UNIT-5

DISTRESS OF CONCRETE STRUCTURES & THEIR REPAIR TECHNIQUES

INTRODUCTION World

If a building has given about 25v to 30 years of service without much maintenance or repair then it is reasonable to expect that it would need some repair sooner later.

CATEGORIES OF REASONS DISTRESS OF CONCRETE STRUCTURES

1. WEATHERING
2. AGEING
3. ENVIRONMENTAL EFFECTS
4. INADEQUATE MAINTENANCE
5. POOR DESIGNING AND CONSTRUCTION QUALITY
6. CHANGE OF LOADING PATTERN OR NON CONVENTIONAL LOADING ON STRUCTURE
7. WATER LEAKAGE LEADING TO CORROSION OF CONCRETE STRUCTURE

JNTUCAUSESOFEARLYDETERIORATIONOFCONCRETE STRUCTURES

EFFECTS OF CRACKING ON LIFE OR D RABILIY OF STRUCTURE

IDENTIFICATION OF DISTRESSED LOCATIONS ON STRUCTURES

MATERIALS AND ME HODS FOR CRACK REPAIR

SOME SPECIFIC REPAIR ECHNIQUE FOR CONCRETE SURFACE ASSESMENT OF

QUALI Y OF S RUC URE SOON AFTER ITS CONSTRUCTION REQUIREME FOR

TRAINING FOR CONCRETE REPAIR AND CONCRETE WORKERS THA K YOU

METHODS OF REPAIRING CONCRETE STRUCTURES

1. INTRODUCTION World

3 Basic symptoms of distress in a concrete structure

Cracking, Spalling and Disintegration

Reasons for their development may be poor materials, poor design, poor const uction p actice, poor supervision or a combination

repair of cracks usually does not involve strengthening

repair of a structure showing spalling and disintegration, it is usual to find that there have been substantial losses of section and/or pronounced corrosi n f the reinf rcement

2. **Repairing cracks**

In order to determine whether the cracks are active dormant, periodic observations are done utilizing various types of telltales

- by placing a mark at the end of the crack
- a pin or a toothpick is lightly wedged into the crack and it falls out if there is any extension of the defect
- A strip of notched tape works similarly :
  Movement is indicated by tearing of the tape
- he device using a typical vernier caliper is the most satisfactory of all.
  Both extension and compression are indicated
- If more accurate readings are desired, extensometers can be used
- Where extreme accuracy is required resistance strain gauges can be glued across the crack

2.1Types of cracks

- active cracks and dormant cracks
- the proper differentiation between active and dormant cracks is one of magnitude of movement, and the telltales are a measure of the difference
- If the magnitude of the movement, measured over a reasonable period of time (say 6 months or 1 year), is sufficient to displace or show significantly on the telltales, we can treat the crack as an active one.

Regular patterns of cracks may occur in the surfacingWorldofconcreteandinthinslabs.Thesearecalled pattern cracks

- If the movements are smaller, the crack may be considered as dormant.

Cracks can also be divided into solitary or isolated cracks and pattern cracks

Generally, a solitary crack is due to a positive overstressing of the conc ete either ue to oad

shrinkage

Overload cracks are fairly easily identified because they follow the lines demonst ated in aboratory load tests

In a long retaining wall or long channel, the regular formati n f cracks indicates faults in the design rather than the construction, but an irregular distributi n f s litary cracks may indicate poor construction as well as poor design

Methods of repairing cracks

1. **Bonding with epoxies**

Cracks in concrete may be bonded by the injection of epoxy bonding compounds under

pressure Usual practice is to

- drill into the crack from the face of the concrete at several locations
- inject water or a solvent to flush out the defect
- allow the surface to dry
- surface-seal the cracks between the injection points
- The limitation of this method is that unless the crack is dormant or the cause of cracking is removed and thereby the crack is made dormant, it will probably recur, possibly somewhere else in the structure
- Also, this technique is not applicable if the defects are actively leaking to the extent that they cannot be dried out, or where the cracks are numerous

2. **Routing and sealing**

- This method involves enlarging the crack along its exposed face and fi ing and sea ing it with a suitable material

The routing operation

placing the sealant

This is a method where thorough water tightness of the j int is n t required and where appearance is not important

3. **Stitching**

Concrete can be stitched by iron or steel dogs

A series of stitches of different lengths should be used

bend bars into the shape of a broad flat bottomed letter U between 1 foot and 3 feet long and with ends about 6 inches long

The stitching should be on the side, which is opening up first

if necessary, strengthen adjacent areas of the construction to take the additional stress

the stitching dogs should be of variable length and/or orientation and so located that the tension transmitted across the crack does not devolve on a single plane of the section, but is spread out over an area

In order to resist shear along the crack, it is necessary to use diagonal stitching

The lengths of dogs are random so that the anchor points do not form a plane of weakness

4. **External stressing**

cracks can be closed by inducing a compressive force, sufficient to overcome the tension and to provide a residual compression

