

# Structural Audit

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**Abstract:** In a framed structure building, frame which is the heart of building. This frame is design by structural engineer taking in to consideration of factors and various codes which necessary. Different techniques used to assess of frames of old structure. Visual inspection non destructive test are used to access frame of structure is made.

**Keywords:** Framed Structure, Load bearing Structure, Structural Audit, NDT Test.

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## I. Introduction

Before going in detail about the structural audit it is necessary to know about the structure. A structure is a system of inter connected elements to carry loads safely to underground earth.

If we consider an example of "table". The structural engineer will call legs of table as columns, the battens as beams and the ply sheet as slab. When series of tables are joined vertically and horizontally you get a building structure. As the material changes to concrete and steel instead of timber as heavier loads are to be sustained.

The health examination of concrete building called as "Structural audit" or structural audit is an overall health and performance checkup of building like a doctor examines a patient.

Structural Audit is an important tool for knowing the real status of the old buildings. The Audit should highlight & investigate all the risk areas, critical areas and whether the bldg. needs immediate attention. It should also cover the structural analysis of the existing frame and pinpoint the weak structural areas for static, wind & earthquake loads. If the bldg. has changed the user, from residential to commercial or industrial, this should bring out the impact of such a change.

## II. Present Study

Now a day in different locations in India building collapses are occurs. Very few months ago in Mumbai in India near Dockyards 5 storey building was collapse. More than 50 peoples were died and about 30 peoples are injured. Also one of in Mumbra at Mumbai three years old building was collapse.

After building collapse incident at Taljai Pathar, Municipal Corporation has decided to carry out structural audit of all buildings erected at Taljai Pathar.

As municipal corporation survey, there are around 200 dangerous buildings at this location which structural audit is necessary. Now municipal corporations are make compulsory for 30 years old building for structural audit.

Structural Audit is necessary to improve structural health by maintenance recommended in structural audit.

## III. Purpose of Structural Audit

- To know the health of building.
- To project the expected future life.
- To save human life.

- To proactively assist the residents and the society to understand the seriousness of the problems and the urgency required to attend the same.
- To comply with Municipal requirements.

#### IV. Methodology

Structure audit performed by the different methods or the test recommended by structural consultant.

Generally for structural audit following methodology is adopted.

##### *1. Assessment of structure is done by the visual inspection.*

During visual inspection all component parts of structure are visually inspected like is there any wall cracks, length and width of cracks, condition of column, condition of beam, condition of toilets, condition of flooring tiles, condition of internal and external plaster etc. Visual inspection form is prepared and giving the rating as per the importance of damages. After interpreting the result which gives the structural condition, following points related to structure are detailed visually inspected as:

- Any settlements in the foundations.
- Visual cracks in columns, beams and slabs.
- Concrete disintegration and exposed steel reinforcements – photographs can be helpful.
- Slight tapping with hammer can reveal deterioration in concrete.
- Extent of corrosion in reinforcement.
- Status of Balconies – sagging, deflection, cracks?
- Status of Architectural features viz. chhajjas, fins, canopies etc.
- Cracks in walls indicating swelling in R.C.C. members or distress or deflection or corrosion.
- Leakages from terrace & Toilet blocks.
- Leakages & dampness in walls resulting into cracks and corrosion.
- Changes carried out affecting structure.
  - Toilet blocks - Added or changes made?
  - Change of user – from Residential to Commercial to industrial?
  - Change of Partition Walls?
- Status of lift and lift machine room – Type of Maintenance Contract, renewal of license.
- Status of electrical wiring from meter room to all the flats. Substation status. Any explosion in the meter room, substation?
- Status of overhead & underground water tanks - capacity. Leakages, cracks & frequency of cleaning, status of pumps.
- Plinth protection in the compound including status of drainage, water pipes & pumps. How much the Ground was flooded during recent monsoons?
- External paint – When last painted and type of paint.
- Status of repairs & last repaired.
  - What was repaired?
  - Who was the Agency?
  - How much was spent for repairs?
- Bldg. plans available? When approved?
  - Occupation Certificate available?
  - Structural Plans available?
  - Structural Stability Certificate available?
  - Structural Calculations available?
- Last Structural Audit prepared?

*2. Another methodology is by conducting the non destructive test on various components of the structure as column, beams, slabs and wall. Comparing the results with the standard results which give the condition of structure.*

### V. Visual inspection method

By visual inspection survey findings the Health Rating Index of structure by following rating forms. For this study make visual inspection for old existing frame structure and mark ratings as per condition. At the same time taking the photographs of structure as given in figure1 to figure4.



