

# ***STRUCTURAL AUDIT REPORT***

***OF***

**INDIA HOUSE NO:-1.**

***India House Compound,Kemps Corner,  
AK Marg,Grant Road, Mumbai.***

**30<sup>th</sup> June, 2023.**

**COMPILED BY :**

**M/S. ARVIND SINGH CONSULTANTS.**

***SAGAR AVENUE 1 B404,VAKOLA BRIDGE,***

***SANTACRUZ EAST***

***MUMBAI – 400 055.***

***PH :9820993481***

***Email :[ascon2100@gmail.com](mailto:ascon2100@gmail.com)***

***[www.asconinfra.info](http://www.asconinfra.info)***

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# **1. INTRODUCTION**

## 1.0 INTRODUCTION

The building 'India House No:-1' is located at **India House Compund,Kemps Corner, AK Marg,Grant Road,Mumbai.**

- 1.1 **M/s. Arvind Singh Consultants.** submitted a proposal to the client.On request submitted the proposal and discussed the principles and procedures of investigation, finally **client has approved to conduct survey of the said building on 30<sup>th</sup> June,2023.**
- 1.2 No major accident such as fire, partial collapse etc, has occurred since its construction.
- 1.3 Visual inspection, tapping was carried out simultaneous result of the same are presented in this document
- 1.4 Instrumentation such as **Rebound Hammer, Ultrasonic Pulse Velocity Test, Half-Cell Potentiometer Test, Carbonation Test, Core Test, Copper-Sulphate Test** was carried out by our investigation team Civil Engg.**Mr. Adnan Dingankar on 30<sup>th</sup> June,2023,** whose results are also enclosed.
- 1.5**Arvind Singh Consultants.** undertake not to disclose or reveal any technical information collected during investigation or put in possession during the course of our working without the explicit written approval of the clients.

**M/s. Arvind Singh Consultants., disclaim any responsibility of the finding, if the client chooses not to get the structure repaired or rehabilitated within six months of report date.** We also are not responsible for any mishap or failure if the client alters the loading pattern and condition at site knowingly or unknowingly or by any act of nature. **The validity of the report is restricted to six months only from today 30<sup>th</sup> June,2023.**

**This report is to be treated as a status report only of the building under investigation.**

## **REMEDIAL MEASURES AS FOLLOWS**

### **1. Structural members :-**

The internal and external affected structural members if any viz, columns, beams, slabs, chajjas, etc shall be repaired as follows.

a.) Remove all loose plaster and loose concrete and clean the surface of the affected concrete thoroughly with water. Chip the loose concrete till portion of the sound concrete is reached, for repairs of R.C.C. members wall by the side of columns and beam if required shall have to be broken and after repairing of R.C.C. members same shall have to reconstructed and re-plastered.

b.) Remove all the loose rust of reinforcement by hammering and cleaning the rusted surface by stiff wire brush.

c.) Remove the residential rust by applying rust remover with cotton waste swab. Allow the solution to remain for at least 24hrs and then brush off the loose particles of any means of the brush. the chemical used shall be of Sunandaspeciality coatings Pvt. Ltd. Roffe construction chemicals Ltd. Or equivalent.

d.) Apply rust passivator in two coats to reinforcement, which acts as rust preventor, in intervals of 4hrs between 2 coats.

e.) Apply 'Polyalk EP' plus cement slurry 1:1 as primer cum bonding coat on the surface of the old concrete, manufactured by Sunanda Specialty Coatings Pvt. Ltd. This acts as a primer cum boning coat between the old concrete and mortar.

f.) Prepare a special polymer mortar in following proportions. 1 kg. POLYALK EP, 5 kg. Fresh OPC cement, 15 kg, Quartz sand (10 kg. passing 2mm. + 5 kg. Passing through 1 mm. down). Add 1 to 1.5 litres water depending upon desired consistency. Mix by stirrer and place the mortar by hand on above prime surface in the thickness of 10 to 15 mm. each layer allow it to initially set.

g.) Apply in layers of similar thickness till the original shape and size is attained. Finally finish the surface with a steel trowel and cure the surface after covering them with damp gunny bags.

h.) If after the corrosion the existing reinforcement is inadequate then new reinforcement by the side of old reinforcement be provided and the jacketing of the column has to be done as per the advise of the R.C.C. consultant. The walls beside all the columns will be required to be broken for working space.

i.) Grouting shall be done with polymer grout to fill up the voids.

j.) After the repairs to the R.C.C. members, the surface be internally re-plastered and painted as per the requirement.

## **2. PRINCIPLES**

## 2.0 PRINCIPLES

### 2.1 VISUAL OBSERVATION:

The building was investigated flat by flat for observation and also from outside of the building. Each Column, Beam & Slabs within the section was observed for a range of defects such as Cracks, Spalls, Crazing, Seepage etc. all area which formed the total data of the structure.

### 2.2 SURFACE STRENGTH PROFILE: - REBOUND HAMMER METHOD

The hammer is principally a surface hardness tester. The principle is that when a spring loaded shaft strikes a surface. Its rebound is a function of the hardness of the surface. The force on the shaft and its rebound are developed and measured by the hammer. The operations are very simple. They consist of releasing the plunger from locked position by pressing gently against the hard surface and check for zero setting of rebound number indicator on the graduated scale. The hammer is then strongly pressed against the prepared spot of the surface plunger and causes the impact. The position of the indicator on the scale is read as “rebound number” and recorded in test data log. These recorded data logs are then corrected for position of the hammer, position of the reinforcement, moisture contents in the elements and carbonation depth. The together with other data would help design of others actions.

### 2.3 CLASSIFICATION OF BLDGS-

CATEGORY	AUDITORS FINAL CONCLUSION
C1	To be evacuated demolition immediately.
C2-A	To be evacuated and/ or partial demolition requiring major structural repair.
C2-B	No eviction only structural repair.
C3	No eviction needs minor repair only.

