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Study on Feasibility of Modern Institutional Green Building

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Abstract: In the rapid development of construction industries are going towards Green building construction. So my concentration and platform I lay down in study of feasibility of modern institutional green building. The innovative techniques has been adapted in plastering by partial using of red mud along with sand (Each 50%) and increase the opening to adapt ventilation and lighting effective. It helps to reduce construction and maintenance cost of the project and also it enrich the usage of natural ventilation and lighting.

Index Terms: sustainable cement mortar, Green building, Horizontal ventilation, concrete technology, Red mud based building mortar, concrete casestudy

Green building (also known as green construction or sustainable building) refers to both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition. This requires close cooperation of the contractor, the architects, the engineers, and the client at all project stages. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability and comfort.

1 INTRODUCTION

Plastering is a process of obtaining smooth surface on the rough surfaces of walls, roofs, columns and ceilings etc. for long lasting purposes and to meet its estimated design life period. Also plastering make the rough surfaces smooth thereby make it good looking and attractive. Also it helps in preventing damp proofing. The coat formed on the rough surface is called plaster when applied inside of the building and it's called as rendering when applied outside of the building i.e. at outer wall exposed to direct environmental condition.

1.1 OBJECTIVE:

1. Protection of surface against environmental condition and rain water as well as sun light.
2. Protection against insects and fungus etc.
3. Provides aesthetically beautified construction.
4. Defective construction is patched and a little strength is gained.

1.2 REQUIREMENTS OF A PLASTER:

1. It should stick to the back ground and should not spall off during bad weather.
2. It should be inert and should not chemically react with reinforcement or other decorative fInishing or floorings.
3. It should be economical and easily available.
4. It should possess water resistance nature and should be environmental friendly as far as possible.
5. It should be durable, hard and possess good workability.

2 MATERIALS & TOOLS USED FOR PLASTERING:

2.1 MATERIALS:

The materials used for plastering is commonly of two types. These are categorized as general plastering material and special plastering material. General plastering materials are the materials used for plastering everywhere and irrespective of any special requirement and these forms the parent material even for special plastering materials and commonly used in residential as well as commercial buildings. Special materials are used as per requirement of the environment, radiation, atmospheric exposure and type of decoration etc. Both types of materials are discussed below.

2.1.1 CEMENT:

Cement is binding material in the cement concrete. This concrete is used for different engineering works where strength and durability are of Prime importance. Usage of cement as plastering material is normally adopted for external wall though in today's scenario, cement plasters are used in all most all type of plastering. The advantages lie in quick finishing, high workability, no additional binder requirement, and hardened surface as well as non absorbent property of cement. Details of cement are already discussed earlier. The commonly used cement for building works is ordinary Portland cement (OPC) / Portland Pozzolana Cement (PPC) of grade 43 or 53 as available in the market. Also Portland slag cements (PSC) is used for the purpose. The ratio of cement to sand varies from 1:4 to 1:6 in cement plaster and for lime-cement plaster, its ratio varies between Cement: Sand as 1:6 to 1:8.

FUNCTIONS OF CEMENT

1. It fills up voids existing in the fine aggregate and makes the concrete impermeable.
2. It provides strength to concrete on setting and hardening.
3. It binds the aggregate into a solid mass by virtue of its setting and hardening properties when mixed with water.

REQUIREMENTS:

Good cement should satisfy all the requirements as per I.S. specifications

RED MUD: Red mud is classified under fine aggregate category where the size below 4.75 mm is considered as fine aggregate. However, in general practice, it is mixed with regular plastering, mortar for asthetic view and reduce the maintenance cost in painting.

2.1.2 SAND: Sand is classified under fine aggregate category where the size below 4.75 mm is considered as fine aggregate. However, in general practice, sands are termed as coarse sand, medium sand and fine sand and then silts. In plastering works, coarse sand and medium sand is used and not fine sand. Silt is not used any type of construction work. For plastering of roofs or heavy duty floors, where greater hardness is desired, instead of fine sand, broken granite chips of smaller size is used. But sand is a major material for all type of plasters and even on heavy duty floors, coarse sand can replace the smaller broken granite chips.

