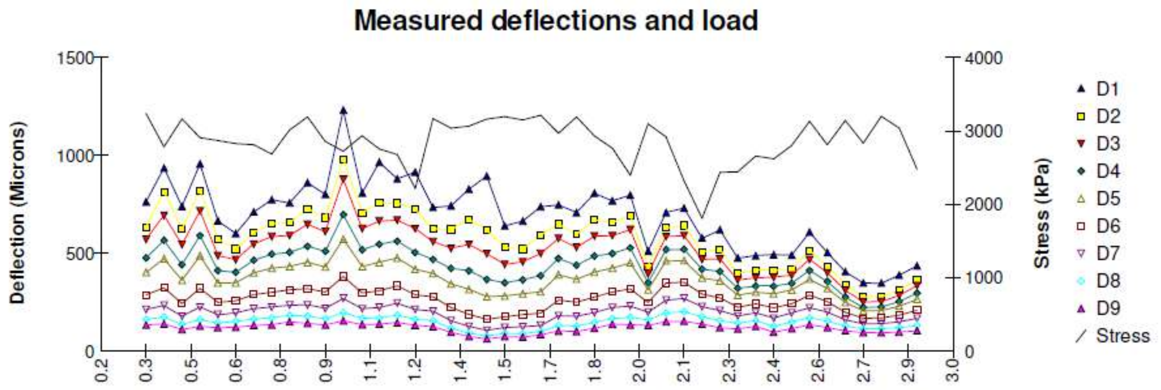


Figure (III.05): PP- 3.5 ml -right

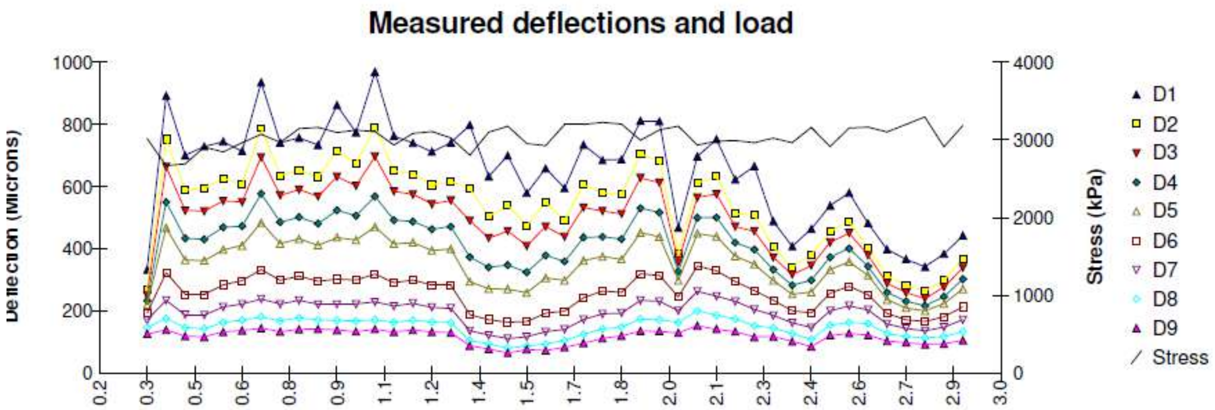


Figure (III.06): PP- 3.5 ml -left

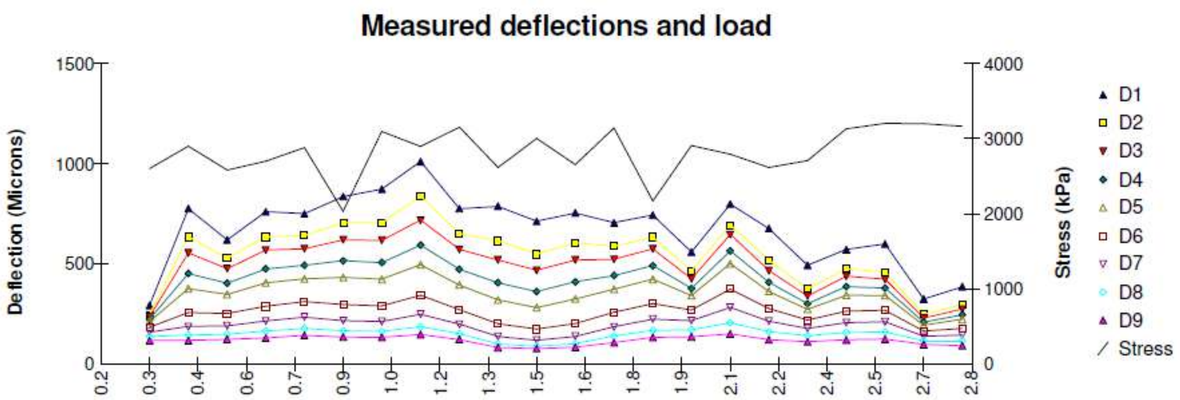


Figure (III.07): PP- 6.5 ml -right

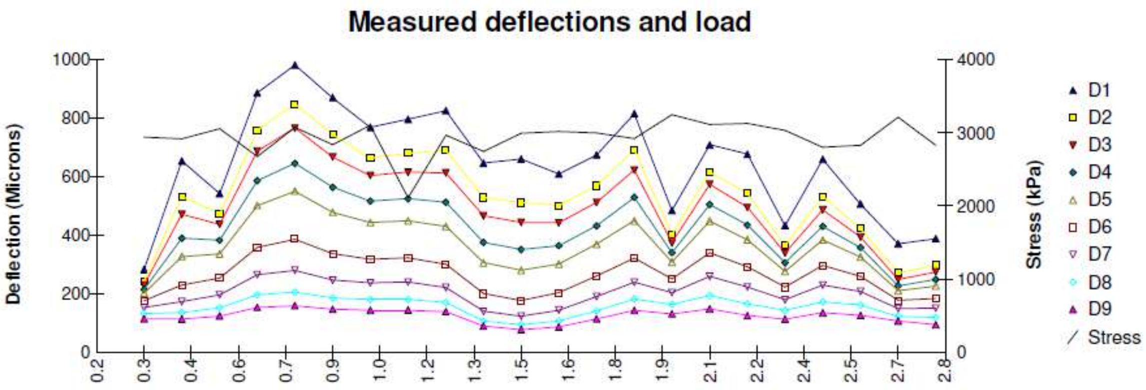


Figure (III.08): PP- 6.5 ml left

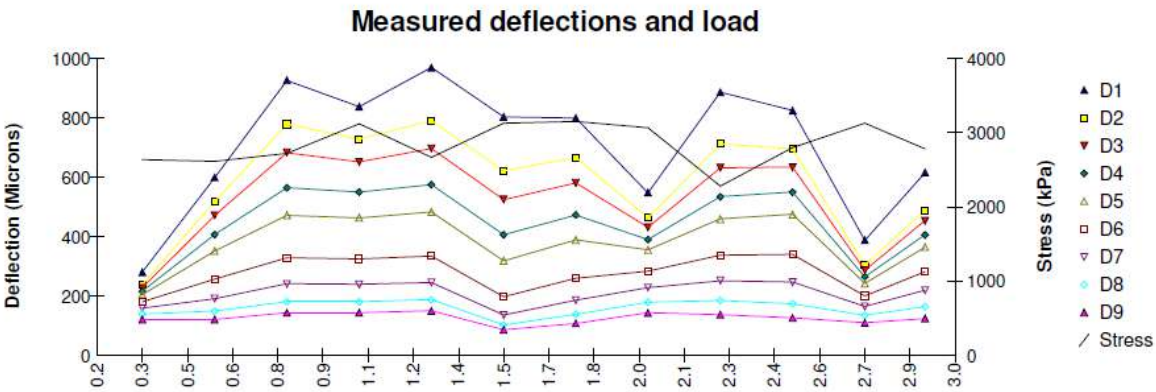


Figure (III.09): PP- 12 ml -right

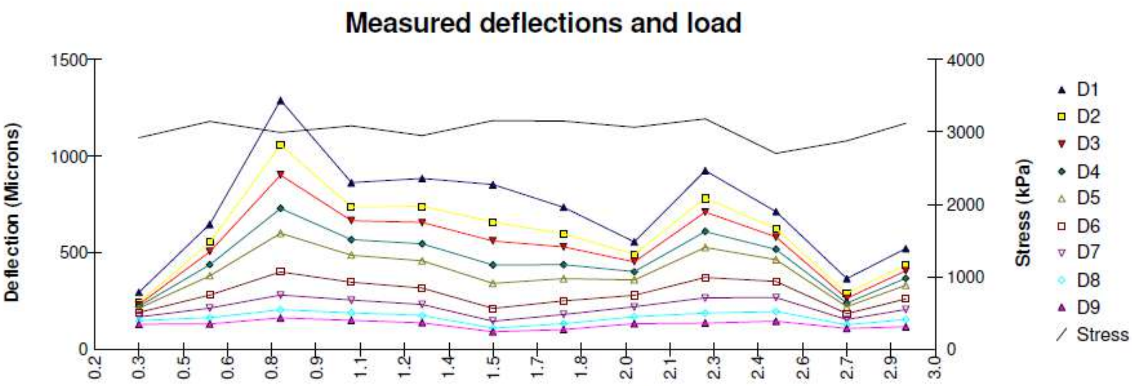


Figure (III.10): PP- 12 ml -left

In summary, the average deviations recorded on all profiles of the main runway are shown in the table (III.09):

Table (III.09): average deflections of the main runway

Distance of the geophone from the center of the loading plate en(mm)									The Section
2250	1800	1500	1200	900	600	450	300	0	
Average deviation µm									
120	150	197	264	369	433	516	582	695	3.5 M D
118	148	193	256	352	411	484	541	651	3.5 M C
119	149	194	257	355	414	490	550	673	6.5 M D
124	155	202	267	363	420	489	540	647	6.5 M C
127	161	210	278	383	446	524	585	707	12 M D
129	164	216	288	396	460	539	601	720	12 MJ
123	155	202	268	370	431	507	567	682	The rate
118	148	193	256	352	411	484	540	647	The lowest
129	164	216	288	396	460	539	601	720	The greatest
122	152.5	199.5	265.5	366	426.5	503	566	684	Average

According to the diagrams above (Figure 01-06), the deviations measured along the main runway in the profiles 06 (six) clearly highlight two distinct sections. The first is limited between PM 0.00 and PM 2300. It has relatively average deviations ranging from 333 to 1994 micrometers, from PM 2300 to PM 3000 small deviations are recorded not exceeding 609 micrometers. The average values obtained reflect that the path between PM 2300 and PM 3000 is stronger than the first segment

