

# Defects and Problems of the Asphalt Paved Roads in Al-Salt City "Reasons and treatment Methods"

Surat Mahmoud Al-Gammaz

**Abstract:** This research aims to identify the reality of paved asphalt roads in the city of Salt in the Hashemite Kingdom of Jordan, and to address defects and problems related to asphalt roads, their causes and possible treatment methods to provide safe and smooth driving, and reduce the number. Of accidents and road rehabilitation costs, the research used field survey to construct roads, and the research concluded that recommendations were made to construct asphalt roads to maximize economic growth, create jobs, and prosperity - the quality of roads is one of the main considerations for developers using selected to do business in the society.

**Keywords:** asphalt paved roads, defects, cracks, Al-Salt City.

## I. INTRODUCTION

Al-Salt city like other cities in the Hashemite Kingdom of Jordan is witnessing expansion in the housing sector, building new complexes, an increase in people's movement from, and Al-Salt city using different means of transportation like the cars, busses, and trucks. Such increases in population, trade, and industrial activities require the continuous construction of asphalt paved roads to satisfy the needs of the citizens and the users of the roads. The constantly increasing the number of vehicles as a result of urban development hurts the asphalt pavement at Al-Salt city streets. The defects emerging during exploitation of streets with movement asphalt payment influence the smooth traffic and driving, the safety of drivers depending on the quantity and size of the defects, (Ziliute, L et al 2008). Defects and problems in Al-Salt city asphalt pavement streets are often observed as resulting from using the wrong construction technology defects in the used materials, and the pavement structure layers thickness. Because asphalt paved streets play a major role in connecting people to their jobs, schools, and affordable housing. They expect to disserve safe and smooth driving, streets free from defects, and problems to achieve sustainable transportation.

## II. RESEARCH PROBLEM:

The research problem stems from observing defects and cracks of defects quantities and sizes in Al-Salt city asphalt paved roads causing unsafe driving, unsmooth driving, and expenditures to treat the defects and the problems adding financial burdens to the authorities.

### A. RESEARCH QUESTIONS:

From the statement of the problem emerges the following major questions:

- 1- What are the causes of the defects in the asphalt paved roads in Al-Salt city?
- 2- What is the role and responsibility of the road's construction firms?
- 3- What is the role and responsibility of the ministry of public works and tenders department in quality assurance while constructing the asphalt paved roads?

### B. RESEARCH IMPORTANCE:

Research Importance derives from the importance of the topic it is addressing for economic and safety considerations since defects in the asphalt roads will result in accidents, risks to the drivers, and damage to vehicles and economic losses. So, The importance of this research comes to shed the light on the main factors that cause the deterioration of asphalt paved streets.

### C. OBJECTIVES OF RESEARCH:

This present research seeks to achieve the following objectives:

1. To identify the defects in the asphalt paved roads in Al-Salt city.
2. To identify reasons for defects and problems in Al-Salt city roads.
3. To provide recommendations and suggestions to improve the durability and quality of the asphalt paved roads in Al-Salt city roads.
4. To achieve the maximum positive economic impact from the asphalt paved roads in Al-Salt city.

### D. LIMITATION OF THE RESEARCH:

This research is limited to the following:

- It is limited to Al-Salt city roads.
- It is limited to asphalt paved roads.
- It is limited to its topic "Defects and problems of the asphalt paved roads in Al-Salt city: reasons and treatment method".
- It is limited to its method.

## III. CONSIDERATION ABOUT THE MAIN CAUSES OF DEFECTS AND PROBLEMS:

One of the main parameters to show the quality of road pavements is the roughness of the roads.

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Since pavement roughness has direct influences on driving comfort, fuel consumption, and traffic flow and safety, the roughness of the road depends on the presence of cracks in the pavement and their damage level. It is influenced by climate and traffic factors, temperature, and rainfall.

The presence of cracks and roughness in the asphalt pavement roads comes as a result of a lack of commitment to specific requirements, standards, and rules (Cygas, D, 2004).

The main factors that cause the damage to street pavements and the appearance of defects are the follows:

A huge amount of cars using the street.

High intensity of traffic.

The growth of vehicle loads.

Environmental impact.

The use of low quality, low strength construction materials in the pavement structure.

### Types of pavement defects:

- Cracks.
- Ruts.
- Potholes.
- Creep.

These defects have the high potential to cause risks to the drivers and their vehicles and problems in allocating the budget and the resources to rehabilitate the street (Kamal & Niazi, 2007).

