

# Major Repairs & Renovation Work of Co-operative Housing Society Building

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**Abstract:** These Spalling of concrete and corrosion of steel, Exposure of steel reinforcement, leakage due to improper drainage are affected by the structure or layout change in original design which may increase the dead load on the structure and reduced strength of structures. It may lead to structural deficiency and hence there is a need to identify the livability of the existing structures. With the help of structural audit it is possible to prevent any unexpected failures of any part or as a whole of structure and will give an assurance and economical solution for the residents. It is the need of the hour to raise exigent demand for raising the awareness and standardizing such procedures. The complete performance of a building needs to be examined its service life as well as to know the real status of building. Multiple Cracks of plaster, spalling of concrete and corrosion of reinforcement, Exposure of steel reinforcement, Major Cracks, leakage due to improper drainage etc. etc. this are common problems causes the building damaged. These localized distresses will get accelerated, if not taken care of at the right time, which may lead to damage of structure resulting in even loss of life.

**Keywords:** Structure, Repairs, Renovation, Society, Building, Polymer, Concrete, Micro, Reinforcement, Sulphate, Plaster, waterproofing.

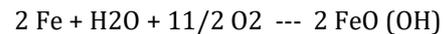
## 1. INTRODUCTION

Our Projects Name Diamond Court C.H.S. Ltd. Is located at Andheri (E), Maharashtra. The building is a R.C.C. frame structure having Ground + 5 storeys. Fieldwork started from 14<sup>th</sup> March, 2017 and the entire survey work was completed by 16<sup>th</sup> March, 2017. Preliminary drawing preparation, Visual inspection and tapping was carried out simultaneously; results of the same are presented in this document. Non Destructive Tests such as Ultrasonic-pulse velocity test, Carbonation depth measurement, Rebound hammer test, Chemical Test, Core Cutting Test, Half-cell potentiometer test, Cover meter test etc. were carried out.

## 2. PRINCIPAL

The building was investigated in detail for inspection from inside and outside thoroughly. Various structural load bearing R.C.C. members such as columns, beams & slabs within the structure were observed for a range of defects such as cracks, spalls, crazing, seepage etc. All these defects are marked on the observation sheets with approximate repair area which helped in compiling the total data of the structure. Various symbols used in floor plan are as per attached legend sheet. Maximum number of columns & beams inside the flat were subjected to tapping by 3 different types of hammers. For residential building structure, medium hammer will be the most effective which gives

delamination from 10mm to 25mm depth. The hollow sound was recorded in the observation sheets as hollow, which was evaluated for Remedial measures. Rusting of Iron and steel is the most commonly known process of Corrosion. The following equation describes the formation process of rust:



Iron + Water + Oxygen Hydrated Iron Oxide

Concrete is permeable to water and solution of Chloride & Sulphate. Penetration of the solution of these chemicals can produce a gradual change in the condition within the concrete ultimately leading to Corrosion of steel and deterioration of concrete. Because of the chemical attack the concrete carbonation starts and the concrete loses its alkalinity. Major constituents like Carbon dioxide, Sulphates, Sulphur dioxide etc. cause the loss of alkalinity in concrete. Any corrosion of reinforcement results in the formation of rust, which occupies a volume of about 2.2 times that of iron from which it is formed. This corrosion product has literally no place to go so that it produces large internal pressure as high as 1 ton/inch<sup>2</sup> around the concrete resulting in longitudinal cracks parallel to reinforcement and cracks the concrete.

## 3. OBSERVATIONS

### 3.1 External

The external face of the building shows cracks in external plaster at certain locations, vegetation growth was observed at external face as well as plumbing joints at few locations. Major structural cracks were found at many locations including beams and columns during the survey/inspection work. Plumbing and sanitation lines at external walls of the building are in moderate condition. Leakage marks are found at the pipe joints of the plumbing lines at few places externally. Refer exhibits for more details.



Some of External cracks

### 3.2 Internal

Many layout changes in the flats have been done by residents of the building. However, these layout changes may affect the building structure in the long run. Hence there should not be any further layout/structural changes inside the flat for better health of the building structure.