FUNCTIONS OF SAND:

1. It fills the voids existing in the coarse aggregate.
2. It reduces shrinkage and cracking of concrete.
3. By varying the proportion of sand concrete can be prepared economically for any required strength
4. It helps in hardening of cement by allowing the water through its voids.
5. To form hard mass of silicates as it is believed that some chemical reaction takes place between silica of sand and constituents of cement.

REQUIREMENTS:

1. Fine aggregate should consist of coarse angular sharp and hard grains.
2. It must be free from coatings of clay and silt.
3. It should not contain any organic matter.
4. It should be free from hygroscopic salt.
5. It should be strong, durable and chemical inert.
6. The size of sand grains should pass through 4.75mm IS sieve and should be entirely retained on 75 micron IS sieve.

2.1.4 Water: Water is another constituent in plastering. Desired amount of water is added to plastering for making the mortar workable. Also after plastering is hardened, for obtaining harder surface and adequate performance of heat of hydration reaction, water is used for curing. The water used should not have a pH below 6.0 and should be free from debris and other materials like chloride, sulpher etc. should remain within acceptable limits as per IS code.

FUNCTIONS:

1. Water is only the ingredient that reacts chemically with cement, then setting and hardening takes place.
2. Water acts as a lubricant for the aggregate and makes the concrete workable.
3. It facilitates the spreading of cement over the fine aggregate

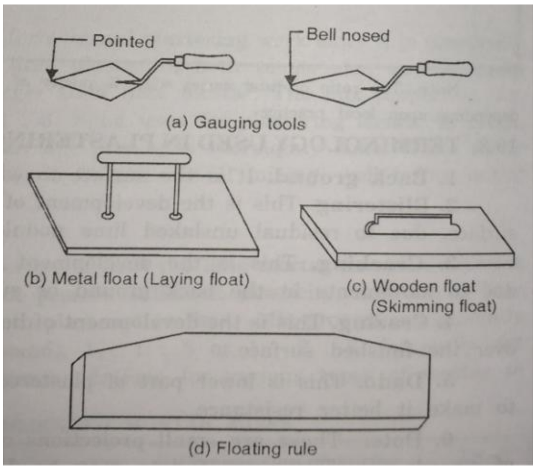
3 Tools used for plstering:

i. **Floating Rule:** It's used for checking the plastering surface whether it's levelled or not.

ii. **Float:** It's used for applying and spreading mortar on the surface. It's made up of either by wood or steel. Steel or metal float is also known as laying trowel. The wooden float is known as skimming float and mainly used for finishing plaster work. The blade size of steel float generally is 10x30 cm^2 and the wooden float blade size varies from 10x30 to 11x33 cm^2. Sometimes the devil float having nail projection of 3 mm is used for making zigzag on the plaster surface for further work upon it.

iii. **Trowel:** A trowel is used for throwing the mortar on to the plastering surface by the mason. It's also used for gauging small quantities of material and applying mortar to moldings, corners etc. The end of the trowel blade may be pointed or may be of bull nose type.

iv. **Other Miscellaneous Tools:** In this type other tools like steel plate (used for discharging mortar from one place to the working place), set square (used for measurement works), plumb line (used by mason to know the leveling), edge brushes (used for cleaning the plaster surface) etc are used.



PLASTERING TOOLS

4 Ventilation

Ventilation is the intentional introduction of ambient air into a space and is mainly used to control indoor air quality by diluting and displacing indoor pollutants; it can also be used for purposes of thermal comfort or dehumidification. The correct introduction of ambient air will help to achieve desired indoor comfort levels although the measure of which varies from individual to individual.

