ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 2, February 2018

Aspects Study and Discussion on 'Structural Health' with Reference to Pre-Construction and ongoing Construction Stage of a Structure.

[1] Leena Prasad Aphale, [2] Swapna Ashok Dhavale, [3] Prasad Arun Aphale,
[1] Assistant Professor, Dept. of Arch, MIT, Aurangabad ,[2] Assistant Professor, Dept. of Arch, MIT, Aurangabad,
[3] Structural and R.C.C Designer, Aurangabad.

Abstract: **-- Structural health monitoring is a technical process which has been activated or treated at post-construction level by the expertise and structural auditor. A lot of emphases has been given for the post-construction structural health monitoring techniques, but 'Pre-construction' and 'During construction' stage of a structure are also equally important so that minimum requirement of the process and best quality assurance will be achieved to make the project economically sustainable over a long period. While thinking for the above mentioned new aspect of health improvement, majorly three early stages are to be taken into consideration as- Architectural design and planning, structural and RCC design, and construction stage which make a 'golden triangle' where the major role of Architect, Structural engineer and the contractor is defined. This paper is a sincere effort to discuss and application of health improvement and monitoring aspects during pre-construction stage and ongoing construction process with the examples and remedial solutions.**

Index Terms**: Structural Health, Preconstruction, Architectural planning, Structural design.**

I. INTRODUCTION

Today's Building construction in India has a wide scope of discussion as this field has a rich and strong historical background of different monuments from different era. In India, the famous say 'Every person should have the experience to construct his own house' derives complete story of management of constructing a building. A completed building is a resultant of the different phases from start to finish. Right from planning and designing, till the door lock, one should look after the perfection of each phase. Majorly, the stages of maintenance of a building are divided in to 3 types. 1) Planning and design (preconstruction stage) 2) construction (during construction stage), 3) Structural health checkup (completion stage).

The keen quality control and work appreciation of the agencies involved in the above 3 types, that are; Architect and planner, project manager and contractor, and structural designer and auditor; are very important to maintain the structural health of any building for life long. Deterioration of the structure and remedial solutions for the same are not only a part of completed structures but it starts from the planning stage just after selection of site. If we follow the rules and regulations, and standards of material and technologies for ongoing work, that will definitely improve the health and reduce the construction time and expenditure. Nowadays, it's difficult to find a single structure without leakage, shear cracks, settlement of footing, deterioration in concrete, and not list- structural changes for interior designing. This article is an honest attempt to find the permanent solution for such problems. If we adopt or design few guidelines to make the structure sustainable, durable and sturdy for life long, that will be the Golden Triangle for any structure which will reduce cost, time and increase the quality of living standards and ease of the habitat.

II. OLD STRUCTURES AND CONSTRUCTION

Though today's technology was not available in the old eras, but, by following good construction practices, and quality control, people could achieve stable and sound structures. The practice was strictly gone with the précised steps, like planning and designing, site analysis, vernacular material study, model making at small scale, actual construction and lastly, finishing of the project. Each and every consultant and agency were equally involved in the project, and the only project had been targeted by them instead of handling multi project at a time.

All Rights Reserved © 2018 IJERMCE

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 2, February 2018

Stonehenge in England (3000-2000BC), construction might be the oldest example of stability and balance after many eras. This site is now under a hold of UNESCO.

Fig. 1 " Stonehenge"

Source: www. Wikipedia.org

There are many examples of different buildings and monuments which are still in a good condition as per structural health. For example: Pyramids of Egypt (2600BC), St Peter's Basilica of Rome (16th Century), Virupaksha Temple of Hampi, India (7th Century), Red fort (16th Century) Taj mahal of India (17th Century) are the signature examples of the world.

Fig. 2 " Virupaksha Temple"

Source: www.karnataka.com

Today's Scenario of building industry

Building construction industry is highly fragmented with different technologies. Though it is workers oriented and dependent, nowadays, mechanism has been adopted by the developers for big projects in metropolitan cities to minimize manual errors. But while adopting mechanism, there are some lacunas created like non availability of skilled labours that can operate the mechanism correctly.

Planning and Designing usually are done by the consultants. Many other consultants like, landscape architect, electrical designer, green building consultant are also contributing lead role with architects and structural engineer while preparing drawings of the buildings. Construction of the building is coordinated by the general contractor who can work on a specific type only, e.g. residential or commercial etc. Crucial part of quality control of raw material and building services are also done by the same contractor without any intimation to the main consultant. Thus major communication gap is formed.

Fig. 3 "Structural collapse"

Source: www.downtoearth.org.in

Fig. 4 "Neglected Building Services"

Source: sourceable.net

Common and NEGLECTED part IN the building construction

The team of consultants, contractors and auditors has to maintain the quality of the building in complete process. They try to do it, no doubt, but anonymously some lacunas remained in the structure after completion. These loopholes become more risky with the time passes. Following are some loopholes found in the general practice of construction.

All Rights Reserved © 2018 IJERMCE

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 2, February 2018

The substructure is a most neglected part of the building. Footings, columns up to ground level, plinth beams remain unplastered causing easy entry for water, chlorides, fluorides etc.