Defluxions du Taxiway

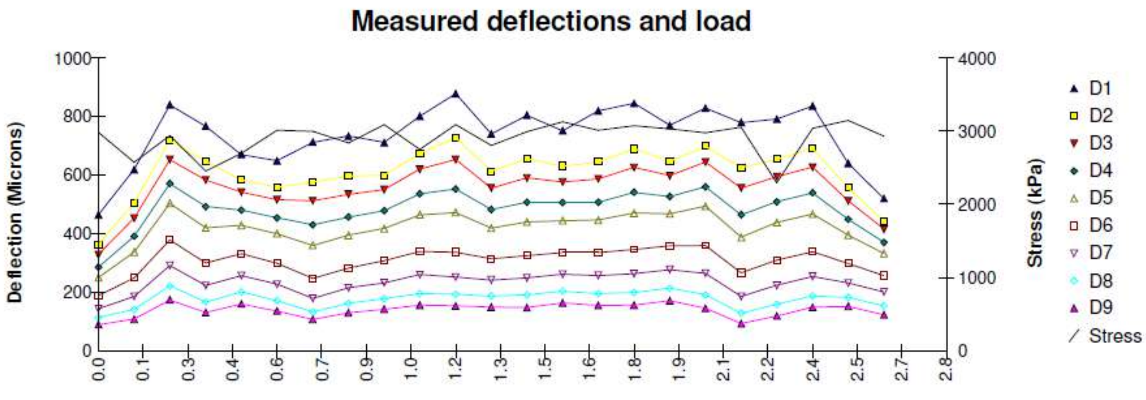


Figure (III.11): TXW- 3.5 ml -right

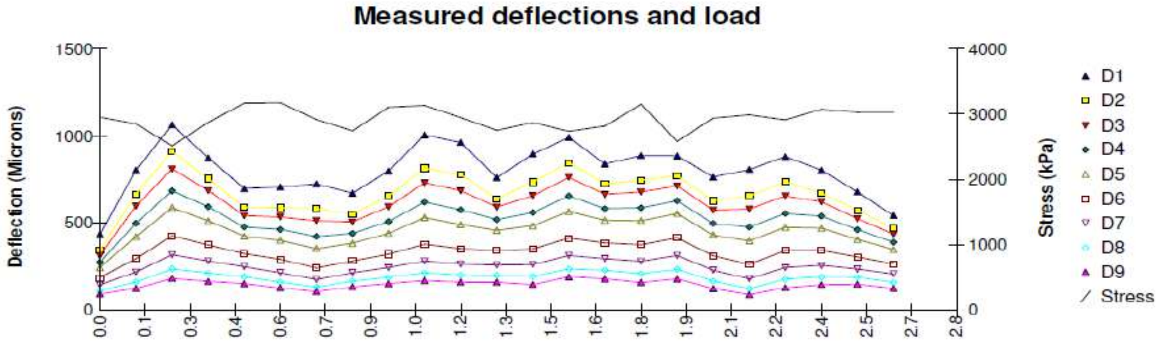


Figure (III.2): TXW- 3.5 ml -left

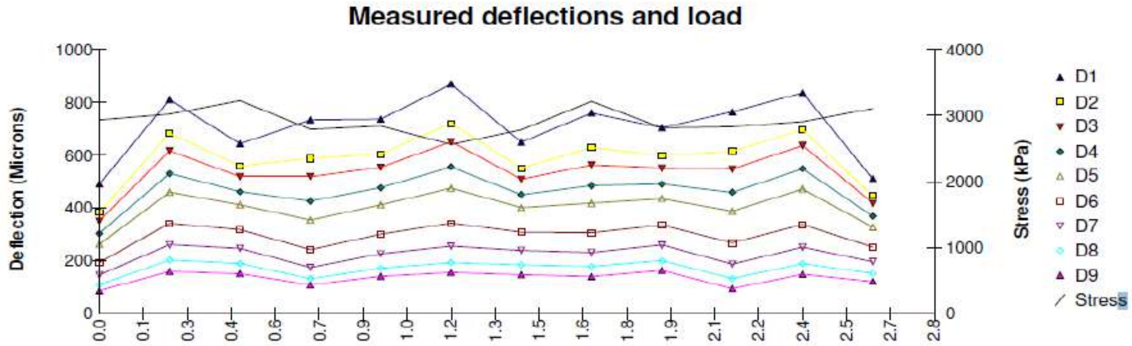


Figure (III.13): TXW- 6.5 ml -right

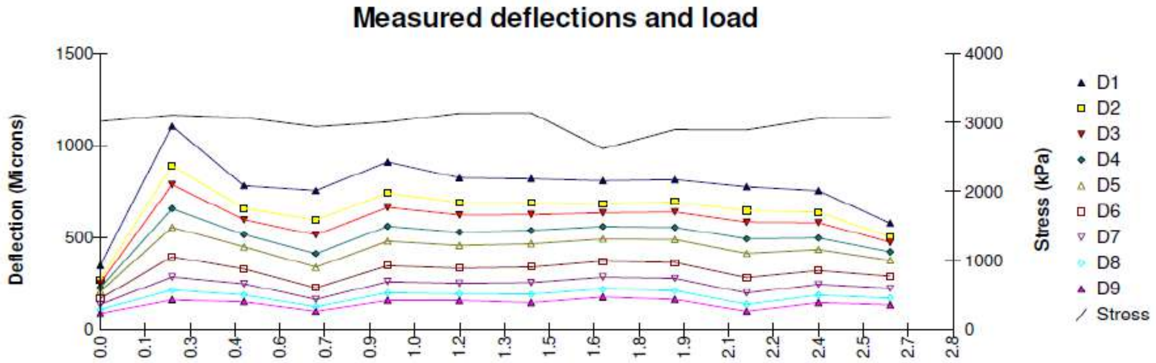


Figure (III.14): TXW- 6.5 ml – left

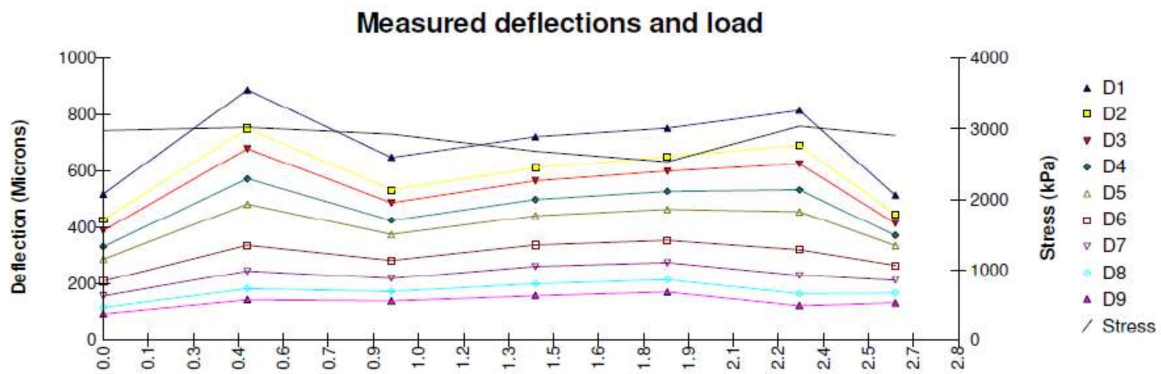


Figure (III.15): TXW- 12 ml – right

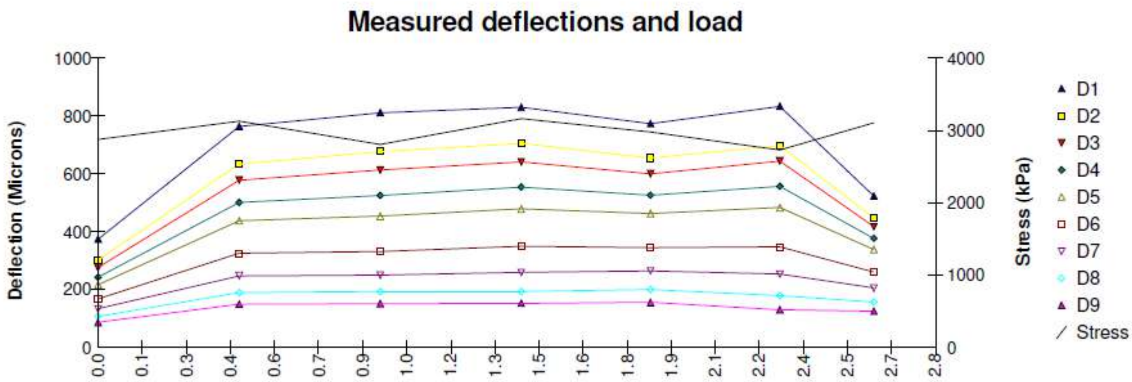


Figure (III.16): TXW- 12 ml – left

The average deflections recorded on the Taxiway profiles are given in the table below.

Table (III.10): average deflections of Taxiway

Distance of the geophone from the center of the loading plate mm									The Section
2250	1800	1500	1200	900	600	450	300	0	
Average deviation µm									
140	177	234	309	416	482	258	613	737	3.5 M D
146	187	248	330	453	522	607	670	803	3.5 M G
135	170	223	295	402	463	563	589	709	6.5 M D
140	178	236	313	429	497	580	641	772	6.5 M G
137	174	229	301	406	466	537	587	694	12 M D
136	174	231	304	410	469	539	588	702	12 M G
139	177	234	309	420	483	560	615	736	The rate
135	170	223	295	402	463	536	587	694	The lowest
146	187	248	330	453	522	607	670	803	The greatest
138.5	175.5	232.5	306.5	414.5	475.5	548.5	601	723	Average

The average deflection values recorded at the geophone near plate D0 varied between 434 and 1063 µm for the Taxiway profiles (3.5 D and 3.5 G), reflecting a pavement with good bearing capacity.

Deviations of Taxi Track 8 and 9

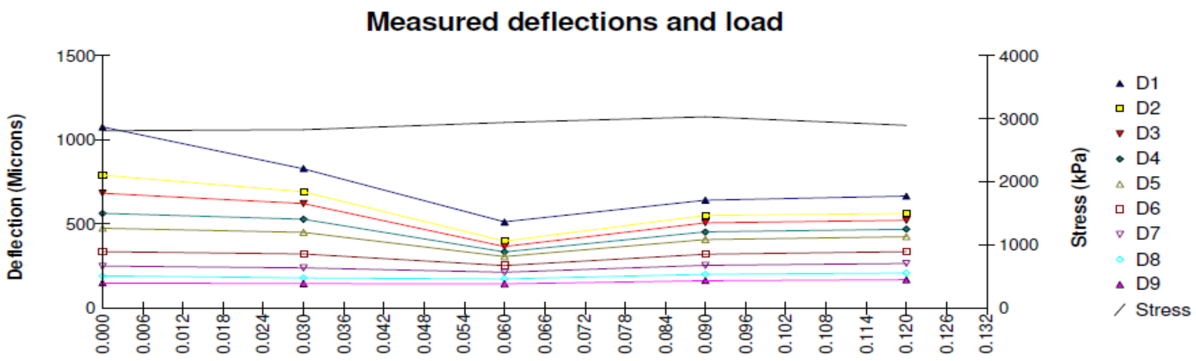
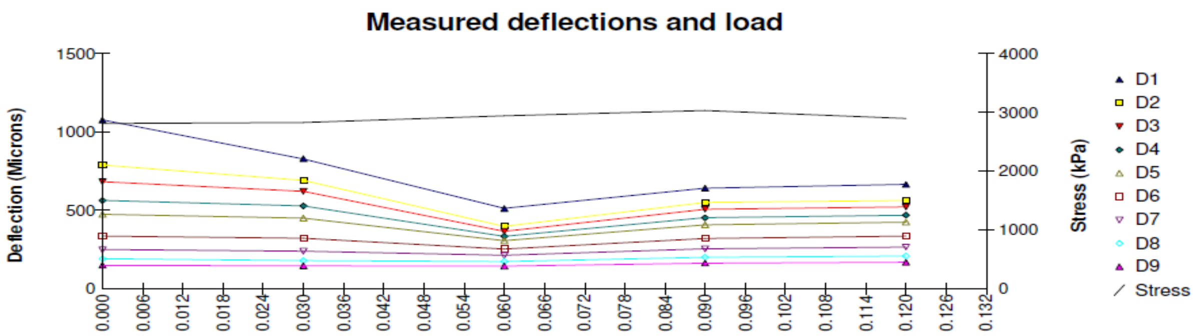


Figure (III.17): BRT 8- AXIS



(Figure III.18): BRT 9- AXE

The average deviations recorded on two parking ramps are presented in the following table the details of the profile are given in the appendix:

Table (III.11): average deflections of Parking

Distance of the geophone from the center of the loading plate mm									The Section
2250	1800	1500	1200	900	600	450	300	0	
Average deviation µm									
154	190	244	312	412	496	539	589	744	Brettelle 8
130	161	209	271	358	407	466	509	599	Brettelle 9
142	175.5	226.5	291.5	385	438	502.5	553.5	671.5	The rate
130	190	209	271	358	407	466	509	599	The lowest
154	190	244	312	412	469	539	589	744	The greatest
142	175.5	226.5	291.5	385	438	502.5	553.5	671.5	Average

The average deviation calculated on all the values recorded by the central geophone varies from 599 to 744 microns, and it is noted that the three points of each slope represent the average deviations.

Unit of area

Runaway

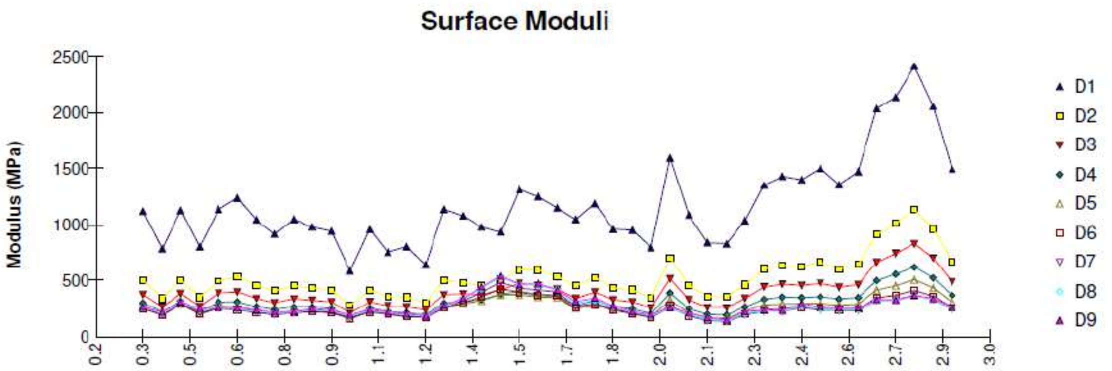


Figure (III.19): PP Profile 3.5 m right side

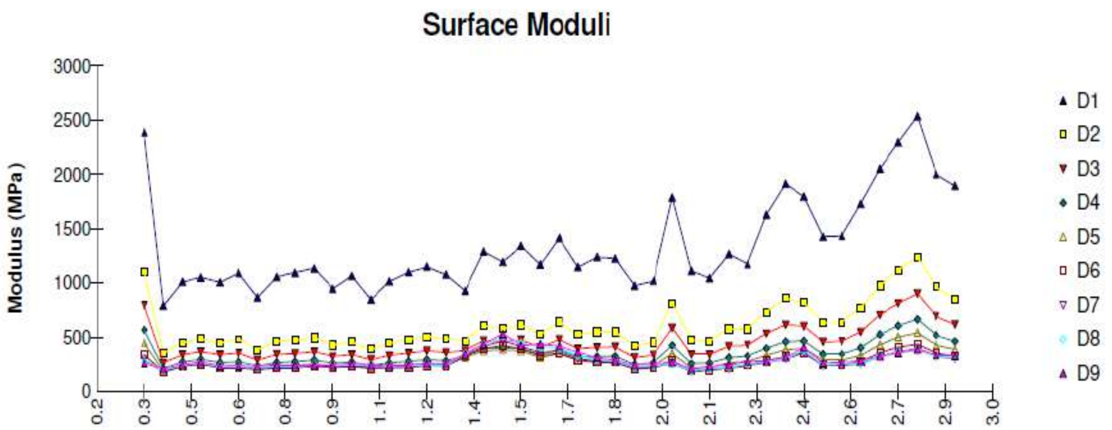


Figure (III.20): PP Profile 3.5 m left side

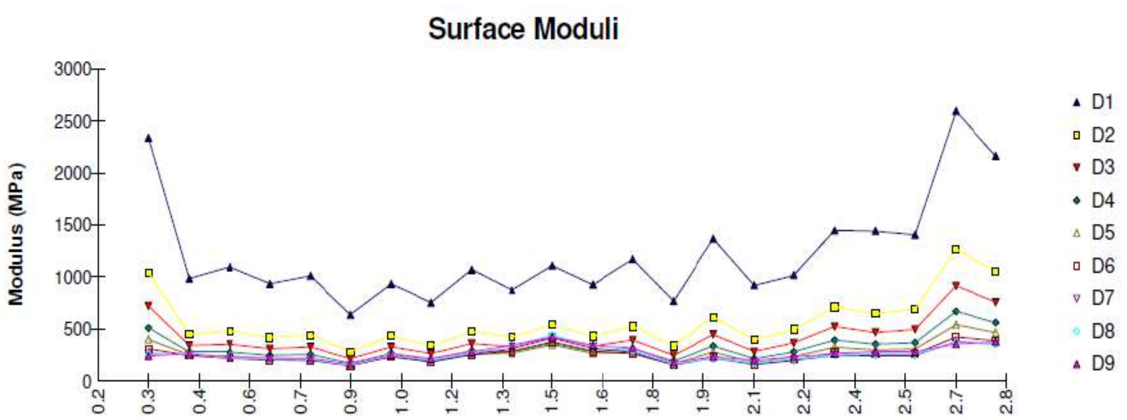


Figure (III.21): PP Profile 6.5 m right side

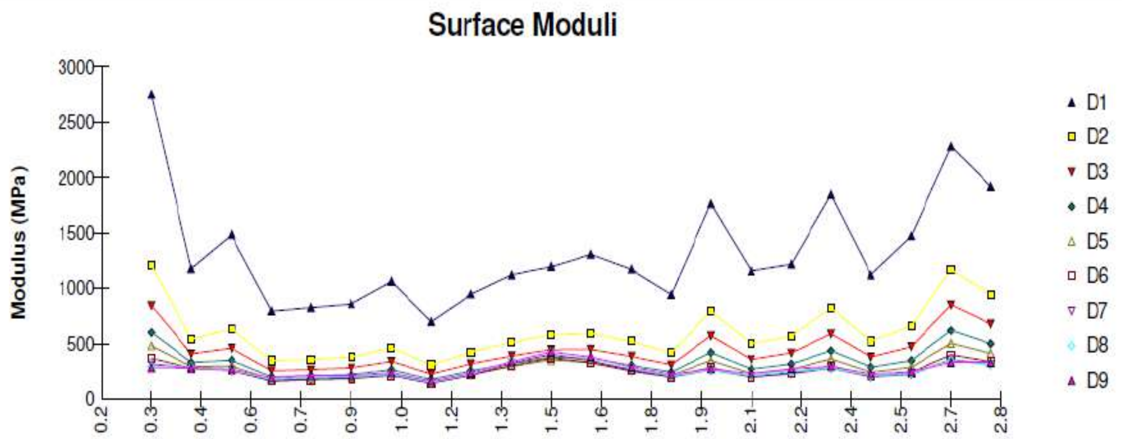


Figure (III.22): PP Profile 6.5 m left side

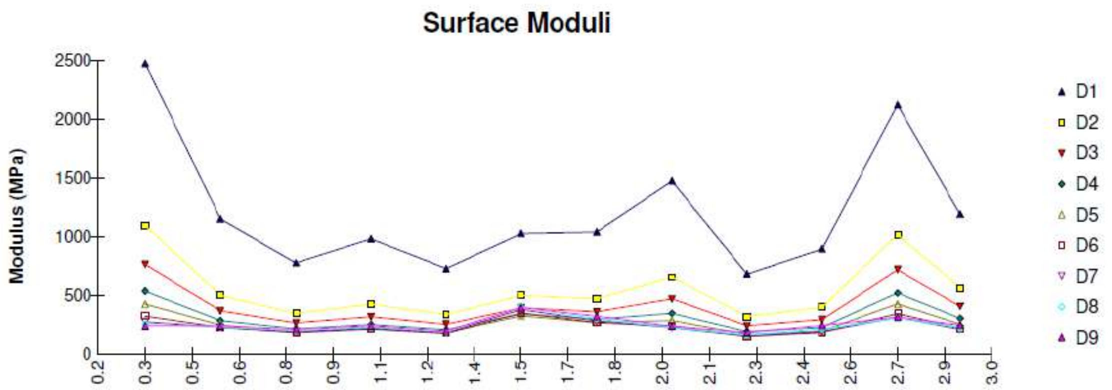


Figure (III.23): PP Profile 12 m right side

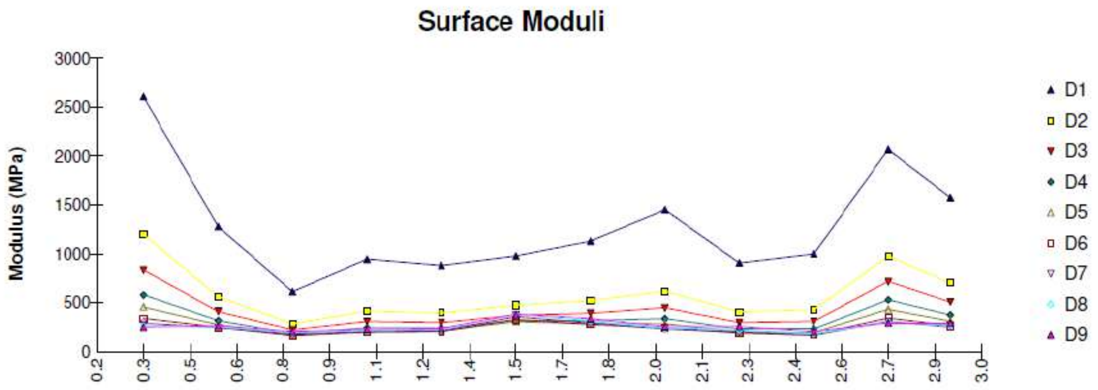


Figure (III.24): PP Profile 12 m left side

Table (III.12): average deflections of model E0 PP

The position of the geophones relative to the plate mm										Profils
1800	1500	1200	900	600	450	300	200	0	N.P .M	
Model E0 medium MPA										
264	255	243	242	260	296	375	500	1116	44	PP 3.5ml d
288	277	266	267	292	335	429	577	1274	44	PP 3.5ml g
264	253	244	245	268	307	393	528	1145	22	PP 6.5ml d
263	254	244	248	275	318	412	562	1243	22	PP 6.5ml g
247	235	226	229	252	290	374	507	1116	12	PP 12 D
260	247	235	238	263	304	394	535	1188	12	PP 12 G
264	254	243	245	268	308	396	535	1180	The rate	
247	235	226	229	252	290	374	500	1116	The lowest	
288	277	266	267	292	335	424	577	1274	The greatest	
263.5	253.5	243.5	243.5	265.5	305.5	393.5	531.5	1166.5	Average	

