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DIAGNOSIS OF CRACKS IN PAVEMENT DESIGN

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Abstract: In recent years, significant advancements have been made in the construction sector, with even more expected in the future. However, these developments have also contributed to various global challenges, such as pollution, global warming, and the increasing frequency of natural disasters, including earthquakes. These issues are causing notable changes in the integrity and safety of structures. One critical concern is the development of cracks in pavement structures, which can compromise safety and durability. This paper discusses the various types of crack formation in pavement structures, their detrimental impacts, and preventive measures to mitigate these issue

Index Terms- Rigid pavement failure, Flexible pavement failure, shear failure, thermal failure, structural cracks

I. INTRODUCTION

According to concrete technology, formation of cracks is most common effect of distress. Development of cracks in any concrete cannot be eliminated but precocious should be taken out. As like patience and doctors diagnosis, cracking diagnosis also same part. As a engineer we understand all concept of concrete technology with construction materials behavior, types of cracks their causes and harmful effects. Detection, diagnosis and remedy are the primary treatment of cracking prevention is better than cure hence practitioner, designer and builder should be ready to reduced cracking effects Following are the classification of cracks. Development of cracks are generally divided into two parts. supercritical cracks and structural cracks can be active and dormant.

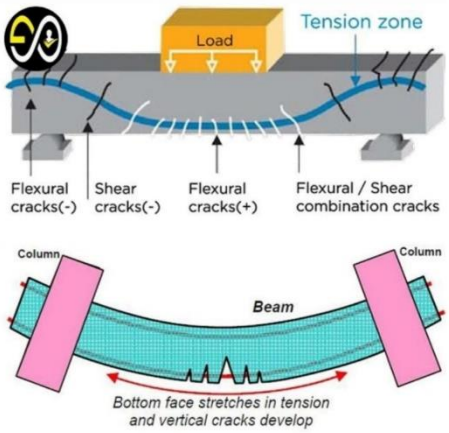

Fig. 1 Structural Cracks in Beams

Fig.1; Structural cracks
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Important points should be considered before diagnosis of cracks.

Some of points are help in diagnosis of cracks.

1.Crack observation (new or old)

2.Crack types

3.Crack pattern.

4.Type of formation, soil conditions.

5.Weather conditions during construction.

Cracks evolution

Evolution of cracks is most important, hence required proper diagnosis. Landmark related structure history, structural design and drawing, specification construction should be studied.

Objectives of cracks repairing

1.Structural strength.

2.Resolution and enhancement of structural durability of pavement.

3.Functional requirements.

Purpose of evaluation of cracks in pavement design.

1.Identification of causes of cracks.

2.Study of extent of cracking.

3.Study of extent of deformation.

4.sustanibility of applications of different remedial measures.

Different reasons are responsible for failure of pavements generally two types of failures are observed in the pavement structure. Normally pavement under goes failure due to shrinkage cracks, flexural cracks and corrosion cracks. Flexible pavement failure and rigid pavement failure are the two types of pavement failure we will study one by one.

1.Flexible pavement failures.

Normally occurs due to settlement. Due to impact of load formation of wavelike structure is created in different layers of pavement material. Failure of composite layer of flexible pavement is responsible for localized depression So it is important to design each and every layer of pavement properly. Rigid pavement failures occurred due to different reasons which will be observed in different layers of the material in pavement. Excessive load application and inadequate stability is a reason for failure in subgrade. If the pavement thickness is unsuitable to resist excessive load end resistant due to deformation under stress is occur then subgrade failure is observed. the main reason for failure in subways is due to inadequate strength in material mixture or mix design and if the wearing court technique is inadequate Then the pavements material is directly contact with climatic condition which will be affect the strength of the pavement. Lack of proper mix design, quality control and oxidation of binders is the reason for failure in wearing course.

2.Rigid pavement failure

Structural inadequacy and efficiency of pavement material are the main reasons behind rigid pavement failure.

II.RESEARCH METHODOLOGY

As we already studied the type of pavement failure some of them are related to failure in pavement layers and other referred to strength and stability of structural design. We will also understand preventive measures for the failure. Following are types of flexible pavement failure.

A.Types of flexible pavement failures.

1.Aligator cracking

Also described as map cracking, observed in surface course. Commonly observed type of flexible pavement and fatigue as well as weakness is reason behind this type. Sometime Sulphur attack is also reason behind map cracking. To prevent such cracking blended or pozzoland cement improve sulphur attack resistivity.

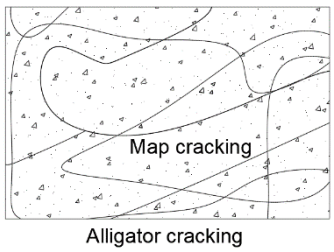

Fig.2; Alligator cracking

2.Pavement layer consolidation.

Consolidation in pavement layer forms a runs. Consolidation is a deformation due to applied load.

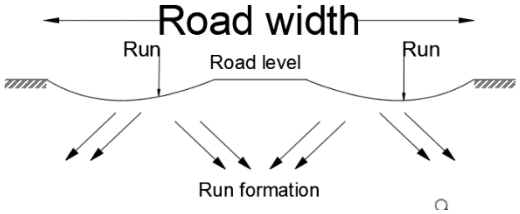

Fig.3; Diagrammatical representation pavement layer consolidation.