# **3. OBSERVATION**



## 3.0 OBSERVATIONS

### 3.1 EXTERNAL

#### i) Structure

**Some of the structural members are not seen in good condition at in internal face with minor structural repairs needed.** Rest structural members are seen in good condition at internal and external face. Mumbai lies in coastal area where atmosphere is saline in nature. This atmosphere enhances the corrosion activity in the Reinforcement. The damage to the concrete is mainly due to the carbonation of the concrete and corrosion of Reinforcement. Area of the Corroded Reinforcement occupies Six to Eight times Volume of original Reinforcement, which in turns exerts pressures on the concrete cover, which results into cracking of concrete from core to cover. These Cracks allow moisture and various corrosive atmospheric elements to enter the concrete area and in turn cause extensive damage to structure. Corrosion of reinforcement can be compared with cancer to Structure and by this way the process of chain reaction of deterioration commences thus gradually reducing the original strength of structural members. This is a continuous process, which can be minimized with the help of selecting appropriate treatment at the time of repair.

**ii) Plaster**

**External plaster of the building is seen in good condition.**



**ii) Drainage/Plumbing Line**

**Drainage/plumbing lines are seen in good condition.**



iv) Waterproofing Work  
Flooring need repairs.



Terrace View

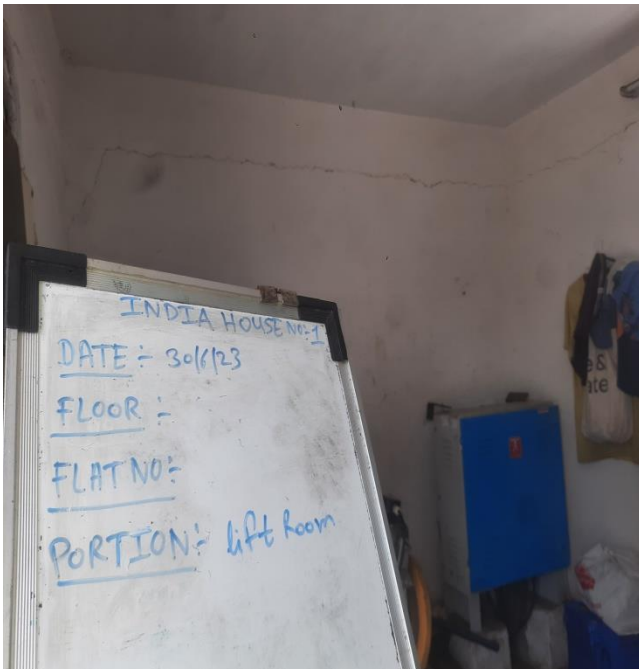
v) Headroom



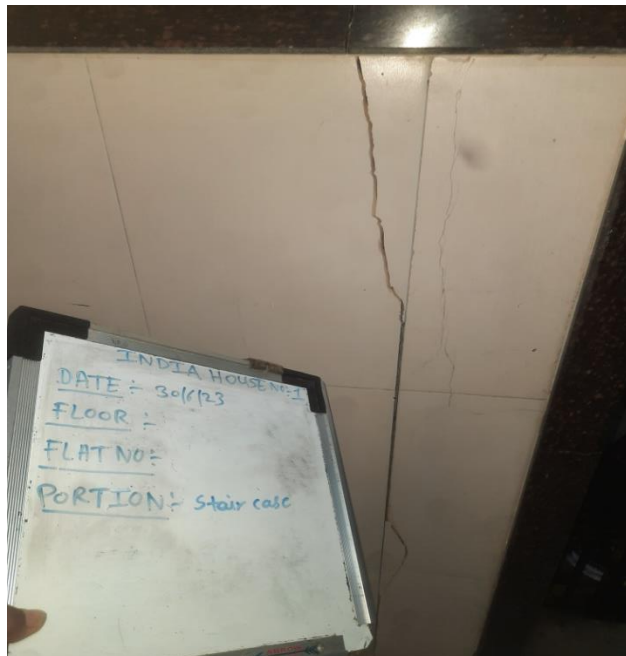
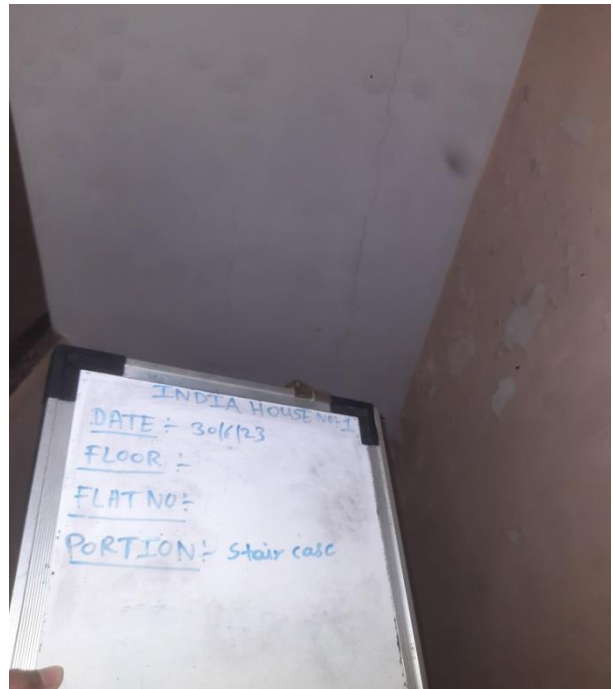
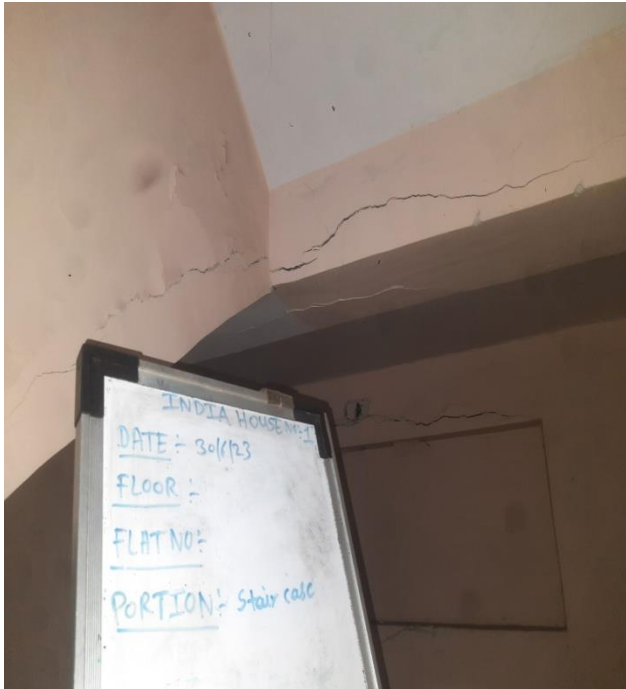
vi) OHT(Overhead Tank)

