Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.13, No.30, 2022

Evaluation of the Level of Service Quality of the Main Road Surface in the Municipality of Al-Baij in Jordan

Safaa Ahmad Al-Shraa
Engineer at Al Mwagar Municipality, Ministry of Local Administration in Jordan, Al Mwagar Municipality, Amman, Jordan

Abstract
This study sought to Evaluation of the level of service quality of the main road surface in the municipality of Al-Baij in Jordan, The methodology depends on making an engineering survey of the network with the latest survey methods and methods adopted and approved globally. The study resulted in the following: The field tests conducted and the analysis show that Al Baij roadway segment understudy suffers from different type of distresses that require immediate treatment. The results of the study showed that the road needs maintenance. The PCI ratings for each section of the roadway segment and corresponding severity, endorses the fact that serious maintenance is needed for Al Baij roadway segment. The study showed the cost of maintenance of each type of these defects. The total cost of maintenance of the roadway turned out to be around 60,000 JD. The most important recommendations reached by the study: Al Baij Municipality can use this research to examine the roadway segment and conduct the required maintenance repairs. However, as stated above, the Municipality of Al Baij should develop a pavement maintenance management system for its road network.
Keywords: service quality, road surface, the municipality of Al-Baij.
DOI: 10.7176/JEP/13-30-09
Publication date: October 31st 2022

1. Introduction

The road surface or road paving was widely used in the past with gravel, cobblestones and granite, but these materials were later replaced by asphalt or concrete layer placed on a coarse, compacted substrate. Asphalt mixtures have been used in paving roads since the beginning of the twentieth century. There are two types of these methods, metallic methods and non-metallic methods. Metal roads are designed to carry vehicle loads, so this type of road is implemented in places where cars run on a daily basis. Non-metallic roads are rough roads, also known as gravel roads. These roads are not metallic and therefore cannot withstand heavy weights. This is why bumps in these roads are usually common. Lines are often drawn on road surfaces to direct traffic. Currently, paving uses water permeability on light-traffic roads. Paving of roads is essential for countries like the United States and Canada that rely heavily on road transportation. Therefore, research projects such as long-term paving are launched to improve the life cycle of various road surfaces.

Usually the roads last a long time. Therefore, it is important to model and predict their future condition. This is the subject of pavement performance modeling, the science of studying the behavior of pavement over time and the factors affecting its degradation. Many factors influence road deterioration including climate, design, construction and operating condition (Nehme, 2017).

Asphalt (specifically, asphalt concrete), sometimes called flexible paving, has been widely used since the 1920s, due to its mechanical nature in load distribution. The viscous nature of bitumen allows significant plastic deformations to occur in asphalt concrete without affecting its functioning, although stress from load cycles is the most common breakdown mechanism. Most of the asphalt layers are placed on a gravel foundation, which is usually equal to or greater than the thickness of the asphalt layer, although some “full thickness” asphalt layers are laid directly on the foundation soil. In areas where the foundation is composed of soft or highly compressive materials such as clay or peat, a thick gravel substrate or stabilization of the foundation with Portland cement or gypsum may be required. Polypropylene and polyester synthetic anchor nets are also used for this purpose and in some northern countries a layer of polystyrene sheet is used to delay the time of frost penetration into the foundation soil (Piryonesi, 2019).

Asphalt is classified according to application temperature into hot, warm or cold asphalt mixture. Hot asphalt is used at temperatures over 300°F (150°C). Warm asphalt is used at temperatures between 200 and 250 degrees Fahrenheit (95-120 degrees Celsius), resulting in reduced energy consumption and VOC emissions. Cold asphalt is often used on rural roads where traffic is light, as hot asphalt cools on the road due to the long distance the vehicle travels from the asphalt plant to the construction site. Asphalt concrete layer is generally applied in major highways with heavy traffic and which average traffic load is more than 1200 vehicles per day. Among the advantages of asphalt roads: relatively low noise, relatively low cost compared to other paving methods, and ease of repair. Among its disadvantages: less durability than other paving methods, lower tensile strength than concrete, softness in hot weather, and contamination of soil, groundwater or waterways with hydrocarbons (Raab, Robert,2017).

Based on the foregoing, the aim of the current study is to assess the level of road surface service quality in the municipality of Al-Ba'aj. Al-Baij municipality is the way between Al-Mashref, Al-Kumar Al-Ahmar,OM Al-serb,Alnahdah and Al-Fuhailiya, a transit area for the main Mafraq Center. It is sometimes considered a link between the Center of Baij and the center of Mafraq.

1.2 The problem of the Study

The problem of the study lies in the following main question:
What is the extent of the evaluation of the level of service quality of the main road surface in the municipality of Al-Baij?

1.3 The importance of the study

The importance of the study can be divided into:
First: Theoretical importance:
The importance of the current study lies in focusing on evaluation of the level of service quality of the main road surface in the municipality of Al-Baij. It is acceptable to engineers and technicians, and it is one of the rare studies in the Arab world.
Second: Practical importance:
It is hoped that this study will be benefited by providing highly efficient tools on the topic of evaluation of the level of service quality of the main road surface in the municipality of Al-Baij, thus facilitating the field for thinkers in the field of road engineering. And researchers in this field to reach important results, and in this regard engineers and officials can benefit from the results and recommendations of this study.