The intentional introduction of subaerial air can be categorized as either mechanical ventilation or natural ventilation. Mechanical ventilation uses fans to drive the flow of subaerial air into a building. This may be accomplished by pressurization (in the case of positively pressurized buildings), or by depressurization (in the case of exhaust ventilation systems). Many mechanically ventilated buildings use a combination of both, with the ventilation being integrated into the HVAC system. Natural ventilation is the intentional passive flow of subaerial air into a building through planned openings (such as louvers, doors, and windows). Natural ventilation does not require mechanical systems to move subaerial air: it relies entirely on passive physical phenomena, such as diffusion, wind pressure, or the stack effect. Mixed mode ventilation systems use both mechanical and natural processes. The mechanical and natural components may be used in conjunction with each other or separately at different times of day or season of the year. Since the natural component can be affected by unpredictable environmental conditions it may not always provide an a ppropriate amount of ventilation. In this case, mechanical systems may be used to supplement or to regulate the naturally driven flow.

In many instances, ventilation for indoor air quality is simultaneously beneficial for the control of thermal comfort. At these times, it can be useful to increase the rate of ventilation beyond the minimum required for indoor air quality. Two examples include air-side economizer strategies and ventilation pre-cooling. In other instances, ventilation for indoor air quality contributes to the need for - and energy use by - mechanical heating and cooling equipment. In hot and humid climates, dehumidification of ventilation air can be a particularly energy intensive process.

5 Natural ventilation

Natural ventilation harnesses naturally available forces to supply and remove air in an enclosed space. There are three types of natural ventilation occurring in buildings: wind driven ventilation, pressure-driven flows, and stack ventilation. The pressures generated by 'the stack effect' rely upon the buoyancy of heated or rising air. Wind driven ventilation relies upon the force of the prevailing wind to pull and push air through the enclosed space as well as through breaches in the building's envelope. Seoul University Professor Wonjun Kwon recently discovered a new way to ventilate large area of indoor space. The so-called "air pump" system uses pressure between inside and outside of rooms to push air out of a structure. (see Infiltration (HVAC)).

Almost all historic buildings were ventilated naturally. The technique was generally abandoned in larger US buildings during the late 20th century as the use of air conditioning became more widespread. However, with the advent of advanced Building Energy Modeling (BEM) software, improved Building Automation Systems (BAS), Leadership in Energy and Environmental Design (LEED) design requirements, and improved window manufacturing techniques; natural ventilation has made a resurgence in commercial buildings both globally and throughout the US.

The benefits of natural ventilation include:

- **i.** Improved Indoor air quality (IAQ)
- **ii.** Energy savings
- **iii.** Reduction of greenhouse gas emissions
- **iv.** Occupant control
- **v.** Reduction in occupant illness associated with Sick Building Syndrome
- **vi.** Increased worker productivity

6 The natural lighting to building

Daylighting is the practice of placing windows or other openings and reflective surfaces so that during the day natural light provides effective internal lighting. Particular attention is given to daylighting while designing a building when the aim is to maximize visual comfort or to reduce energy use. Energy savings can be achieved from the reduced use of artificial (electric) lighting or from passive solar heating. Artificial lighting energy use can be reduced by simply installing fewer electric lights because daylight is present, or by dimming/switching electric lights automatically in response to the presence of daylight, a process known as daylight harvesting.

Daylighting is a technical term given to a common centuries-old, geography and culture independent design basic when "rediscovered" by 20th century architects. The amount of daylight received in an internal space can be analyzed by measuring illuminance on a grid or undertaking a daylight factor calculation. Today, the use of software, such as Radiance, can allow an architect or engineer to quickly undertake complex calculations to review the benefit of a particular design.