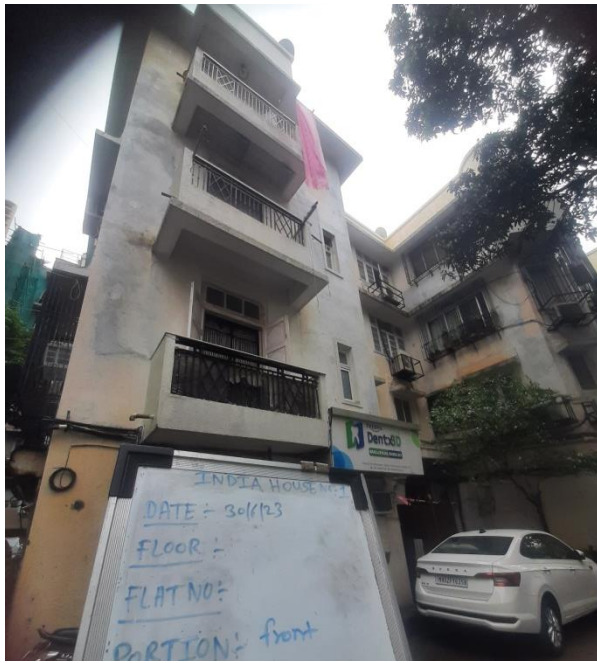


vii) Lift Room



viii) Staircase

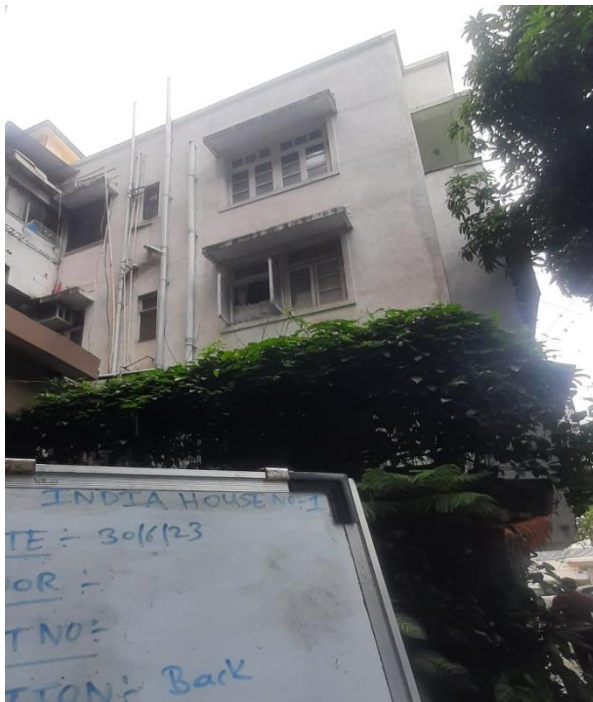




**External**



**External**



**External**

### 3.2 INTERNAL

Shop No.	Observation
<b>Bharat Furnishings</b>	No major distress is seen.
<b>Enrich</b>	Column and beam cracks are seen. Wall dampness is seen.
<b>Duroflex</b>	No major distress is seen.
<b>Dentx 3D</b>	No major distress is seen.
Flat No.	Observation
<b>1</b>	<p>Reception:- Wall dampness during monsoon.            Waiting Area:- Ceiling dampness during monsoon.            Passage:- No major distress is seen.            Cabin:- Ceiling dampness during monsoon.            X Ray Room:- No major distress is seen.            WC/Bath:- No major distress is seen.</p>
<b>2</b>	<p>Reception:- No major distress is seen.            Passage:- No major distress is seen.            Pantry:- No major distress is seen.            Doctor Cabin 1:- No major distress is seen.            Doctor Cabin 2:- No major distress is seen.            WC/Bath:- No major distress is seen.</p>
<b>5</b>	<p>Living Room:- Column cracks are seen.            Passage:- Column distress is seen.            Kitchen:- No major distress is seen.            Bedroom 1:- Ceiling minor cracks and wall paint peel off is seen.            WC/Bath(Bedroom 1):- No major distress is seen.            Bedroom 2:- Column cracks are seen.            WC/Bath(Bedroom 2):- No major distress is seen.            WC/Bath:- No major distress is seen.</p>
<b>6</b>	Closed.
<b>7</b>	Closed.
<b>8 &amp; 9</b>	<p>Living Room:- No major distress is seen.            Passage:- No major distress is seen.            Store Area:-Beam cracks are seen.            Pooja Area:-Lintel beam cracks and wall dampness during monsoon.            Kitchen:- No major distress is seen.            WC/Bath(Kitchen):- No major distress is seen.            Bedroom 1:- Ceiling, lintel beam and wall cracks are seen.            Bedroom 2:- Beam and lintel beam cracks are seen.            WC/Bath(Bedroom 2):- No major distress is seen.</p>