1.4 The objectives of the study

This study aimed to identify the evaluation the level of service quality of the main road surface in the municipality of Al-Baij, in order to reach a complete and comprehensive evaluation of the road.

1.5 The Study Approach

In preparing this study, the researcher relied on:
The methodology depends on making an engineering survey of the network with the latest survey methods and methods adopted and approved globally. The Pavers Micro program was used for analysis and evaluation, and after reaching the results, recommendations were made to reach an appropriate solution.

1.6 The limits of the study

Temporal boundaries: 2022
Spatial boundaries: AlBaij municipality in jordan.

2. Literature review

This chapter deals with an overview of the study variables in terms of the concepts addressed by previous researchers, as well as the dimensions in which the study variables were measured. This chapter also provides a review of the scientific literature that discussed the variables and linked them, in addition to clarifying what distinguishes this study and the extent to which previous studies have benefited.

2.1 Engineering properties of road construction materials:

The quality of the engineering properties of road construction materials is one of the most important factors that affect the quality of roads, and to maintain high quality roads, in addition to good implementation according to the standard specifications of construction methods. The engineering properties of materials are measured by taking samples and doing the necessary laboratory experiments, in order to verify their quality and actual engineering specifications, and then compare the results of the tests with the specifications required for implementation, in order to accept or reject those materials. One of the engineer's priorities is to verify that the samples and tests comply with the methods and specifications for road construction, and that the materials used in the work and supplied to the site comply with the specifications of the contract. To control the quality of the materials used, follow one of the following steps:
1 . The materials are reviewed or samples are taken and experiments are conducted on the site.
2 . Taking samples on site and sending them to specialized laboratories.
3 . Sampling and testing on site, but part of the samples are sent to specialized central laboratories, in order to ensure the performance of equipment and testing steps on site.
4 . Materials are accepted on the basis of a guarantee or certification from the supplier. The engineer and the project observer shall have sufficient knowledge of the methods used to judge the materials and samples supplied to the site, in order to ensure their compliance with the requirements and specifications. Also, the

contractor and the observer must know where, when and how the sample is taken, and what tests should be carried out. The responsibility for ensuring that the materials used in the paving operations comply with the standard specifications rests with the engineer, and in the event that the results of the tests do not comply with the specifications, a decision must be taken to exclude or remove the implemented part of these materials and to exclude the supplied materials.

2.2 Types of samples for road construction materials:

1- Qualifying Samples:

Qualifying samples are taken and tested to determine the quality of a specific product or general source, in order to determine the acceptance or rejection of asphalt or any materials related to asphalt work, such as comparing fragmentation and sieve analysis of aggregates.

2- Job Control Samples

Production control is tested on site or on site for the purpose of quality control of all materials used in construction Samples are taken in places where materials require the fulfillment of certain specifications.

3- Split Samples

They are samples taken to determine the results of the tests. The samples are taken and numbered, and some tests are conducted on some of them The main central laboratories and others in the project laboratory, then compare the results with each other.

4- Laboratory Check Samples

Samples are taken with a maximum revision of the materials used in construction, and are similar to production control samples except that they are taken and tested by the engineer or in the presence of the engineer or his representative, and the purpose of these tests is reviewed at equipment and steps in taking samples and testing materials and to verify the quality of implementation.

5- Information Samples

Questionnaire samples are samples not mentioned above, and these samples are taken during the production of materials and before the process

Acceptance, such as the grading of materials to indicate their suitability for use, as well as samples taken during the calibration of the asphalt mixer.

hot .

6- Acceptance Samples

These samples are taken from random places for the purpose of verifying the compliance of the implementation materials with the specifications before final receipt.

7- Places of sampling.

Sampling places vary according to the type of materials and the information required. Samples are taken from the materials every period to make a proper control of the work and to ensure the quality of the materials to determine their acceptance and compliance with the specifications for their implementation.

Samples are usually taken during the operations of mixing aggregates from the mixer or transport vehicles or from containers used for storage and from any other places according to the requirements and specifications of implementation.

2.3 Specifications of asphalt mixture:

The asphalt material in the asphalt mixture constitutes only about 5% of the weight of asphalt mixtures, and only 10% of its volume, but its role is essential in the performance and quality of the mixtures. And giving it the ability to resist tensile, pressure and shear forces resulting from external influences as well, in addition to isolating gravel grains from water and other materials reaching them. The specifications of the asphalt mixture include the following:

First: Water resistance of asphalt mixture:

Asphalt is a lightweight material, water repellent and does not dissolve in it. It is also a material with high flexibility, and has strong adhesion and cohesion with mineral materials, which makes its use appropriate in places exposed to rain water.

Second: Asphalt viscosity:

The hardness and density of the asphalt mixture are reflected in the viscosity of the asphalt, and the viscosity test of an asphalt or bitumen sample is one of the important tests that must be carried out before constructing roads to ensure its quality and ability to bind materials together.

Third: Softness of asphalt:

When the asphalt is impacted by an external force, such as a truck traveling on an asphalt road, it deforms without breaking, and when the effect of the external force wears off, the solid material returns to its original shape after the load is removed from it.

Forth: Not affected by temperature changes:
Asphalt has a low sensitivity to temperature differences, so it is not affected by much variation in weather, or by various weather factors, and therefore its viscosity does not vary and its performance does not differ much.