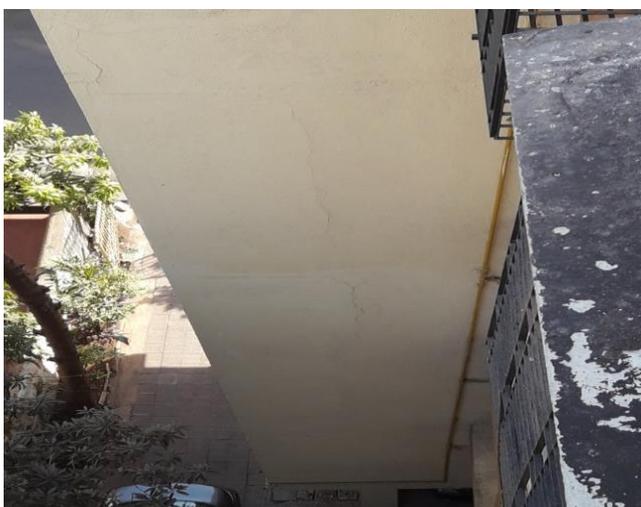
Leakage & seepage marks are observed inside the flats due to internal wall to wall leakages with damaged external plaster & formed cracks. Cracks in ceiling was observed at many location. Major structural cracks is observed in R.C.C. load bearing members. Uneven flooring tiles were observed at many places inside flats.



**Some of Internal cracks**

### 3.3 R.C.C. Frame

The observations are based on visual survey and non-destructive Test conducted by our team of Engineers. An extensive investigation to collect full details and scope if repairs has been carried out. Observations are prepared in this effect, and the same are attached with this report. The R.C.C. members are in a distressed condition.



**Some of External cracks**

### 3.4 Water Proofing

We observed China mosaic laid on the terrace floor. Leakage from terrace floor has been observed in the flats due to the damaged condition waterproofing.

Vegetation growth is observed near pipe joints as well as on the parapet wall. Refer exhibits for more details. Cracks in parapet wall observed a few locations.

The headroom was observed to be in distressed condition. Leakage and dampness observed in headroom ceiling. Absence of R.C.C. Coping was observed on the parapet wall whereas marble finishing observed during the survey. The overhead water tank is in distressed condition. Leakage marks was found bottom portion of the tank. Cracks were observed in the column of the water tank at few locations.

### 3.5 Staircase & Passage

Staircase & passage areas were observed in distressed condition. Leakage and dampness was found in the staircase and passage wall and ceiling. Cracks in ceiling was observed staircase and passage.

### 3.6 Pavement

The pavement tiles was observed in distressed condition and requires repair work at the earliest.

### 3.7 Compound wall

Compound wall is in damaged condition and require repair work at the earliest.

Painting can be done on compound wall as well as on grills as a beautification & durability point of view.

## 4. Recommendation

As per the actual observations after detailed survey, consultant recommend society that it will be desirable to strengthen the R.C.C. members internally and also externally wherever required as there were major structural/civil repair work of R.C.C. members & other damaged areas of the building and existing plaster was in damaged condition at many location and cracks was observed at many places hence patch plaster work is recommended to external face of the building, since staircase, headroom also needs to be treated from internally and externally along with the floor tiles are observed in distressed condition hence the base slab is to be checked.

Water proofing over terrace was observed in damaged condition however based on actual observation from terrace it is need of hour to retrofit the terrace floor with injection/chemical and since the work is of critical nature we also recommend to execute the major repairs of the building under professional supervision.

## 5. PROCESS TO START WORK

At site the observation and inspection of the surfaces and building is carried out by using tapping hammer and inspecting the visible damages and cracks to the building and after that the doubtful area is marked with marker with colour and Non-destructive test such as 1.Rebound hammer, 2.Ultra sonic pulse velocity, 3.Half Cell potential, 4.Core cutting, 5.Chemicle Test, 6.Covermeter tests are carried out on different place/surface of the building (mainly as Beam, column etc.).

After that the doubtful area is removed and cleaned for further process in which the areas then treated by putting the polymer and micro concrete on desired places. the weaken beam's and column's plaster and unwanted part are deteriorated/broken down and cleaned off, after that the exposed corroded reinforcement is covered by polymer and after that with micro concrete is applied on beams and columns, after doing all necessary plastering and concreting external work team also performs similar inspection on internal side (apartments) of the building and similarly like the external in internal the doubtful area is repaired.

After execution of all the required structural repairs on the building the building is then white washed and painted and finishes.

## 6. Non Destructive Tests

### 6.1 Ultra Sonic Pulse velocity test

These tests are primarily done to establish:

1. Homogeneity of concrete
2. Presence of cracks
3. voids and other imperfections
4. Changes in quality of concrete over time
5. This test does not establish compressive strength of tested concrete

UPV Tests are done in accordance with Indian standards IS: 13311 (Part 1)

Ultrasonic pulses travel faster in denser material. Each material has typical ultrasonic pulse velocities. E.g. Steel, Concrete etc. using benchmarks over a period of time and conducting extensive laboratory and in-situ tests.