	<p><b>Bedroom 3:- Lintel beam cracks are seen.</b>  <b>WC/Bath(Bedroom 3):- Column distress is seen.</b>  <b>WC/Bath:- No major distress is seen.</b></p>
10	<p><b>Living Room:- Column plaster cracks are seen.</b>  <b>Passage:- No major distress is seen.</b>  <b>Kitchen:- No major distress is seen.</b>  <b>Bedroom 1:- No major distress is seen.</b>  <b>Bedroom 2:- Column and beam plaster cracks are seen.</b>  <b>WC/Bath:- No major distress is seen.</b></p>
11	<p><b>Living Room:- No major distress is seen.</b>  <b>Passage:- No major distress is seen.</b>  <b>Kitchen:- Column and beam distress is seen. Wall dampness is seen.</b>  <b>Bedroom 1:- Column distress and wall minor cracks are seen. Wall dampness is seen.</b>  <b>Bedroom 2:- No major distress is seen.</b>  <b>Bedroom 3:- No major distress is seen.</b>  <b>WC/Bath:- No major distress is seen.</b></p>
12	<p><b>Living Room:- Leakages from terrace due to rains.</b>  <b>Passage:- No major distress is seen.</b>  <b>Kitchen:- Column cracks are seen.</b>  <b>Bedroom 1:- No major distress is seen.</b>  <b>WC/Bath(Bedroom 1):- No major distress is seen.</b>  <b>Bedroom 2:- No major distress is seen.</b>  <b>Bedroom 3:- No major distress is seen.</b>  <b>WC/Bath(Bedroom 2):- No major distress is seen.</b>  <b>WC/Bath:- No major distress is seen.</b></p>
13	<p><b>Living Room:- Flooring unevenness is seen.</b>  <b>Passage:- No major distress is seen.</b>  <b>Kitchen:- Beam tile cracks are seen.</b>  <b>Bedroom 1:- Column plaster cracks and wall dampness due to monsoon.</b>  <b>WC/Bath(Bedroom 1):- No major distress is seen.</b>  <b>Bedroom 2:- Column hairline cracks are seen.</b>  <b>Balcony(Bedroom 2):- Ceiling distress is seen.</b>  <b>WC/Bath:- No major distress is seen.</b></p>
12A & 14	<p><b>Living Room:- Column hairline cracks are seen.</b>  <b>Passage:- Beam minor cracks are seen.</b>  <b>Kitchen:- No major distress is seen.</b>  <b>Bedroom 1:- Ceiling dampness during monsoon.</b>  <b>WC/Bath(Bedroom 1):- No major distress is seen.</b>  <b>Bedroom 2:- Ceiling dampness during heavy monsoon.</b>  <b>WC/Bath(Bedroom 2):- No major distress is seen.</b>  <b>Bedroom 3:- Column and wall hairline cracks are seen.</b></p>

	<p><b>Balcony(Bedroom 3):- Ceiling plaster cracks are seen.</b></p> <p><b>WC/Bath:- No major distress is seen.</b></p>
<b>Staircase</b>	<ul style="list-style-type: none"> <li>• <b>Ground Floor Passage:- No major distress is seen.</b></li> <li>• <b>Ground to 1<sup>st</sup> Floor:- No major distress is seen.</b></li> <li>• <b>1<sup>st</sup> Floor Passage:- Ceiling and wall paint peel off is seen.</b></li> <li>• <b>1<sup>st</sup> to 2<sup>nd</sup> Floor:- Waist slab cracks are seen.</b></li> <li>• <b>2<sup>nd</sup> Floor Passage:- Beam cracks are seen.</b></li> <li>• <b>2<sup>nd</sup> to 3<sup>rd</sup> Floor:- Beam distress is seen. Waist slab and pardi wall cracks are seen.</b></li> <li>• <b>3<sup>rd</sup> Floor Passage:- No major distress is seen.</b></li> <li>• <b>3<sup>rd</sup> to Terrace Floor:- Wall cracks are seen.</b></li> </ul>
<b>Terrace</b>	<ul style="list-style-type: none"> <li>• <b>Headroom:- No major distress is seen.</b></li> <li>• <b>OHT(Overhead Tank):- No major distress is seen.</b></li> <li>• <b>Lift Room:- Wall cracks are seen.</b></li> <li>• <b>Parapet wall minor cracks are seen.</b></li> <li>• <b>Flooring need repairs</b></li> </ul>
<b>External</b>	<ul style="list-style-type: none"> <li>• <b>Seen in good condition.</b></li> </ul>

## **4. DIAGNOSIS**

In any building structure, damage to the structural members and others parts of building like external walls, partition walls, chajjas is primarily caused due to water seeping in from the parts of the building structure at top like terrace, coping on parapet wall, staircase top and through porous plaster or cracks in the plaster. This water percolate in the structural and other RCC members and when in contact with reinforcement steel causes oxidation reaction. The diameter of the rods thereby increases and tries to throw the surrounding concrete away thereby forming cracks in the concrete structure. Similarly, water also seeps in through junctions of chajjas and walls due to failure of waterproofing system.

The continuous splash of rainwater affects the terrace-waterproofing top and development of and development of cracks starts. The cracks allow water inside and the structure starts deterioration. The corrosion of reinforcement results in the formation of rust, which occupies a much larger volume than the steel from which it is formed. This corrosion product exerts large internal pressure resulting in cracks and spalling in concrete.

The formation of cracks in concrete further leads to quicker rate of corrosion, due to ingress of moisture and air resulting in failure of structure in due course. Quality of concrete, cover thickness of concrete over reinforcement and condition of reinforcement are the major factors affecting the corrosion.

When the concrete cracks excessively during very early stage of its life. Excessive air entrapment also produces low strength concrete. Thus a cyclic of cracking, entering of further moisture corrosion, etc. on structural members. The construction deficiencies may also be the cause of damage to the building structural.

The damage thus caused has to be repaired by appropriate methods and proper schemes of repairs. In the following pages, we have given our observations and inferences on the status of the building and the suitable methods of repairs are also described in brief.

The causes of these structural defects can mainly be attributed to –

- Monsoon leakage from walls.
- Plumbing leakages.
- Carbonation of concrete.
- Corrosion of reinforcements.
- Inadequate maintenance.
- Proximity to surrounding drainage/sewerage system.
- Weathering effect of salty climate in Mumbai.

# **5. INSTRUMENTATION**

## **6. RECOMMENDATIONS :**

### **1. PLASTER**

External plaster of the building is seen in good condition.

### **2. STRUCTURE :**

**Some of the structural members are not seen in good condition at in internal face with minor structural repairs needed** Rest structural members are seen in good condition at internal and external face. In future if Cracks are developed on structural members, it should be treated with proper polymer treatment under Supervision of structural engineer.

As mentioned earlier damage to most of the structures in mumbai area is mainly due to carbonation of concrete and corrosion of reinforcement. to repair same any one of the following method can be adopted.

- a. Epoxy and Polymer Modified Mortar: Epoxy/ Polymer modified mortar gives good compressive, flexural and shear strength as compared to shotcreted mortar. This process consist of cleaning the reinforcement, removing the Rust, providing additional reinforcement wherever required, Passivating the same and applying polymer/ epoxy modified mortar on the structure. We recommend use of cementations material i.e. polymer over epoxy as it behaves like concrete, and is easy to handle.
- b. Base on the inspection certain Structural Elements as discussed in paragraph 3.00 of General Observation and internal survey have been identified for Possible repair. Structure should be treated front outside & inside wherever required. (All Internal Modification henceforth should be allowed only after approval from Licensed Structural Engineer.)