The most common pavements defects:

Cracks are considered the most common defects in asphalt pavement streets, they depend on the number of loading cycles, the size of pavement streets, and on the mechanical characteristics of asphalt.

Cracks constitute up to (70%) of all defects coursing damage of the pavement.

### Classifications of cracks of Asphalt pavements:

Cracks of asphalt pavements can be divided into two groups, depending on time and climate, these groups are:

1- Structural cracks: They appear in the pavement as a result of the impact of traffic loads and weak strength of pavement structure, and because technological requirements are not completely implemented.

2- Thermal cracks: result from variation in temperature and freeze of the pavement structure. (Zilute, L, et al, 2007).

### Importance of available good road infrastructure:

Al-Salt city road requires good infrastructure to avoid many problems for the users of these roads and to minimize maintenance and repair costs.

Good road infrastructure plays an important role and is considered an essential requirement for national economic growth by enhancing national and international trade.

For the citizens, good infrastructure facilitates mobility, opens opportunities for employment, markets, education & health services.

A good road infrastructure contributes to linking all relevant locations preserving the routes and maintaining them to provide a good service condition.

To keep road pavement in good service conditions without the need for major rehabilitation and un-due costs of additional works, they have to be built in a way that will extend their durability.

According to (Nicholls, Mchale, & Griffiths, 2008). Maximizing the durability of road pavement has the following advantages:

- Reducing the delays to the road users caused by the maintenance.
- Reducing the costs to the road authority of that maintenance.
- Improving the sustainability of asphalt pavement construction.

The frequent incidents of maintenance of the asphalt pavement roads in Al-Salt city came as a result of weak infrastructure, closing the road searching for using sub-roads, longer and time consuming, causing the users complaints about the lack of the preferred asphalt surfacing's that are quieter and provide a smoother ride, without causing any damage to their vehicles.

Because the option of the alternative road during maintenance work is uncomfortable and inconvenient to the citizens who want to reach their destination without delay and extra fuel consumption costs.

### Deflation of asphalt pavement durability:

One of the major problems in Al-Salt city asphalt paved roads is the lack of appropriate durability resulting in frequent maintenance. Asphalt pavement is considered durable if it maintains its structural integrity and functional properties at a satisfactory level with its nominal design-life when exposed to the effects of the environment and the expected traffic loading. According to the best practice. There are two distinct definitions of durability:

1- Asphalt Durability: Maintenance of the structural integrity of compacted materials over its expected service-life when exposed to the effects of the environment (Water, sunlight, and traffic loading).

2- Pavement durability: preserving a satisfactory level of performance over the structure's expected service-life without major maintenance for all properties that are required for the particular road situation also asphalt durability.

These two definitions are important to keep in mind by those who execute asphalt pavement roads to limit or minimize any possible negative effects on the roads.

Underestimating both asphalt and pavement durability will be costly in terms of maintenance work costs and discomfort to the road users. Furthermore, it is important to be aware that asphalt durability depends on the component materials used. The weather conditions during laying, the mixture, the workmanship during mixing, and on the site location. As it can be seen and noticed from the best practice guide, it is very important to encourage everyone and each sector working in the asphalt industry to focus and pay more attention to durability property, to make a better contribution to making asphalt pavement more durable and practicable for the benefit of the roads. Users, and to the authorities in charge of road construction. One of the challenges and difficulties causing major problems is the lack of due focus on durability and its importance according to (Hasan et al, 2008). It is very important to choose the most relevant techniques in executing asphalt pavement roads, the best solutions, and the availability of the required funds for the project,



having the relevant contract type, defining responsibilities and obligations of the contractor because such provisions can have the grate impact on the quality and durability of the road under construction, through allocating all responsibilities to appropriate organization or company.

To limit or to minimize as possible the defects and problems in Al-Salt city's asphalt pavement roads. It is beneficial to refer to the guiding principles for asphalt pavement, and to benefit from universal results that should be kept in mind at all stages of design and execution of the asphalt pavement.

Among these principles and approaches that can be used to achieve durable pavement are:

The three core principles of asphalt:

- Pavements are designed to act as one layer.
- All joints are weaknesses.
- Sealing and bonding between layers are very important.

The three core virtues of asphalt:

- High binder content.
- Small nominal size aggregate.
- Low air voids content.

Water should not get in from the side, get in from the joints, or finds its way between unbounded layers.

Important things to take into account about drainage:

- It is very important.
- It needs to be continuous and maintained.

