



**INDIAN FARMERS FERTILISER  
COOPERATIVE  
LTD, PARADEEP, ORISSA**

March - 2013



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IFFCO/ SDCPL /2013/2730

March 25, 2013.

**Health survey of the existing plant structures at IFFCO**  
**Paradeep Unit.**

**INSPECTION REPORT**  
**For**  
**Condition Assessment**  
**For**  
**Control Room**  
**Of**  
**AFBC PLANT**  
**At**  
**Paradeep, Orissa.**

### History / Background of the structure:

- The structure under reference i.e. "Control Room" situated in AFBC Boiler Plant at Indian Farmers Fertilizers Cooperative Ltd. (IFFCO) Paradeep unit, Orissa.



**North side elevation.**

- This is a R.C.C framed structure covered with A.C sheet roofing. It has one steel staircase for vertical movement provided on West side. Ground floor area being used for electrical cabling system and first floor area use for office purpose.



**West side elevation.**

### **Observations:-**

Structural Audit is an important technical requirement for any structure and has series of parameters to be adequately investigated and assuredly complied with.

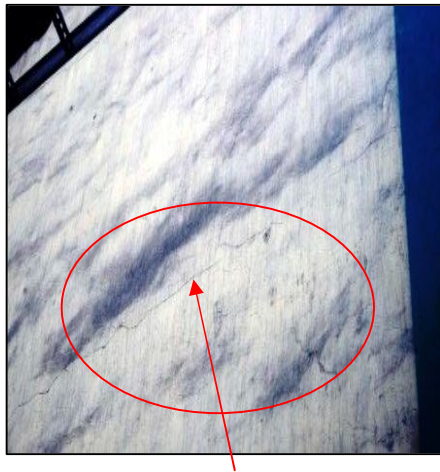
During this exercise the structure was inspected thoroughly on several occasions by us to record, verify, and study the modifications/additions made if any, to observe distresses, level of malfunctioning and corrosion levels in structural steel members.

In the period of last approximately 12 years of its existence, various defects developed in the said structures, mainly as follows –

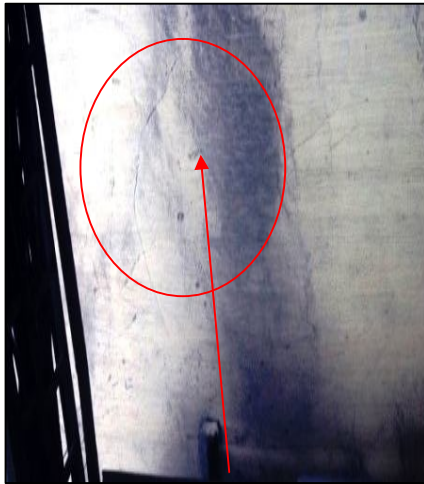
### **General Observations:**

#### **A) East side:-**

This area reveals distresses like undulation in external plaster at various locations, also noted openings were made are kept unfinished. Please refer below photographs.



**Undulation and cracks noted at external facade.**



**Discoloration and cracks in external plaster.**

**B) West side:-**

This area reveals distresses like cracks in external plaster at various locations, discoloration and seepage mark noted on external façade. Please refer below photographs.



**Horizontal cracks and seepage mark noted.**

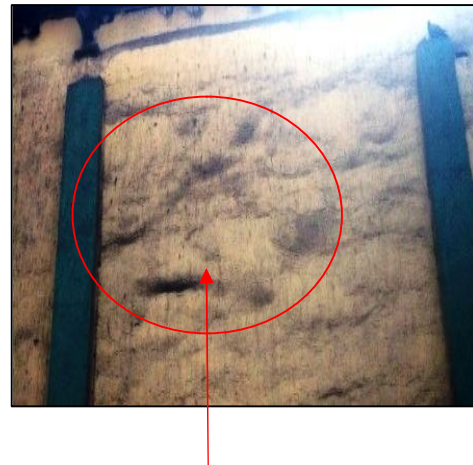


**Cracks and seepage marks noted**

**C) North side:-**

This area reveals distresses like, undulation in external plaster and horizontal crack at various locations.

Please refer below photographs.



**Horizontal cracks with undulation**



**Internal Observations:-**

Internal area noted with distresses like severe corrosion in structural framing system of roof including corrosion in pre-coated sheets. Also been noted gap between wall and roofing sheets. Please refer below photographs.



**Corrosion/pitting noted in pre-coated sheets & structural framing system at roof.**

## **INFERENCE OF N.D.T. RESULTS AT CONTROL ROOM NEAR AFBC BOILER HOUSE:**

In order to have adequate assessment of the pathological condition of the structure i.e. series of health parameters, series of NDT investigations are carried out. These include number of ultrasonic pulse velocity readings, half cell potentiometer test for corrosion potential, number of concrete chemical analysis, Carbonation and Cover meter test have been carried out. All the NDT findings are enclosed herewith.