### **3. INTERNAL LEAKAGE**

Waterproofing by chemical coating is required to avoid any further seepage or dampness which can be done under regular maintenance work as per mentioned in the observation sheet.

**NOTE ON STRUCTURAL DISTRESS**

RCC building are frame structure (members of the frame are columns, beams, slabs) buildings. The healthy condition of the RCC frame members is must from the stability point of view of building. The structural distress sets in the RCC members slabs, beams, columns, etc due to various reasons. However, LEAKAGE is the main cause. These corrode the reinforcement bars in the RCC members which in turn increase the volume of the reinforcement bars resulting initially in cracks and subsequently in spalling of cover concrete along with plaster or spalling of core concrete, as the case may be. This further aggravates the rusting process. Thus the deterioration process continues with time affecting the STABILITY of the building and the long life of the building. Advised to rehabilitate all the RCC members as per methodology no.1 both from outside, in the common areas and from inside of all the flats of the building.

The methodology will have to be modified during the stage of surface preparation (Process of removal of loose / bad concrete) in specific cases. Is is expected – a portion of the RCC member or complete member may give way during the surface preparation – i.e. when removal of loose / bad concrete is in progress. In such situation utmost safety precautions with respect to structure and workmen and occupation needs to be ensured.

i.e. when rehabilitation of a severely deteriorated roof slab of a room (which is the floor slab of upper flat room) is taken up – then take following precautions:

1. Ensure that nobody occupies and there is no material in both rooms below & above this slab.
2. Tackle slabs one by one in a flat.
3. If the slab taken up for rehabilitation was rehabilitated earlier by guiniting and if now the guinited material is deteriorated and mesh is rusted then in such a situation either the complete slab needs replacement or Rehabilitate by micro concrete from pockets at regular intervals in floor slab of upper flat room.
4. Remove the floor tiles over the slab (floor of upper flat room) and inspect the slab from above. If decision is taken to replace the slab by new slab then removal of the same from top is advised which will ensure better safety.

In these location slab will be restored with the ready to use micro concrete or with regular concrete as per the site condition. In such situations temporary supports are advised prior to starting the work of surface preparation, as detailed by the consultant.

Many flats have false ceiling and cladding provided over the RCC members in some locations. Shops have hoardings over the RCC members. These areas cannot be inspected for any structural distress. The concerned flat owners / shop owners be inforoomed to constantly monitor these areas and if any cracks are noticed in the cladding material or spalling of cover concrete is noticed – it is advised to remove – then – the false ceiling and

the cladding material and Rehabilitate the RCC members. In (old) building where severe structural distress to RCC members is observed, remove complete false ceiling to slabs and

cladding material to columns and beams and inspect RCC members and Rehabilitate them immediately. Dismantle any additional brick partition walls placed over the slab, This is absolutely necessary from the STABILITY point of view of the building. This is advised as there could be resistance to the removal of the false ceiling and cladding as lot of money is spent on this. The concerned flat owners have to reconcile and understand that here the STABILITY of the building is involved.

In the visual inspection at many locations it is difficult to differentiate between the plaster cracks, the separation gaps and the structural distress cracks. Proper treatment should be given as advised after opening out the cracks. The plaster cracks and the separation gaps should be treated as per the details given in the

## Technical Specifications (Typical)

### A. MATERIAL SPECIFICATION :-

1. All materials to be supplied by the Contractor and should be of approved quality and will be in conformity with the specifications. If material delivered on the site does not satisfy the Consultants, the Contractor shall remove the same from site. Cost of testing the material as required shall be borne by the Contractor as and when directed by Consultant.
2. Unless otherwise stated OPC Cement of approved Brand should be used. The cement to be used should not be more than 3 months old (from the date of manufacture).
3. Sand to be used shall be river water sand, as specified. Marine sand shall not be allowed to be used. Sand to be used should be well graded and free from any salts and silt. Slit content should not be more than 5%. All the sand to be used on site should be first screened and washed before use.
4. Water to be used should be free from acids, salts, organic matter or other substance that may be deleterious to concrete and steel and shall be potable type as per statutory norms. Test certificate shall be submitted to the Consultant and Society as and when asked for.
5. Solid content of the polymer @ 1050 C should be greater than 40% and pH should be greater than 8. Polymer shall be of approved make and quality.
6. Independent testing, if insisted by the Consultant shall be carried out in approved laboratory for the Polymer Cement Mortar which After 28 days should give following minimum strength result.
 

Compressive Strength	>	35 N/mm <sup>2</sup>
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Tensile Strength > 6 N/mm<sup>2</sup>

Flexural Strength > 8 N/mm<sup>2</sup>

Bond Strength > 1.8 N/mm<sup>2</sup>

7. Brick to be used should have minimum crushing strength of 35 Kg/Cm<sup>2</sup>. Maximum Water absorption allowed 25%.

8. Non Shrink Cementitious Grout shall have following properties and should give following strength at 28 days.

Compressive Strength > 35 N/mm<sup>2</sup>

Bond Strength 14 days at 250 C > 3.5 N/mm<sup>2</sup>

9. Micro Concrete should give following strength at 28 days.

Compressive Strength > 55 N/mm<sup>2</sup>

## **B. WORK SPECIFICATIONS :-**

1. Scaffolding :-

(a) Wooden Bamboo Scaffolding :

Double Bamboo of size not less than 50mm dia and more than 3 m length of each. Bamboo shall be strong, seasoned and straight and shall be acceptable for building height up to 25 m. The Bamboos shall be well spliced and tied at all joints by strong coir rope. The scaffolding shall be well braced and secured to the outside wall at intervals.

(b) Steel scaffolding :

These shall be of approved manufacturer 'ACROW' or equivalent and with all the accessories, fixture, bracings etc. complete.

Note: 1. No Holes in walls will be permitted for fixing ties.

2. Scaffolding shall rest on firm ground and concrete pedestals.

Area for payment to contractor shall be Front exposed Surface area only.

2. Screens and Safety Nets :-

These should be good quality thick Nylon or similar type to secure the entire exposed area, however, horizontal netting shall also be provided at 1<sup>st</sup> floor level wherever required.

Payment is supposed to be included in scaffolding rate.

3. Window Coverings :-

The openings should be will covered by plywood or similar material. Ventilation should be provided wherever required.

Measurement shall be on actual area basis.

