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Can structural audit alone stop collapses of buildings?

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Can we stop collapses of occupied buildings just by making 'Structural audit' compulsory? What is 'Structural audit'? How does a building behave? Buildings are of different types-of different age and having different levels of deterioration. Is there any test to tell us when a building will collapse! We would like a new building to give service for say 80 to 100 years or so depending upon life for which it is designed. During this period it will see minimum three generations. Planning has to be such that it takes care of changing needs of the occupants over the years. There are many issues - not one.

Many RCC buildings built during the last 20 to 30 years in Mumbai are in severe structural distress. They have severe leakage problems. They require immediate restoration/upgrading.

It is informed that presently 500 crores are spent annually for restoration of buildings in Mumbai alone. It is estimated that this will shoot up to 5000 crores or so in next 10 years. Same is the situation all over the world. There are many reasons for early deterioration. But the main reason is buildings are not built to durability parameters. Many professionals talk of quality construction. Though they mean durable

construction but constructions are limited to satisfying few laboratory tests like strength, slump, etc, and testing of materials. Infrastructure projects have specifications in which many durability parameters are specified and further supervision is good. But all the ills are in Building Industry.

The buyer of a flat/room/gala have no control on construction. He has to choose from ready buildings.

Further what should be our policy for following issues?

1. Loft tanks
2. Pasting of ceramic tiles over existing tiles during renovation.
3. How do we control wastage of water by individual units?
4. And many other issues.

Above points and many other issues connected with buildings need detailed study- then formulation of comprehensive policy and finally most important- an

Agency/ Institution to implement them. This requires strong will power and awareness drive in a big way.

Introduction

In this article I have expressed my concern in brief on few issues. These need elaboration/additions to each point and a dialogue to explain my point of view.

One wing of Lakshmi Chhaya building at Borivali, Mumbai, came down crashing like a pack of cards on the evening of Wednesday 18th July 2007 killing many innocent lives. What was there fault? They lost their precious lives perhaps, for somebody's mistake or may be due to in different attitude of few members to attend to this sick building (having leakage and distress to RCC frame members- columns, beams and slabs-which are actually the back-bone of the building) at right time or may be due to indiscriminate renovations.

The newspapers have reported as follows:

1. The warning signs for Lakshmi Chhaya were visible six years ago. Only no one was in a mood to acknowledge them then. The two wings of the building were taken up for major repairs in 2001. The work included repairing the damaged columns, beams and slabs. Floors one to six were attended to but most of the ground floor was left untouched after commercial establishments resisted the move. It was then that the building's structural engineer shot off a letter -"Unless they cooperate, the consequences could be grave and could lead to structural mishaps.
2. It was only when the jeweller brought down a wall four days ago to expand his store that a very badly damaged beam was exposed.
3. One shop owner said when his tenant returned shop no. 5 to him on July 15 he found four columns were in precarious condition.
4. A day before the collapse, the committee members and other residents had visited one owners shop. They found rods sticking out and portions of the pillars which had been cut down.
5. Two extra floors have been built.
6. Over-head water tank is too heavy.

This brought to focus many suggestions from Government /MCGM/Experts.

Similarly, many buildings have collapsed in the past killing many precious/innocent lives. We have the

reports giving reasons/precautions to be taken. Let us learn from these failures and reports.

There are incidents where innocent people are killed due to collapse of just a compound wall and during excavating a pit when earth caved in and so on.

With this Prelude and Introduction let us discuss the points raised.

In this article problems with existing RCC buildings and problems with new RCC buildings are discussed. Problems of very old cessed buildings are different and not discussed as author is not associated with them.

What Is the root cause of failures?

Experts say that buildings behave- just like human beings lying in coma but still surviving due to a strong will power- even though they have severe distress to RCC frame members and leakages all over. This leads to indifferent/casual/careless attitude to problems with buildings by society members. This is the problem.

There are umpteen examples where RCC members/ structures are misused- used for which they are not designed and are deteriorated severely but still surviving. They give way without any warning when the inertia/equilibrium is disturbed by one or the other reason resulting in mishaps taking innocent lives.

This educates us to attend to all problems (leakages from all sources and distress to all RCC members) immediately as soon as observed/noticed without delaying the matter. Again the renovations have to be taken without touching/ tampering to RCC members. Both as per advice and supervision of a competent civil engineer.

Following are the causes listed serially which deteriorate the buildings and later become the reason for collapses.

