

A Study on Barriers in the Existing 200 Years Old Institutional Building at Adayar, Chennai & Proposing Suitable Repair & Rehabilitation Technique for Rectification

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ABSTRACT: The quantification of the various impacts of an old institutional building can help to identify processes of loss of life cycle span of the building. Therefore Life Cycle Assessment (LCA) is considered the most adequate method for evaluating the environmental pressure caused by materials, building assemblies and the whole life-cycle of a building. This paper aims to suggest a repair & rehabilitation technique for the old institutional building to overcome the identified barriers.

KEY WORDS: Distresses, Repair, Structural strengthening, Construction chemical products

I. INTRODUCTION

1.1 GENERAL

The World Commission on Environment and Development at their final meeting stated that -We remain convinced that it is possible to build a future that is prosperous, just, and secure. Construction is not an environmentally friendly process by nature. The cumulative environment impacts of construction processes have been increasing in the world due to large number of ongoing construction projects [1]. The operational energy and embodied energy are important factor in life cycle of the building. They fail to concentrate on rehabilitation and eventually demolition through the production of materials. LCA (Life cycle assessment) provides better estimation of energy[2]. LCA helps to provide better tool for whole life span of the construction project. Others are ozone depletion, water consumption, toxicity, eutrophication of lakes and rivers, and resource depletion, and the aim of this paper is to review Life Cycle Assessment (LCA) as a means of evaluating the environmental impact of the old institutional building and suggesting the suitable renovation technique for the old institutional building.

1.2 LIFE CYCLE ASSESEMENT OF BUILDING

There are many methods available for assessing the environmental impacts of materials and components within the building sector[3]. While adequate to an extent for a particular purpose, they have disadvantages. LCA is a methodology for evaluating the environmental loads of processes and products during their whole life-cycle. The assessment includes the entire life-cycle of a product, process, or system encompassing the extraction and processing of raw materials; manufacturing, transportation and distribution; use, reuse, maintenance, recycling and final disposal. LCA has become a widely used methodology, because of its integrated way of treating the framework, impact assessment and data quality. LCA methodology is based on ISO 14040 and consists of four distinct analytical steps: defining the goal and scope, creating the life-cycle inventory, assessing the impact and finally interpreting the results. Employed to its full, LCA examines environmental inputs and outputs related to a product or service life-cycle from cradle to grave, i.e., from raw material extraction, through manufacture, usage phase, reprocessing where needed, to final disposal. LCA is often employed as an analytical decision support tool.

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1.3 OBJECTIVE

The overall objective of the study is to calculate the energy consumption in the institutional building and suggesting the measures to repair and rehabilitation of the institutional building[4]. The specific objectives of the study are as follows, to identify the environmental impact of the building, to identify the factors affecting due to construction materials and components, to identify the factors affecting the energy conservation building and green building materials.

1.4 SCOPE

The primary scope of the project is to implement the life cycle energy concepts in institutional building and to renovation and maintenance of the building[5]. The scope of the project is given below as:

- Analyze the factors affecting the building due to environmental impacts.
- Reuse and Recycle the materials and components during maintenance of the building.
- Suggest the suitable renovation technique for effective life cycle span of the construction project.

II. THE LIFE CYCLE ASSEMENT APPROACH

2.1) Embodied Energy : Definition And Interpretation

Buildings are constructed with a variety of building materials, each of which consumes energy throughout its stages of manufacture, use, deconstruction and disposal. Similarly, each building consumes energy during its life cycle in stages Post construction phases, such as renovation and refurbishment, and final demolition and disposal also consume energy. The energy consumed in these life cycle stages of a building is collectively interpreted as embodied energy.