Sr.No.	Pulse velocity by cross probing	Concrete Grading	Quality
1.	Above 4.5 km/s	Excellent	
2.	3.5 km/s to 4.5 km/s	Good	
3.	3.0 km/s to 3.5 km/s	Medium	
4.	Below 3.0 km/s	Doubtful	

Permissible Value



**Ultra Sonic Pulse velocity test**

### Result:

The readings in this case are in range of 1.62 Km/sec to 1.92 Km/sec and the average reading is 1.71 Km/sec, which indicates concrete quality to be doubtful.

### 6.2 Rebound Hammer Test

These tests are primarily done to assess:

1. the likely compressive strength of concrete
2. the uniformity of concrete

Rebound Hammer tests are done in accordance with Indian standards IS: 13311 (Part 2).

Harder the surface of the material tested, greater is the rebound. In new concrete, as it gains strength, hardness increases and as a result, the readings increase. The hammer can be used in 3 orientation, Vertical up or down (typically used for slab), horizontal (for columns). Depending on the orientation used and age of concrete, the results are interpreted for strength.



**Rebound hammer test**

**Result:**

The rebound number in this case are in range of 22.4 to 24.2, average reading is 23.16 & average Equiv. Cube strength is 11.88 N/mm<sup>2</sup>, which indicates poor compressive strength.

**6.3 Half Cell Potential and Carbonation Test**

**6.3.1 Half Cell Potential**

The potential in millivolts decrease with the increase in probability of corrosion in the steel reinforcement



**Half Cell Potential**

**Results:**

The readings lies between -272 mV to -291 mV which indicates that an increasing probability of corrosion.

**6.3.2 Carbonation**

Concrete, being basically a porous material, undergoes carbonation process with ageing. As the protective cover of the concrete carbonates completely, the corrosion reaches the steel reinforcement, rapidly accelerating the process of corrosion in steel.



**Carbonation**

**Result:**

Depth of carbonation in R.C.C. members are in range of 45 mm to 50 mm and average depth of carbonation is 47.5 mm, which indicates 86% carbonation of concrete.

**6.4 Concrete Core test**

A core sample is the actual representative of the material used in the structural element. When processed and subjected to load, it fails at a particular load, giving a fair idea of its compressive strength.

These tests are primarily done to obtain the compressive strength of the concrete sample. In addition, the density of the concrete sample is also obtained.



**Concrete Core Test**

**Result:**

The equivalent cube strength of concrete is 11.9 N/mm<sup>2</sup> which is poor.

**6.5 Chemical Test**

These tests are used to assess the pH level, Chloride (Cl<sub>2</sub>) content and SO<sub>3</sub> content of concrete. Each material has distinct pH value, Chloride Content, Sulphide Content, E.g. Concrete, Water, etc. depending on various atmospheric and sand conditions at site, using benchmarks over a period of time and conducting extensive laboratory tests, we have correlated pH, Chloride, Sulphide content values to arrive at estimate the quality of concrete.

pH	Not less than 8
Cl (kg/m <sup>3</sup> )	For PCC, maximum 3.0 kg of Chloride per m <sup>3</sup> of concrete.
	For RCC, maximum 0.6 kg of Chloride per m <sup>3</sup> of concrete.
SO <sub>3</sub> (%)	Less than 4% by mass of cement in the concrete mix.

**Permissible Limits**

**Result:** The chloride content and sulphate content of concrete was found to be 20 mg/l and 40 mg/l respectively, which is within the permissible limits.

The pH Value was found to be 10.5 which is within the permissible limits.

## 6.6 Cover meter Test

In this test the cover meter dimension of any beam or column is taken in this test the concrete cover in column was found to be 59 mm.

## 7. EXECUTION

The columns and beams were highly deteriorated and reinforcement was corroded "For checking the columns, beams and slab the elements are checked with rubber hammer and visual inspection." The following process is been taken.

### 7.1 EXTERNAL STRUCTURAL REPAIR:-

#### 7.1.1 Rust Remover

Brushing with wire brush and removing all rust scales from rebars & washing with water as required and providing and applying Rust Remover on existing exposed reinforcement bars



**Anti-rust chemical application**

#### 7.1.2 R.I. Coat

Providing and applying Rust Inhibition Coat / system to exposed rebars & also new rebars complete.

#### 7.1.3 Bond coat

Providing and applying raw Polymer Bond Coat / system to all exposed concrete surface and rebars prior to polymer treatment complete.