The analysis of the data of the six previous profiles makes it possible to conclude the following: the values of the calculated surface averages of the segments produced on runway 02/20 vary between 1116 and 1274 MPA, and these average values indicate a docking body with a good bearing capacity.

Taxiway

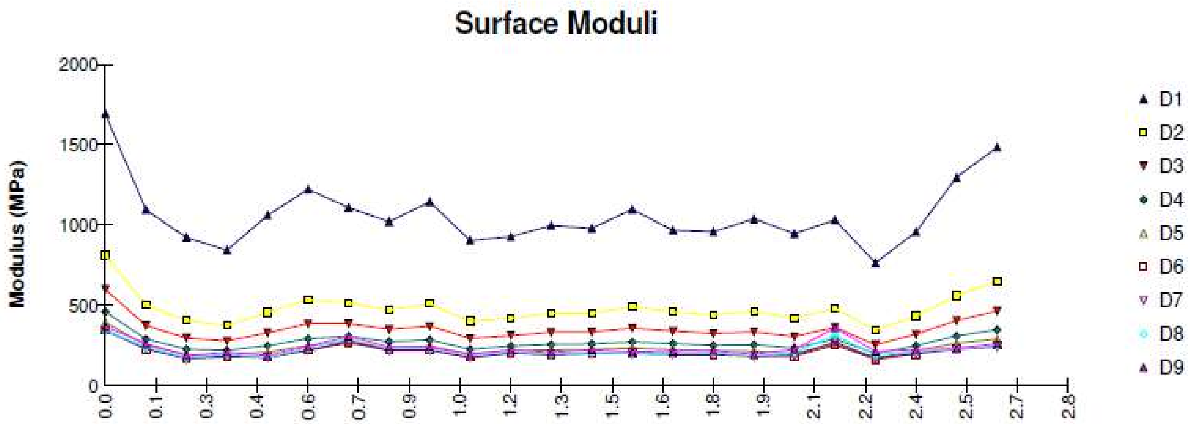


Figure (III.25): TXW Profile 3.5 m right side

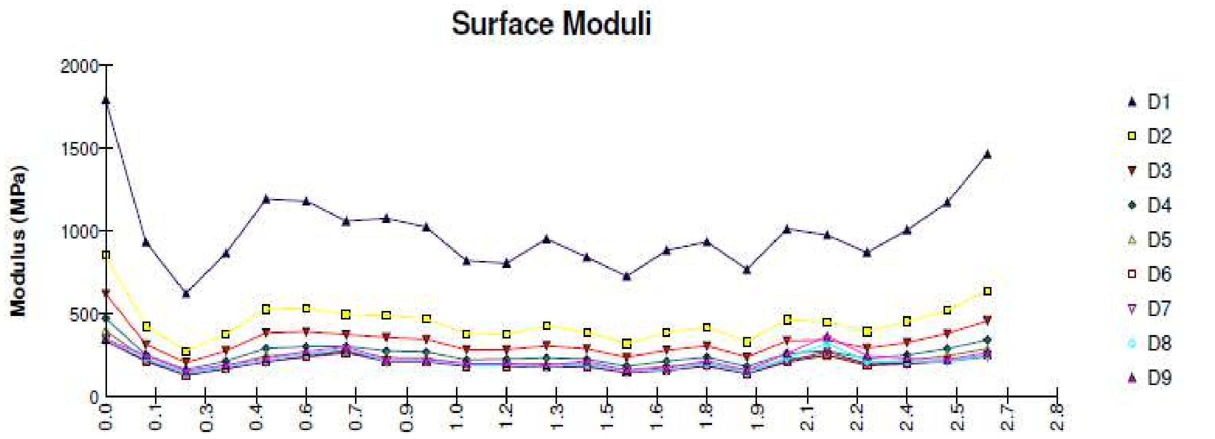


Figure (III.26): TXW Profile 3.5 m left side

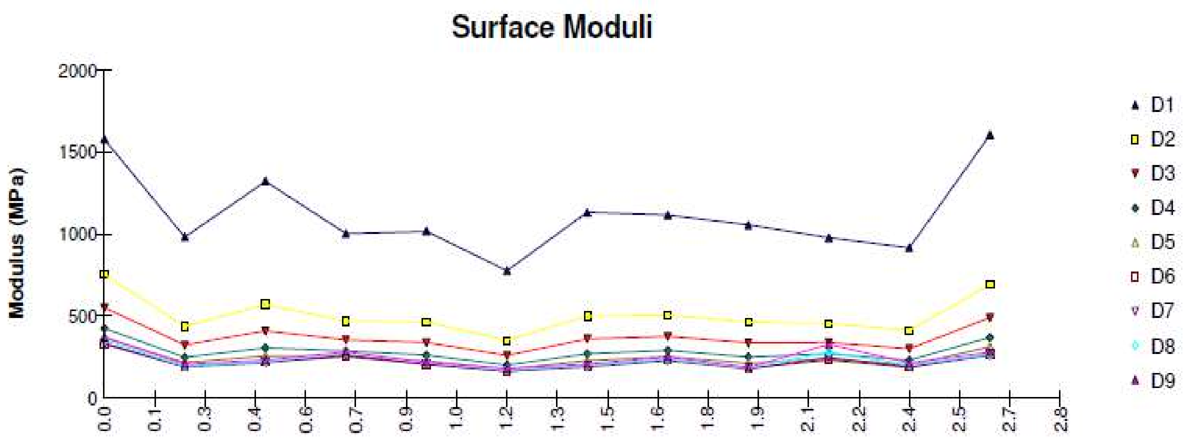


Figure (III.27): TXW Profile 6.5 m right side

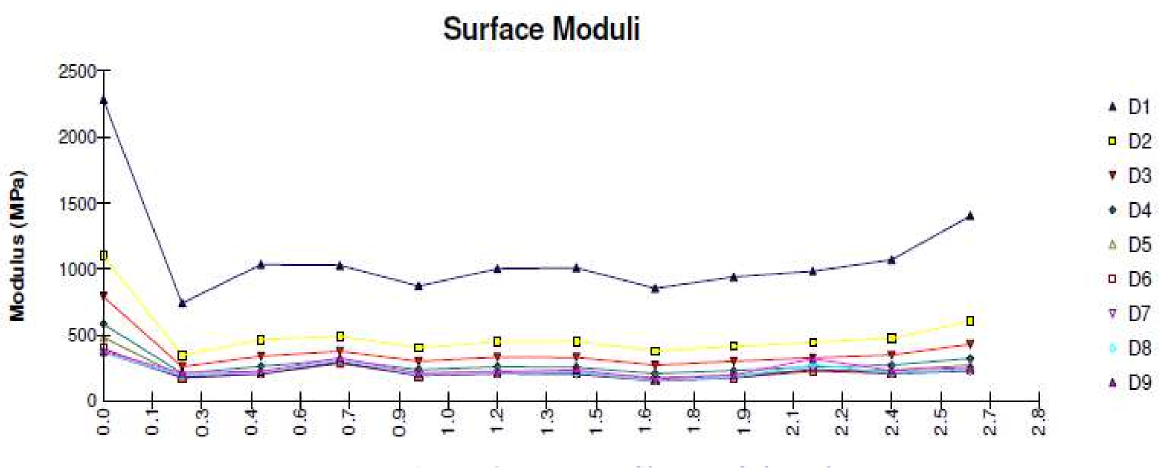


Figure (III.28): TXW Profile 6.5 m left side

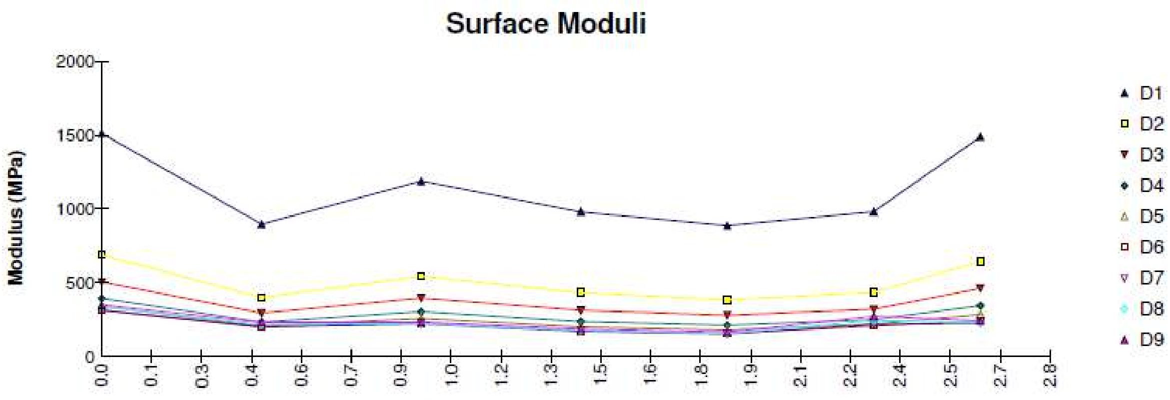


Figure (III.29): TXW Profile 12 m right side

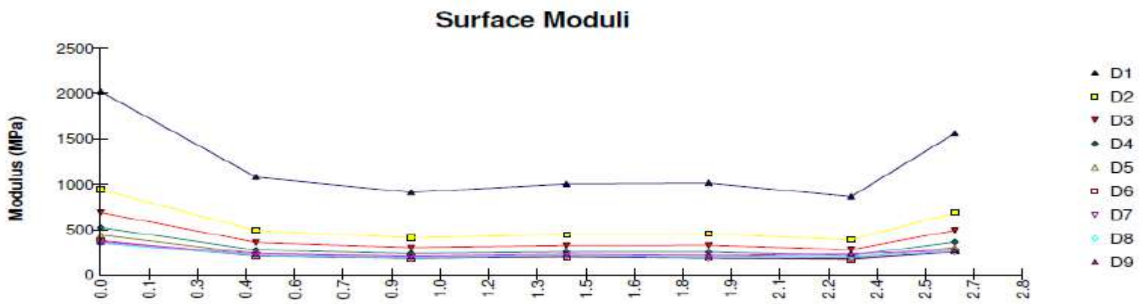


Figure (III.30): TXW Profile 12 m left side

Table (III.13): E0 medium of PP

	The position of the geophones relative to the plate mm									Profils
1800	1500	1200	900	600	450	300	200	0	N.P .M	
Model E0 medium MPa										
231	219	207	208	230	267	346	472	1046	23	PP 3.5ml d
223	210	197	147	216	250	322	438	974	23	PP 3.5ml g
241	230	218	219	242	280	362	495	1098	12	PP 6.5ml d
239	225	213	214	235	272	350	476	1053	12	PP 6.5ml g
232	220	208	212	236	274	357	490	1106	07	PP 12 D
244	229	217	220	246	287	376	517	1154	07	PP 12 G
235	222	210	212	234	272	352	481	1072	The rate	
223	210	197	197	216	250	322	483	974	The lowest	
244	230	218	220	246	287	376	517	1154	The greatest	
235.5	222.5	210.5	213	235.5	273	353.5	483	1075 5.	Average	

The values of the calculated average surface averages of the profiles made on the taxiway vary between 974 and 1154 MPa, and these average values indicate a docking body with a good bearing capacity.

Taxi Track 8 and 9

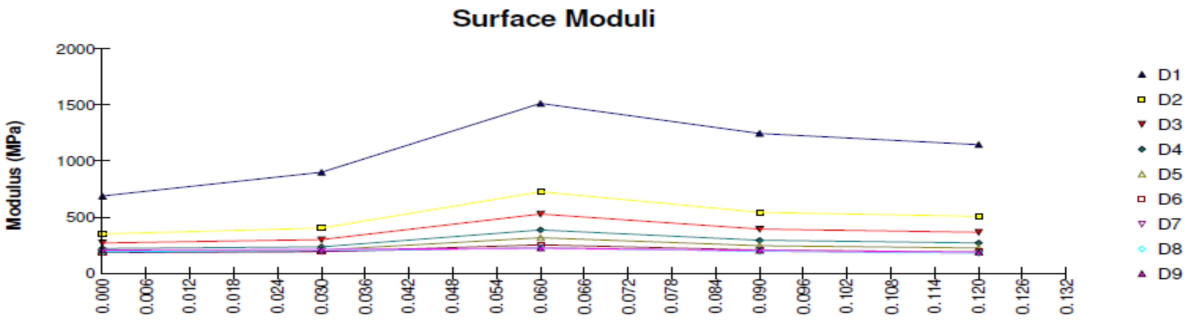


Figure (III.31): BRT Profil B08 axe

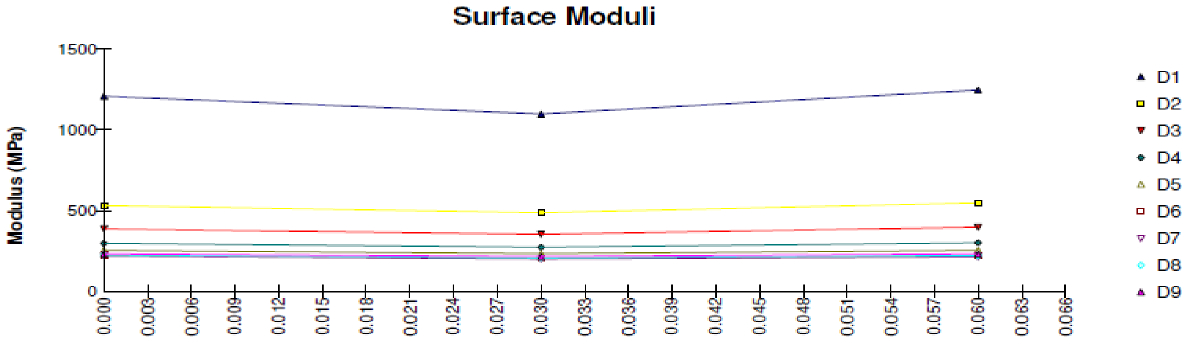


Figure (III.32): BRT Profil B09 axe

Table (III.14) : E0 medium of Taxi Track

The position of the geophones relative to the plate mm										Profils
1800	1500	1200	900	600	450	300	200	0	N.P	
Model E0 medium MPA										
154	190	244	312	412	469	539	598	744	05	3.5 Taxi 8
130	161	209	271	358	407	466	509	599	03	3.5 Taxi 9
142	176	227	292	385	438	503	554	672	The rate	
130	161	209	271	358	407	466	509	599	The lowest	
154	190	244	312	412	469	539	598	744	The greatest	
142	175.5	226.5	291.5	385	502.5	553.5	553.5	671.5	Average	