### ***1. Ultrasonic Pulse Velocity Test :- (IS 13311 - Part I)***

This instrument works on the principle of passing high frequency sound waves through the body of the concrete & measuring the time taken. Distance of path length divided by the time taken provides velocity of the waves through the concrete member being tested.

Depending on the velocity, the quality of concrete as regards homogeneity can be judged. Lower velocity (less than 3 Km / sec) indicates some defects like honey combing, cracks, voids, rebounding etc. at the location of test.

The concrete surface is thoroughly cleaned & dried. The instrument is calibrated before taking readings. Coupling medium such as grease is applied to the probes, and reading is taken for the pulse velocity at the location. Appropriate correction factors are applied, wherever desired, for the presence of steel.

The USPV readings around 3 Km/sec and above indicate fair quality concrete whereas readings below 2 Km / sec indicate localized weakness at that particular zone.

As per IS, velocity below 3.00 Km / sec indicates 'Doubtful' quality concrete, velocity between 3.00 to 3.50 Km / sec indicates 'Medium' quality concrete and velocity above 3.50 Km / sec indicates 'Good' quality concrete. And velocity 4.50 Km / sec

indicate 'Excellent' quality concrete. From the above parameters we can judge the quality of concrete.

**Details of Testing:**

- The tests were conducted at total 12 locations.
- Maximum reading obtained as 4.38 km/sec at column B8.
- Minimum reading obtained as 3.93 km/sec at column B5.
- Average reading obtained as 4.11 km/sec, which indicates good quality of concrete.

**Conclusion:**

The test results indicate good quality concrete at most of the locations.  
Please refer the test results attached herewith for details.

**2. *Schmidt Rebound Hammer (IS 13311 Part II)***

Total 16 impact readings were taken at each location and average of middle ten was calculated after discarding the top three and bottom three readings. In this manner, total no. of points was tested on the selected concrete members. The probable accuracy of prediction of concrete strength by the rebound hammer is + 25% as per IS code 13311(part II)

**Details of Testing:**

- The tests were conducted at 5 locations.
  - The average of all the readings is 386.00 Kg/ Sq.cm.
- Please refer the test results attached herewith for details.

**3. *Cover meter investigations.***

This test indicates the cover of concrete over the reinforcement. In this case the cover is without the plaster.

**Details of Testing:**

- The tests were conducted at total 5 locations.
- Several readings of cover meter are in the range of 62 mm to 72 mm.

- Clear cover does not indicate depth beyond 72 mm where test has carried out.
- The average cover of concrete reveals as 67 mm.

**Conclusion:**

- The test results confirm sufficient cover of concrete provided to the reinforcement at many locations.

Please refer the test results attached herewith for details.

**4. Carbonation Test** (Ref BS 1881 Part 201: 1986).

This test is carried out to measure the depth of concrete from the external face up to which it has undergone carbonation.

The test requires core samples of 25 mm or 50 mm diameter to be taken out for a depth of about 80 to 100 mm. higher diameter cores taken can also be used for this test. The core sample is sprayed by 2% phenolphthalein solution starting from the exposed or external surface of concrete. If sprayed concrete turns pink, it is considered as non-carbonated. The depth of carbonation is measured in millimeters as the depth from the external face of concrete to the point beyond which the phenolphthalein sprayed concrete turns pink in color. If the core of concrete is not available the test can be performed by suitably exposing the concrete by cutting or breaking by chisel and performing the test on this freshly exposed surface as described above.

**Details of Testing:**

- The tests were conducted at total 2 locations.
- The readings of carbonation depth are noted up to 30 mm depth.

**Conclusion:**

- Comparing to the average clear cover of concrete to reinforcement for R.C.C. Columns, as revealed through cover Meter test i.e. 67.00 mm, the Carbonation test results confirms that the cover of concrete has carbonated up to 30 mm at representative locations where test has carried out. A carbonation test result at slab confirms that the cover of concrete has carbonated.

Please refer the test results attached herewith for details.