The principle is very similar to stitching, except that the stitches are tensioned; rather than plain bar dogs which apply no closing force to the crack

Some form of abutment is needed for providing an anchorage for the prestressing wires or rods

5. **Grouting**

- installing built-up seats at intervals along the crack
- sealing the crack between the seats with a cement paint g out
- flushing the crack to clean it and test the seal; and then grouting the whole

6. **Blanketing**

similar to routing and sealing

applicable for sealing active as well as dormant cracks

Preparing the chase is the first step

Usually the chase is cut square

The bottom suld be chipped as smooth to facilitate breaking the bond between sealant and concrete

The sides of the chase should be prepared to provide a good bond with the sealant material

- same manner as the injection of an epoxyWorld
- cleaning the concrete along the crack

The first consideration in the selection of sealant materials is the amount of movement

anticipated and the extremes of temperature at which such movements will occur elastic sealants

mastic sealants

mortar-plugged joints

7. **Use of overlays**

Sealing of an active crack by use of an overlay requires that the overlay be extensible and not flexible alone

Accordingly, an overlay which is flexible but not extensible, ie. can be bent but cannot be stretched, will not seal a crack that is active

Gravel is typically used for roofs

concrete or brick are used where fill is to be placed against the overlay

An asphalt block pavement also works well where the area is subjected to heavy traffic

Repairing spalling and disintegration

In the repair of a structure showing spalling and disintegration, it is usual to find that there have been substantial losses of section and/or pronounced corrosion of the reinforcement

Both are matters of concern from a structural viewpoint, and repair genera y invo ves some urgency and some requirement for restoration of lost strength

1. **Jacketing**

primarily applicable to the repair of deteriorated columns, piers and piles

Jacketing consists of restoring or increasing the section f an existing membe , p incipally a compression member, by encasement in new concrete

The form for the jacket should be provided with spacers to assure clearance between it and the existing concrete surface

The form may be temporary or permanent and may consist of timber, wrought iron, precast concrete or gauge metal, depending on the purpose and exposure

Timber, Wrought iron Gauge metal and other temporary forms can be used under certain conditions

Filling up the forms can be done by pumping the grout, by using prepacked concrete, by using a tremie, or, for subaqueous works, by dewatering the form and placing the concrete in the dry

The use of a grout having a cement-sand ratio by volume, between 1:2 and 1:3 , is recommended

The richer grout is preferred for thinner sections and the leaner mixture for heavier sections

The forms should be filled to overflowing, the grout allowed to settle for about 20 minutes, and the forms refilled to overflowing

The outside of the forms should be vibrated during placing of the grout

2. **Guniting**

Gunite is also known as shotcrete or pneumatically applied mortar

It can be used on vertical and overhead, as well as on horizontal surfaces and is particularly useful for restoring surfaces spalled due to corrosion of reinforcement

Gunite is a mixture of Portland cement, sand and water, shot into the place by compressed air

Sand and cement are mixed dry in a mixing chamber, and the dry mixture is then transferred by air pressure along a pipe or hose to a nozzle, where it is forcibly projected on to the surface to be coated

Water is added to the mixture by passing it through a spray injected at the nozzle

The flow of water at the nozzle can be controlled to give a mix of desired stiffness, which will adhere to the surface against which it is projected

3. **Prepacked concrete**

This method is particularly useful for carrying out the repair under water and e sewhere where accessibility is a problem

Prepacked concrete is made by filling forms with coarse aggregate and then fi ing the voids of the aggregate by pumping in a sand-cement grout

Prepacked concrete is used for refacing of structures, jacketing, filling and f cavities in and under underpinning and enlarging piers, abutments, retaining walls and f structures, tings

Pumping of mortar should commence at the lowest point and pr ceed upward

Placing of grout should be a smooth, uninterrupted operation

4. **Drypack**

Drypacking is the hand placement of a very dry mortar and the subsequent tamping of the mortar into place, producing an intimate contact between the new and existing works

Because of the low water-cement ratio of the material, there is little shrinkage, and the patch remains tight. The usual mortar mix is 1:2.5 to 1:3

5. **Replacement of concrete**

This method consists of replacing the defective concrete with new concrete of conventional proportions, placed in a conventional manner

This method is a satisfactory and economical solution where the repair occurs in depth (at least beyond the reinforcement), and where the area to be repaired is accessible

This method is particularly indicated where a water-tight construction is required and where the deterioration extends completely through the original concrete section

Overlays

In addition to seal cracks, an overlay may also be used to restore a spalled or disintegrated surface

Overlays used include mortar, bituminous compounds, and epoxies

They should be bonded to the existing concrete surface

Conclusions

When repairing cracks, do not fill the crack with new concrete or mortar

A brittle overlay should not be used to seal an World activecrack

The restraints causing the cracks should be relieved, otherwise the repair must be capable of accommodating future movements

Cracks should not be surface-sealed over corroded reinforcement, without encasing the bars

The methods adopted for repairing spalling and disintegration must be capab e of esto ing the ost strength

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