1. First major cause is leakage/seepage and dampness in buildings.
2. Second cause is misuse/wrong use of the building/RCC member for which it is not designed.
3. Third cause is our in different attitude to house-keeping and regular maintenance.
4. Fourth, major cause is indiscriminate Renovations.

Following are few suggestions for consideration of all concerned.

For new constructions

My suggestions are covered in my articles-on durability of buildings in various magazines published over the years and in special issue edited by self that of Abhiyanta Vishwa of April 2007. All points with photos/figures are compiled in one place in my book on durability.

The buildings are not planned, designed and built so that there is no leakage.

But question is how are we going to construct all these new structures?

There is hardly a building / bungalow / tower in which there is no leakage / seepage / dampness. Builders take pride in giving granite in entrance hall and this facility and that amenity in the campus and many free gifts and so on. It will be a golden day when they will boast and take pride saying that there is no leakage, seepage and dampness in their buildings anywhere and that service pipes are easily accessible for regular inspection and maintenance for the entire life of the building.

Is this difficult?

Only change of attitude is necessary. The problem of leakage - seepage - dampness - waterproofing exists/persists due to our mind set/attitude of looking at this problem. Let it be a big company or a big builder who have fleet of highly qualified technical staff or a medium level builder and even a small builder - when it comes to waterproofing - All sub-let the work (terrace waterproofing and waterproofing of basement) to an agency-so to say expert in waterproofing - ask for ten years guarantee and lowest quotation. This is the problem. Mr. M.D. Tambekar a very senior- renowned civil Engineer - conducted a survey on guarantees and presented a paper in a seminar. His conclusion was that not a single society in Mumbai is benefited due to guarantees. It is necessary to understand the methodology and specifications and the main agency must carry out the work of waterproofing themselves or get it done through their own sub-contractor instead of subletting it to an agency-considered expert in waterproofing.

There are innumerable sources of leakage in a building. These are not discussed here.

We read in papers that state health centre opened on 7th April 06 had, leakage all over immediately in first

monsoon. It is reported that leakage in health centre was experienced during 2007 monsoon also. The Newspaper 'Mumbai Mirror' dated May 4, 2007 published that new Thane swimming pools were closed immediately after inauguration due to leakage.

Even the Rashtrapati Bhavan has not escaped this problem. Mumbai Mayor bungalow had leakage all over. Practically everybody has this problem.

Many experts from all over the world have defined a durable building - structure as ability of a building/structure to withstand the deterioration, which is caused under the influence of environment throughout its desired life, without the need for undue maintenance.

My simple and straight forward definition of durable building is one - in which there is no leakage-seepage-dampness and that its ducts-where plumbing lines are housed are accessible easily for life time of the building for inspection, regular maintenance and repairs.

Is it difficult to build houses without Leakage- Seepage and dampness? Not at all. Minimum that a user wants is to have his flat/ apartment/ gala without Leakage - Seepage and Dampness. This needs proper planning, monitoring and implementation at every step. The steps are:

- at Architectural planning stage (Architect)
- at design of building stage (Design Engineer)
- at construction stage (Contractor)

How can we achieve this?

Following are few suggestions for consideration of concerned.

Every construction should have a durability consultant to co-ordinate with architect, design civil engineer, contractor and other specialized agencies, like plumbing, electrical and the owner and finally guide the owner on durability Aspects. The author has worked as a durability consultant on one building project named Gitanjali with excellent results.

Durability parameters need to be included in tender document itself. This ensures proper implementation.

Financial Institutions should not approve loan to a new project unless durability parameters are included in project report.

From decades codes are available for design of buildings to cater to forces generated by earthquake. BIS code is mandatory. Even then Government of Maharashtra

thought to bring in a legislation that every building should be designed for earthquake forces. Now Chief Minister of Maharashtra has declared State Housing Policy. Let us all especially those affected with the nuisance of leakage write to him in big numbers and bring this problem to his notice. Further let us request him to include a clause in the state housing policy making it obligatory/ compulsory on the part of the builders to build buildings durable i.e. buildings without any leakage - seepage and dampness as done for earthquake forces.

Durability is the need of the hour. If we continue to build buildings which are not durable and which require heavy repairs in short span of life, let us understand that society is not going to excuse - we technical community hereafter. Let us rise to construct durable buildings. Author was working for last five years to compile on durability parameters after going through all engineering journals, books, interaction with experts and has come out with a book "A handy guide to construct RCC buildings (structures) durable & eco-friendly", in association with ACC.