The recorded surface models of Taxi Track 8 and 9 promise averages of 599 to 744 MPA, which indicates a pavement body with an average bearing capacity

Modulus of elasticity

Runaway

Table (III.15) deviation on right side

Standard deviation	Average MPa	Number of points	Layer
1.381	5518	44	E1
1.986	813	44	E2
1.459	153	44	E3

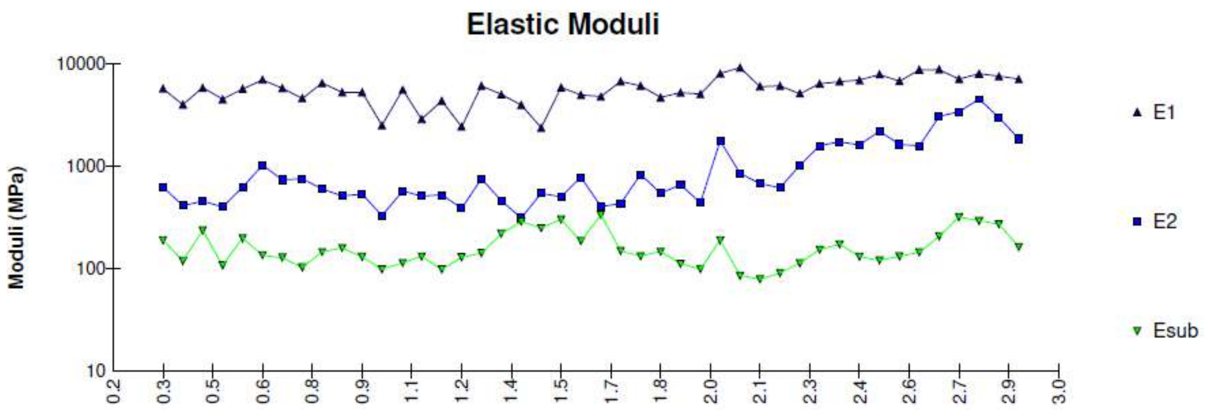


Figure (III.33): PP Profile 3.5 right side

Table (III.16): deviation on left side

Standard deviation	Average MPa	Number of points	Layer
1.269	5859	44	E1
1.285	1095	44	E2
1.401	165	44	E3

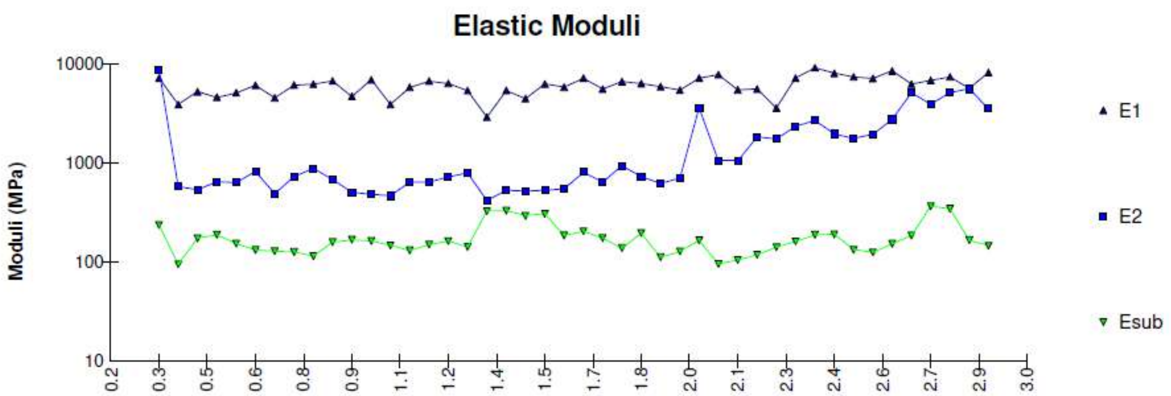


Figure (III.34): PP Profile 3.5 left side

Table (III.17) deviation on right side

Standard deviation	Average MPa	Number of points	Layer
1.382	4881	22	E1
1.338	1040	22	E2
1.549	155	22	E3

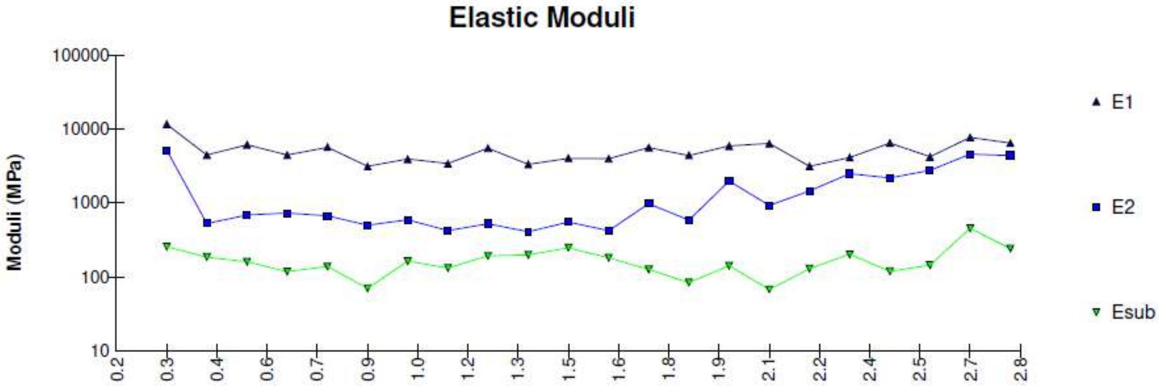


Figure (II.35): Profile 6.5 right side

Table (III.18) deviation on left side

Standard deviation	AverageMPa	Number of points	Layer
1.344	5855	22	E1
2.441	1226	22	E2
1.412	143	22	E3

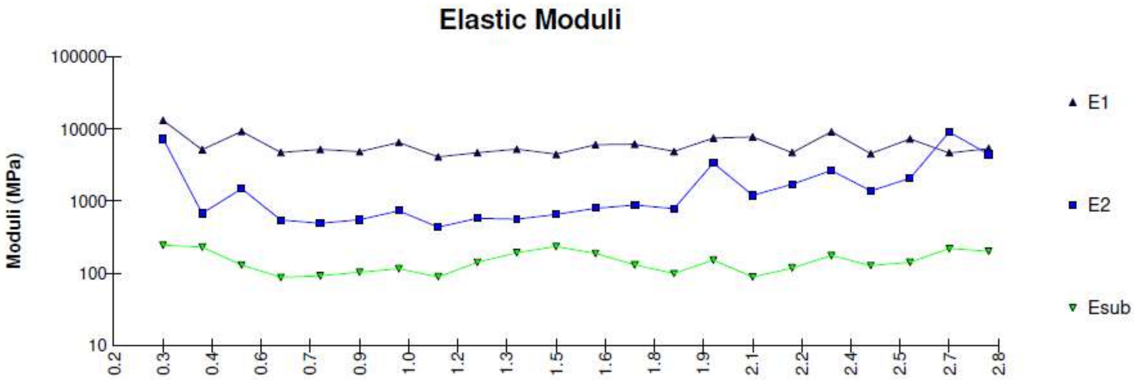


Figure (III.36): Profile 6.5 left side

Table (III.19) deviation on right side

Standard deviation	AverageMPa	Number of points	Layer
1.536	6519	12	E1
2.47	1017	12	E2
1.53	142	12	E3

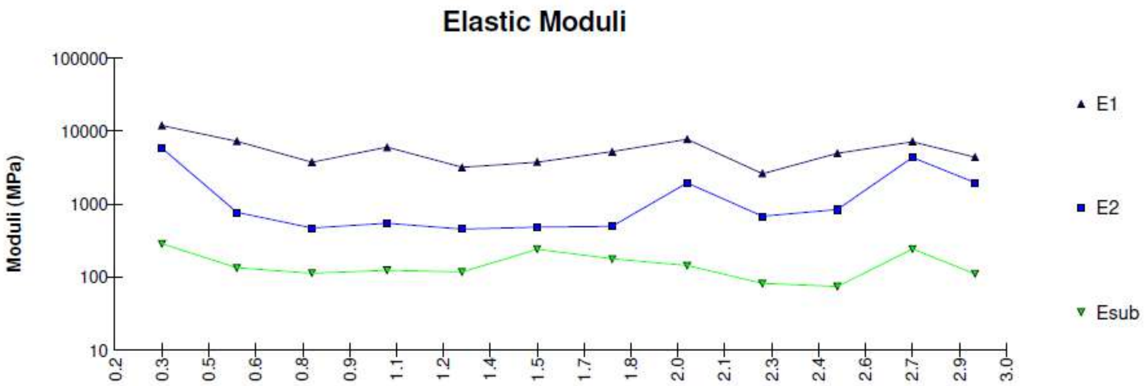


Figure (III.37): PP Profile 12 right side

Table (III.20): deviation on left side

Standard deviation	AverageMPa	Number of points	Layer
1.475	5832	12	E1
2.704	1131	12	E2
1.507	137	12	E3

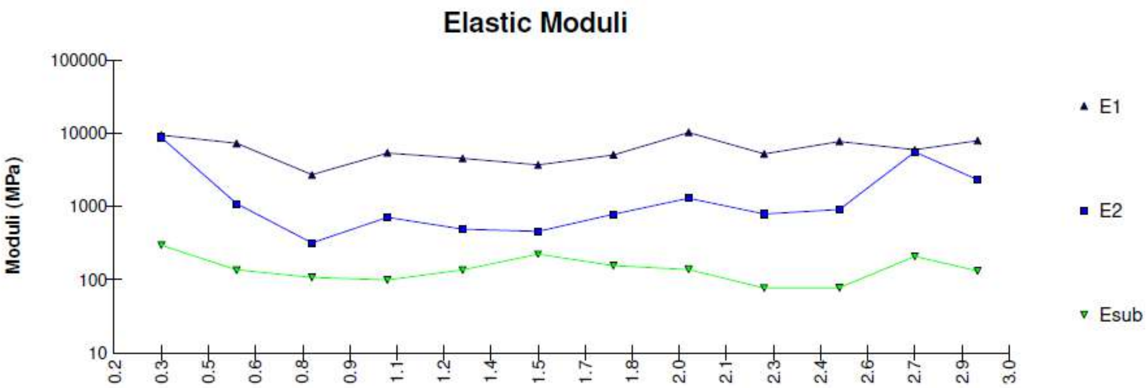


Figure (III.38): PP Profile 12 left side

The results are summarized in the following table (III.21):

Table (III.21) RESULTS SUMMARY

Coefficients E1. E2. E3. in MPa			Number of Stations	Profiles
E3	E2	E1		
153	813	5518	23	Profile 01
165	1095	5895	23	Profile 02
155	1040	4881	12	Profile 03
143	1226	5855	12	Profile 04
142	1017	5196	07	Profile 05
137	1131	5832	07	Profile 06
149.2	1053.7	5529.5	Average	

The average coefficient E1 of the bituminous layer has acceptable average values ranging from 4881 MPA to 5895 MPA, with a general average equal to 5529.5 MPA at a temperature of 30 C°.

The E2 moduli, calculated as average values for the second layer (crushed gravel) vary between 813 and 1226 Mpa.

The average E3 moduli of the subgrade vary between 137 and 165 Mpa.