2.4 Asphalt mixture:
The asphalt mixture consists of a mixture of sand, gravel, crushed stone, asphalt and some additives. It is used for paving roads. It has several types, differing according to the proportions of the materials that make it up, the quality of the materials added to it, and the nature of the road that will be paved on it.

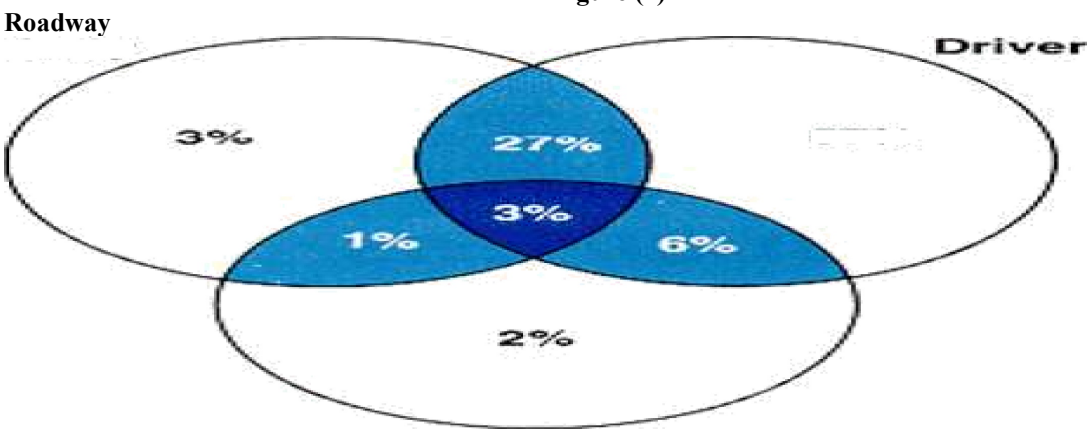
2.5 Types of asphalt mixtures:
The appropriate asphalt mixture must be selected according to the area you will serve and the surrounding conditions, such as heavy traffic, weather conditions, the weight of heavy vehicles traveling on the road, the temperature of the site and the amount of pressure that may affect the paved road and other details, and here are the most common types of asphalt mixtures :

1- Hot Mix Asphalt (HMA).
2- MC cold mix.
3- UPM cold asphalt.
4- Warm Mix.
5- Cut back asphalt.
6- Mastic asphalt.

3. Statistical Analysis
Description of Roadway Under Study
The roadway under study connects Al Baij and Amman - Bagdad International road. The length of this section of roadway is about 4600.

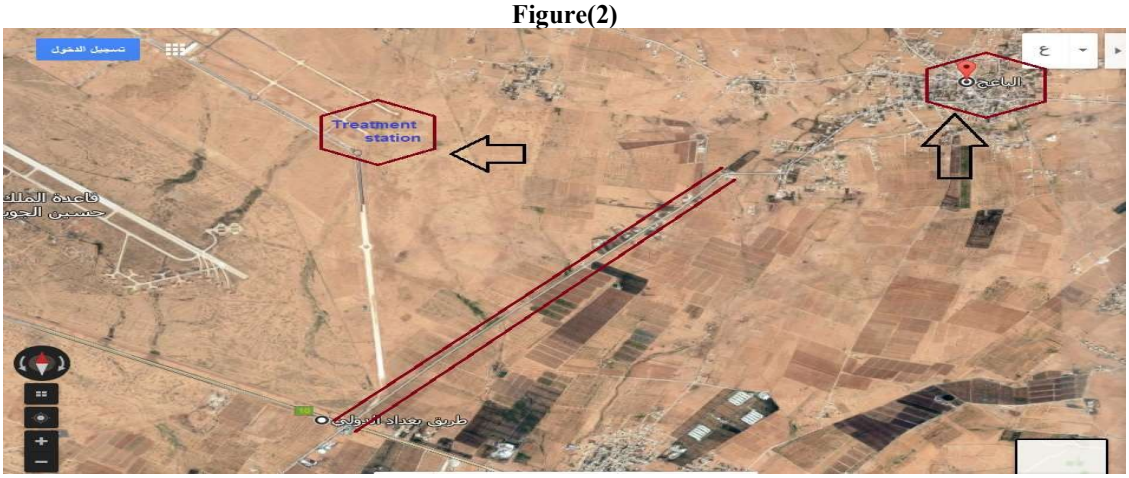
The road width is 4m. It is undivided with one lane in each direction.The road has no shoulders and the posted speed is 100-120 kmph. The flow on this road is around 122 veh/hr. The road in general has a poor riding quality due to lack of road maintenance. More details about the riding conditions will be presented later on in this report. Shows Figure (1) given description to the relationship between driver ,roadway ,and vehicle :

Figure (1)