4. Grills and Weather Sheds :-

These existing items will need careful handling as these are to be dismantled and re-fixed after the repair works are completed. Grills are likely to distort and re-fixing may be a problem. Re-fixing screws should be drilled and not hammered. Measurement shall be on exposed surface area basis.

## **C. REPAIR WORK SPECIFICATIONS :-**

1. Terrace Water Proofing :-

A. Repairs by complete removal of existing heavily damaged Water proofing and Re-laying new W.P.

- a) Remove existing coba carefully up to R.C.C. slab surface
- b) Repair any damage in R.C.C. slab by PMM/Micro concrete and additional reinforcement wherever necessary.
- c) Provide with hand pressure pump non-shrink cement grout in cracks and crevices in slab, through nozzles.
- d) Rain water outlets to be made leak proof by (Polymer + Cement) rendering to inside surface.
- e) Provide suitable water proofing polymer membrane coating on R.C.C. slab surface and wata as per consultant's direction.
- f) Provide new brick-bat Coba on membrane coated surface, using cement mortar laid to slope and cure by water ponding after initial set.
- g) Finish with IPS and china mosaic on top.

B. Repair Minor-damaged existing water proof surface.

- a) Clean the surface by water jet and coir brush to expose cracks.
- b) Grout through the cracks using PVC nozzles, wherever necessary, and fill the open cracks by water proofing putty. Cracks should be prepared with 'V' groove for filling.
- c) Apply appropriate water proofing polymer coating on the prepared surfaces. Coating should be flexible, hard and UV-resistant as per consultant's direction.

2. Repair to Parapet Walls :-
  - a) Remove the existing damaged plaster and damaged coping.
  - b) Provide new coping beam if the existing coping is damaged.
- c) Provide new water proof plaster in 2 coats as per specifications.
  - d) Provide 2 coats of elastomeric water proof paint of approved make on the plastered surfaces.
3. Repair to R.C.C. Water Tanks :-
  - a) Remove existing damaged water proof plaster from inside.
  - b) Grout the junctions with non-shrink cement slurry using nozzles and pressure pump.
  - c) Provide water-proofing polymer membrane coating from inside, all over the repaired surface, as directed.
  - d) Provide water proof plaster over membrane coating from inside to protect the coating and cure the same.
4. Chajja Water Proofing :-
  - a) Remove the existing damaged IPS.
  - b) Repair any damage to R.C.C. by PMM/Micro Concrete with additional reinforcement wherever necessary.
- c) Provide appropriate water-proofing treatment on top surface led to slope and as directed.
- d) Provide new IPS with wata at will junction. Ensure drip mould at bottom.
5. Outside wall water proofing :-
  - a) Remove cracked and debonded plaster and repair.
  - b) Open separation joints and seal the gap with PMM. Grout the gaps with non-shrink cement grout using nozzles through PMM.
  - c) Replace damaged plaster by new W.P. plaster in 2 coats using a bond coat.
  - d) Provide water proof elastomeric paint on outer surface as directed.
6. Basement Wall Water Proofing from inside :-
  - a) Expose the inside leakage areas and cracks by 'V' groove formation.
  - b) Grout the cracks with non-shrink cement or polymer grout as specified.
  - c) Provide coating to the inside concrete surface using crystallizing polymer slurry to seal the pores in concrete with surface penetration method.

- d) Provide water proof Membrane coating from inside as directed.
  - e) Provide W.P. membrane coating on floor and dado as directed.
  - f) Provide new coba and check for any leakage and provide tiling with proper joints.
  - g) Seal damaged door frame bottoms with Micro concrete or PMM.
8. Repair for Minor Leakages in Bath Room :-
- a) Seal Tile joints by polymer water proofing putty.
  - b) Water proof the 'Trap's as per '7d' above.
  - c) Seal door frame damaged bottoms using Micro concrete or PMM.
9. R.C.C. Repairs:-
- A. Repair by using (Polymer Modified Mortar) PMM :
- a) Provide necessary steel props to reduce load on damaged R.C.C. member.
  - b) Provide damaged R.C.C. portion carefully by chiseling.
  - c) De-rust the reinforcement.
  - d) Provide 2 coats of passivator/corrosion inhibitor coat to reinforcement.
  - e) Prepare polymer mortar as per specifications.
  - f) Moisten the surface and apply a bond coat (1:0.5 on surface to be repaired.
  - g) Hand press PMM in thin layer (? 20mm) on specified bond coat.
  - h) Additional thickness of PMM shall be provided if required, next day using a bond coat again. (It is advisable to embed small Pea-gravel to get a good grip for additional layers of PMM).
  - i) Cure for 4 days and finish with plaster.
- Note : PMM must be mixed in a mortar mixer or use mechanical stirrer.
- B. Repair by R.C.C. jacketing :
- a) Same process as above up to d.
  - b) Provide additional Reinforcement for jacket as directed and passivate it.
  - c) Provide shuttering around the distressed member to achieve required thickness of Jacket around R.C.C. Provide a suitable (Epoxy based) bond coat on concrete surface prior to fixing shuttering. (bond coat should be tacky till the jacket work is complete)
  - d) Prepare mix of M25 or as specified grade concrete and pour it in the shuttered area. Compact the concrete by rodding and tapping on outer surface.
  - e) Remove shuttering after 3 days and cure with water properly.

- f) Finish the surface with plaster as specified.
- g) The surface can be coated with anti-carbonation polymer coating if directed to do so.

C. Repair by using Micro Concrete for jacketing :

- a) Same process as above up to d.
  
- b) Prepare mix of Micro Concrete powder adding 12.5% water. Stir well before pouring in the shuttering area. (Use mechanical stirrer for mixing).
- c) Remove shuttering next day and cure the new jacketed surface for 4 days.
- d) Finish the surface with plaster and anti-carbonation coat as directed.