3.Formation of wave

Excess vehicle speed, defective rolling, spongy foundation, unstable construction materials are the different reasons for formation of wave. It can be reduced by control actions above reasons.

4.Frost heaving: The phenomenon in which groundwater is gate converted into frost due to climatic condition on the surface of the pavement get heaving up as action of frost.

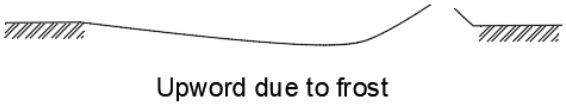

Fig.4; Frost Heaving

5.Lack of binding with lower course:

Slippering of layers is occurred due to effect of first surface is not tightly bonded with next surface course Which shows loss of pavement material.

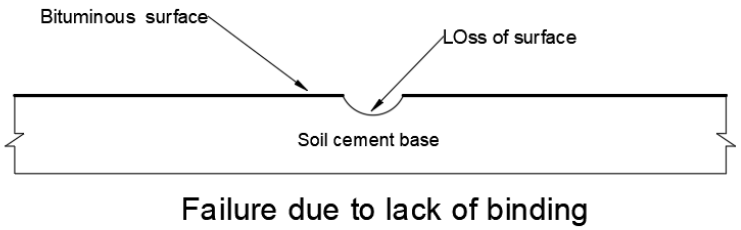

Fig.5; Failure due to lack of binding with lower course.

6.Longitudinal cracks:

Due to differential volume changes longitudinal cracks developed.

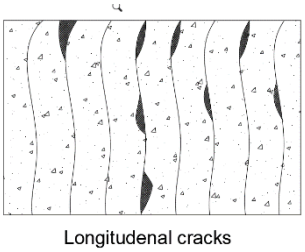

Fig.6; Longitudinal cracks

7.Shear failure;

If shearing resistance is low, shear failure cracking occurs. The upheaval of pavement material is caused by formation of cracks.

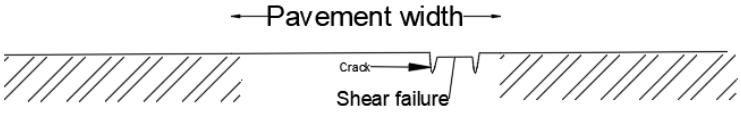

Fig.7; Cracks due to shear failure.

8.Refiective cracking.;

For protection of concrete pavement bituminous layer is provided on concrete surface. If in such case pavement get failed cracks are generated on surface of bituminous layer. Such cracks are not affect on structural activity of pavement surface. But sub grade get damage due to entry of rainwater.

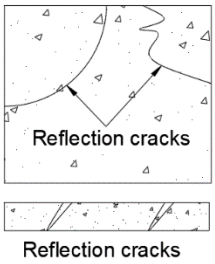

Fig.8; Reflective cracking

B.Types of rigid pavement cracking:

Following are the classification layout of rigid pavement cracking with preventive measures

1.Shrinkage cracking

In hard concrete loss of water content is observed due to climatic conditions as resultant volumetric shrinkage observed which developed shrinkage cracks. Usually cracking depends on amount of shrinkage, modulus of elasticity, amount of creep.

Fig.9; Shrinkage cracking

2.Plastic concrete cracking.:

Observed due to rapid loss of moisture. Shallow cracks discontinuous in all direction. After hardening of concrete cracks are sealed. Other reason behind plastic cracks is rapid loss of moisture, high temperature, wind action when freshly placed concrete exposed to such environmental conditions

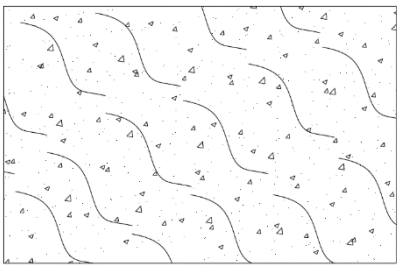

Fig.10; Plastic concrete cracking

3.Thermal cracking;

If there is temperature difference within in concrete surfaces produced differential volume changes which increases tensile strain which develop cracks. Expansion joints are provided to reduce thermal cracking.

Table 1:Crack size limit.

Classification	**Width of cracks (mm)**
Thin	<1
Medium	1-2
Wide	>2

4.Cracking due to corrosion reinforcement.:

Reinforcement corrosion is the one of the reason due to that reinforced concrete gets a cracks. Corrosion by-product such as iron oxide and hydroxide have volume which is more than that of original metallic iron. Due to volume change steel rebars produced high radial bending stresses develop cracking. Due to swelling along the bar, longitudinal cracks developed parallel to the bar.

5.Cracking due to poor mix design and construction: Adding more water, lack of curing, inadequate compaction poor quality of concrete mix are some of the reason behind cracking of pavement.

CONCLUSION

For stability and strength of structural pavements is important to take care all important parameter. Many time development of the cracks are measured reason behind failure of any structure. If the pavement is not crack free they harms not only vehicles but also to the pavement material. Generally cracks in a pavement due to permeability of concrete, thermal movement, corrosion of reinforcement, chemical changes, moisture content, creep, foundation movement, settlement of soil, shrinkage, elastic deformation, overloading, environmental stresses, earthquakes, wrong design, For safety purposes and longtime users maintains and repairing of cracks must be important.

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