Investigation and Repairing of Damage Surface

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Abstract – The focus of this paper (study) is to investigate the cracking of concrete bridge decks and the sealants used in repairing transverse cracks. Cracking could occur in both hardened mature concrete, early age concrete. Several factors affect concrete cracking, such as age-dependent material properties, thermal, moisture-related stresses and strains, material viscoelastic behavior, restraints, concrete expansion and contraction, casting sequence, formwork, material characteristics, and environmental exposure. The causes of early age cracking primarily attributed effects such as plastic shrinkage, temperature effects, drying shrinkage and autogenously shrinkage. This deck cracking could greatly reduce durability, lead to loss of functionality, loss of stiffness, and ultimately the loss of structural safety.

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INTRODUCTION

Bridges are the most important part of transportation infrastructure. There are two main tasks for contemporary bridge engineering, mainly, to construct new bridge structures according to the development of transportation needs and to maintain the existing bridge stock according to current and predicted traffic and safety requirements. The basic problem of bridge deck cracking lies in the heating, hydrating, and expanding of young concrete next to older concrete and or fixed members that are cooling and shrinking at different rates which results in cracks in young concrete. The cracks can be influenced by: material characteristics, casting sequence, formwork, climate conditions, and geometry; all of which are time dependent The term maintenances is considered as a multi-component process leading to the fulfillment of all conditions related to the safe utilization of existing bridges in the anticipated period of their future service. Reasons leading to deterioration of the existing bridge stock are more or less than same in every country, most important once concerning mostly bridges which have been in service 20 to 30 years of more may be listed as follows.

a) Increase in traffic flow and weight of vehicles

b) Harmful influence of environmental pollution

c) Common use of de-icing agents in countries of moderate climate

d) Low quality structural materials as well as bridge equipment elements such as expansion joints, water proofing membranes etc.

e) Limited maintenance program

f) Structural and material solutions, particularly sensitive to damage produced by both traffic loads and environmental factors

LITERATURE SURVEY

a) **Prateek Prasanna[1]:-**"Automated Crack Detection on Concrete Bridges "This paper content, novel automated crack detection algorithm.

b) **Prof.HengZhang[2]:-**"Accurate extraction of cracks on the underside of concrete bridges "The proposed method is evaluated with real crack images on the underside of bridges collected by an unmanned aerial vehicle (UAV). Compared with competitors, our proposed method achieves better performance in terms of accuracy and completeness.

c) **Hung Manh La[3]:-**"Autonomous robotic system for bridge deck data collection and analysis". This paper content, the electrical resistivity (ER), impact-echo (IE) and ultrasonic surface waves (USW) data collected by the robot are analyzed to generate the corrosion, delamination and concrete elastic modulus maps of the deck. The presented robotic system has been successfully deployed to inspect numerous bridges.

d) **Audrey Van der Wielen[4],LucCourard[4],Frederic Nguyen[4] :-** "Non-destructive detection of delamination's in concrete bridge decks "This paper content, Detect simulated defects in twelve repaired concrete slabs. These were scanned with high frequency ground penetrating radar (GPR) with the common offset (CO) and common midpoint (CMP) methods.

e) **Juan-hong Liu[5], Shao-min Song[5], Jian-feng Zhong[5],Xiao-fang Chen[5]** :- "Application of Lightweight Aggregate Concrete in Old Bridge Deck Pavement Engineering", This paper content, excessive loss of pre-stress, severe vehicle overload, oversized thickness of bridge deck pavement, and construction errors.

Typical Damage of Bridge structures

Bridge structures are subjected to many types of loadings and other in fluences resulting both from the live load sand exposure of structure to environmental effect and weather. The most important factors classified are follows;

1. Obsolescence

The functional Obsolescence of the structure is frequently encountered due to grade separation or change in pattern of traffic passing over the railway or highway using the bridge while it may still have many years of normal life left. The changing of the traffic conditions, particularly on the railways and national highways.

2. Damage

The structure may be damaged due to a erve accident occurring over it, particularly in the cases of railway bridges. The bridge may be damaged fully or partly due to heavy and unexpected high floods.

3. Weathering

Even a well maintained steel or concrete structure or concrete structure of the bridge can deteriorate over the years from the effects of weathering action of saline atmosphere, fumes, abrasion, etc.

4. Maintenance

The Maintenance cost of the structure generally increases as the bridge nears end of the service life. With the increase cost of labour and repair materials, it may be found more economical to replace the structure with modern materials than spending money in old maintaining the in old one until the critical service life of the structure. And also the age of bridge structure, traffic load factors, weather and environmental factors, adjacent construction.

INSPECTION

Inspection is an integral part of maintenance. The structure of the bridge should be inspected on regular basis, not after the failure of the bridge. A bridge inspector must possess the following qualifications.

1. Must be a licensed structural engineer.
2. Should have knowledge in structural behaviour and design of bridges.
3. Should be aware of the changing behaviour of materials with age, chemical properties.
4. Must be familiar with construction practices and proper execution.

Surface repairs of deck slab

This work shall consist of hot-mix asphalt surface removal, when required, the removal and disposal of all loose and deteriorated concrete from bridge deck and the replacement with new concrete to the original top of deck

Figure 1. Shows surface Damage and repair of bridge

Figure2. Shows developed cracks of deck surface

SURFACE PREPARATION

Obtaining a good bond between the repair material land the regional concrete is extremely important in any concrete repair. After the unsound concrete is identified. Removal is performed by jack hammers

or hydro jetting. The hammer's size or the water jet's pressure should adjust according to the volume, size and sensitivity of damage. Water jet technique is far better due to fast and efficient removal of dust and elimination of unpleasant noise. Water jet technology provide clean surface with no hair line cracks.