**Note :** 20% of Micro concrete powder can be replaced by Pea-gravel, if permitted by the Consultant.

10. Plaster – Repairs :

A. External Plaster :

- a) The external plaster shall be applied in two coats and finished with sand face by sponge. Mortar for plaster must be mixed as per specifications using a mechanical mixer. Use a bond coat on surface before plastering if specified so.
- b) The existing plaster, if cracked, damaged or de-bonded, the loose and damaged plaster shall be removed carefully by chipping or by light chiseling, and care should be taken not to damage the inside wall surface.
- c) Joint between new and existing good plaster, should be tapered at 45° for good bond.
- d) If the plaster is to be applied on repaired concrete surface, the same shall be made rough to provide a key to the new plaster. If brickwork is to be plastered, the joints shall be raked out at least 10mm deep to get a good key effect.
- e) The surface to be plastered shall be cleaned of loose dust, thoroughly watered earlier, and kept adequately wet before plastering, A suitable bond coat may be applied before plaster, if specified so.
- f) If plaster is carried out in patches, approved bond coat may be applied on wall surface prior to new plaster. The external plaster shall be applied in two coats as per specifications.
- g) The first coat applied is 10 to 12mm thick mortar mix (1:4 generally). Water proofing additives and Polypropylnfibres can be mixed in 1<sup>st</sup> coat of mortar mix. The surface shall be even and without any undulations so as to have a second coat of thickness 8 to 10mm roughly. The first

coat is roughened to provide a key to the second coat. The 1<sup>st</sup> coat shall be thoroughly watered and cured for seven days before the second coat is applied.

- h) The second coat generally is of mortar mix (1:3) using water proofing and activities. We have should be controlled and mortar applied evenly using a trowel and finished to required granular texture by a sponge. The surface of plaster should be cured for 8 days. Mortar must be prepared in mechanical mixer and used within 20 minutes of mixing.

- i) In case of large panels of plaster, it is advisable to introduce 'Breaker Bands' at suitable intervals to avoid cracks in plaster.

**B. Dash Coat Plaster :**

Whenever outside face of brick wall is uneven or damaged due to defective construction of wall, there could be local depressions varying even upto 20 to 60mm thickness. In such case a pre-treatment of leveling or filling the depressions by applying additional layer of 'dash coat' using (1:3) C.M. 1<sup>st</sup> coat of plaster may be applied on this leveled surface. It may be necessary to apply a bond coat before dash coat to get a firm grip on brick wall. 'P' gravel can be impregnated in dash coat for good grip of 1<sup>st</sup> coat. Dash coat has to be cured for 3 to 4 days.

Measurement of finished plaster shall include all Grooves, Bands, Drip Moulds, Cornices etc.

**C. Internal Plaster :**

Plaster on internal areas, which are not exposed directly to rain and weather, is applied in one coat and finished smooth. The plastering mix shall be (1:4) and process will be similar to 1<sup>st</sup> coat of external plaster. This will be finished on surface by 3 mm thick Birla white putty.

**11. BRICK WORK / BLOCK WORK :**

- a) All bricks shall be immersed in a drum or tank of water till bubbles cease to come up before being used in the work. No broken bricks shall be used, excepted as closure. The course shall be truly horizontal and the work strictly plump.
- b) Joints shall be broken vertically, and they shall not exceed 10mm in thickness. The brick work shall not be raised more than 12 courses a day (1.0 m height). Freshly mixed mortar of specified proportion shall be used.

- c) All joints in brickwork shall be properly raked out to 10mm as the work proceeds. The work shall be well watered three times a day for 8 days and afterwards twice a day for 10 days.
- d) Half brick interior partition walls shall be provided with 12mm thick R.C. (1:2:4) stiffeners with 2 nos. 8mm for bars as reinforcement. R.C.C. stiffeners shall be provided at every 1m vertical spacing. In case, wall length is more than 3M than vertical R.C.C. stiffeners of same size shall be provided at 1.5 M C/C.

## 12. MISCELLANEOUS REPAIR WORK :

- a) PCC Plinth Protection :-

This is to be provided on outer periphery of the building and adjoining to the outside plinth wall. Excavate about 750mm wide and 300 mm deep around the building. Provide hard 230 thick Rubble packing and 150 thick (1:2:4) concrete laid to slope with smooth finish, over the soling as plinth protection. 'Wata' should be formed at the junction of wall periphery.

- b) Paver Blocks :-

Surrounding area of the building up to compound wall should be covered by compacted Rubble Soling and paver blocks laid on 50mm thick (Sand + Cement) prepared bed. Joints should be filled with same mix. Paver blocks are generally 50 to 65 mm thick.

- c) IPS :-

This shall consist of 38mm thick PCC flooring laid in cement concrete (1:1 1/2:3) mix. It shall be mixed like cement concrete, and laid in panels of 3m x 3m to avoid cracks. After completion, it shall be finished with chequered pattern on surface as directed. The surface shall be kept watered for a period of 10 days. Joints between panels shall be filled with (sand + Bitumen) mix (1:2).

Note : Actual finished area shall be measured for payment.

## 13. Flooring / Tiling :-

- (i) Shahabad Flooring
- (ii) Polished Kotah stone Flooring
- (iii) Ceramic Glazed Tiling
  - (i) Shahabad Flooring :-

The Shahabad stones shall be of average of 35mm thick, specified sizes. It should be of best quality and approved by the consultant. The flooring shall be set in cement mortar bedding of mix (1:3), and finally set in cement float. They shall be laid to slope as directed. The rate for the work shall be inclusive of supplying, fixing and setting in place with CM and finishing the joints with cement putty.

Measurement shall be on laid surface area.

(ii) Polished Kotah Stone Flooring :-

The Stone flooring shall consist of machine cut and polished stone, laid in cement mortar bedding in particular pattern as directed by consultant and shall be of uniform specified thickness. These stones shall be free from cracks and flakes. The joints shall be neatly

finished with cement putty. Cut size of these stones are generally 300mm x 300mm unless noted otherwise. The rate shall be inclusive of supplying, laying, fixing and polishing etc., on laid surface area.

(iii) Ceramic Glazed Tiles :-

Ceramic glazed tiles shall be of approved quality. They shall be of uniform colour and factory glazed. Tiles shall not be less than 6mm thick and shall be free from warped surfaces, cracks and shall be true and straight. Tiles shall be laid to required slope on floors and truly vertical on walls. A bedding of 20mm thick cement mortar and is set in cement float with close joints and set to level.

For walls, the backing shall be of cement mortar 12mm thick. The joints of tiles shall have coloured cement pointing to match with the colour of tiles. The surface between the W.C. pan and the top of the tiles shall be finished in white cement along the curve of the pan.

Note : Actual finished area shall be measured for payment.