### ***Recommendations / Conclusion:-***

Following recommendations are made, in light of the observed defects, for efficient improvement in serviceable life and performance of the structures under reference:

Corrosion related damages shall be rectified with the use of 'Polymer Modified Mortar' as per standard methodology as follows -

#### **1. Cracks due to corrosion of steel reinforcement in**

##### **RCC members**

- Expose the cracked / spalled elements completely. Use long sharp chisels of about 16-20 mm diameter and hammers upto 2 lbs weight. Remove the complete corrosion of reinforcement with wire brushes (preferably mechanical type). Remove all the loose and damaged concrete particles till sound concrete of uniform texture is visible. Apply rust removers like 'Rusticide SS' or equivalent to the reinforcement to remove the traces of rust. Clean the reinforcement once again with the wire brush. Wash the complete concrete surface including the reinforcement to remove the traces of rust remover. Apply a coat of rust passivator like 'Polyalk Fixoprime and cement' or equivalent as per the recommendations of the manufacturers. The concrete surface treated for corrosion shall be patch repaired with Polymer Modified Mortar like 'Polyalk EP' or any other equivalent as per the manufacturer's recommendations.

## **2. Exposed steel reinforcement**

- Follow methodology to treat exposed reinforcement as per recommendation mentioned in corrosion cracks in R.C.C members with replacement of snapped steel with new steel reinforcement of similar diameter, as per requirement as per existing design.

## **3. Hollow sound in RCC member**

- Break open the loose and damaged concrete, till the uniform and solid stage of concrete is witnessed.
- Give Polymer Mortar Treatment to this area as per recommendation mentioned for crack due to corrosion of reinforcement in R.C.C members.
- Grout the weak concrete areas with cement and non shrink additives or with low viscous epoxy.

## **4. Honey Combing / Cracks / separation crack between R.C.C. & masonry:-**

- These areas shall be grouted with cement grouting with addition of non shrinking additives.
- Aluminum / PVC multi-perforated nipples may be used to carry out the injection operation.
- The pressure of 1.00 to 1.5 kg per sq cm may be applied for grouting.
- Care should be taken to remove trapped air inside the crack / honey combing areas to avoid back pressure.

### **5. Spalling of Concrete: -**

- This area shall be rectified by the process as explained earlier i.e. in recommendation no.1

### **6. For Internal plaster**

- The area affected shall be removed manually or mechanically.
- The surface shall be cleaned of all dust, loose mortar droppings, traces of algae/efflorescence and other foreign matter by water or by brushing.
- The POP/ Neeru finish plaster shall then be applied and the work shall not be soaked but only damped evenly before applying the plaster.
- The lambi or putty shall be applied on the surface to make surface even and smooth.
- One coat of primer of approved manufacturer shall be applied over the smooth surface.
- After the wall dries completely, two coats of paint similar as existing of approved manufacturer as per matching shade & specifications shall be applied.

### **7. For external plaster**

- The area affected shall be removed manually or mechanically.
- R.C.C members shall be treated with proper polymer mortar and hack-aid-plaster bonding coat.
- After the preparation of the surface, the first coat of 12mm thick plaster shall be applied and the surface shall be made rough for proper bonding of second coat.



- After the application of first coat, minimum three days of curing shall be done for the surface.
- The second coat of 8mm sand faced plaster shall be applied on that rough surface.
- After giving second finishing coat, plaster shall be cured for minimum seven days.
- All plastered surfaces shall be protected by applying paint similar as existing of approved manufacturer as per matching shade & specifications shall be applied.

### **8. Moss Growth**

- Wherever the moss growth has been observed check that area for any hollow sound in the plaster.
- Remove and redo the damaged plaster and protect the surface with good quality paint.

### **9. Vegetation Growth**

- Cut the vegetation by its root.
- Treat the root area with "weedyicide" as per the manufacturer's specification.
- Treat surrounding area as per requirement with normal procedures.

### **11. Defective Plumbing and Sanitary Work**

- Remove the damaged and corroded G.I. pipes at all locations and replace the G.I. pipes with the same specifications as per existing design.

- Remove the damaged / mal-functioning sanitary pipes i.e. Rain water, waste water, vent and soil pipes and replace by PVC pipes of reputed brand.
- Fix all the plumbing and sanitary lines with spacers.

- **12. Unfinished cut – outs**

- Unfinished cut – outs in the masonry walls & at terrace shall be finished with Micro concrete of reputed manufacturer as per specifications.

- **13. Gap between existing masonry wall & precoated sheets**

- Gap between masonry wall & roof shall be filled with adequate masonry and the area to make watertight as per standard specifications.

### **For Structural steel elements**

- Localized replacement of the deteriorated steel elements as also further strengthening has to be done and need to be followed for the proposed rehabilitation work. However, the said strengthening work shall be done according to the design.
- Few General distresses like Existing corrosion of the steel members shall be removed as per standard method and all the Structural Steel members shall be treated with application of 3 coats of 'SUNPUGUARD' (a high quality Anti corrosive two component Polyurethane coating) or equivalent as per Manufacturer's

recommendations. Proper surface preparation of all Structural Steel members shall be done before application of SUNPUGUARD or equivalent, as per manufacturer's recommendations.

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