Construction industry has welcomed the book. Experts have said that this book should be prescribed as textbook for final year students of civil engineering and architecture, who are our future builders. Durability should be a subject for final year students of civil engineering and architecture.

It is high time something is done to in-built durability into every new construction.

Should there be a separate institution to monitor Durability Parameters for every Project?

Should there be a legislation to specify durability parameters in every project?

In any case something has to be done urgently on war footing, as we cannot afford- constructions which are not durable - requiring heavy funds for repairs during the lifetime of the buildings.

Every construction must be planned designed and built with life cycle cost concept with sustainable development in mind with total holistic approach and with full safety measures.

This is a very important aspect for flat owners and it is for all in construction / government to ensure durability into new construction of buildings .

Let us make it clear to all in construction of buildings that flat owners are not going to excuse them anymore if they give leaking houses.

For restoration/ upgrading a building

Water corrodes the reinforcement in the RCC frame members deteriorating the same and reducing life. This necessitates early restoration. There are innumerable examples where restoration is not taken up at all. Many a times this is delayed. Even if this is taken up, this is not done as per latest scientific methods. Tips for restoration/upgrading a building are given in my articles published in various magazines over the years and compiled in one place in my book on repairs.

After the collapse of 'Pushpanjali' building in Khar, Mumbai, all corporaters in Mumbai demanded to set up independent 'Repair Board' for repairs of buildings in the suburbs as suggested by the Afzulpurkar committee. It is felt that the idea of setting up an independent 'Repair Board' is good. This board can take up various aspects connected with astronomically increasing repair work. Few are discussed in brief below.

(a) Structural audit

What is structural audit? This is nothing but regular health check up. This is done by The visual inspection and hammer sounding (a small hammer to find out hollow plaster and hollow concrete- and not Schmidt Hammer used for non destructive testing.) In fact this is nothing but Inspection Report on the condition of the building. Non Destructive Testing/Destructive testing check up in addition to the visual inspection is required in exceptional cases where deterioration is severe.

Structural audit report (inspection report) should contain following details.

1. Detailed covering letter with advice on each and every problem observed.
2. Detailed flat-wise report of all flats.
3. Detailed methodologies with specifications/ sketches for all problems
4. Few photographs highlighting problems
5. Detailed measurement sheets of quantities worked out
6. Estimate at prevailing market prices in detailed Bill of Quantities

Special attention should be given to following points during Investigation of RCC buildings:

- We need to look for all the sources of leakage/ seepage/dampness.

- It is necessary to measure the quantities of structural distress as accurately as possible both in common areas and inside all flats.
- Check if the external walls are in brick/RCC or in concrete blocks either solid or hollow.
- Check how many layers of brickbat coba are provided on the terrace top.

(b) How to choose a repair consultant

MCGM has proposed that structural audit be carried out by structural engineers registered with MCGM. Let me first make it clear with due respect to my professional friends that a structural engineer is a civil engineer first. He is competent in design of buildings. Generally there is no design in health check up of buildings. Hence a competent civil engineer with good knowledge of repairs is what one should be looking for. Repair is a very specialised branch of civil engineering and only a few have mastered this subject. In case of complications we consult a surgeon. Similarly one has to consult a structural engineer if one has to do any structural changes. Government/MCGM must make a note of this as they want every building in the state audited. DNA, Mumbai, Friday, September 21, 2007 reported as follows.

‘Ground Reality : Senior Civic officials felt that getting structural audit of all 15-year old buildings in the city was unrealistic. There are 5 lakh RCC buildings in the city while only 700 structural engineers/architects are registered with the BMC.’

Again, structural audit has to be done by civil engineers alone and not by architects which fact is already accepted by all concerned as this service is not of their expertise. Thus the number of engineers registered with MCGM will be much less than 700 once the architects registered with MCGM are omitted from this list. Further many structural engineers are not interested in carrying out this service as they are heavily loaded with new works and due to other reasons not elaborated here. Hence it is absolutely necessary for MCGM to register civil engineers who are competent in repairs for carrying out structural audit of RCC buildings spread across the state. Further civil engineers are in short supply, which fact we have to keep in mind.

(c) MCGM/repair board permission

If at all permission is necessary, then it should be made simple and made available from a single window

immediately. It will be extremely unfortunate if a building collapses as the society was awaiting permission from relevant authorities to start restoration. In fact if societies are going in for upgrading their buildings, they should be given incentives for obvious reasons discussed below.