2.2) Significance of Embodied Energy:

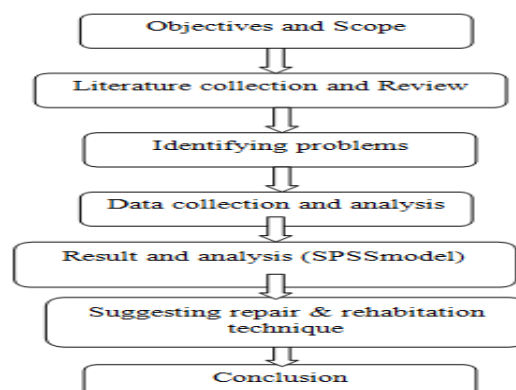
The emphasis of energy conservation research was on the operational energy of a building; while embodied energy was assumed to be relatively insignificant Operational energy conservation may be accomplished with readily available energy efficient appliances, advanced insulating materials and the equipment of building performance optimization[4]. For example, an increase in the number of Energy home appliances in the India could reduce operational energy. Embodied energy, however, can only be reduced if low energy intensive materials and product share selected at the initial stages of building design.

2.3) Calculation of Embodied Energy

The Embodied energy for the major materials such as Cement, Steel, Lime, Aggregates has been calculated for the entire work in the project[6]. Similarly CO₂ emission is also calculated for the major materials used in the project.

III. WORKING METHODOLOGY

Figure 3.1: Representation OF The Methodology That Is To Be Carried Out In The Project Work.



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IV. SAMPLE DETAILS (DATA COLLECTION):

4.1) IDENTIFYING THE CASE STUDY

After thorough analysis and considering practical hurdles the structure selected for the study in the project is “An old institutional Building located in Greenways Road, Ayer, and Chennai”. Even though the building is located in the centre of the city, it is surrounded by number of green trees. The drawings are obtained from the Public Works Department, Government of Tamil Nadu and thoroughly studied[3]. The building is provided proper with proper drainage and sanitation facilities. The building is also provided with rain water harvesting measures, which will enhance the ground water recharge. The old institutional Building in Greenways Road, Ayer, and Chennai had been constructed over an area of 7 Grounds and 573 sq.ft. The building is constructed as a framed structure and the building is designed by Planning and Design wing of Public Works Department, Government of Tamil Nadu. The details of each floor accommodation of the building based on the obtained drawings from the Public Works Department are furnished in Table 4.1.

S. No.	Name of floor	Build up area in	Accommodation	Height of floor
1	Ground Floor	1369	Meeting hall, Dining hall, Kitchen, Lobby, Office, Store, Warden Room, Hostel Room – 18 Nos.	3.60 m
2	First Floor	1369	Class room, Faculty room 2 Nos, Principal room, Common toilet, Common room, Record	3.60 m
3	Second Floor	1206	Library, Class room, Faculty Room, Guest Faculty room, Recreation hall, Warden room, Hostel Room – 18 Nos,	3.60 m
4	Third	701	Warden room, Hostel Room – 18 Nos, Open terrace.	3.60 m

Table4. 1: Details of the Building

S. No.	Description	Approximate Dimensions	Area (Sq.ft.)
1	110 rooms of double occupancy	(20' x 10')	22000
2	Class rooms – 3 Nos.	(30' x 30')	2700
3	Dining hall with kitchen and store	(50' x 60')	3000
4	Meeting Hall	(50' x 80')	4000
5	Library and Reading Hall	(50' x 50')	2500
6	Computer Hall	(40' x 40')	1600
7	Recreation Hall	(30' x 30')	900
8	Office rooms 3 Nos.	(20' x 15' per room)	900
9	Faculty rooms 3 Nos.	(15' x 15')	675