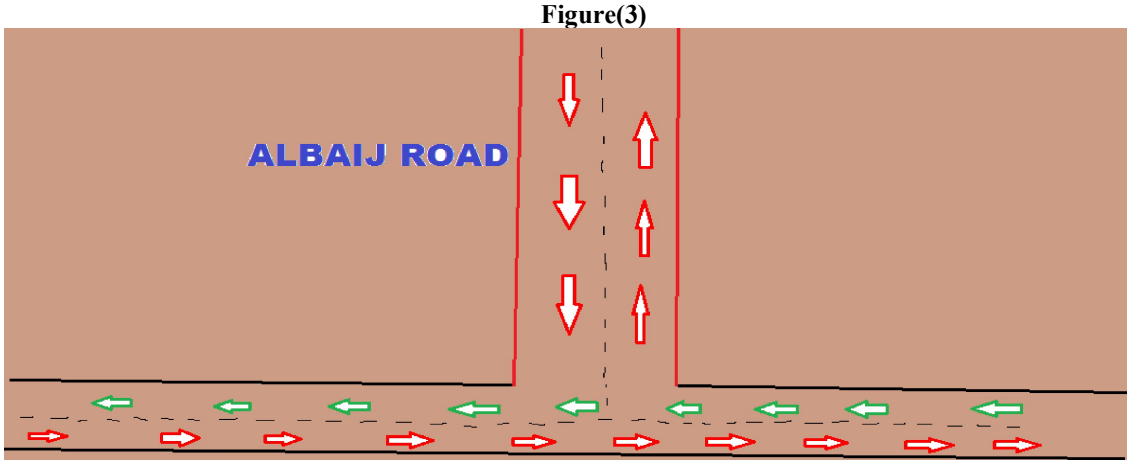


A branch of the main road leads to two sub-roads, one connecting the main road and the treatment plant, the other connecting the main road and the village of Al-Fuhailia, as well as a farm on the side of the main road. Shows Figure 2 ,3,and 4.

Figure(2)



Figure(3)



BAGHDAD lflTERflATlOflAL ROAD

Figure(4)

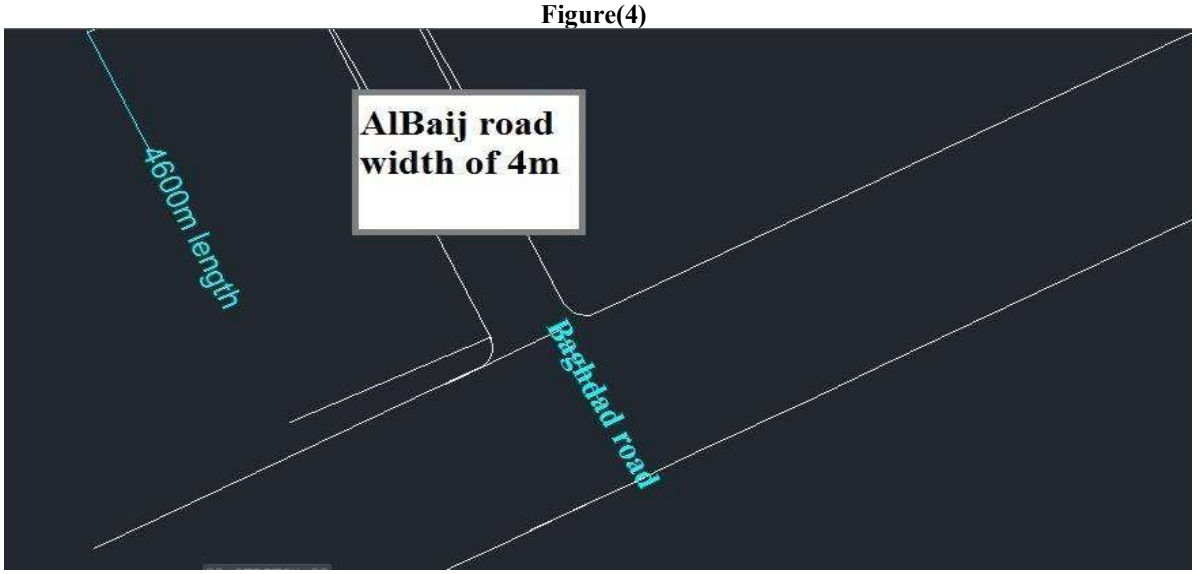


Table x :Work in road maintenance using public safety means.

YEAR	The number of accidents	The number of Death	The number of wounded
2015	3	2	1
2016	4	3	4

Table Y: Design of the pavement in proportion to the load ratio of cars and heavy vehicles:

Today	Peak Hour(7- 9)Am	Peak Hour(10- 12)Pm
Monday	116	44
Tuesday	103	59
Wednesday	122	49

3.1 Modern Studies

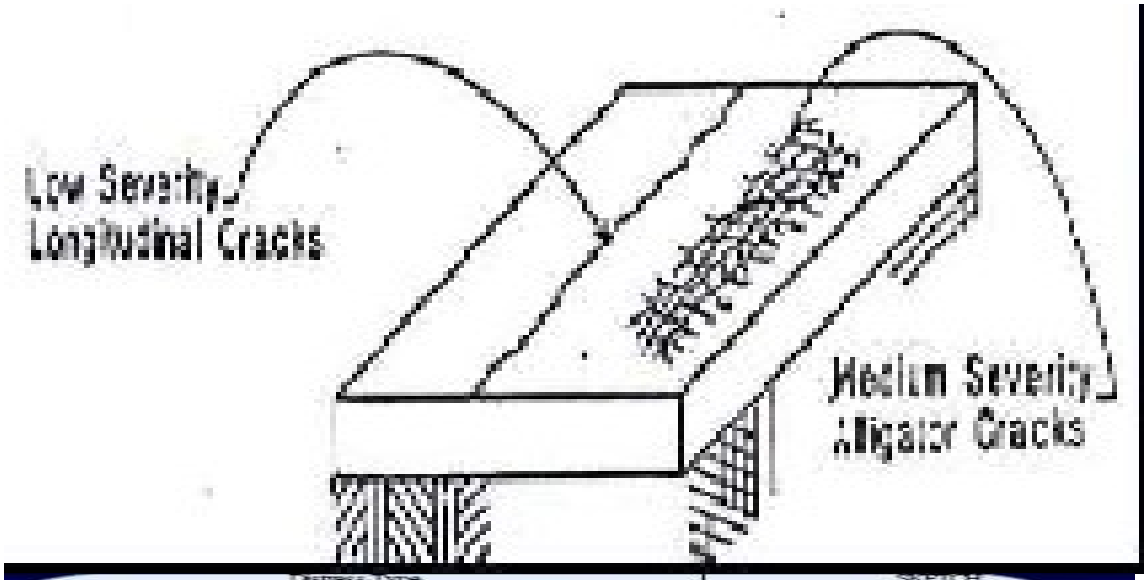
The length of this section of roadway is about 4600m.The road width is 4m .It is undivided with one lane in each direction.