It can be noted from observations and field inspections that most types of defects and problems in Al-Salt city's asphalt roads result from poor drainage networks and lack of the required continuous inspection and maintenance of the drainage system.

Other defects and problems emerge from a lack of solid foundations that allow good compaction because it is impossible to fully compact unsupported edges.

Field observations of Al-Salt city's asphalt road indicate at the presence of frequent joints, reducing continuity of the work resulting in less durable roads, and infrequent cases, compromising durability to minimize traffic disruption, since minimizing the immediate disruption to traffic by requiring a road to be reopened at peak periods may be detrimental to the long term traffic disruption because working in small packages may increase the need for maintenance.

#### Methods of forming Joints:

Joints need to be away from sensitive areas, whether due to higher traffic stressors or limitations in drainage.

It should be noted that joints represent the weakness part of the pavement and are susceptible to the formation of longitudinal cracks, pavement performance can be greatly improved by limiting the number of joint formed.

Benefits of pavements with superior joint construction include a longer pavement performance life and reduced life cycle costs (Sebaaly & Barrantes, 2004).

There is an agreement about the fact that joints are the potential source of weakness that requires great care and attention in their formation and location because they are often the first part of the pavement to show signs of distress. The address this problem, there is a clear need for selecting suitable joint construction techniques to minimize or to eliminate cracking and revealing problems at the joint to improve its performance.

Forming the appropriate joints is a longstanding problem in Al-Salt city's asphalt roads causing defects, cracks, and

problems in the maintenance processes and additional costs, because of lack of having the appropriate paving schemes and utilizing experienced equipment operators who have the sufficient skill and experience to work with paving and compaction equipment and techniques.

Having available such skills and experiences in the operators will limit the errors which the intern will lead to the construction of good quality pavement.

This implies that the authority encharges of the asphalt pavement should provide training to the workers for the proper use of the equipment and the techniques in paving and compaction to limit or minimize the appearance of defects, cracks, and problems negatively affecting the roads users.

According to Toepel (2003). Maintaining continuity of density across the joint is generally considered a key factor in maintaining durability.

Joints need to be sealed not only because of the discontinuing but also because of the potential inferior compaction, joints, other than in the surface course should be sealed with a thin film of bituminous sealer, but it is important to consider that the sealant should be increased at locations where the joint is not tight or where the asphalt on one or both sides of the joint has a particularly high air voids content.

#### IV. PAVEMENT SURFACE DEFECTS AND THEIR TREATMENT:

The precise description of pavement surface defects is very important to go define surface conditions and to establish a diagnosis of the problems encountered, and selecting the most appropriate maintenance treatment methods. This description must be understandable to all concerned engineers with road maintenance, to have common interest and language about the objectives to be achieved through describing what they observe of defects on the road surface.

Observation of surface defect provides the engineer with the knowledge and understanding of a device and implement the best approaches and techniques to deal with the surface defects.

Such objectives can be achieved through following the established requirements concerning road surface deficiency catalogs, by classifying the many types of defects, they mostly cause and the appropriate remedial methods, the inventory of road surface defects to achieve better maintenance practice (Highways, department, 2019).

The different types of defects that may occur are considered under the following categories to better understand them and dealing with them:

The first category is the name of the defect, description of the most important features of the defects, a listing of attributes, photographs, a listing of possible or most likely causes, and finally, the recommended remedies (Guidance, Notes, Catalogue for road defects, 2013).

Asphalt road construction authority in Al-Salt city should be aware of the different types of defects that are most likely to appear on the asphalt pavement because some defects are in the form of fine cracks hard to distinguish them satisfactorily, some of defects identification depend on training and experience when assessing defects.



## V. METHODS OF DEFECTS OBSERVATION AND DESCRIPTION :

A defect refers to the visible evidence of an undesirable condition in the pavement affecting the service, structural conditions, or appearance of the asphalt pavement.

Correct diagnosis of the cause of defects can only be made after careful inspection of the pavement by an experienced and skillful observer because he can see the defects from different angles, heights, and distance.

But fine cracks are more difficult to see when the road surfaces are wet, only can be seen when the roads dry out.

Since this research afield surveys observational research, recording field notes should be done using a special format for reporting the defects with the intended method of processing (Manual or computer), the defects and the main attributes should be recorded in the inspection form.

The defect description outlines the characteristics feature of the particular defect type, including photos of defect forms, and levels of severity. (Highways, department, 2019).

The attributes included with each defect description can be divided into two broad groups:

- Those which describe the size of the defect (area affected lengths ). and
- Those which describe the severity of a defect, such as depth of deformation & width of the cracks.