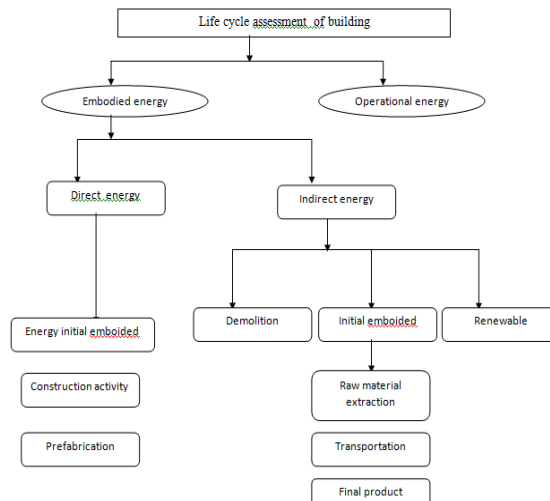
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10	Guest Faculty room	(15' x 15')	225
11	Record Room	(15' x 15')	225
12	Stationery Room	(20' x 20')	400
13	Warden room	(15' x 15')	225
14	Principal room	(20' x 20')	400
15	Reception Hall	(15' x 15')	225
16	Electricity room	(30' x 30')	900
17	Extra toilets (10 Nos.)	(20' x 25')	500
Total			41,375Sq.ft.

V. RESULTS AND DISCUSSIONS



5.1 Distress Observed

Since the building was very old and located in a marine climate, the water leakages and reinforcement corrosion were major issues[5]. There were leakages in the roof and water seepage through the external walls. The walls were made of laterite stone block masonry. The pointings of the stone masonry were disintegrated and water was leaking through these joints. There were spalling of plaster, cracks in the masonry walls and also cracks in the ceilings of the RCC roof. The water seepages and leakages led to growth of fungus and mosses on the walls and the ceilings. The corrosion of reinforcement led to spalling of concrete. There were cracks in the RCC ceilings and columns.



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5.2 Repair of Cracks in Masonry walls

There were some cracks in the masonry walls. At those locations the plastering was chipped off and cutting of V-grooves were made along the length of the crack by chiselling[6]. The cleaning was made by a high pressure water jet. A wire mesh was fixed along the cracks after which the cracks were repaired with medium structural grade repair mortar.



V. CONCLUSIONS

Although, LCA is considered the best method available to assess the environmental performance of a product, its application in construction is very complex. This is because the huge number of different materials, products, actors, processes and also the wide life cycle span of a construction product. Based in the work of questionnaire on different construction companies and with help of (SPSSToolPT), this paper presented some solutions to overcome the difficulties in using an LCA-based approach to suggest some repair & rehabilitation technique for the old institutional building as follows.

6.1) Repair and Strengthening of RCC Columns, Beams and Slabs

The reinforcements in the most of the columns were corroded. There was complete loss of cover concrete in some columns. The following steps were taken:

- Distress and spalled concrete portions were identified and marked for repair and restoration.
- Reinforcements were exposed by chiselling properly with light weight hammer and chisel.
- The exposed reinforcements were properly cleaned by wire brushed and entire concrete and steel surface were washed with potable water.
- Thereafter the reinforcements were applied with a rust remover and rubbed with gunny sacks, wiped properly and washed with high pressure water jet to wash out the traces of any residues.
- Then the same reinforcements were applied with anti-corrosive epoxy zinc primer to prevent further corrosion.
- After that the distressed concrete portions were properly applied with epoxy bonding agent for acting as an impervious layer to restoration patch.
- Finally a cementations high structural grade repair material was applied in mortar consistency to build the thickness of the cover concrete as needed at site condition. The ceiling surface of roof slab and beam can also be repaired in the similar manner.

6.2 Strengthening of Masonry Columns

The masonry columns of the corridor needed to be repaired and strengthened for carrying out additional loads. This was achieved by providing steel jacketing to those masonry columns. The steel jackets were made of 4-ISA

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75x75x6 and braced with tie rod in a zigzag way. The concreting was done with compendious high grade structural repair mortar.

6.3 External Wall Plastering and Protective Coating

All the external wall plasters were loosened and deboned from the masonry surface for which plastering was chipped out and replastering was done. It was finished with cement mortar admixed with polymer modified mortar and finally protected with an elastomeric acrylic coating.

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