7 Windows

Windows are the most common way to admit daylight into a space. Their vertical orientation means that they selectively admit sunlight and diffuse daylight at different times of the day and year. Therefore, windows on multiple orientations must usually be combined to produce the right mix of light for the building, depending on the climate and latitude. There are three ways to improve the amount of light available from a window: (a) placing the window close to a light colored wall, (b) slanting the sides of window openings so the inner opening is larger than the outer opening, or (c) using a large light colored window-sill to project light into the room.

8 BRIEF OVERVIEW OF LITERATURE

"Sustainable Construction: Green Building Concept" Ishan G.Kevadiya1, Ankush A.Patil2 & Shruti-Mrudula N.Waghmode3 –IJIERE: Improving the quality of life is a goal we all dream for, which can be achieved by using natural resources responsibly. Green building concept includes smart approach for the saving of energy; it saves our water resources and helps us for minimising wastages and maximising reuse. Green building concepts emphasises in to improving health and wealth of the society and more importantly connects us with nature. It helps for creating jobs, value of resources used, increases energy efficient way and adds financial benefits for the society. Green building concept is a future need of a country and it leads us towards the healthier and wealthier environment and as well as it shows the way to keep in touch with nature.

"Sustainability and Innovative Construction: Green Building with Concrete" Yang Lu* –IREAP: In general, the construction industry consumes 40% of the total energy and about one-half of the world's major resources. Hence, it is imperative to regulate the use of green materials and less energy consumption in construction industry. Sustainable usage of resources plays an important role in the development of sustainable construction.

"ENERGY EFFICIENCY IN GREEN BUILDINGS – INDIAN CONCEPT" Ramesh S P[1], Emran Khan M[2]–IJETAE: In general, the construction industry consumes 40% of the total energy and about one-half of the world's major resources. Hence, it is imperative to regulate the use of green materials and less energy consumption in construction industry. Sustainable usage of resources plays an important role in the development of sustainable construction.

"GREEN TECHNIQUES IN BUILDING CONSTRUCTION (CONCEPT)" Hema. C"–IJBTT: Now-a-days everyone is looking for the concept "Go Green".This can be achieved by lowering the energy demand and consumption of materials, utilizing the reusable or recyclable products in a holistic way which will eventually offer an economic and cost effective sustainable living environment.

"GREEN BUILDING MATERIALS – A Way towards Sustainable Construction" [1·]Akshay B. Mokal, Allaudin I. Shaikh 2Shamashree S. Raundal3,Sushma J. Prajapati4,Uday J. Phatak5–IJAIEM: economically benefits for construction industry and human health. Green construction material reduces side effects on environment to make efficient sustainable structure as well as will lesse the environmental pollution content, and like greenhouse gas emission, resource depletion, soil pollution, health hazards, ozone depletion etc. Hence there is an urge to use the eco-friendly materials for the better tomorrow and healthy life of coming generation

9 SCOPE AND OBJECTIVES

- To prepare the plan of the institutional building.
- To prepare a quantity estimation for the project.
- To find the ireplaced fine aggregate quantity.
- To study the feasibility of the building.

