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A Review on Sustainability Analysis of High Rise Building Integrated With BIM

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ABSTRACT: In order to provide sustainability of the high rise building is one of the major challenge in the world . In Combination with the BIM technology at design ,construction process strength the high rise structures. In this paper mixed review to recent BIM implementation in existing structural building construction project management and determine the current state of the BIM development for sustainability. In sustainability process the calculation of energy requirement for high rise building summarizes and prospects the current situation of energy-saving design in india high-rise building and the seismic stability of building taken into consideration.

KEYWORDS: BIM,energy -saving design,sustainability.

I. INTRODUCTION

Increasing rate of urbanization in current decades seen a boost up construction of high rise building worldwide. Now a days Tall, slender buildings design are necessity for big cities where space is limited. The development of these buildings has not kept pace with the growth of many other systems. In process of designing high-rise buildings concept has been changed over the past years. because increased in numbers of software in computer analysis .However, Sustainable engineering is the process of designing or operating systems such that they use energy and resources sustainably and these models produce large amount of data and results in which possible errors and failure overlooked, especially if the model is big and complex.

These trends have put the structural engineers at the core of the design process for tall building projects. Whether it is in the choice of the lateral load-resisting structure or the impact of wind on the structure, and against earthquake forces or in the approach for integrating the structure in the overall geometry and architecture of the building, the decisions made by the structural engineer have a profound impact on the cost, constructability, and sustainability of tall buildings.

For the proper information theory of Building Information Modeling was developed by scholars at Georgia Institute of Technology in the late 1970s. It progressed quickly. Construction teams have found value in using BIM to integrate the process of the construction industry. This Building Information Modeling, firstly used in 2002 to explain virtual design, construction and facilities management, and gained attraction with the release of several BIM authoring tools. Building Information Modelling has transformed the construction industry from the traditional two-dimensional CAD to a multi-dimensional modeling platform through the combination of 3D object based parametric model with schedule, cost data etc. . BIM serves as an excellent data management tool due to the ability to create data rich models, facilitating easy and fast access to the information . BIM enables the user to feed specific data into the 3D model, which can be parsed out of the model and transformed into activity data to generate construction schedule as well as refine construction sequences.

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II. WHY BIM IS SO IMPORTANT

BIM moved from 3D CAD (including 3 dimensions: place, size and shape) format to 4D format, added Time dimension to basic three dimensions. Fourth dimension leads to full construction coordination in design. Afterwards, Cost dimension was added to 4D format, that brought BIM to a new improved 5D level. Fifth dimension makes possible the calculation of cost for the entire construction project as well as if it is necessary for project parts. The total cost of projects based on information about cost of labor, materials, etc. those currently could be set up manually or automatically with help of The last development of BIM brought it to the new 6D level. The sixth dimension is about a life cycle of building, management of its facilities, and an environmental impact.

III. OVERVIEW OF LITERATURE

Akponanabofa Henry et al. (2014): presented construction of earthquake resistant buildings and implementing seismic design and building code in northern Pakistan 2005 earthquake affected area. The main objective of this study was to find out the solutions for the construction of building structures in Pakistan to make the building structures more resistant to earthquake and to lessen the damage. The comparison is done between the building codes of Japan and Pakistan as Japan's building code including seismic provisions is very well updated and is a worth standard to follow for construction of building structures and other infrastructures. It is suggested that extensive studies should be carried out in seismology and earthquake resistant construction for developing and updating specifications codes and engineering parameters for the design and construction of several types of structures.

Bhusar Arpit et al (2014): This paper explores how the use of Building Information Modeling (BIM) can be a beneficial platform for structural engineers. The present state of BIM is analyzed, giving a overview on how architectural, engineering and construction firms are applying it on their projects. The interlinking of BIM with structural analysis softwares like ETABS, SAP2000 and Robot Structural Analysis is evaluated. Also, an independent structure is modelled in BIM and is analysed and designed in Structural Analysis software. after that , the ease in redesigning and modifying the structure is discussed.