#### 7.1.4 P.M.M.

Providing and applying Polymer modified mortar in ratio 1:5:15 (1 part by weight of polymer: 5 parts by weight of cement: 15 parts by weight of Quartz sand) up to 25 mm thickness all complete as per the direction of Consulting Engineer / in-charge.

### 7.2 INTERNAL STRUCTURAL REPAIR:-

Same as above Specification but on internal surface all complete as per the direction of Consulting Engineer / in-charge.

### 7.3 PRO & FIX STEEL:-

Providing and fabricating, fixing steel as required dia. For column, beams & slab. Etc. Complete as per the direction of Consulting Engineer / in-charge.

### 7.4 MICRO CONCRETE:-

Providing and laying Super Fluid Micro concrete which shall be single component, non-shrink, free flow, self-compacting, ready to use after mixing water in specified proportion to the beam bottoms, columns, slabs, etc. with shuttering, pouring, temping, Consolidating, curing etc. Complete as per the direction of Consulting Engineer / in-charge.

### 7.5 PLASTERING WORK:-

Providing 25mm thick External Plastering in two coats, under layer 15mm thick with C.M. 1:4 finished with a top layer 10mm thick in C.M. 1:5 including admixture with approved Water proofing admixture @ 2% by weight of cement used or as per manufacturer's specifications, sieving of sand to required fineness, finishing, curing, etc. complete as per specifications, drawings and as per the direction of Consulting Engineer / in-charge.

### 7.6 DASH COAT:-

Removing the loose plaster material and repairing the damaged wall surface with application of Dash coat of 1: 4 cement mortar and inserting brickbats or metal chips to level the surface complete as per the direction of Consulting Engineer / in-charge.

### 7.7 INTERNAL NEERU PLASTER:-

Providing & Applying internal Neeru finish plaster 12 mm thick in CM 1:4 complete to the wherever necessary area. Including breaking of plaster & scaffolding etc. complete as per the direction of Consulting Engineer / in-charge.

### 7.8 CHHAJJA WATERPROOFING:-

Providing & laying brick bat coba waterproofing treatment on chajjas top/ Balcony top with 75 mm average thickness with small brick finished with joint less waterproofing layer in CM 1:4 of average 25mm to 30 mm thick finished smooth

with cement slurry & marking thin lines in to 300 x 300 mm false squares with minimum 6mm thick cotton line 150mm x 150mm Watta carried long with the wall with throating at the junction of the wall and Watta top curing, cleaning, as directed etc. complete. As per the Direction of Consulting Engineer / In-Charge.

**7.9 TERRACE WATERPROOFING BY CHEMICAL COATING:-**

Cleaning the existing surface and filling all the cracks with crack sealant then providing 02 coat of waterproof chemical coating of approved brand complete as per direction of consulting Engineer In-Charge.

**7.10 WATERTANK WATERPROOFING:-**

Cleaning the existing surface and filling all the cracks with crack sealant then providing 02 coat of waterproof chemical coating of approved brand complete as per direction of consulting Engineer In-Charge.

**8. MATERIAL USED**

SR. NO.	MATERIALS	APPROVED BRANDS
1.	Cement OPC,PPC Grade 43 / 53	Gujarat Ambuja, Ultratech, A.C.C
2.	White Cement	'A.C.C.' (Silvicrete), JK White, Birla.
3.	U-PVC Plumbing pipes.	Supreme or Prince ISI "A" grade.
4.	C.I. Pipe	Nikko ISI or Conforming to I.S.1230 for rain water pipes & Fittings & the I.S.1729 & ISP 3889 for soil & wastewater pipes
9.	P.V.C. Pipe	Prince, Krishna
5.	Acrylic Paint	ICI Paints, Asian Paints, Sherwin Williams, New World Paint
6.	Elastomeric Paint	ICI Paints, Asian Paints, Sherwin Williams, New World Paint
8.	Metal Red-oxide Primer	ICI Paints, Asian Paints, Sherwin Williams, New World Paint
9.	G.I. PIPES	TATA, Zenith "C" Class
10.	Sand For plastering & other work	Packed Gujarat Sand Bags, SILPOZ or pure river Sand
11.	Sand for waterproofing work	Pure River Sand
12.	Micro Concrete	STP Limited, Sunanda, Roof, Parr

**9. FUTURE SCOPE**

So all the above work tell us that most of the old structures/buildings are repairable and we can increase lifespan by providing strength to that structure.

**10. Acknowledgments**

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**11. CONCLUSION**

Since from this paper we can conclude that the deteriorated part or any structure or building can be examine and repair or we can increase the strength of any old structure or building and there's no need to demolish the structure if not required.



BREAKING SHUTTERING MICRO CONCRETE

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