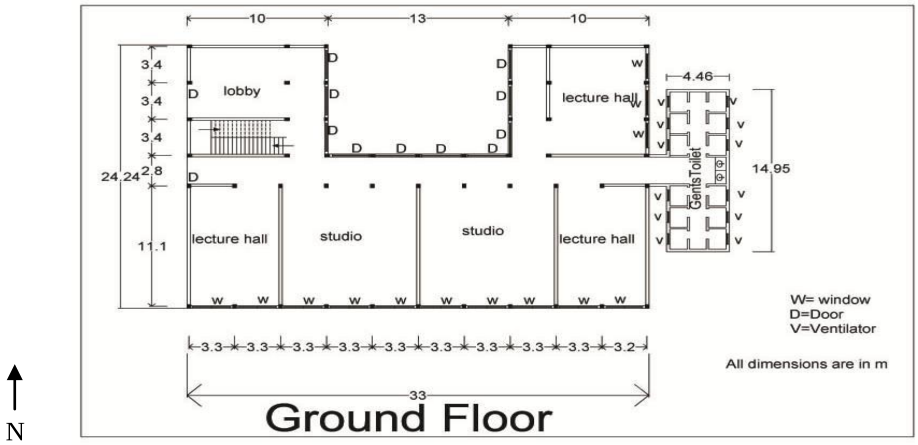
10 PROJECT OVERVIEW

The New block building which considered in this casestudy is located PRIME College of Architecture and Planning, Kilvelur, Nagappatinam District, Tamil Nadu. The constructed plinth area is 740 square meters and ground plus three storied building. It is constructed for B.Arch students in addition to the Existing old block.

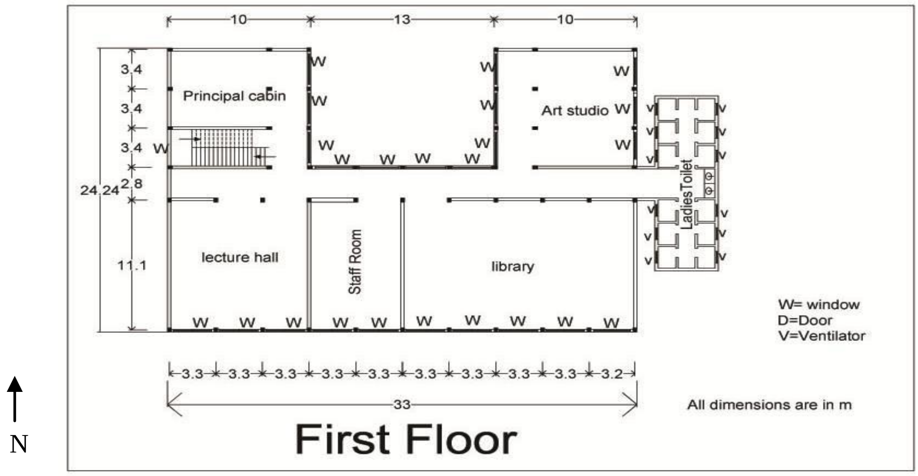
11 PROJECT VIEWS

12 PROJECT FLOOR WISE PLAN

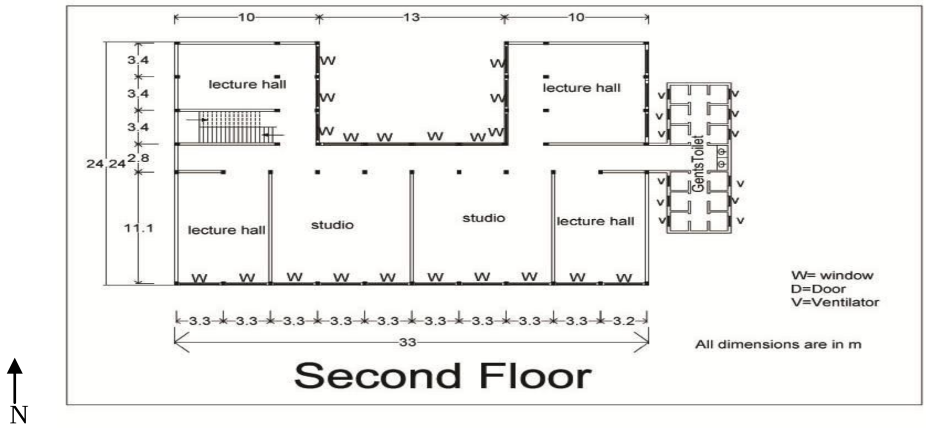
12.1 Ground floor: The New block Ground floor consist of constructed plinth area is 740 square meters and it covers three lecture halls, two studio, one lobby and Gents toilet areas. It also featured by 12 nos doors in the size of 2.28m x 3m, 13 nos Windows in the size of 1.22 m x 2.28 m, 12 nos Ventilators in the size of 0.6m x 0.6m.