14. Plumbing and Sanitary Piping :-

1) Plumbing Pipes :-

These are G.I. pipes to class 'C' approved by Statutory Municipal Authority for supply of drinking water. All joints in the water lines shall be screw joints and made leak proof by use of



proper plumber's putty. All fittings, bends, T's and valves should conform to relevant I.S. standards and shall be of approved quality. The G.I. piping should be hydraulically tested for safe working without leakages. Pipes should be properly clamped on G.I. Brackets.

2) Sanitary Pipes :-

Sanitary pipes and fittings should conform to relevant I.S. standard specifications for PVC/C. I. Piping, wherever specified. All sanitary piping should be smoke tested for any leakage at joints. All joints should be sealed by plumbers putty. Sanitary pipe fittings and accessories shall be as per standard practice. The vertical pipes should be properly clamped on G.I. brackets to wall surface. Proper vent lines, anti-syphone lines, gully traps etc. should be provided as per statutory by-laws. Rain water outlets should be connected from roof/terrace levels through G.I. jail and drop on to plinth.

Note : Measurement should be on laid length on running meter basis.

15. Painting :-

A. Exterior Painting :-

Exterior surface to be painted shall be level, clean, washed and free from any dust, cracks, or algae. Paint is classified in following 3 categories :-

(i) Cement Paint :-

These are cement based paints and are applied in 3 coats. A base coat of primer should be applied on moist surface. Primer coat shall be mixed in (1:2) (Powder:Water) proportion. After the primer coat the surface shall be applied with 2 coats of (1:1) paint. Painted surface shall be cured for a week.

(ii) Acrylic Emulsion Paint :-

Surface cleaning process shall be similar as in (i) above. A primer coat shall be applied as specified. After the primer has set in, the surface shall be finished with acrylic paint in 2 coats with 10% dilution with water. The paint shall be of reputed, approved manufacturer's produce and shall be of reputed, approved manufacturer's produce and shall be guaranteed for 5 years against fading and 'water proof' quality. The film thickness is measured in microns and for 2 coats it shall not be less than 75 micron.

(iii) Elastomeric Acrylic Paint :-

Shall be as per reputed manufacturer's specifications and shall be of film thickness not less than 100 micron. These films shall have stretchable qualities to bridge minor 'plaster cracks', if any and paint shall be guaranteed for 8 years against fading waterproofing, etc.

**B. Interior Application Paints :-**

There are 2 types of interior wall paints :

a. Water Based :-

i. Distempers :-

These can be oil bound or acrylic distempers.

ii. Plastic Paints :-

These are acrylic emulsion paints. These are washable types.

b. Solvent Based Paints :-

i. LustreFinish :-

These are non-porous and silky finish paints and are dust free.

ii. Flat Oil Paint :-

These are non reflective and smooth finish.

Procedure for painting will involve.

- Surface Preparation :-

Dry the surface and clean the dust by sand paper.

- Application of putty and primer :-

Fill all pores by putty and make the surface level. Fill all cracks.

Primer will be applied for better adhesion.

- Application of paint :-

Generally 2 coats are applied with brush or roller. Desired finish and colour may require 3<sup>rd</sup> coat.

Note : Measurement shall be based on actual painted area.

**C. PRECAUTIONS DURING PAINTING WORK :-**

1. Flaking off paint :-

Surface should be dry and clean. Putty should be properly covered.

2. Blistering or Swelling of Paint :-

If air, moisture or solvent is trapped between the surface and paint film, swelling takes place.

3. Spoiling of Paint at some location :-

This can happen at plaster surfaces which have developed cracks due to drying, shrinkage etc.

This can also be due to leaching of calcium hydroxide releasing salts at surface. To avoid this, it is advisable to seal all cracks with crack filler prior to starting painting.

## **6. REGULAR MAINTENANCE**

Every Building / Structure must have specific maintenance program with proper rules for alteration and renovation.

The following steps would help in proper maintenance of the structure.

- Attend to seepage / leakage problems immediately i.e. proper filling the flooring joints, skirting joints, window sill joints and internal leakage problems etc.
- Plant growth, visible cracks must be investigated and attended to.
- Additions / alterations must be carried out under proper technical guidance.
- Renovations must be carried out under proper technical supervision. (Especially Windows toilets).
- Carry out periodic checks / sealing around plumbing / drainage lines.
- It is suggested to avoid frequent washing of staircase landing areas.
- Plants should not be kept in balconies or they may be kept in trays to collect the water, which should be cleaned regularly.
- Heavy grills / kaddapa with brackets should not be used, as they overload the balcony, resulting in heavy deterioration of balcony.
- **Since the building is more than 30 yrs, we recommend no structural changes to be done inside the flats that will weaken the whole structure. Utter most precaution should be taken to avoid damages to structure during flats repairing / renovation etc.**

**Conclusion:-** Looking at the extent of deterioration and quality of concrete (as per the NDT report ),  
The building is Categorized as C2-B, No evacuation but need minor structural repairs.  
The building require the following repair work under its regular civil and structural maintenance work.

- 1) Slab ceiling, Columns, Beams & Lintels processing corrosion crack, concrete deterioration & reinforcement exposure internally must be treated immediately with polymer modified mortar upto 25mm. Microconcreting of M25 grade should be done above 25mm with application of 2 coats of anticorrosive epoxy coating on steel to avoid structural failure.
- 2) Terrace:-Flooring need urgent repairs.
- 3) The Repair/Restoration work should be done under the supervision of Registered/Empanelled structural engineer of MCGM.

All observation are made on visual survey. No suppression or extrapolations has been adopted. Foundation assessment of any manner has not been done. This report relate to the findings of our team on the date of survey. The process of deterioration will continue and the level of distress will go on increasing with time.

This report stands valid provided no major structural changes or major alterations / addition like tampering of walls, removing of walls, chiseling of concrete, puncture beams, slabs, columns etc. or major loading changes etcare carried out. This report should be considered as a status survey / audit report and shall not be considered as habitation guarantee. Also, we should not be held responsible if immediate structural repairs are not done.

Our responsibility is limited to the technical advice given in this report. The legal. Procedural and operational matters which include instructions for implementation, supervision and execution of work on site will be the responsibility of society and parties using this report.

**Yours faithfully,  
For. ARVIND SINGH CONSULTANTS.**

**Proprietor  
Arvind U.Singh  
B. E. (Civil), MIE, Chartered engineer  
BMC Registered Structural Engineer License No: STR/229/S**