It is a common practice to pour the concrete from a height more than 1m, especially in case of column concreting which causes segregation of concrete. Also for easy workmanship, labour increases w/c ratio which reduces its strength and increases bleeding problems.

Columns casted (Generally 2.4m in height at a time) are difficult to compact and vibrate.

Unequal or improper covering is a major cause to reduce the life span of the building.

Casual approach towards proof checking of the design

Enclosure of cantilever balconies, terrace without intimation to the designer is a major cause of deflections.

Core cutting of beams to pass the conduits without design considerations is a cause for the cracking of beams.

Improper Plumbing lines attached to building surfaces cause seepage in the building.

Fig. 5 "Slab leakage"

Source: www.connectedrestoration.com

No waterproofing or improper water proofing causes the easy access to the environmental attacks to the terraces.

Improper rain water drains, plinth protection causes water entry. Growing shrubs on the terraces reduce the structure's life drastically.

Fig. 6 "Growing shrubs and debris" Source: author

Open column reinforcement on the terrace is an easy access for the water.

Fig. 7 "Open reinforcement" Source: author

13) Small building components: Chajja, Boxes, Pergola, screen walls, pardi (ferrocement wall), sunk, cantilever beams, balcony are also having main role for cracks in the structure because of no attention is given at the time of construction.

V. HELPFUL HINTS TO OVERCOME THE PROBLEMS AND IMPROVEMENT OF STRUCTURAL HEALTH

A. Pre-construction stage

1) Planning should be done with minimum dead spaces and negative spaces for the sake of building maintenance.

2) Plumbing layout should be pre planned and predefined. Service ducts should be designed as per architectural norms.

3) After excavation, substructure should be treated with anti-termite treatment.

4) In the structural design, it is a common practice to assume SBC of soil by visual inspection, but this may create errors in the foundation design. So it is recommended to test SBC of soil in laboratories.

5) Architects must apply the rules and geographical conditions. The regional climatic conditions are also responsible for deterioration of the quality of structure. This can be achieved by preparing detail questioner as data collection before starting the designing.

6) The developer/ owner should stick up with the purpose or usage of building and consider future horizontal and vertical expansion at planning stage.

All Rights Reserved © 2018 IJERMCE

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 2, February 2018

7) Local material instead of other regions materials are to be used in the construction as they are more compatible with the climate and regional conditions. This can help to improve the life of a structure with less maintenance.
8) Many times it is observed that, consultants or owner of the structure don't give the importance to commonly used "Coba waterproofing" for the structure as early as it is completed. The team try to postponed the process and apply it after several years when leakage starts. It is author's recommendation that, as soon as the work is completed, we should also complete the damp proofing of plinth level as well as water proofing of terrace or open slab.

Fig. 8 "Brick bat coba"
Source: civilatwork.blogspot.in

B. Ongoing construction stage.

1) Footings, columns up to ground level and plinth beams are not available for inspection and remedial measures after their construction. So these building components shall be treated with protective coatings and special attention shall be given towards quality measures.
2) Provide sufficient and IS code recommended coverings to the reinforcement as exposed reinforcement gets rusted earlier causing reduced life of the structure.
3) RCC and brickwork joints shall be airtight and watertight. We can use holdfasts at the time of brick wall construction and polypropylene mesh at the joints while plastering.
4) In general practice, after casting any member in rcc, curing is done on the next day. In between heat emission takes place and surface cracks may takes place in the concrete. To minimize these cracks, the concrete should be kept in wet or moist condition, without flooding of water. This technique will reduce the surface cracks.

Fig. 8 "Curing compound"
Source: www.cegyan.com

5) Curing must be done without any shortcut. Many of the sites due to shortage of water remain uncured. If we start the curing process immediately after 30min. or setting time of the concrete, the strength gets increased and the resultant of it is durable structure for a longer span. For horizontal component, we can use curing compound method in which water can be flooded in to the short compartments, and for the angular or domical surface, we can adopt wet gunny-bags for curing. Provided, gunny bags should keep wet for all the time.

V. CONCLUSION

Collaborative efforts taken by the consultants, contractors and structural designers, auditors for creating best health structures, are today's essential part of the industry. Durability generates from conceptual level to completion and has to maintain from excavation to top slab coba. Even, training and Durability workshops are to be taken up frequently, especially for repeatedly constructed buildings, e.g. residential, commercial, etc. If the building is constructed with the materials having same life, the structure may achieve strength and long life. Thus, we contribute a holistic approach towards nation and world.

REFERENCES

1. Jayakumar Jivraj Shah, "Good construction practices to construct durable building (stuctures) part 2," ISSE quarterly journal, vol. 19-4, pp. 13-15, Oct-Nov-Dec 2017.
2. Jayakumar Jivraj Shah, "Good construction practices to construct durable building (stuctures) part 1," ISSE quarterly journal, vol. 19-3, pp. 8-15, July-Aug-Sept 2017.

All Rights Reserved © 2018 IJERMCE

3. sourceable.net/high-rise-fires-rethinking-exit-strategies
4. www.do0077ntoearth.org.in
5. sourceable.net
6. www.cegyan.com
7. civilatwork.blogspot.in
8. www.connectedrestoration.com

All Rights Reserved © 2018 IJERMCE