**Fig.1**  
Crack on beam



**Fig.2**  
Wall Crack



**Fig.3**  
Column Crack



**Fig.4**  
Plaster Crack

Visual inspection rating form with ratings given in following TABLE I.

**TABLE I**

S.No	Description	VB	B	F	G	VG
<b>A</b>	<b><u>External building faces &amp; stilts:</u></b>					
1	Columns & Beams Cracks,Bulging,Corrosion in RCC				8	
2	Walls & Plaster (especially west & south) Cracks, Hollowness, Dampness, Vegetation				8	
3	Chajjas, porch, Balconies Cracks, Bulging, corrosion in RCC		4			
4	Drainage & Rainwater pipes Leaking, Broken			6		
5	Water supply pipes Corrosion, Low pressure			6		

6	Paint Weathering, Fading, Absence			6		
<b>B</b>	<b><u>Staircase, Lobby &amp; Passage:</u></b>					
7	Column, beams, Slabs, Parapets Cracks, Hollowness, Dampness, Vegetation				8	
8	Walls & Plaster Cracks, Hollowness, Dampness, Vegetation				8	
9	Jali, Cracks, broken	2				
10	Flooring Loose, Cracks				8	
11	Paint Weathering, Fading, Absence			6		
<b>C</b>	<b><u>Terrace:</u></b>					
12	Terrace Slab Seepage into flats below		4			
13	Waterproofing Cracks, Roughness, absence	2				
14	Staircase Cabin, Lift Room Cracks, Bulging, corrosion in RCC			6		
15	RCC Water Tank Cracks, Bulging, corrosion in RCC			6		
16	Parapet Wall & Plaster Cracks, Hollowness, Dampness, Vegetation	2				
17	Loading Overloading		4			
<b>D</b>	<b><u>Flats:</u></b> (especially ground floor & top floor)					
18	Columns, Beams Cracks, Bulging, corrosion in RCC				8	
19	Slabs, Lofts Cracks, Bulging, corrosion in RCC				8	
20	Walls & Plaster Cracks, Hollowness, Dampness, Seepage			6		
21	Toilets & kitchen Seepage from above		4			
<b>E</b>	<b><u>Other:</u></b>					
22	Termites (white ants)					10
23	Rodents (rats)					10
24	Water logging during monsoon	2				
25	Choking of drainage	2				
26	Cracks in compound wall				8	
27	Cracks in paving				8	
28	Seepage, Cracks from underground tank					10
29	Cracks dampness in pump room				8	

A R.C.C. Framed structure as visually inspected and giving the ratings as Very Bad- 2, Bad – 4, Fair – 6, Good – 8, Very Good – 10. Inspected building giving ratings in between 2 to 10 as mentioned above. Add the scores and divide it by 29 to get Health Rating Index (HRI).

## **VI. Result**

As per above rapid survey or by visual inspections HRI becomes 6.2068, i.e. fair. That means over all structural condition of existing building under inspection is fair. The said G+4 structure is about 23 years old. The plaster of beam and slab spall out above 3<sup>rd</sup> floor. Ground floor to first floor building is in good condition. General maintenance required above 3<sup>rd</sup> floor. Our structural opinion says that the whole structure is safe for occupants but he has to do the general routine maintenance.

## **VII. Limitation of Present study**

Present study about structural audit is done on the basis of visual inspection method. This is the initial step to carry out the structural audit. By visual inspection only visual damages or defects in components of building should be observed. For detection of technical damage or defect for a particular component of building at particular place non destructive tests are necessary. By this test results and comparing with standard results, get the condition of structural components. It is very useful to decide repair and maintainance method.

## **VIII. Future Scope**

By visual inspection HRI of structure is finding. This is the initial stage of structural audit of buildings. To get more specific reasons for damages and defects, Non Destructive Tests (NDT) is necessary. By these test results the strength of different components of existing old buildings can be work out.

## **IX. Conclusion**

- ❖ For any load bearing or framed structure structural audit is necessary. From structural audit overall inspection of structure carried out and it beneficial to decide remedial measures to any type of structural defects and damages.
- ❖ For every structure once in five years structural audit is necessary.
- ❖ If building older than 15 years, once in a 3 years structural audit should be done. However it is advisable to carry out structural auditing every 3 years regularly as many harmful modifications self inflicted damages get also checked during auditing.
- ❖ Government also make compulsory for structural audit for buildings which are more than 30 years old in Maharashtra.

## **References**

- [1] Building and construction authority guidelines.
- [2] Cpwd - Handbook on Repair and Rehabilitation of R.C.C. Structures.
- [3] Structural audit of existing buildings by I.H.Shah.
- [4] News papers dated sept.13 TOI, Lokmat.
- [5] Sakal times.com
- [6] www.technoesis.com