Taxiway

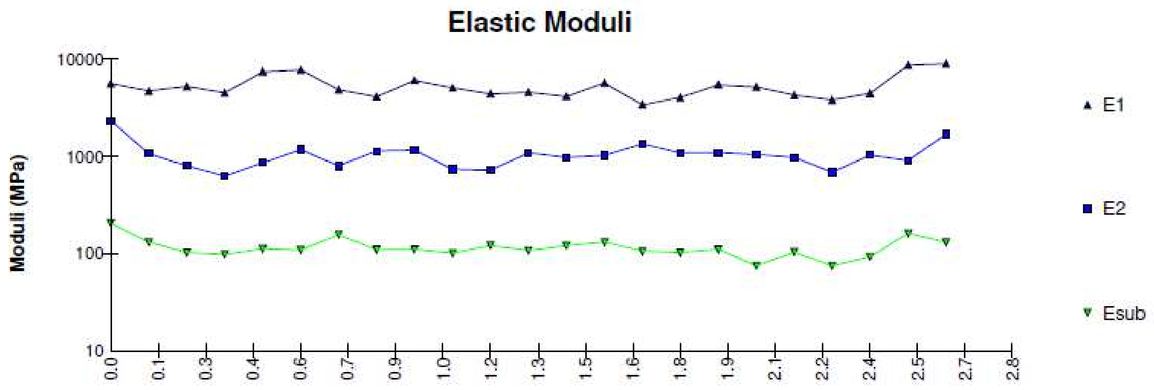


Figure (III.39): TXW Profile 3.5 m right side

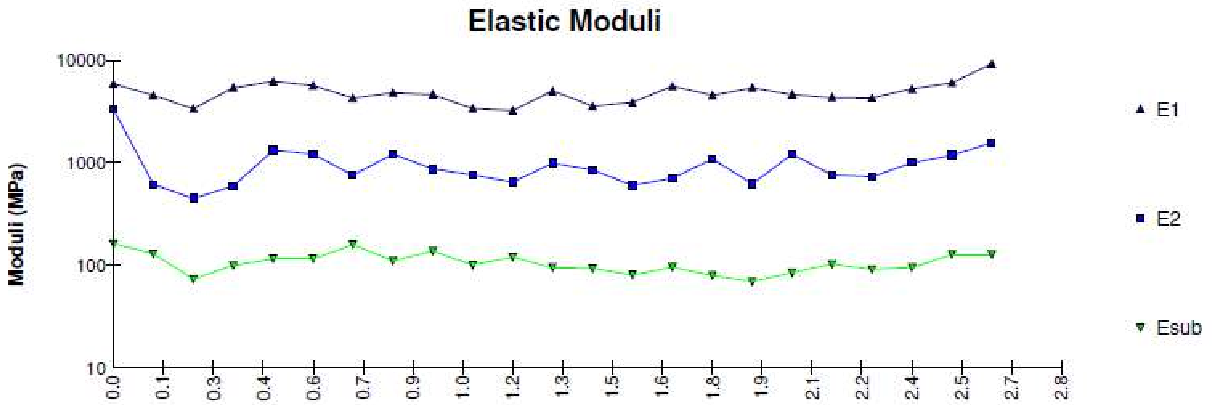


Figure (III.40): TXW Profile 3.5 m left side

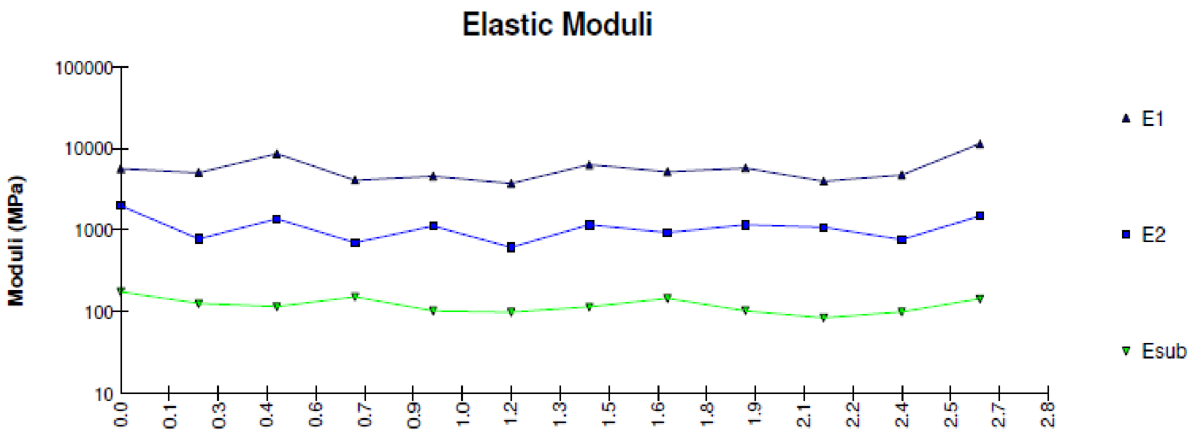


Figure (III.41): TXW 6.5 m profile right-hand side

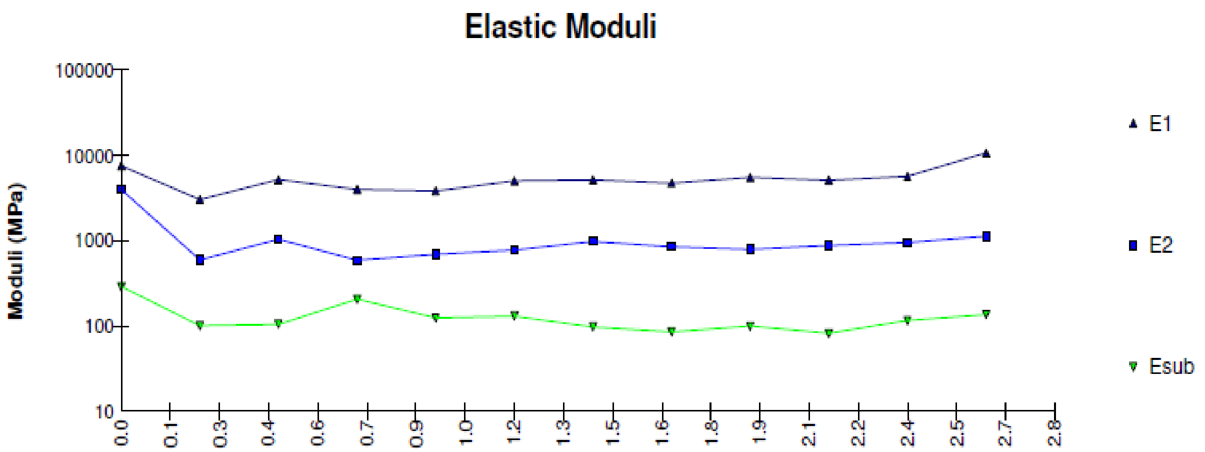


Figure (III.42): TXW 6.5 m profile left side

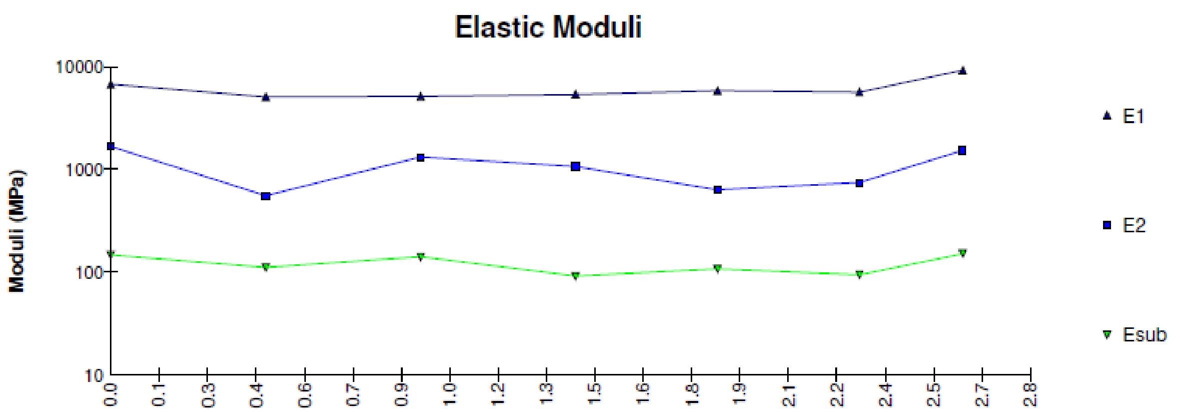


Figure (III.43): TXW Profile 12 m right-hand side

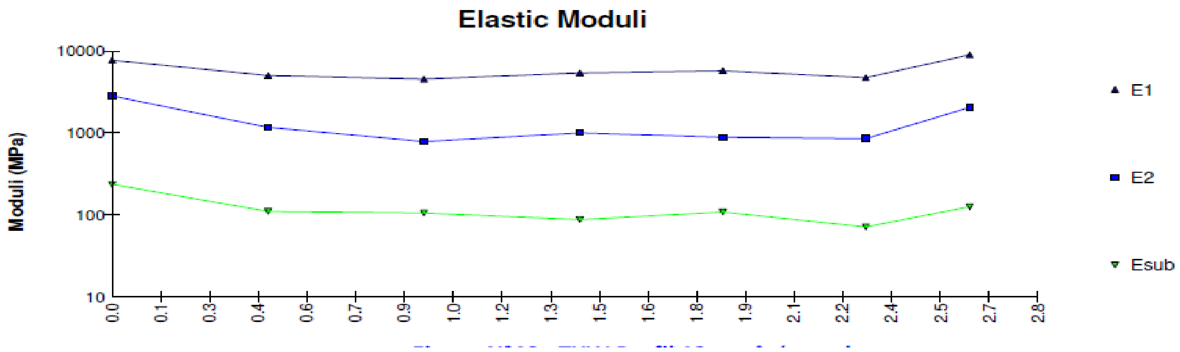


Figure (III.44): TXW 12 m profile left-hand side

A summary of the results is given in the following table:

Table (III.22) RESULTS SUMMARY

Coefficients E1. E2. E3. in MPa			Number of Stations	Profiles
E3	E2	E1		
113	1008	5108	23	Profile 01
104	908	4800	23	Profile 02
119	1040	5431	12	Profile 03
122	937	5135	12	Profile 04
118	991	6034	07	Profile 05
113	1221	5829	07	Profile 06
114.8	1017.5	5389.5	Average	

The average E1 coefficient of the bituminous layer varies between 4800 MPA and 6034 MPA, with a general average equal to 5389.5 MPA, which are acceptable from a bearing capacity point of view of the trend. The coefficients E2, calculated as average values for the second layer (crushed gravel) vary between 908 and 1221 MPA

The E3 units of the supporting soil vary in average value between 104 and 122 MPA.

5.3 Taxi Track 8 and 9

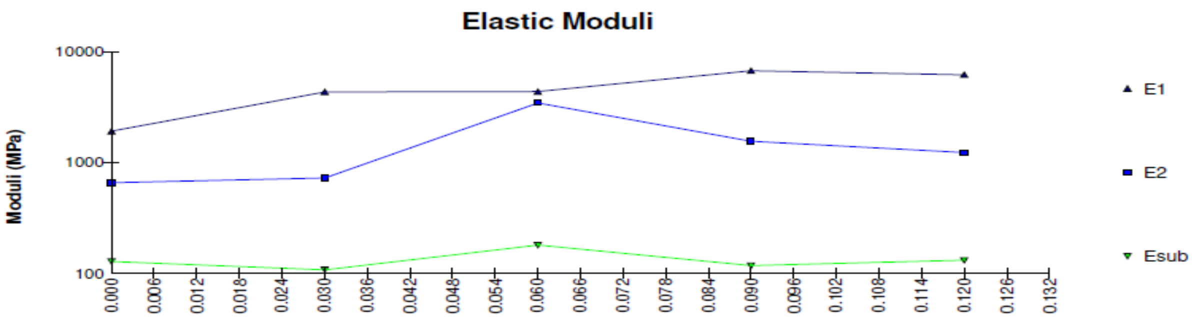


Figure (III.45): BRT Profile B08 axis

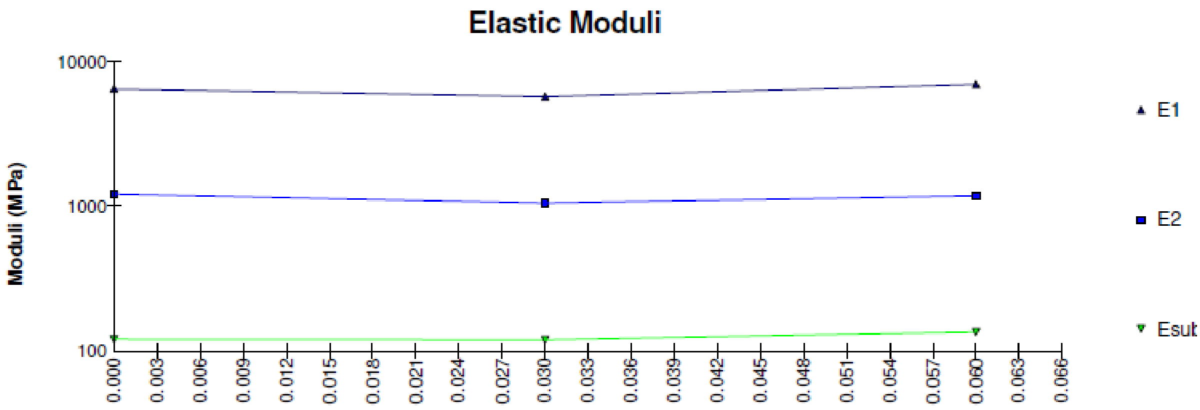


Figure (III.46): BRT Profile B09 axis

The results are summarized in the following table (III.23):

Table (III.23) A brief table of the results obtained

modules E1, E2, E3 en MPa			Number of Stations	Profiles
E3	E2	E1		
130	1254	4312	05	Suspendere 8
125	1146	6364	03	Suspendere 9
127.5	1200	5338	Average	

The average coefficient E1 of the bituminous layer varies between 4312 MPA and 6364 MPA with The average year is equal to 5338 MPA.

E2 units, calculated by the average values of the second layer (crushed gravel) 127.5

They range from 1146 to 1254 MPA.

The E3 units of the supporting soil vary in average value between 125 and 130 MPA.