The observer can estimate length, width, and area by the naked eye bypassing.

An accelerated wedge is recommended o determine the extent of certain defects.

In some cases, multiple defects and attributes of the component defects should be measured and reported separately (Highways department, 2013).

Possible causes and recommended remedies:

Although the visual inspection is useful in detecting the defect, still using the visual observation as a diagnostic tool has its limitations, because the internal properties of the pavement are unknown, therefore, it is important to assure that any inspection visually assessed cause by more road testing and investigations following appropriate repair or maintenance treatments recommended for the particular defect.

Deformation in the asphalt pavement is the change in a road surface from the intended profile resulting from traffic load and environmental changes (high temperatures and freeze). (Ziliute el, al, 2008).

Deformation is a very serious and dangerous attribute that can affect the safety of driving quality, it may lead to water pending and increasing the chances for traffic accidents and hazards.

Defects and cracks in bituminous pavements include deformation, surface texture deficiencies, and potholes, affecting the pavement surface.

Such defects include deformation, fatigue failure of the surfacing or pavement structure, aging of the surfacing, the reflection of the movement of underlying layers, shrinkage, and poor construction.

The detrimental effect associated with defects and cracks include:

- Loss of waterproofing.
- Loss of fines from the base course.
- Loss of driving quality.

Defects, deformation, and cracks of the asphalt pavement negatively affect the intended service to the road users and significantly affect vehicle operating costs.

### New trends in measuring asphalt pavement defects:

In addition to the visual inspection of asphalt pavements defects because of its limited ability to detect fine cracks, new trends have been emerged to measure defects in asphalt pavements reads automatically, using the mobile laboratory (RST) road survey tester.

The laser technology and innovative mechanical and optical solutions help the inspectors to obtain a detailed view of road pavement surface such technology provides reliable data about the condition of the road pavement surface and driving comfort.

The roughness of road pavement is detected using laser technology significance of using the new technology represent in that the defects of road pavement are presented in graphical maps, electronic tables easily to understand, advancement in technology has provided the help to measure pavement defects and roughness automatically using laser profilometer to detect these parameters.

The intensity and composition of traffic were measured using stationary permanent measurement stations and temporal stations.

It is recommended that using one method is not enough to assess street pavement condition, rather the range of methods must be used to receive rich and explicit data, (Larrinavicius, Oginskas & Zilioniene, 2006).

Nowadays, for the definition of the condition of asphalt pavement streets, there are available deferent main methods, including estimation of defects by visual observations and inspection.

While roughness o the pavements can be measured through the use of a laser profilometer, and the most modern technology, like road survey tester.

Having permanent traffic volumes measurement data, and its rise for a longer period can be forecasted because traffic volume affects the pavement surface casing cracks and affecting the roughness of the pavement.

Inspectors should be able to determine which streets have the highest quantity of defects to take the apocopate measures to reduce the defect impacts on smooth and safe driving, protecting the vehicles from any possible damage to the tyers as a result of roughness in the pavement surface and poor joints to prevent water from interring into the infrastructure of the road causing weakness in its compaction strengths

## VI. RESULT AND DISCUSSION

To improve the quality of the asphalt pavement roads in Al-Salt City, a set of recommendations can be introduced both to the authority in charge of and responsible for road construction, and at the same time to the contractors who are assigned to execute the roads projects in Al-Salt City.



1. The tenders department should pay more attention to technical reports from the contractor regarding the processing of the new and appropriate equipment, machines, operators' skills, and experience who will execute the project. The focus should not be exclusively on financial aspects.

2. Preparing and designing the plans for the roads, taking into account traffic density, location of the road, and the environmental features to determine the most relevant thickness of the asphalt pavement.

3. The use of modern technology to detect defects, cracks, and roughness as early as possible to be able to manage any defect before becomes a serious and costly problem.

4. Carefully monitoring the contractor's work makes sure adherence to the specifications, requirements, and standards at every step in the preparation and execution of the asphalt pavement.

Providing training courses to the authority's employees to use the up-to-date technology in determining the size and effects of cracks and roughness to be able to treat them time before they are come to require major and costly treatment. The following suggestions have the potential to improve the quality of the asphalt pavement roads in Al-Salt city:

- Making available an employee with an expert and experience in monitoring the contractor's execution of the road projects.

- Building mutual trust and agreement between the contractor and his authority regarding the common goals of constructing high-quality roads free from defects which will positively reflect on both parties regarding delivering the project timely, and avoiding additional repair treatment costs.

