

RESIDENTIAL BUILDING DESIGN WITH GREEN MATERIALS USING BIM

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Abstract— Building information modeling is an advanced way of technology which is now becoming popular in India due its extensive utility in designing, analysis and planning. This is paper research is of a residential building design using green materials and is based out in Lusaka, Zambia the southern part of Africa. This study is aimed at creating a smart model by designing, analyzing, planning, estimating, clashing detection using the BIM software. This software addresses more about the project difficulties and helps in managing the various stipulations of any architect and any civil engineer. This paper shows a detailed 3D smart model, complete design report, complete scheduling and estimation along with clash detection if any are found in the project.

Index Terms—BIM (Building Information Modeling), STAAD PRO (Structural Analysis And Design Program), Green Materials, AutoCAD (Commercial computer-aided design and Drafting software Application).

I. INTRODUCTION

Building Information Modeling (BIM) is a process used to combine information and technology that creates a digital smart model of any project that merges data from many other sources and develops it into parallel with the real project across the timeline, design, construction and operational information which is economical and has less environmental impact. The BIM software allows realistic digital representation of a building to be created for architects and civil engineers to collaborate on all aspects of building design.

BIM is beginning to change the way of planning, designing and constructing buildings and other infrastructure. When it comes to BIM technology, precise virtual model of buildings are digitally made.

When it's completed, the computer generated model contains precise geometry and data needed to support the constructions, fabrications, and procurement activities needed to release the building. BIM also serves many of the functions needed to model the lifecycle of a building,

providing the basis for new construction capabilities and changes in the roles.

BIM assists in finding components of a building such as its floors, foundation, slabs, columns, beams, roof, stairs and walls by applying their characteristics such as usage, structures and functions. As a result, the building components specifications and their relative information are acquired by the use of a simulation model, which makes it possible for decision making of a pending construction project. BIM does not just prepare anticipatable information with respect to amount, expenses, schedules and materials but it also provides it and makes it possible to perform analyzing data that depends on the structure and ambience. A BIM is a project simulation which consists of 3D models of the project components by connecting with all the needed information linked to the project such as planning, constructing, operating and decommissioning. Therefore, BIM enables an integrated design and construction process that results in better quality buildings at lower cost and at a reduced project duration.

The building and construction industry has been motivated to support green building strategies in view of increasing sustainability problems such as the reduction of CO₂ emission and energy dependency on fossil fuels. As a revolutionary technology and process, BIM is now been considered by many as an important opportunity in the Architecture, Engineering and Construction (AEC) industry.

II. LITERATURE REVIEW

K. W. Chau et.al (2004) For construction managers, a 4D model was created with the planning of daily activities with more efficiently in a wider and more workable management of the site context and therefore, add increase our understanding and grasp about how important the latest computer graphics to the duties of the construction site manager are overall.

Kyuman Cho et.al (2010) researchers from around the world have made many attempts to come up with a model for scheme and cost integration in projects that involve construction, but hard to fuse or join and manage the scheme and cost when it comes to an actual construction site using such a prototype. The scheme and cost model that is merged and developed in this study allows the plan and control of construction processes that happen to be repetitive is used by a Project Manager or the one in charge at the construction site. In addition, a combined cost and scheme model for the core wall construction is an important process that is repetitive in the recent booming high rise building construction.

Kuo Feng Chien et.al (2014) had come up with a practical study for BIM projects that will show and give us the risk factors. There were about 13 of these risk factors found. These were connected to the financial, technical, personnel, management and legal features of BIM adoption. In Taiwan, for engineering consultants, architects, construction companies and academics, a survey questionnaire was made and given out to them. After the survey it conclusions were drawn from the connection between risk factors that were drawn out using the evaluation laboratory method and the decision making trial. According to the results of the test, lack of skilled workers and not enough experience on the project were the two major risk factors that were identified to also affect other factors.

Mr. JiauZuo and Mr. Zhen Yu Zhao had made some research on technology and the makings of green buildings. The report that they had presented had a critical review of the information and analysis of buildings that are eco-friendly. Their research had focused on the similar research matters like benefits of green buildings compared to the standard building and different ways to come up with green buildings. In their research, it was stated that the future opportunities such as conditions of climatic effect on the efficiency of the green buildings assessment tools, real performance and validation of green building requirements of specific population and future proofing.