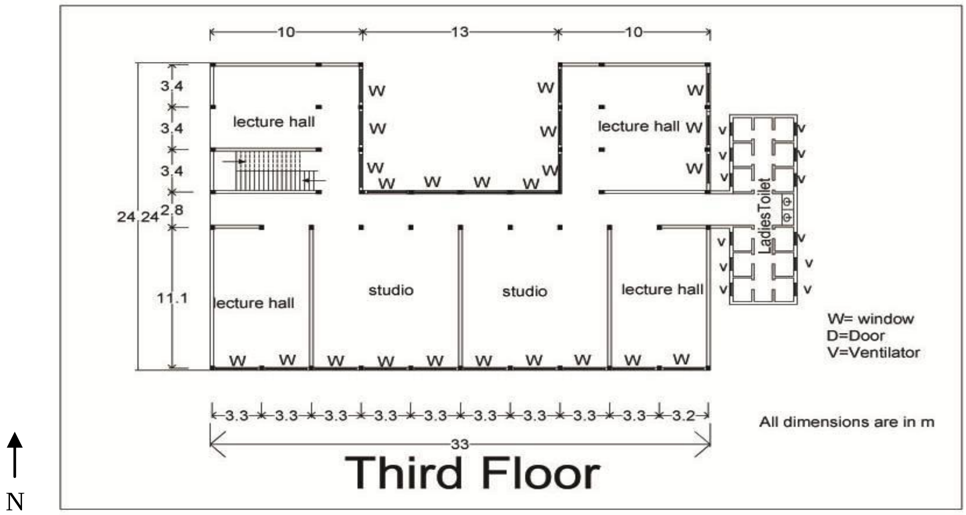
12.2 First floor: The New block First floor consist of constructed plinth area is 740 square meters and it covers one Principal cabin, one lecture hall, one staff room, one library, one Art studio and Ladies toilet areas. It also featured by 24 nos Windows in the size of 1.22 m x 2.28 m, 22 nos Ventilators in the size of 0.6m x 0.6m.



12.3 Second floor: The New block second floors consist of constructed plinth area is 740 square meters and it covers Four lecture halls, Two studio and Gents toilet areas. It also featured by 24 nos Windows in the size of 1.22 m x 2.28 m, 22 nos Ventilators in the size of 0.6m x 0.6m.



12.3 Third floor: The New block Third floors consist of constructed plinth area is 740 square meters and it covers Four lecture halls, Two studio and Gents toilet areas. It also featured by 24 nos Windows in the size of 1.22 m x 2.28 m. 22 nos Ventilators in the size of 0.6m x 0.6m.



13 STUDY ON PLASTERING

OVERALL PLASTERING AREA BASED RED MUD USAGE CALCULATION

PLASTERING AREA CALCULATION

SL.NO	DESCRIPTION	UNIT	AREA
1	**Overall Plastering**		
2	Inner plastering by the mortar proportion of 1:6	m^2	1971.45
3	Outer plastering area by the mortar proportion of 1:6	m^2	2157.64
4	**Total**		**= 4129.12m²**
5	**Opening Deduction**		
6	**a)Ground floor**		
7	doors (2.28 x 3)	10 Nos	68.4 m^2
8	main door (2.28 x 3)	2 Nos	13.68 m^2
9	Windows(1.22 x 2.28)	13 Nos	36.14 m^2
10	Ventilators (0.6 x 0.6)	12 Nos	7.2 m^2
11	**b)First floor**		
12	Windows(1.22 x 2.28)	23 Nos	63.94 m^2
13	Ventilators (0.6 x 0.6)	22 Nos	14.4 m^2
14	Lightening window (1.22 x 2.28)	1 No	2.8 m^2
15	**c)Second floor**		
16	Windows(1.22 x 2.28)	23 Nos	63.94 m^2
17	Ventilators (0.6 x 0.6)	22 Nos	14.4 m^2
18	Lightening window (1.22 x 2.28)	1 No	2.8 m^2
19	**d)Third floor**		