Pavement management is the process of planning the maintenance and repair of a network of roadways or other paved facilities in order to optimize pavement conditions over the entire network.

It is also applied to airport runways and • ocean freight terminals

Pavement Condition Index:

STEP 1: INSPECT SAMPLE UNITS TO DETERMINE TYPE, QUALITY AND SEVERITY LEVEL OF PAVEMENT DISTRESSES.



Distress Type

1. Alligator Cracking
2. Bleeding
3. Block Cracking
4. Bumps and sags
5. Corrugation
6. Depression
7. Edge Cracking
8. JJ Reflection Cracking
9. Lane / Shoulder Drop Off
10. Long & Trans Cracking
11. Patching & Utility Cut Patching
12. Polished Aggregate
*13. Potholes
14. Railroad Crossing
15. Rutting
16. Shoving
17. Slippage Cracking
18. Swell
19. Weathering & Raveling

SKETCH

Inner Boundary

2.17m 8.1m 2.8m

EXISTING DISTRESS TYPES

		1	6	9	10	12
		0.3*30.85 (L)	0.5*0.7(L)	30.85(L)	66.25(M)	8.0*30.85(L)
		2*2 (L)	0.7*0.3(L)		13.10(H)	
Total Severity	L	13.255	0.56	30.85		246.8
	M				66.25	
	H				13.10	

PCI CALCULATION

DISTRESS TYPE	DENSITY	SEVERITY	DEDUCT VALUE
1	13.255	L	25.2
6	0.56	L	4.3
9	30.85	L	5.9
10	66.25	M	27.9
10	13.10	H	23.4
12	246.8	H	19.8
DEDUCT TOTAL			106.5
CORRECTED DEDUCT VALUE (CDV)			57

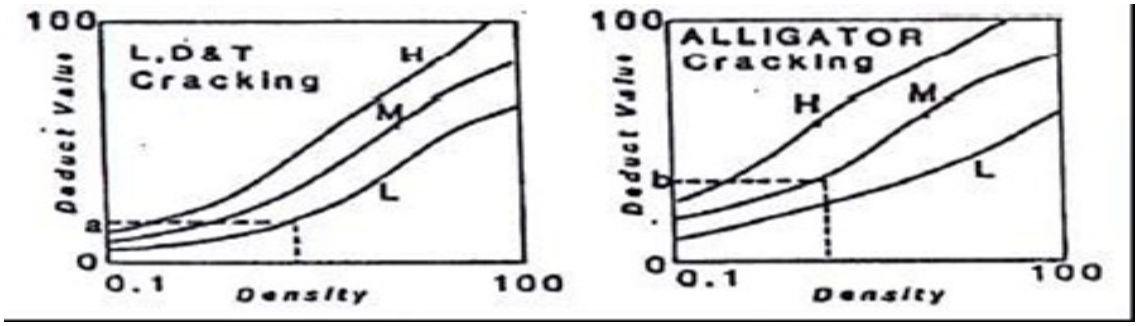
PCI =100- CDV =

43

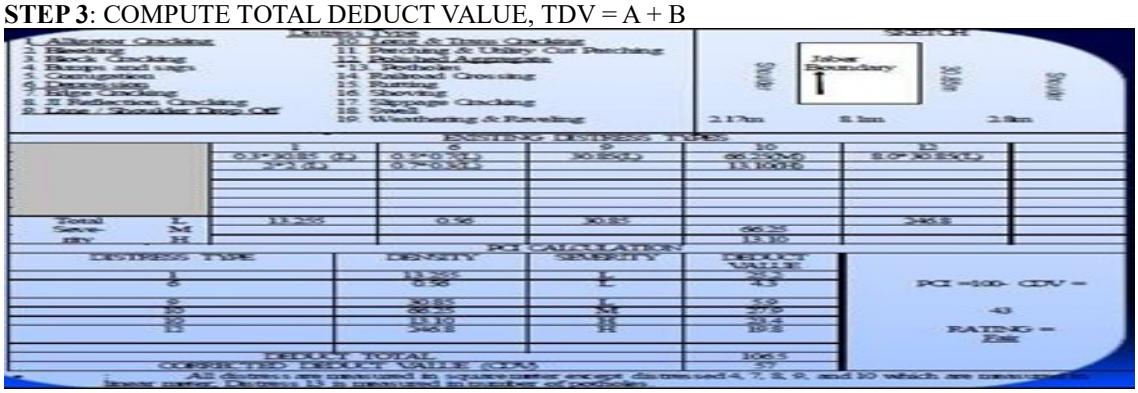
RATING = Fair

All distress are measured in square meter except distressed 4, 7, 8, 9, and 10 which are measured in