Ignacio Zabalza Bribian; Antonio Valero Capilla; Alfonso AndraUson produced a research paper that talked about building and environment. The results of this paper had presented a life cycle study that compared standard common materials for buildings with ecofriendly materials and three different impact categories used. The aim of the research paper was to know more about energy and environmental specification of building materials. It was concluded that in order to sop or reduce the usage of material that could be toxic to the environment, it is essential to use the best available techniques and innovation in the production. And this would also include the concept of reuse and recycle and not to forget the minimization of transport of

some of the materials and products hence using the available resources in the areas close by.

III. PROJECT WORK

The in-depth design of a structure is usually done by architects but some engineers are also able to do the same. The planning and design of a structure isn't only conceptual thinking and imagination but it also needs some practical knowledge of certain aspects and areas like bylaws of structure design.

Here are two major types of design which is functional and structural. Functional design focuses more on the model and design of the building while structural design focuses more the the analysis and the indepth details and calculations.

During Functional design, the structure being constructed should look presentable and not only presentable but attractive too and this is the primary goal considered when doing the design.

Structural Design itself has 5 stages which are **Structural planning, Action of forces and computation of loads, Methods of analysis Member Design, Detailing Drawing and presentation of schedules**

The objective of this project is focused on using green materials on a residential building design. Using green materials on a residential building is good for a lot of reasons that not only benefit the people around but the enviroment too. Some of these benefits are low maintainace and operation costs, energy effeciency, water effeciency, better health and better environment.

A residential building is supposed to provide different kinds of facilities such as sleeping and washroom facilities but cooking and dining facilities are rather optional. A residential building should still be also able to provide the maximum comfort for the people residing in it even with the minnum requirements.

The idea is to integrate eco-friendly materials into a normal Indian residential house. As discussed before there are a lot of benefits for the people residing in the house in the long run. There will be a number of materials used on the said residential house. Some materials used in the project are:

Wool Brick - Wool bricks are bricks made when wool fibres are added to ordinary clay material. Because they can be made without firing, they are considered to be environmental friendly. Tests indicate that they are around 37% stronger than the coventional unfired stabilized earth brick.

Standing Seam Metal Roof - This type of roof is a metal roof and metal roofs are advantageous to both, the people

and the environment. This roof is an advantage for people in areas where there is snow because the snow will just slide off which is the same for places with heavy rainfall.

Cork - Cork is a material that can be seen as wine bottle tops or wall materials. But it was recently introduced as a flooring material. When harvesting the bark from the tree, the tree is not cut down so that the bark may grow back making a good renewable resource.

Wood - Wood is a rather popular building material used around the world and is known for its efficiency, durability, and it being a renewable source. The energy used during the making of wood products is less compared to other materials.

Standard Gypsum Boards - 'Standard' is a type of regular core Gypsum board. It is placed in a strong paper liner which is 100% recycled. Almost 100% of the material used for the manufacture of the gypsum board back and face paper is from post consumer waste materials and newsprint. Majority of synthetic gypsum used by the industries is a unique By-Product of industrial processing that is used to remove pollutants from the exhaust created by burning fossil fuels for the generation of power..

DESIGN ANALYSIS

Design analysis is a process of developing a design including all information discovery, communications and planning. Basically, in this stage, we are trying to assess the loads and effects that will affect the structure both in the present and future. In doing this we can come up with ways to counter these effects so that the structure designed is durable and less likely to damage due to the the negative effects of nature.

This is now the structural planning part of the project and STAAD Pro is the software that was used for this. We used this software to design beams columns and slabs

Beams are parts of a structure that are meant to resist loads that are applied in a lateral manner to their axis.

A column also known as a pillar, is a part of a structure that transmits the weight of the structure above to the part below through compression.

A slab is a part of a structure usually made out of concrete that is placed horizontally to make a flat surface for things like floors, ceilings and roof decks.

CONCLUSION

To conclude, it is important to use eco friendly materials, not only in our day to day lives but also in our works. We have seen that it is possible for an engineer to use eco friendly materials and methods in the construction industry. Using these materials and methods can be beneficial not only for us individuals but also the environment. With these methods we can preserve the earth and even improve it if possible. We can slow down the rate of global warming and other issues that are causing the earth to slowly deteriorate. So from this project we go in detail and see that the implementation of green materials is an important thing and even though it may be costly to manufacture build or create, it is still a better option because its beneficial in the long run money wise and health wise.

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