Figure 3.Shows the surface preparation of repairs

- **Surface Preparation Equipment**

Surface preparation and concrete removal equipment:

Sawing Equipment: Sawing equipment should be concrete saw capable of sawing Concrete to the specified depth.

Blast Cleaning Equipment: The blast cleaning may be performed by wet sand blasting, high-pressure water blasting. Blast cleaning equipment shall be capable of removing rust and old concrete from exposed reinforcement bars, and shall have oil traps.

Power-Driven Hand Tools: Power-driven hand tools will be permitted including jack hammers lighter than the nominal 45 lb. (20kg) class. Chipping hammers heavier than nominal 15lb.(6.8kg)class shall not be used for removing concrete from any reinforcing bar for partial depth repairs, or for removal within 1ft(300mm) of existing beams, girders or other supporting structural members that are to remain in service or within 1ft (300mm) of the boundaries of full-depth repairs. Chipping hammers or Jack hammer shall not be operated at an angle in excess of 45 degree measured from the surface of the slab.

CLEANING

Immediately after completion of the concrete removal and reinforcement repairs, the repair are as shall be cleaned of dust and debris. Once the initial cleaning is completed, the repair are as shall be thoroughly blast cleaned to a roughened appearance free from all foreign matter. Particular attention shall be given to removal of concrete fines. Any method of cleaning which does not consistently produce satisfactory results shall be discontinued and replaced by an acceptable method. All debris, including water, resulting from the blast cleaning shall be confined and shall be immediately and thoroughly removed from all areas of accumulation. If concrete placement does not follow immediately after the final cleaning of deck, the area shall be carefully protected with well-anchored polyethylene sheeting. Exposed reinforcement bars should be free of oil, dirt, paint, detrimental scale, or other foreign substances which may reduce bond with the concrete. A tight non-scaling coating of rust does not considered objectionable. Loose, scaling rust should be removed by rubbing with burlap, blast cleaning, wire brushing, or other methods approved by the Engineer.

PLACEMENT OF MATERIAL ON REPAIR SURFACE

Grout Placement: After the repairs are as have been cleaned and immediately prior to concrete placement, the grout shall be applied to a dampened surface. A thin layer of grout shall be thoroughly scrubbed into the deck surface. All vertical as well as horizontal surfaces shall receive a thorough, even coating. The rate of grout placement shall be limited so the brushed grout does not dry out before it is covered with concrete. Grout that has become dry and chalky shall be blast cleaned and replaced at the Contractor's expense. No concrete shall be placed over dry grout.

Concrete Placement: In deck slabs, where the spalls extend below the to pre-reinforcement, the area is built up with conventional concrete. On over head and vertical surfaces, forms are normally necessary if concrete is to be cast. Forms are first attached to the sound concrete surrounding the shall either by any other suitable anchoring devices or expansion bolts. Cast in concrete is deposited from the top by pressure grouting or by gravity. Normally,

super plasticisers are admixed for the production of free flowing concrete in hot weather.

Materials used for Repairs are:

Cement concrete:

These are most popular because of their common availability and relatively low cast. They applied both small and large repairs.

Fiber reinforced concrete:

These are most commonly used for structural applications, including repair of concrete bridge structures.

Polymer cements concrete:

Polymer cements concrete used large surface of bridge structures to be repaired.

Non-shrink quick-setting mortars:

Used with expensive cements and admixtures that increase strength, bond and workability and reduce curing time.

Epoxy mortars:

Used mainly concrete repair, protection of reinforcing steel and improvement in adhesion between fresh and old concrete.

Curing and Protection

Concrete patches shall be cured by the Wetted Burlap or Wetted Cotton Mat Method. The curing period shall be 3days for Class PP-1,PP-2,PP-3,PP-4,and PP-5concrete. The curing period shall be 7days for Class BS concrete. A72- hour minimum drying period shall be required before hot-mix asphalt surfacing or placing water proofing.

Factors affecting damaging

Water- The more the water the greater c racking tendency water increases the shrinkage and reduces strength.

Cement- The amount and finesse of cement important in general the richer concrete can crack more.

Aggregate- The mineral composition, shape, surface texture and grading of aggregate. Affect the concrete quality, thermal co-efficient, shrinkage, stiffness.

Exposure-Weather conditions to which the concrete is exposed influence of cracking greatly.

Restraint-Rigid restraint by underlying part, foundation or adjacent structural member may lead to cracking.

Admixtures- Some admixtures may affect cracking because of their effects such contributory factors as, rate of hardening, shrinkage, creep, calcium chloride admixture as an accelerateor increases shrinkage considerably and the reduce early cracking.

CONCLUSION

It is possible to strength many of existing bridges against the damage by using simple retrofitting measures. In this paper the needs, typical damage of bridge structures such as crack and surface damage of a deck slab, and process of inspection procedures to Retrofit of surface and crack of bridge deck. In country like Indian the construction of new bridge is uneconomical hence retrofitting is done so as to attain its original strength. If bridge is collapse there is heavy or huge loss of life and property hence the retrofitting of bridge is became necessary.

REFFERENCE

Alok sarkar “Repairs of bridges”, Indian concrete journals, June 2008

Guide for repair of concrete superstructures ACI 5461R-80, Americal concrete institute, USA.

V K Raina, “Concrete bridge practice, construction and maintenance and rehabilitation”, pp. 512 to 524.

S Ponnuswamy, “Bridge Engineering”, pp. 492 to 518

Indian concrete journal February 2008, repair of concrete bridges pp. 26-28.

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