Remaining life

Runway 01/19

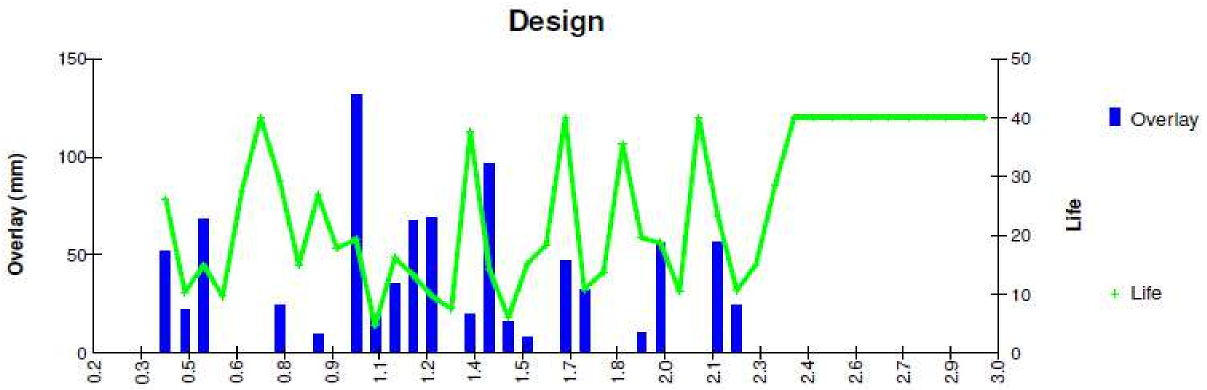


Figure (III.47): Profile 3.5 right side

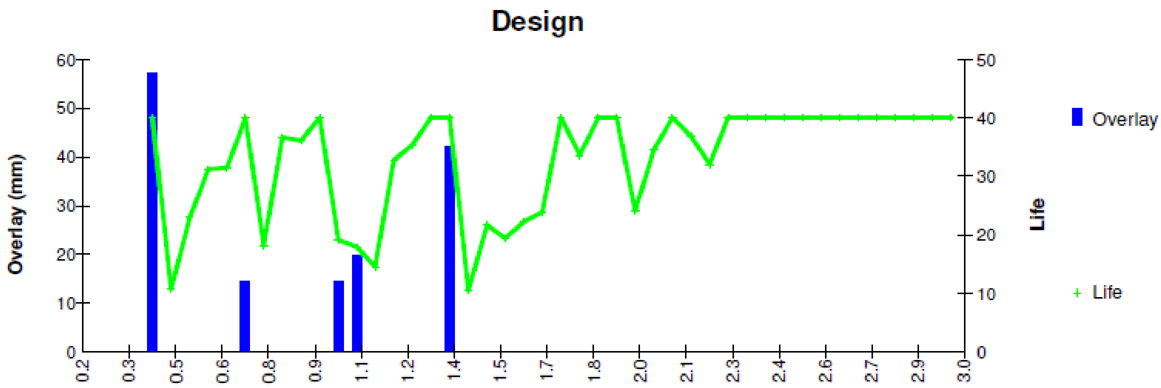


Figure (III.48): Profile 3.5 left side

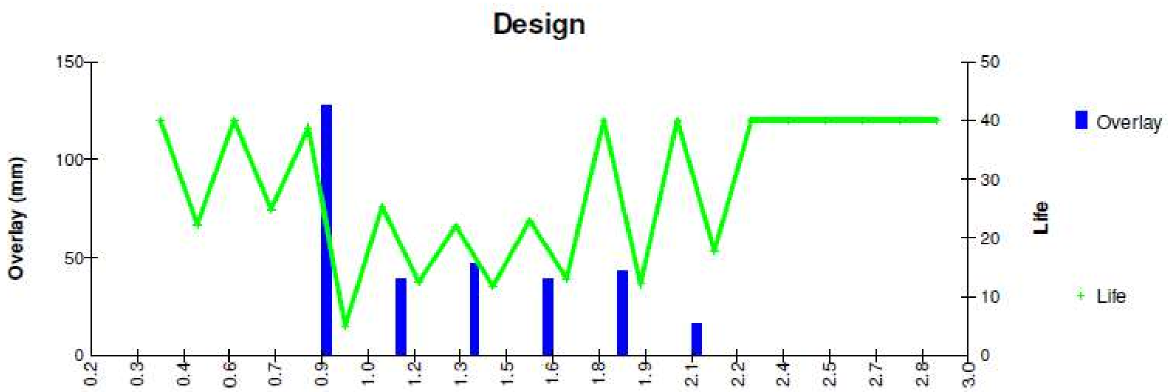


Figure (III.49): Profile 6.5 right side

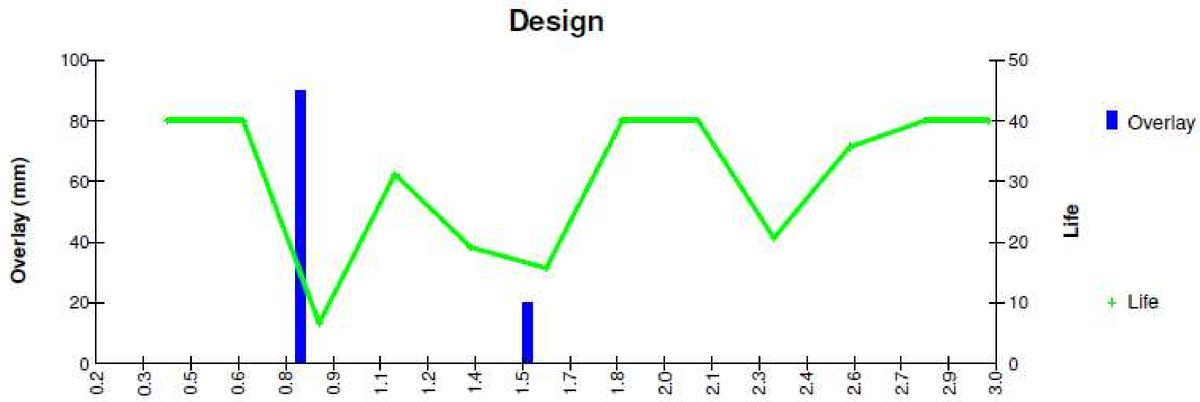


Figure (III.50): Profile 6.5 left side

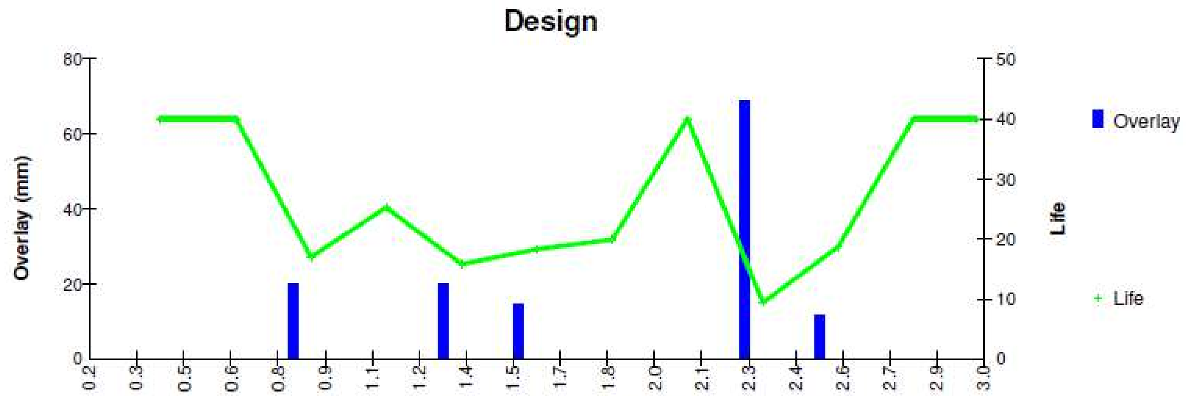


Figure (III.51): Profile 12 right side

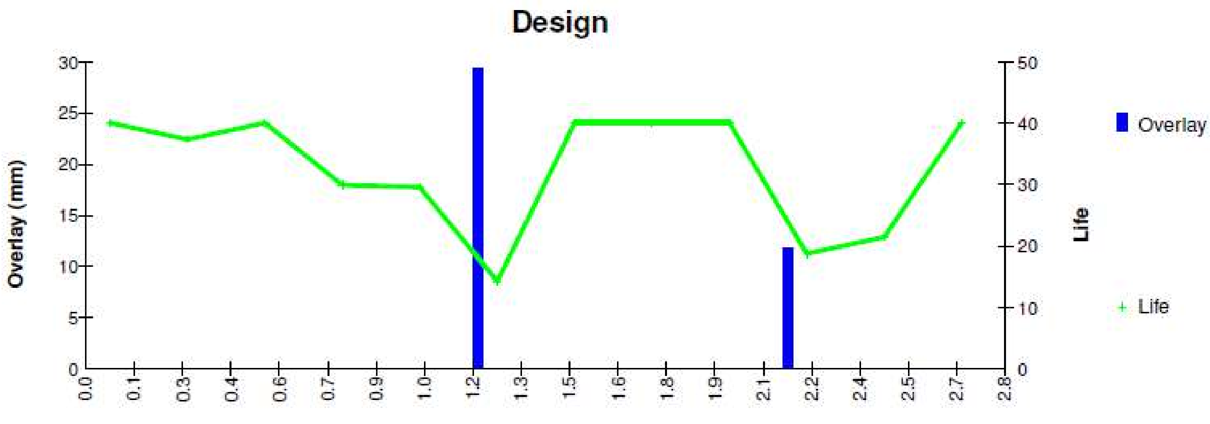


Figure (III.52): Profile 12 left side

The life span of the main track shown in the graphs above (the curve is in Green), Well it varies between 5 and 40 years of which 88% of the results are above 15 years.

the Route

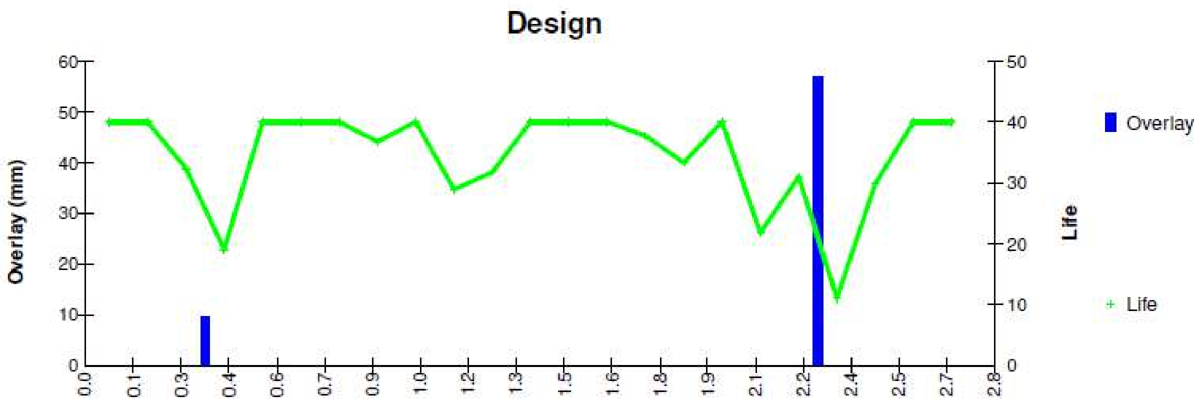


Figure (III.53): TXW Profile 3.5 right side

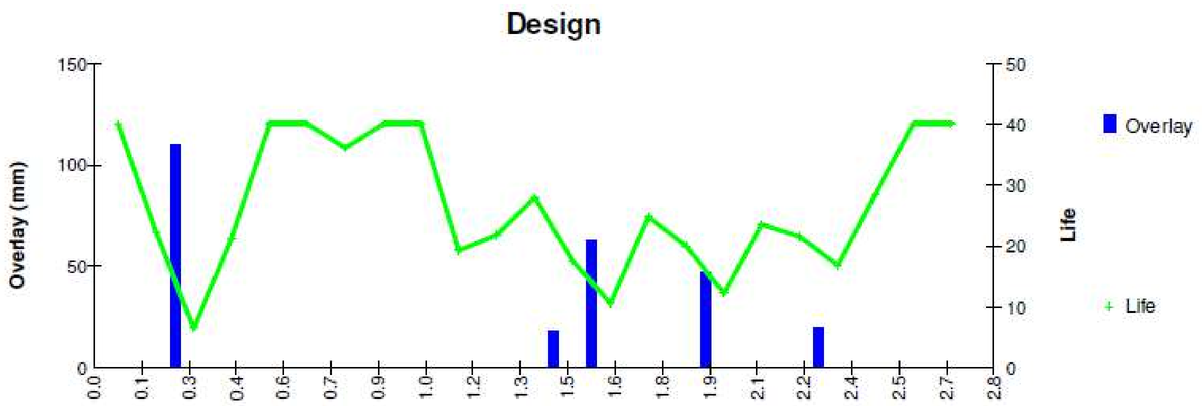


Figure (III.54): TXW Profile 3.5 left side

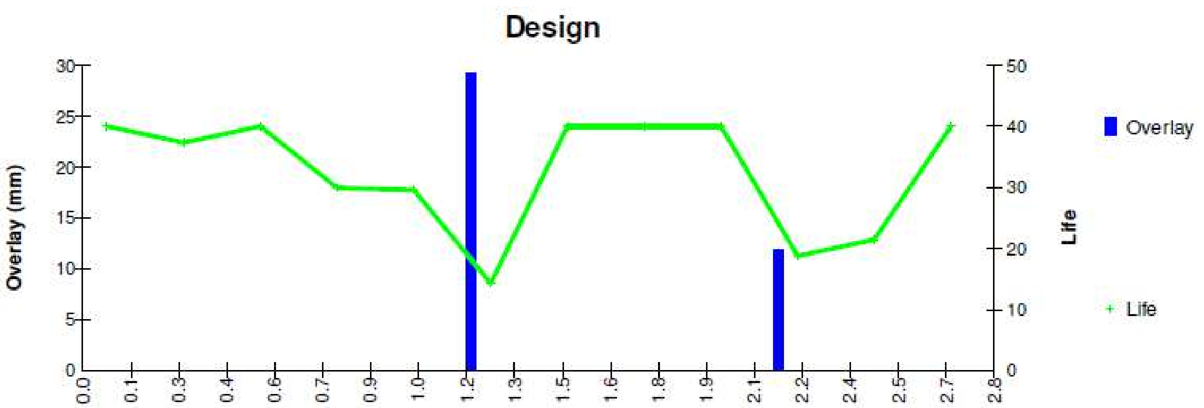


Figure (III.55): TXW Profile 6.5 right side

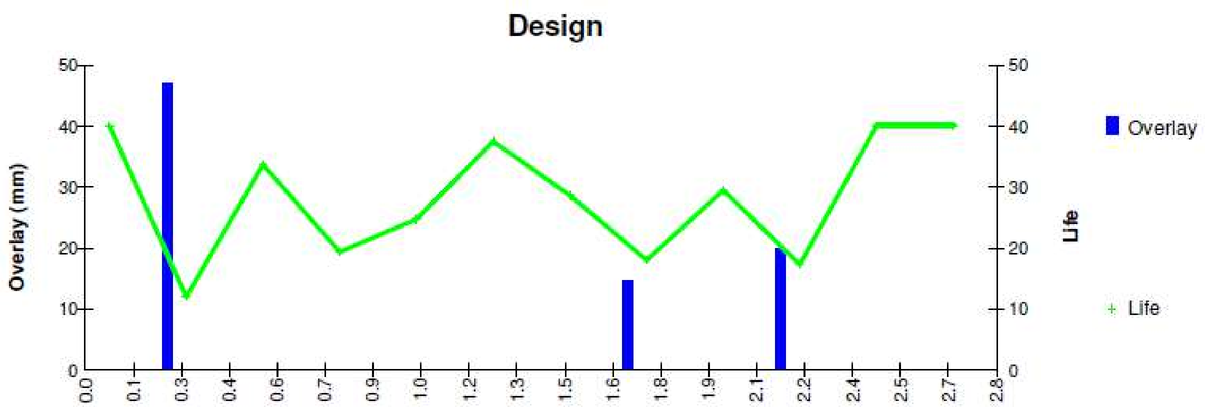


Figure (III.56): TXW Profile 6.5 left side

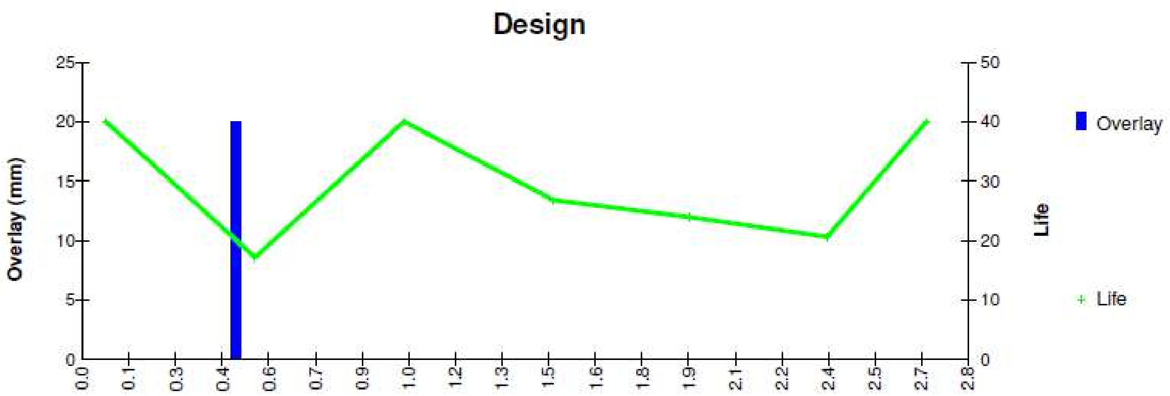


Figure (III.57): TXW Profile 12 right side

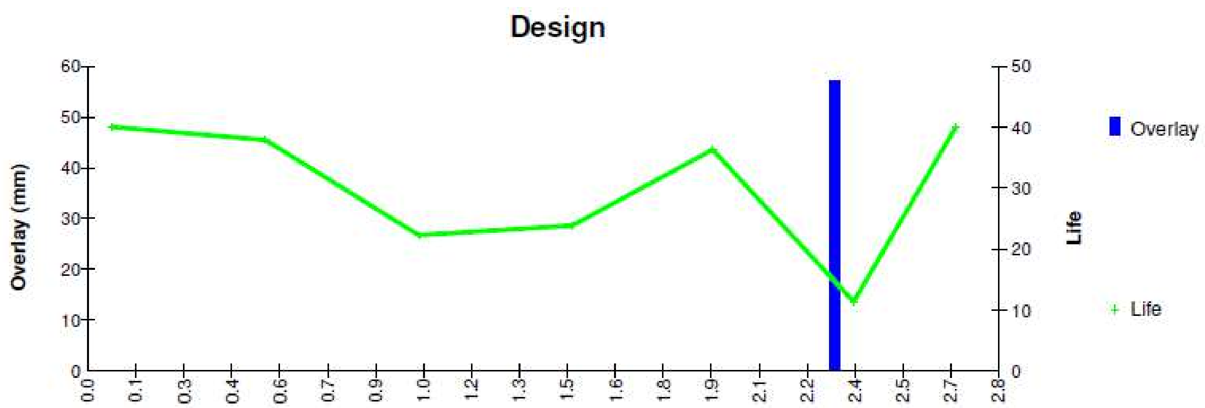


Figure (III.58): TXW Profile 12 left side

The age of the corridor shown in the graphs above (curve in green), average, ranges from 3 to 40 years of which 90% of the durations are older than 20 years.