Renovation

Societies must ensure that none of the RCC frame members-columns, beams, slabs are touched/tampered. Renovations must be done with permission/supervision of a civil engineer.

Incentives for motivating societies to take up restoration work by latest scientific methodologies

When a occupied building collapses there is tremendous strain on the government/fire brigade/police and such other organisations and heavy expenses. It is the experience of all in restoration field that in majority of cases society members do not co-operate and do not contribute to repair fund. This results in buildings not taken up for restoration in time and they deteriorate further. Hence there has to be a permanent arrangement so that the work of house-keeping-regular maintenance and restoration/upgrading does not suffer for want of funds. Society should have sufficient funds in fixed deposits to earn sufficient interest considering escalation over the years and or other source or sources of permanent income.

Again societies should be given incentives so that they take up restoration/upgrading work regularly without delay.

Awareness drive

When we fall sick we go to a doctor and take treatment. We are not required to take any body's permission. In fact same should be the system in case of buildings. Societies should be free to choose competent consultant of their choice and start restoration/upgrading without permission. In fact incentives should be in-built in the system as discussed above so that restoration/upgrading is taken up regularly in time.

Further MCGM/repair-board should take up awareness drive on lines as Mr. Cyrus M. Dordi, Customer Support Group Head -West and Exports of Gujarat Ambuja Cements Ltd. is doing now from many years. He has a fleet of engineers who go to different societies and make the society members aware of problems with their buildings and advise them to engage a competent repair consultant and proceed with restoration/upgrading work.

Pasting of ceramic tiles over existing tiles during renovation/Changing of tiles

Many members remove the tiles in their individual flats and replace them by marble or other tiling material. In the process the members below their flats experience leakage/dampness, damages to false ceiling (if provided), de-bonding of plaster, and short circuiting of the fans etc., This must be discouraged. as a general rule removal of the tiles should be avoided except for the ground floor flats. Instead individual members should paste ceramic tiles (not marble) over the existing tiles by tile adhesive. This will avoid problems mentioned above and leakage in flat below. Further this is a clean job and requires one day for fixing the tiles and skirting is fixed the next day. Conventional method of removing tiles and re-fixing requires one full week and generates lot of dust and debris against only two days for system suggested.

Few structural engineers expressed concern that here we are increasing the load on the floor. However there are many who opine that a very small increase in load distributed all over should not matter looking to the advantages in the system suggested.

In few exceptional cases where the exiting tiles have de-bonded and/or are in bad condition, pasting over the existing tiles may not be possible. Again pasting tiles over existing tiles in kitchen requires modification to platform shutters. Here we have to go in for conventional method. In such cases utmost care must be taken to ensure that there is no leakage and other problems in flat below, as discussed above.

One has to decide on the method only after inspection of the floor.

In some cases cracks are observed in the slab (ceiling of lower flat) of flat below. Micro cracks could be present even before removal of tiles due to leakage and subsequently due to corrosion of reinforcement bars- but the owner of lower flat feels that these have developed due to excessive / forcible hammering during removal of tiles. This strains the relations between the owners of the top floor flat and the lower floor flat.

Actually in this case slab needs rehabilitation as per method no. 1 before fixing tiles over the same.

It is advisable to take up the work of changing of tiles by taking the owner of the flat below in confidence, whatever way this is done.

Loft tanks

I am convinced that loft tanks should be made compulsory. Many societies take objection on the grounds that those who do not have loft tanks do not get sufficient water. In fact those who do not have loft tanks store more water in drums/buckets and throw it as soon as fresh water comes. Those who have loft tanks do not waste water.

Again in many societies water supply is cut for a day or few days either because the society pumps are under break-down or there is some problem with municipal water supply or under ground water tank along with pumps are under flood water. In such situations water in the loft tank is the only source of water.

Hence loft tanks should be made compulsory and the the slab on which it rests should be designed accordingly.

Wastage of processed water by individual units

We all know how we waste water while brushing/washing/bathing and so on. We pay for every single unit of electricity and hence do not waste it. I am convinced that- whatever may be the difficulties-they must be resolved- and water must be supplied to every unit by meter. This is now recommended by Chitale committee.

Over loading

There is a class of people who stack one full years ration on the loft. I have not come across so far any body who has taken up this issue. Such over loadings- I feel can not be controlled by any legislation. Design engineers have to account for such loadings.

This is a vast and important subject connected with lives of human beings and hence needs detailed discussion- a policy framed and implemented strictly without any delay.



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