- Making available temporary laboratories to test the material quality and specifications, degree of adherence to the standards, and requirements issued by the ministry of public works.

- Special attention to the placement of the joints since they lay an important role in the safety and comfort of driving by preventing water from interring under the asphalt pavement causing serious damage to the asphalt pavement.

1) Finally, it is suggested to select the most qualified contractors to execute the asphalt road projects to avoid treatment costs and rehabilitation costs resulting from poor execution and lack of sufficient skills and experiences.

## VII. CONCLUSION

The Jordanian city of Al-Salt witnessed a rapid growth in population, commercial and industrial activities, and problems with asphalt pavements.

1. Faulty sidewalks cause dangers to drivers' lives, the costs of repairing damage to their vehicles, in addition to the moral suffering resulting from delays in work.

2. The defects and problems related to asphalt pavement streets in the city of Al-Salt are due to several factors such as preparing the base layer, which must be strong and solid enough to pressure to place the asphalt pavement on it.

3. The materials for the base layer shall be selected according to general works and according to international

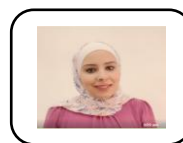
standards regarding the components of the asphalt mixture, with regard to the temperature of the mixture, the size and proportion of the components in the mixture.

4. Defects in asphalt paving methods in the city of As-Salt are due to apparent cracks and roughness of the surface, inadequate joints and blockage, which leads to water penetration into the layer under the asphalt pavement, which reduces the quality. Of the road and lead to additional costs for maintenance and replacement of damaged areas of the road.

## REFERENCES

1. G. O. Young, "Synthetic structure of industrial plastics (Book style with paper title and editor)," in *Plastics*, 2nd ed. vol. 3, J. Peters, Ed. New York: McGraw-Hill, 1964, pp. 15–64.
2. W.-K. Chen, *Linear Networks and Systems* (Book style). Belmont, CA: Wadsworth, 1993, pp. 123–135.
3. H. Poor, *An Introduction to Signal Detection and Estimation*. New York: Springer-Verlag, 1985, ch. 4.
4. B. Smith, "An approach to graphs of linear forms (Unpublished work style)," unpublished.
5. E. H. Miller, "A note on reflector arrays (Periodical style—Accepted for publication)," *IEEE Trans. Antennas Propagat.*, to be published.
6. J. Wang, "Fundamentals of erbium-doped fiber amplifiers arrays (Periodical style—Submitted for publication)," *IEEE J. Quantum Electron.*, submitted for publication.
7. C. J. Kaufman, Rocky Mountain Research Lab., Boulder, CO, private communication, May 1995.
8. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interfaces(Translation Journals style)," *IEEE Transl. J. Magn.Jpn.*, vol. 2, Aug. 1987, pp. 740–741 [*Dig. 9<sup>th</sup> Annu. Conf. Magnetics* Japan, 1982, p. 301].
9. M. Young, *The Technical Writers Handbook*. Mill Valley, CA: University Science, 1989.
10. (Basic Book/Monograph Online Sources) J. K. Author. (year, month, day). *Title* (edition) [Type of medium]. Volume(issue). Available: <http://www.URL>
11. J. Jones. (1991, May 10). *Networks* (2nd ed.) [Online]. Available: <http://www.atm.com>
12. (Journal Online Sources style) K. Author. (year, month). *Title*. *Journal* [Type of medium]. Volume(issue), paging if given. Available: <http://www.URL>

## AUTHORS PROFILE



**Surat Mahmoud AL-gammaz**, My name is Surat Mahmoud Awwad Al-Qummaz. I live in Jordan in the city of Salt. I was born on November 30, 1988, in the capital, Amman. I graduated from Mu'ta University in 2011 with a specialization in civil engineering. I worked in several locations,

including the New Salt Hospital from 2011 to 2012, where I was a site engineer and also worked in the Greater Salt Municipality from 2012 to this point as an engineer for service road projects.

I got married in 2013 and have two sons, the first-named Muhammad, six years old, and the second, Murad, three years old

I love my job and my position at work. I aspire to promotion in my work and I aspire to complete my postgraduate studies in the field of road engineering. Among my hobbies are reading and playing sports, including swimming, tennis, and yoga, and among the most important achievements that I have made as a result of reading, studies, and problems facing me in my work, I made a research paper that is the first from the beginning of my career, which are problems and defects of asphalt mixtures, and I aspire to publish more research on that.