Taxi Track 8 and 9

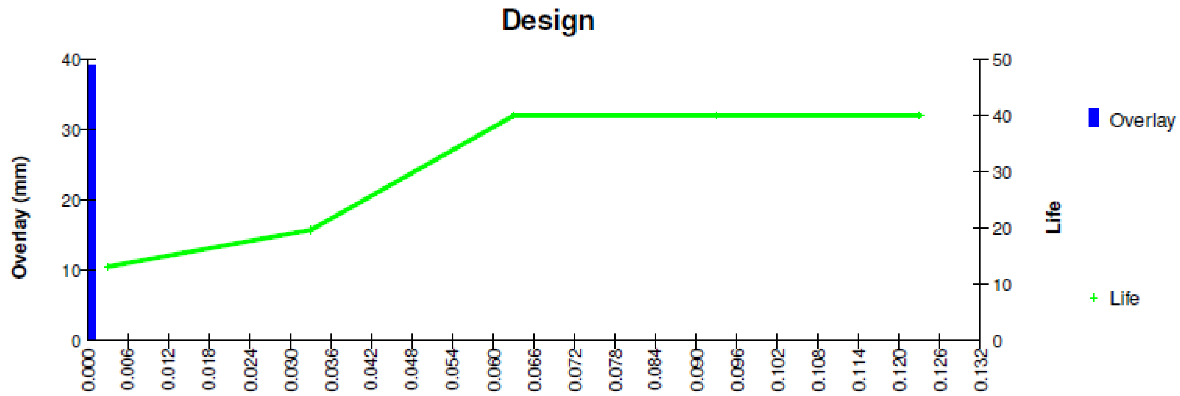


Figure (III.59): Profile B08 axis

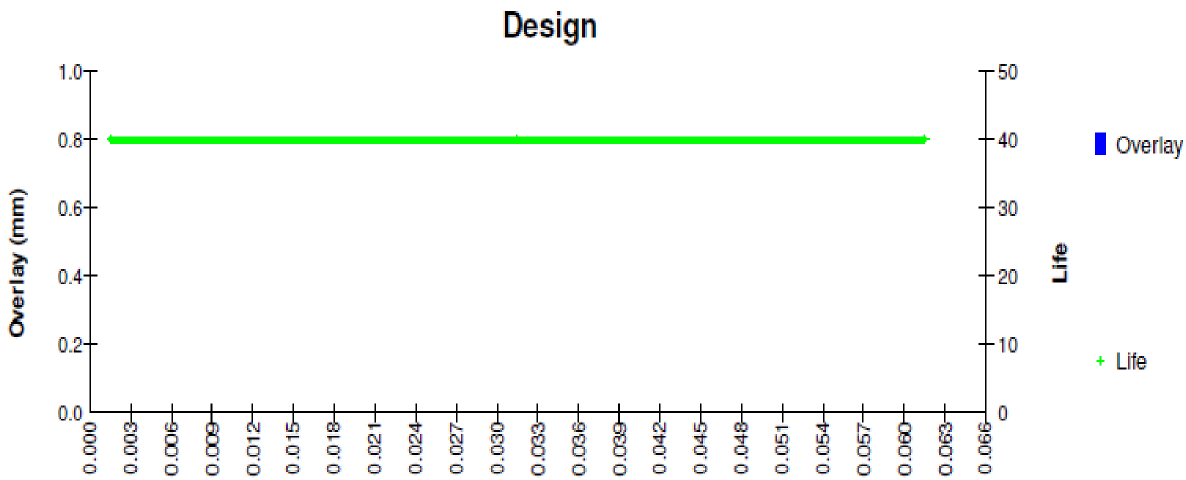


Figure (III.60): Profile B09 axis

The age of the 8th and 9th bars shown in the diagrams above (curve in Green) is excellent, their age exceeds 30 years for the eight points measured at the level of the two bars.

Evaluation of PCN and ACN

The PCN berth classification number (berth classification number) is a berth classification number rounded to an integer, an indicator expressing the bearing strength of the berth for unrestricted operations; it can also be considered a load supported by a standard single wheel authorized to use the track without restrictions.

The ACN (Aircraft Classification Number) is another parameter representing the "aggressiveness" of an aircraft on a roadway. It is determined by aircraft manufacturers in accordance with certain standardized procedures.

The ACN/PCN method is an international standardized system developed by the International Civil Aviation Organization (ICAO) to provide information on the resistance of aeronautical pavements, enabling the admissibility of each aircraft to be judged on the basis of its load and pavement resistance Since 1983 by all ICAO member states.

The NCP values calculated for all profiles are illustrated in the graphs below:

Runway 01/19

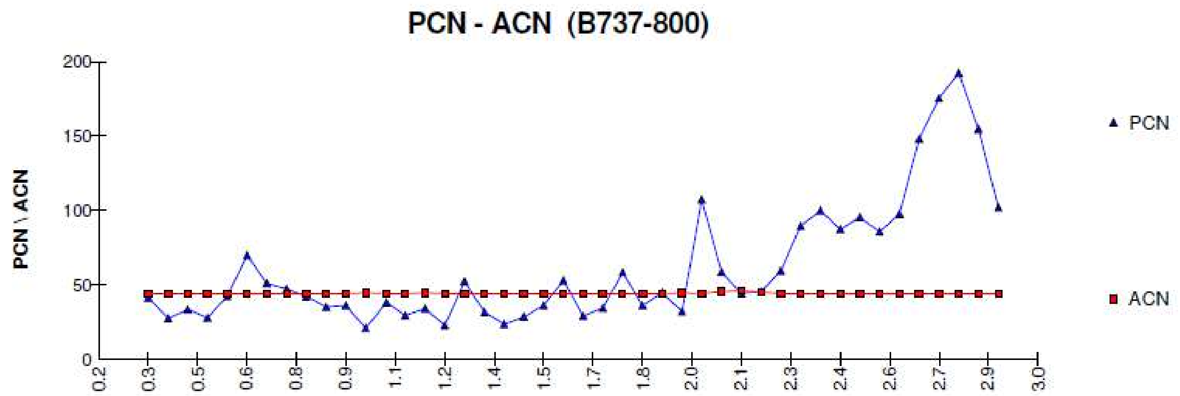


Figure (III.61): Profile 3.5 right side

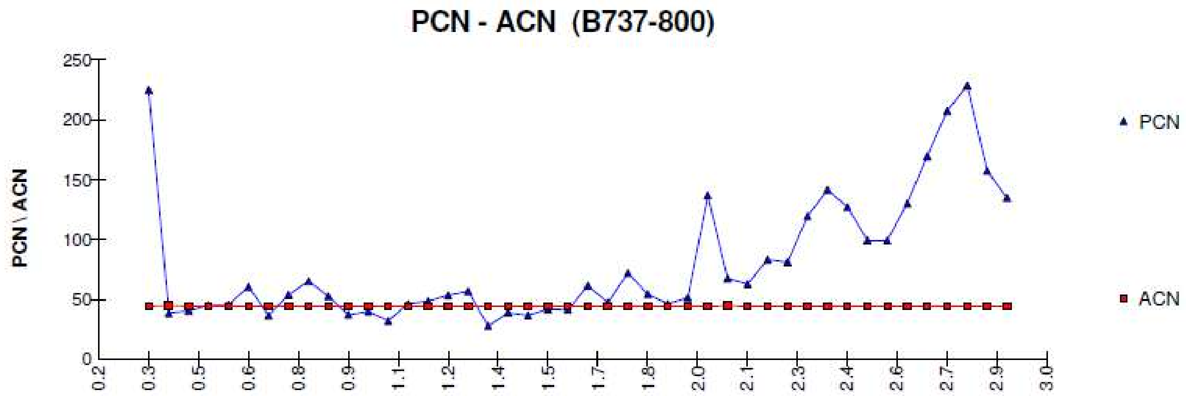


Figure (III.62): Profile 3.5 left side

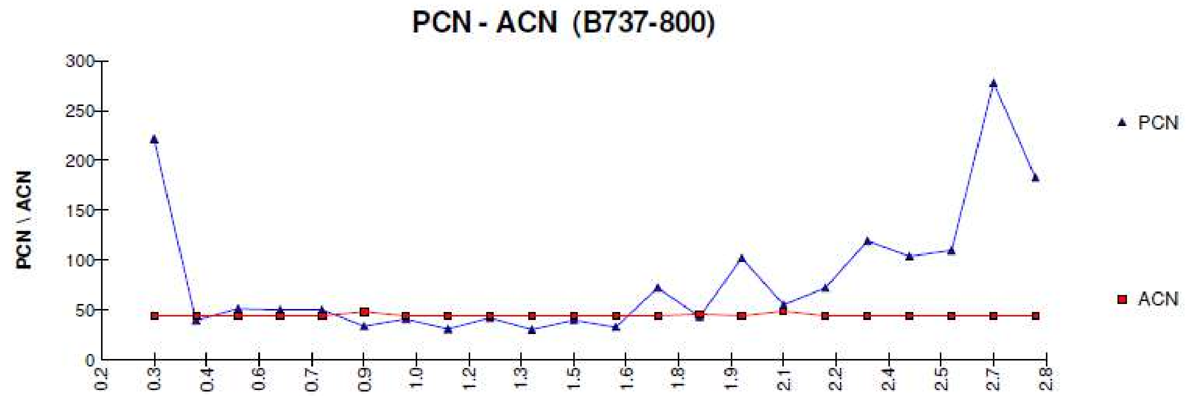


Figure (III.63): Profile 6.5 right side

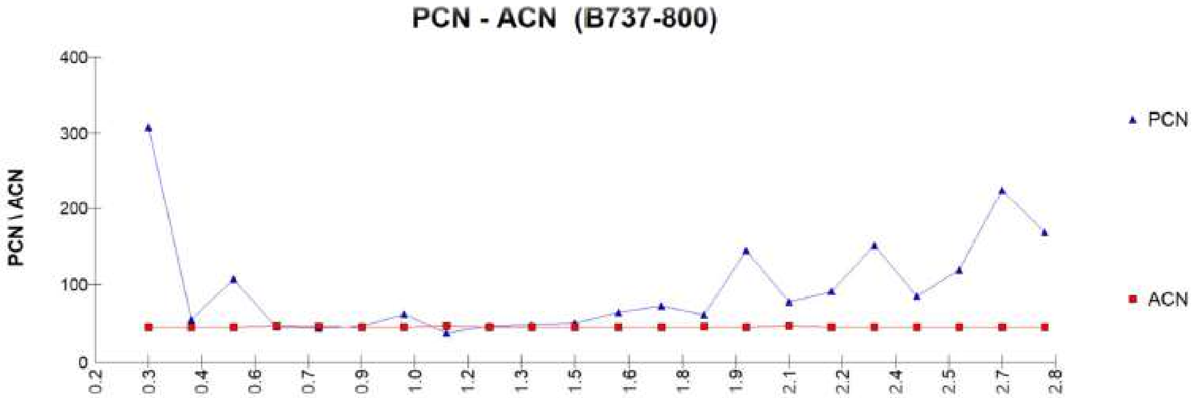


Figure (III.64): Profile 6.5 left side

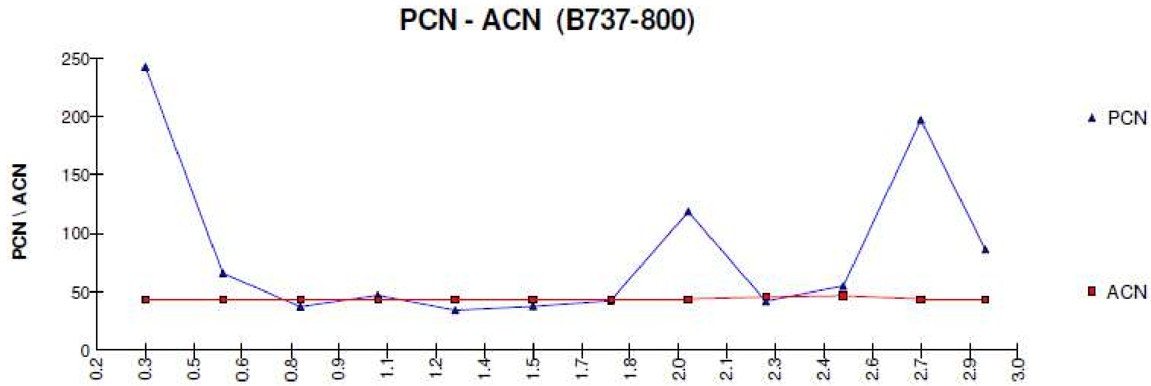


Figure (III.65): Profile 12 on the right side

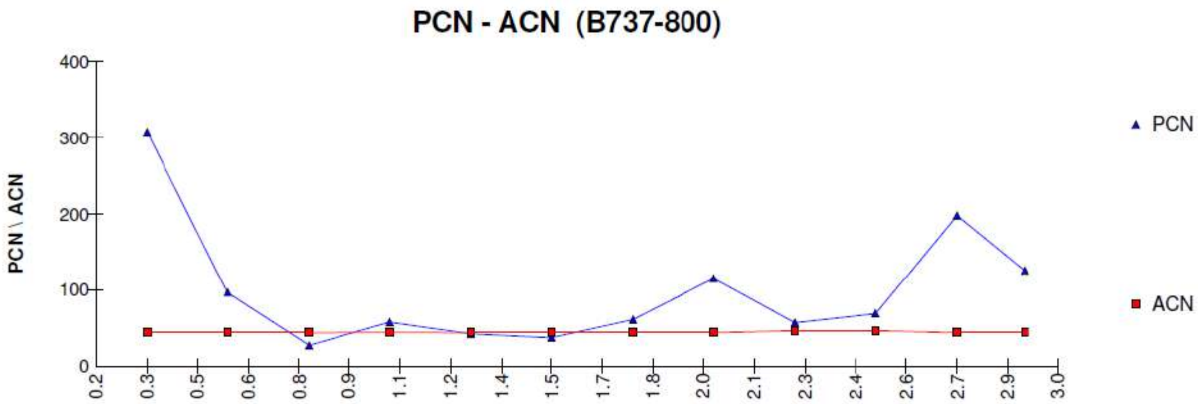


Figure (III.66): Profile 12 left side

The following table summarizes the PCN values calculated from the deviations measured by HWD:

Tableau (III.24): PCN values calculated from HWD measurements

Profiles	Number of Stations	Traffic 10/day PCN rate	average	min	Max	Observations
3.5 ml To the right of the centre line of the runway	44	61.3	44.5	21	192	
3.5 ml To the left of the centre line of the runway	44	80.4	55.5	28	228	
6.5 ml To the right of the centre line of the runway	22	81.8	50.5	30	278	The runway 01/19
6.5 ml To the left of the centre line of the runway	22	95	67	36	308	
12 ml To the right of the centre line of the runway	12	83.8	51	34	242	
12 ml To the left of the centre line of the runway	12	99.4	65	27	308	
Average		95				

Raising the secondary runway indicates all the following information:

- Pavement classification number (PCN)
- Studying the type of pavement to determine ACN-PCN numbers
- Soil Category-support
- Maximum permissible tire pressure
- The basis of the assessment.

Information on the bearing capacity of the main runway 01/19:

- PCN = 60 / F / A / X / T.

- F: code letter corresponding to flexible pavement type ؛
- A: the code letter corresponding to the supporting soil resistance class, representing all CBR values greater than 13 ؛
- B: the letter of the code corresponding to the resistance Class of the supporting soil, representing all CBR values equal to 10 ؛
- W: a symbol letter corresponding to the maximum permissible tire pressure and representing unlimited high pressure ؛
- X: a symbol letter corresponding to the maximum permissible tire pressure and representing an average pressure limited by 1.50 MPA ؛
- T: the letter of the code corresponding to the basis for assessing the characteristics of paving and represents the type of technical assessment that uses techniques for studying paving behavior.

the ACN, corresponding to the BOEING 737-800, is 44, which is lower than the average PCN (95) recorded on the the central 30 metres of the main runway 01/19. The aircraft in question may be admitted without number of movements.

CONTROL OF THE UNI

1. Material used

The unit is measured by means of a device of the RSP 5051 laser inertial profilmeter type from Dynates brand fixed using metal supports at the front of the vehicle.

The device consists of two laser probes and two accelerometers and a distance measuring instrument (DMI) attached to the rear wheel of the vehicle. It is assisted by an acquisition unit (DPU) and an on-board computer. Our Profilmeter is also equipped with a camera for capturing images during its passage.

Figure (III.67): DYNATEST laser profilometer.

Principle of measurement

Measurements were taken at speeds ranging from 20 to 80 km/h. The lasers measure the between the pavement and the sensors (D) and the accelerometers correct the movement of the vehicle movement (A). The profile is obtained by combining these measurements.

The following diagram gives a clear idea of the measurement principle.