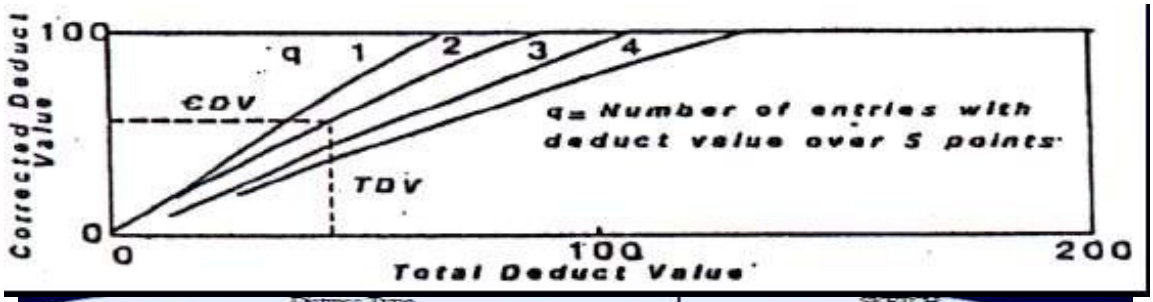
STEP 2: DETERMINE DEDUCT VALUES:

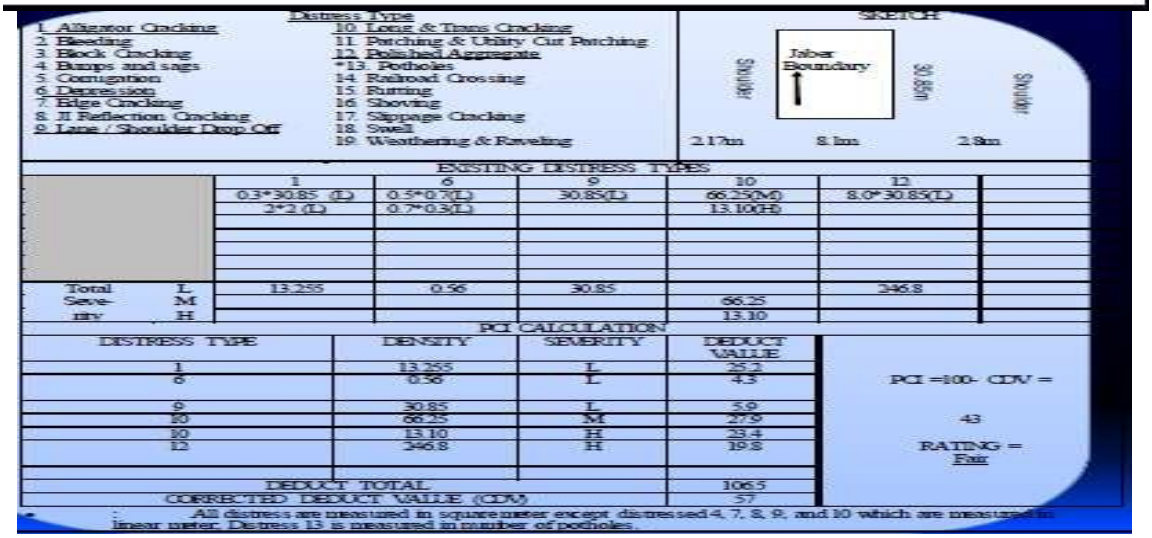


STEP 3: COMPUTE TOTAL DEDUCT VALUE, TDV = A + B



STEP 4: ADJUST TOTAL DEDUCT VALUE:





STEP 5: COMPUTE PAVEMENT CONDITION INDEX, PCI = 100 – CDV, FOR EACH SAMPLE UNIT INSPECTED

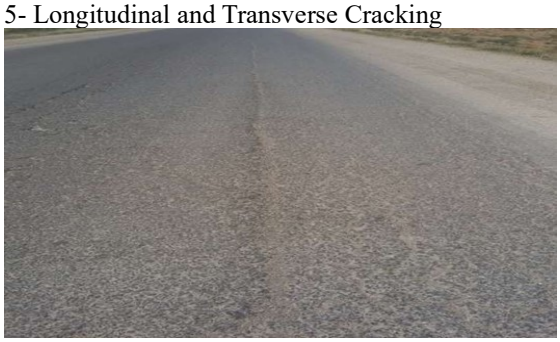
3.2 Micro Pavers is a microcomputer version of the PAVER Pavement Maintenance Management System. PAVER is a field- tested, validated pavement maintenance management for airports, cities, counties, and military installations which is designed to optimize the funds allocated for pavement maintenance.
Distress in Asphalt Pavements in the road can take different forms:
1-Alligator Cracking:

2- Block Cracking

3- Edge Cracking

4- Joint Reflection Cracking

5- Longitudinal and Transverse Cracking



6- Depression

7- Bumps and Sags

8- Patching and Utility Cut Patching

9- Weathering and Raveling

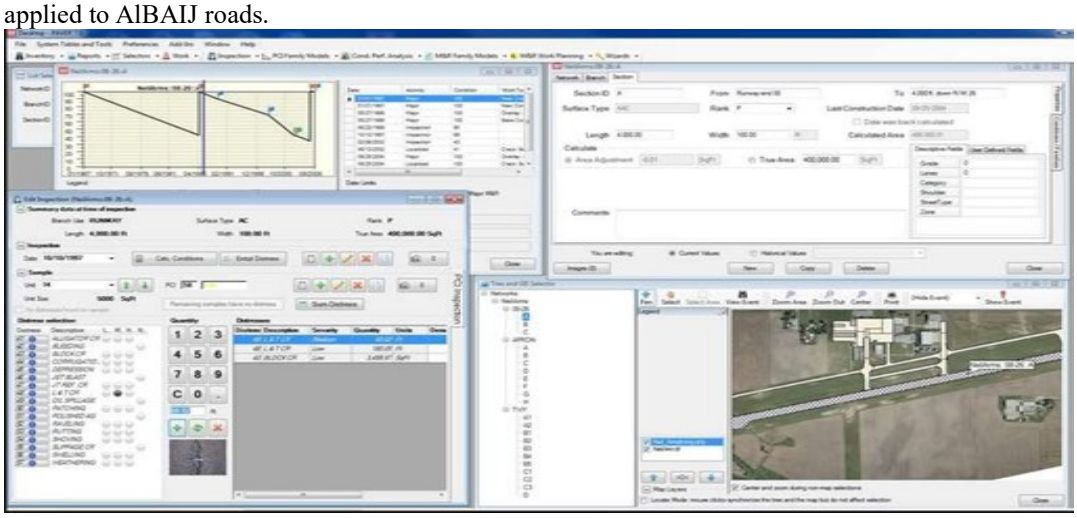
3.3: Methodology

Maintaining Al Baij Road Segment length: 4600m
Last major repair: before 6 years
Surface type: Asphalt

3.4 Use of Micro Paver Program for pavement Maintenance Management:

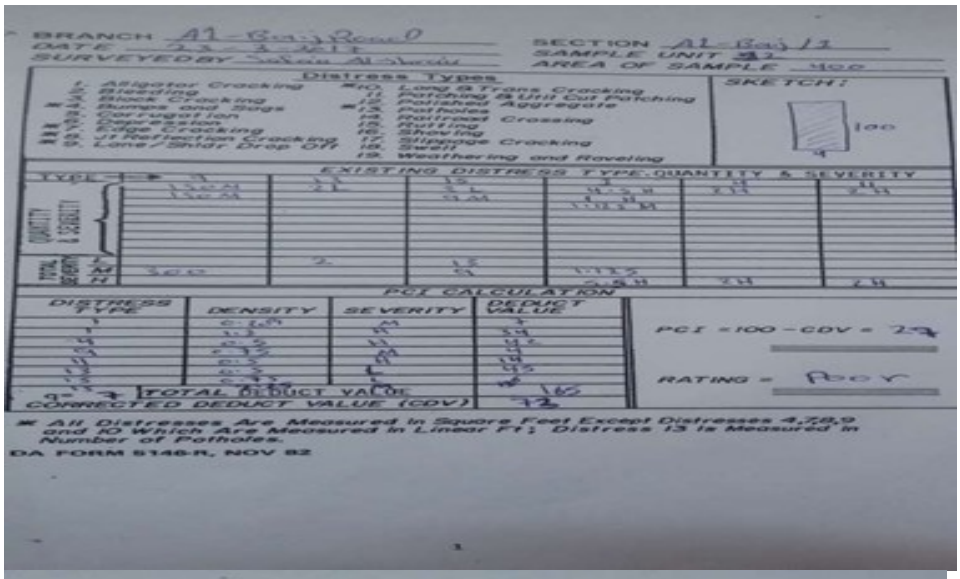
Pavement maintenance management system using pavement condition index (PCI). They also determine effective and economic management of maintenance expenditures.

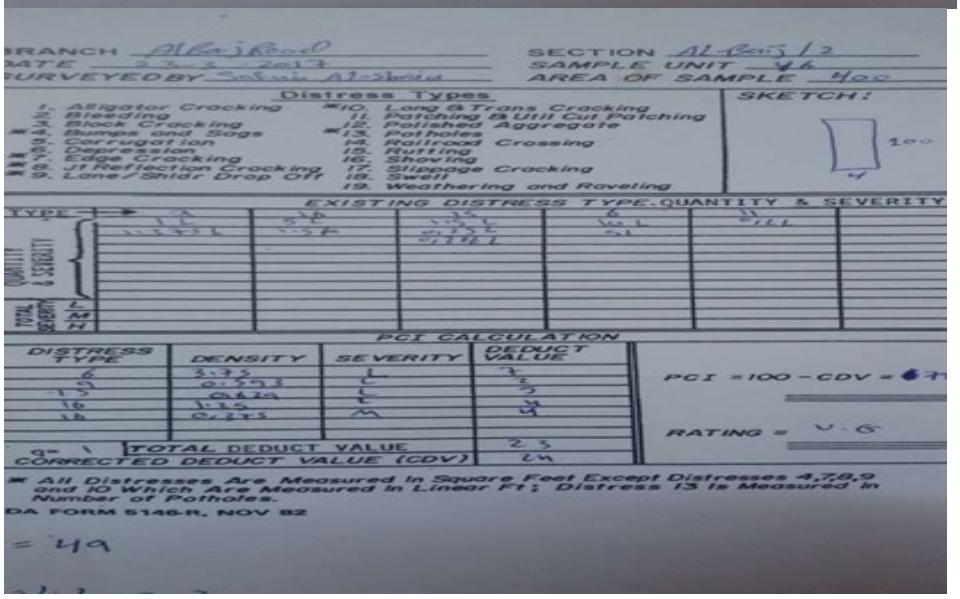
PCI computation by Micro PAVER is based on determination of defects. In this paper the Micro PAVER was applied to AlBAIJ roads.