20	Windows(1.22 x 2.28)	23 Nos	63.94 m^2
21	Ventilators (0.6 x 0.6)	22 Nos	14.4 m^2
22	Lightening window (1.22 x 2.28)	1 No	2.8 m^2
	Total		**= 369 m^2**
	Total Deduction in double side plastering (369x2)		**= 738 m^2**
	Total plastering Area after Deduction (4129.12-738)		**=3391 m^2**

Materials required for the proportion of 1:6 mortar with the thickness of plaster 12mm:

As per CPWD Norms,12 mm thick 1:6 palstering for 10sq.m reqired cement=55kg and sand=0.227m^3
So for the Total plaster area=3391 m^2
Cement required = 3391x (55/10) =18650 kg
Fine aggregate required = 3391x (0.227/10) =77 m^3

So required quantity:
Cement =373 bags
Sand =2719 Cft (27.2 units)

Materials required for the proportion of 1:6 mortar with 50% replacement of Fine Aggregate by Red mud:

Cement = 373 no of bags
Fine aggregate = 1360. Cft
Red mud = 1360. Cft

So in the current Sand demand senerio, in the overall 2719 cu.ft we can effective replace the sand 1360 Cu.ft by introducing Red mud as adjacent fine aggregate.

14 STUDY ON VENTILATION

OVERALL VENTILATION CALCULATED WITH THE GUIDANCE OF IS3103-1975 GENERAL CONSIDERATION.

Ventilation from Horizontal opening (Doors, Windows, Ventilation)

Q = E A V

Where,
Q = Volume of air in m^3/min;
E = Coefficient which varies from 0.5-0.6 when opening face winds and 0.25-0.35 when openings are at angle.
A = Free Area of inlet opening in m^2
V = velocity of wind in m/mm

When
E = 0.5; A = 369 $m^{2;}$
V = (9.8km/hr) x (16.67) = 163.33m / min

Q = 0.5x369x163.33
Q= 30135 m^3

So using the door windows and ventilation based high level of ventilation are achieved. So it helpful to Improved Indoor Air Quality (IAQ), Energy savings, Reduction of greenhouse gas emissions, Occupant control, Reduction in occupant illness associated with Sick Building Syndrome and occupant productivity.

15 STUDY ON NATURAL LIGHTING

OVERALL NATURAL LIGHTING CALCULATED WITH THE GUIDANCE OF IS10894-1984 CONSIDERATIONS.

The levels of illumination recommended for the different areas in educational institutions are achieved based on the Horizontal opening (Doors, Windows and Ventilation)

	Areas	Illumination (Lux)
a)	Class room	300
b)	Lecture room (Including demonstration areas)	300
c)	Reading Rooms	300
d)	Corridors	300
e)	Library	70
f)	AV halls	70
g)	Staff rooms	150

Special attention is given to daylighting while designing a building is important. When it aims is to maximize visual comfort or to reduce energy use. Energy savings can be achieved from the reduced use of artificial (electric) lighting by using Natural lighting. This technology termed as natural light harvesting.

16 SUMMARY/ CONCLUSION

From this study, the innovative techniques adapted in plastering by partial using of red mud along with sand (Each 50%) will causes coloured plastered surface. So asthetic look without painting and cost effective in the current sand scare senerio and increase in opening like doors, winows and ventilators to adapt maximum ventilation and lighting effectively. These techniques helps to reduce construction and maintenance cost of the project and also it enrich the usage of natural ventilation and lighting. The structure special design will Improved Indoor Air Quality (IAQ), Energy savings, Reduction of greenhouse gas emissions, Occupant control, Reduction in occupant illness associated with Sick Building Syndrome, Increased worker productivity. Both a structure and the application of processes those are environmentally responsible and resource-efficient, so it satisfies green building concepts.

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