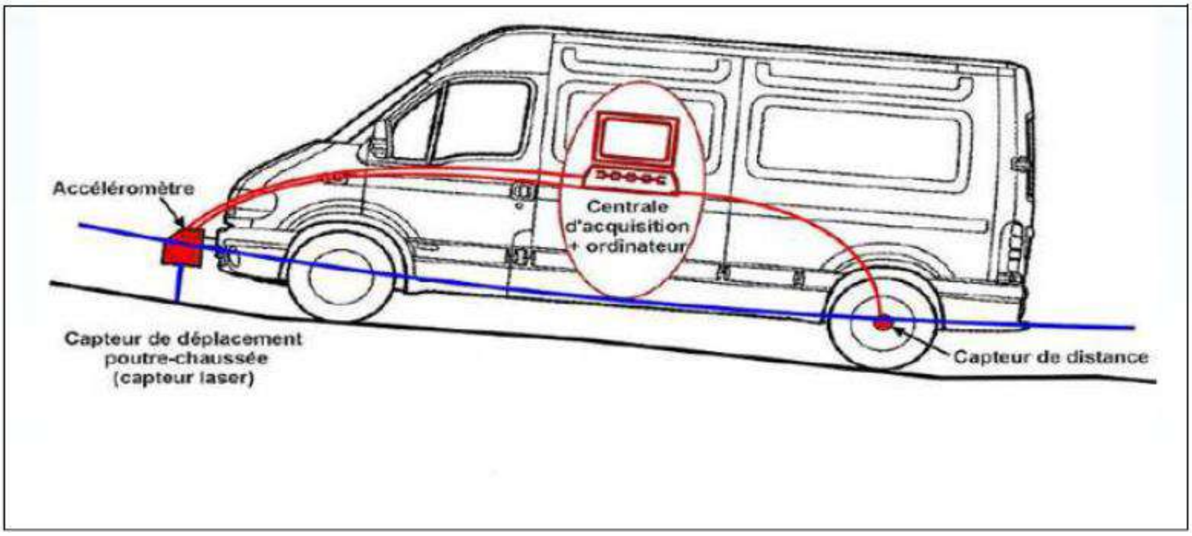


Figure (III.68): measurement principle

The data obtained are recorded in the form of long profiles, the IRI "International Roughness Index" flatness or comfort index or rolling index is calculated every 10 m. The latter represents a unit indicator proportional to the cumulative vertical displacements of the axis of a wheel relative to the chassis of the vehicle expressed in m /km. The IRI varies between 0 m / km and 10 m / km representing, respectively, a perfect roadway and a completely deteriorated roadway on which we can only travel at reduced speed.

Layout of the profiles

On 17 March 2014, six (06) profiles for checking the evenness were carried out on runway 02/20 at Ouargla aerodrome, and six profiles were carried out on the taxiway. The profiles were installed so as to cover the most stressed areas of the runway, and the length of the profiles carried out on the runway is 2700m (flexible part). The origin of all the measurements is threshold 02 (0+300), although the length of the profiles made on the taxiway is 2600m, the origin of which is the end of the taxiway located on the same side of threshold 02 of the runway. The following table (III.25) shows the positions of the profiles.

Table (III.25): Profile positions

The test element	Profile positions		
	3.5meters from the side of the track axis	07meters from the side of the track axis	12meters from the side of the track axis
Take-off runway 01/19	02	02	02
Suspendere	02	02	02

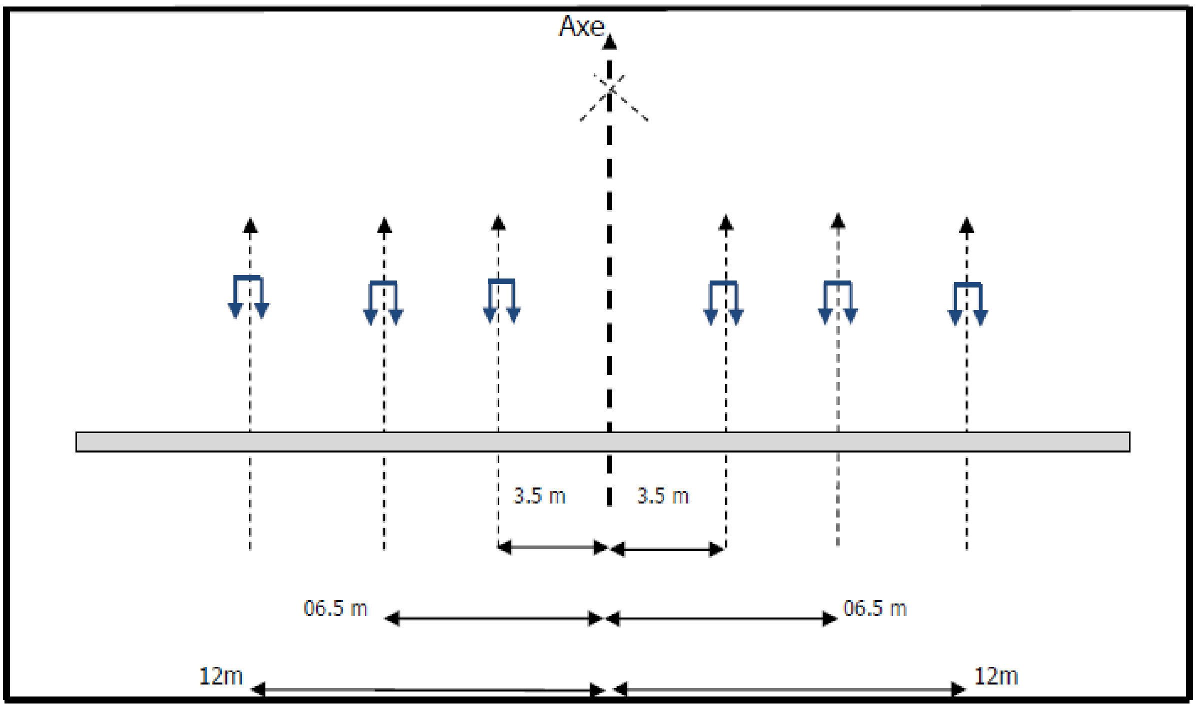


Figure (III.69): Profile positions

. Analysis of results

The following tables give the average IRI values for each profile with three sections. The obtained longitudinal profiles are presented in the appendix.

runway 01/19

The following table (III.26) shows IRI average of runway 01/19

Table (III.26): IRI average of runway 01/19

Take-off runway01/19				The Section
IRI	IRI	IRI	IRI	
3.02	2.93	3.05	3.08	3.5 D
3.32	3.42	3.52	3.01	3.5 G
2.52	2.78	2.38	2.4	7 D
2.93	2.8	3.12	2.88	7 G
2.98	3.22	2.8	2.93	12 D
3.19	3.46	2.91	3.19	12 G
2.99	IRI average (m/km)			

The average IRI values obtained, at the level of the landing strip (01/19), range from 2.52 to 3.32 m / km, with an average of 2.99 m / km. the average of this value generally characterizes the average flatness of the state. . The results recorded in the table show that the IRI ratios characterizing the average state are between 43 and 66% and those characterizing the acceptable state are between 32 and 55%, therefore, the path equalization state is considered from average to acceptable, without neglecting the presence of some unevenness defects (IRI> 5m / km) whose ratio, in comparison with the total IRI values obtained, is between 0.80 and 1.97%.

Taxiway

The following table (III.27) shows IRI average of Taxiway

Table (III.27): IRI average of Taxiway

Take-off runway01/19				The Section
IRI	IRI	IRI	IRI	
2.52	2.89	2.42	2.25	3.5 D
2.41	2.58	2.44	2.22	3.5 G
2.47	2.67	2.47	2.26	7 D
2.47	2.67	2.47	2.26	7 G
2.66	2.97	2.78	2.22	12 D
3.23	4.22	3.19	2.27	12 G
2.63	IRI average (m/km)			

The average IRI values obtained, at the level of the auxiliary corridor at Ouargla Airport, are between 2.41 and 3.23 m / km, with an average of 2.63 m / km, and the average of this value generally characterizes the average flatness of the state.

MEASURING ROUGHNESS USING A FRICTION PENDULUM

1. General information

The adhesion of a coating is its ability to mobilize the frictional forces in contact with the roadway under the effect of stresses generated by driving, acceleration, braking .... It can be assessed by the direct measurement of the coefficient of friction using the LEROUX pendulum. This method is described in the standard P 18-578.

2. Measurement principle

The pendulum at its end holds a rubber pad that rubs during the test on the surface to be measured. During friction, the spring applies the pad to this surface with a specific force. An adjusting device makes it possible to maintain the friction length. The maximum height of the pendulum's ascent, which depends on the energy absorbed by friction, is determined by a needle placed in front of a disk that is included directly in the "friction coefficients measured by the pendulum"

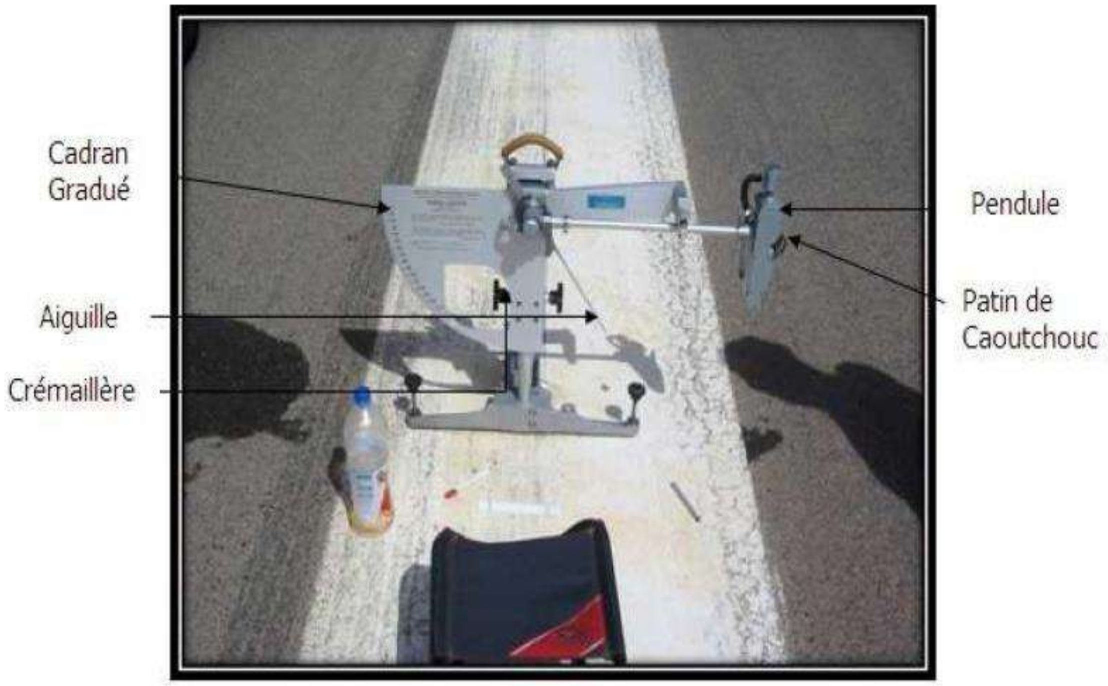


Figure (III.70): Roughness measuring device

3. Analysis of the results the following table summarizes the results of the measurements made: The following table (III.28) shows Measurement of runway friction coefficients

Table (III.28): Measurement of runway friction coefficients (01/19)

Measuring stations	positions (PM)	water température(C°)	Reading	coefficient of friction(%)
1	300	21	64	59
3	400	24	60	55
4	500	24	67	61
5	700	23	74	69
6	800	22	73	73
7	900	23	63	63
8	1000	22	73	73
9	1100	22	74	74
10	1200	22	70	70
11	1300	25	78	78
12	1400	24	88	88
13	1500	24	63	63
14	1600	24	60	60
15	1700	25	61	61
16	1800	25	61	61
17	1900	25	64	64
18	2000	22	49	49
19	2100	25	57	57
20	2200	24	52	52
21	2300	22	63	63
22	2400	24	60	60
23	2500	24	57	57
24	2600	24	68	68
25	2700	25	61	61
Average flexible part(%)				64.04
Standard déviation (%)				8.56

The measurement of runway friction coefficients (01/19) of Ouargla airport revealed values ranging from 49% to 88% with an average of 64.04% and a spacing of 8.56%, these values reflect the average grip of the main runway.

Conclusion

the specific objective of this study is to observe the behavior of the runway sidewalks and the handling of these appendages with the artificial Earth product (geocomposite PGMG 50x50) by comparing two sections in each case mentioned above, that is, the behavior of the geocomposite reinforced paving section with a section that has not been treated by this product. It affected only the hydrocarbon part of the road surface. -The process of strengthening the relevant structures began in June 2008, and the solution adopted consisted of:

The infrastructures involved in the conduct control process are:

- Main runway (flexible pavement part): 2700 × 45 m ؛

- Traffic lane: 2644 × 25 m ؛

- Taxi Track 8 and 9: 2 × (250 × 25) m.

- The survey of the condition of the surface of the main runway four (05) years after the start of operation did not reveal any cracks in the lower layers.

- Apart from the joints between the bands (these are the axial ones), in accordance with which the longitudinal cracks are relatively large, which are clearly marked by the thickness of the opening (from 0.5 to 2 cm), the road surface is in good condition, with the exception of some low-grade local damage, and this is for the entire route.

- The deterioration survey carried out on the flexible part of the main runway gave a construction service index of 99.85% indicating an excellent paving structure.

- In the absence of cracks and stress in the parabola, core sampling on the pavement was not carried out by core drilling in order not to disturb and damage the structure of the pavement body because the track was in service and fully functional.

- Deflection measurements taken using HWD and hardness coefficients obtained from road surface layers using the ELMOD version 5 program confirm our diagnostics on the track. The deviations measured in the region (PM 0 to PM 2300) are in the order of 700 micrometers on average, the regions with average degrees from PM 2300 to PM 3000 have a

The average deviation is 400 micrometers.

- The calculated average age of the measured points in the HWD of the main corridor

01/19 from Ouargla airport based on 10 movements / day of the reference BOEING 737-800 aircraft, its age ranges from 5 to 40 years.

- The ACN, corresponding to the BOEING 737-800, is 44, which is lower than the average PCN (95) recorded on the central 30 meters of the main runway 01/19. The aircraft in question can be accepted without restrictions on the payload or the number of movements.

- The average IRI values obtained, at the level of the landing strip (01/19), range from 2.52 to 3.32 m / km, with an average of 2.99 m / km, and this average value generally characterizes the average flatness.

- The average IRI values obtained, at the taxi route level, range from 2.41 to 3.23 m / km, with an average of 2.63 m / km. the average of this value generally characterizes the average flatness condition.

- At the conclusion of this first stage, the main runway 01/19 and these ancillary structures have a very good surface condition, the behavior of the Land Rover is judged by all the tests and observations carried out regarding dynamic stresses, and to ensure a very long life, we recommend sealing the open longitudinal joints along the entire length of the track.

- In these three years of monitoring the main runway of Ouargla airport and these annexes, we observe constancy in the values of deviations and evenness values, which confirms the effectiveness of the ground fittings used in the last process of reinforcement. on the other hand, we observe a decrease in adherence values in each measurement of roughness values.

Conclusion

Runway maintenance has been extensively analyzed, leading to a complete understanding of the diagnosis of pavement degeneration, the factors that cause it, and preventative measures.

Neglecting runway maintenance is a disastrous practice that jeopardizes the safety of passengers and crews residing in airports. It's safe to say that the regular upkeep of runways is crucial. Serious incidents are the result of failure to perform routine maintenance, which can lead to harm to those aboard the plane.

The condition of runways requires careful attention, which necessitates periodic checks. Such inspections focus on the surrounding soil and whether there are potholes, cracks, or any changes in the floor's condition under the runway. Testing the runway weight capacity, assessing the runway surface and ground signals, and keeping the protective barriers in good condition are all essential maintenance tasks for a runway. Regular cleaning and upkeep of these elements ensure the continued safety of aircraft operations.

For a safer travel experience, it's crucial that we prioritize the upkeep of our runways. Regular safety checks must be conducted to ensure passengers and crew can journey without fear. If we commit to maintaining our airports and prioritize the safety of those who traverse them, we'll foster a much safer environment.

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