3.5 Field Examination Outcomes

When studying the road network we found that the best sample is 76 and the worst sample is equal to 27 to found the interval is equal to 5.





Sample number	PCI	Interval	Rating
1	76	Best Sample	Very good
2	27	Worst Sample	Poor
3	45	5	Fair
4	44	10	Fair
5	66	15	Good
6	41	20	Fair
7	75	25	Very Good
8	67	30	Good
9	55	35	Good
10	64	40	Good
11	65	45	Good

Table 4 shows a summary of results:
indicating type of distress, severity (low, medium, high), location and cost of repair. Types of distresses include: lane/shoulder, rutting, alligator cracking, shoving, patching, long/trans, and potholes. The total cost of repair turned out to be around 60,000 JD.

Type of Distress	Severity	Distance from Origin(m)	Coast of repair (ton from asphalt)
Lane/Sholder	L/M	60/130/165/240/360/ 490/620/1100/11 70/2220/2630/3 430/4400	40.147
Rutting	L/M	55/160/550/690/750/ 1030/10250/165 0/3220/4550	5.237
Alligator crack	L/M/H	60/150/560/760/103 0/1600/2120/26 80/3400/3960/4 100	4.913
Shoving	L/M	600/1150/3960/4120	1.022
Patching	H/L	770/1680/2200	0.76
Long/Trans	H/L/M	690/1560/3840/3950	2.023
Potholes	M/L	550/690/3200/4090	2.50
Other distress lowest effect	L/M	50-4600	4.051
Total			59.445

4. Conclusion

The field tests conducted and the analysis show that Al Baij roadway segment understudy suffers from different type of distresses that require immediate treatment. The results of the study showed that the road needs maintenance. The PCI ratings for each section of the roadway segment and corresponding severity, endorses the fact that serious maintenance is needed for Al Baij roadway segment. The study showed the cost of maintenance of each type of these defects. The total cost of maintenance of the roadway turned out to be around 60,000 JD. Al Baij Municipality should seek financial resources to maintain the roadway. Otherwise major reconstruction will be needed. According to the study conducted, the Percentage of people who feel that AL Baij roadway require immediate maintenance was around 95%. It was found that the roadway segment did not receive any preventive or routine maintenance. The Municipality of Al Baij should have a pavement maintenance management system. Part of this system is to conduct preventive and routine maintenance. All maintenance operations should be documented. The data collected showed that the • number of accidents, number of fatalities and number of injuries have increased in 2016 when compared with 2015. Part of such increase may be due to poor conditions of the road surface. The study showed the importance of maintaining the road to avoid accidents. Al Baij Municipality can use this research to examine the roadway segment and conduct the required maintenance repairs. However, as stated above, the Municipality of Al Baij should develop a pavement maintenance management system for its road network, and Al Baij should do road maintenance from time to time.

References

1. Nehme, Jean (July 14, 2017). "About Long-Term Pavement Performance", Federal Highway Administration. Archived from the original on June 19, 2018, accessed October 22, 2017.
2. Raab, Robert (2017). "Long-Term Pavement Performance Studies", Transportation Research Council, archived from the original on December 30, 2019, accessed on October 22, 2017.
3. Piryonesi, S. M., & El-Diraby, T. (2018). Using Data Analytics for Cost-Effective Prediction of Road Conditions: Case of The Pavement Condition Index: [summary report] (No. FHWA-HRT-18-065) United States. Federal Highway Administration. Office of Research, Development, and Technology." Archived from the original on April 16, 2019.
4. Ford, K., Arman, M., Labi, S., Sinha, K.C., Thompson, P.D., Shirole, A.M., and Li, Z. 2012. NCHRP Report 713: Estimating life expectancies of highway assets. In Transportation Research Board , National Academy of Sciences, Washington, DC. Transportation Research Board, Washington DC." (PDF). Archived (PDF) from the original on November 23, 2015.
5. Piryonesi, S. M. (2019). The Application of Data Analytics to Asset Management: Deterioration and Climate Change Adaptation in Ontario Roads (Doctoral dissertation)

6. Piryonesi S. Madeh; El-Diraby Tamer E. (June 01, 2020), “Role of Data Analytics in Infrastructure Asset Management: Overcoming Data Size and Quality Problems,” Journal of Transportation Engineering, Part B: Pavements, 146 (2): 04020022, doi:10.1061 JPEODX.0000175. Archived from the original on April 12, 2020.
7. "NUAE Geosynthetics Ltd. News: Project Scout Moor Wind farm" (PDF), NUAE, May 2007, archived from the original (PDF) on March 4, 2016, accessed on November 02, 2008.
8. Anon (June 1991), "Highway construction/ Ground insulation" (PDF), Styropor: Technical information, archived from the original (PDF) on October 2, 2018, accessed on January 29, 2010.