Brunesi E. et al.(2016): In this dynamic finite element analyses devoted to assess abnormal aspects in the seismic response of high-rise mega-frame prototypes with outriggers and belt trusses. Thirty- and sixty-storey planar frames, extracted from reference three-dimensional structures composed of an internal symmetric braced core, were designed in accordance with European rules. The core consisted of a concentrically braced frame system, while the outriggers were placed every fifteen stories to limit inter-storey drifts and second order effects. Numerical models able to account for material and geometric nonlinearities were developed within open source platform, using inelastic force-based fibre elements to model structural members and mechanical idealizations to reproduce the behaviour of bolted beam-column and welded gusset-plate connections

Mohamed A. Azab (2010): In this paper is to focus and establish groundwork for sustainability techniques and applications related to the RC high-rise buildings design, from the structural point of view. A set of recommendations related to local conditions, structural modeling and analysis is given, and some helpful suggestions for structural design team work are addressed. This paper attempts to help structural engineers in identifying the building sustainability design, in order to meet local needs and achieve alternative solutions at an early stage of project design.

Nasir Syed Rizwan et al.(2016) This paper studies the efficient use of outrigger and belt truss system for highrise concrete building subjected to wind or earthquake load. Seven 44 storey two dimensional models of outrigger and belt truss system are subjected to wind and earthquake load, analysed and compared to find the lateral displacement reduction related to the types of outrigger and belt system. The analysis has been carried out to study the effect and performance of outrigger system in 44 storey building. The outrigger system is provided at different levels along the height of the building. The depth of the Outrigger and belt trusses is equal to the height of the typical story and maintained same in all the models. The key parameters discussed in this paper include lateral deflection, storey drifts, base shear and fundamental time periods.

Nie Jianguo et al.(2013): The main lateral force resisting system is the composite core tube composed of steel plate shear walls and concrete-filled steel tubular columns. To investigate the seismic performance of this structural system and to provide design instructions, two specimens of 2-bay and 5-story steel plate shear walls were tested under low-

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cycle reverse loading. The unstiffened steel plates of the first specimen were connected to the boundary beam and column frame by high-strength bolts. The steel plates of the second specimen were connected to the boundary frame by welding, and the steel panels were stiffened by channels. Both specimens showed satisfactory energy dissipation mechanisms during the loading process. For the unstiffened specimen with bolted connections, the considerable postbuckling strength generated excellent ductility and energy dissipation performance, but a slip at the bolted connections and the buckling of steel panels decreased the stiffness in the serviceability condition. The stiffened and welded specimen showed higher stiffness in the elastic range and excellent energy dissipation capacity, but the cost of stiffeners would decrease the economy of the steel plate shear walls

Patil Dhanaraj M. et al (2016): This paper investigate the seismic behaviour of outrigger braced buildings to find out the optimum location of outrigger in high rise 2-D steel buildings. For this purpose, a nonlinear static pushover analysis was carried out on different outrigger braced high rise steel buildings of 20, 25, 30, and 35 storeys to capture the seismic response. In this study, the position of outriggers varies from a first storey to top storey in outrigger braced buildings of particular storey height. It is observed that the position of outriggers, lateral load patterns, and height of building significantly influences the seismic performance of the high rise building. The position of outriggers in high rise building significantly influences the seismic performance by increasing strength and stiffness, which are measured in terms of base shear, storey displacement, interstorey drift ratio, and performance point. Furthermore, nonlinear static pushover analysis using different lateral load patterns points out that the optimum location of outrigger can be varied with different load patterns.

Patil Dhanaraj M. et al (2015): In this research seismic Behaviour of Different Bracing Systems in High Rise steel structure with different types of frame is taken into analysis of their behavior Nonlinear static pushover analyses were carried out to assess the structural performance on different bracing systems in high rise steel buildings of 15, 20, 25, 30 and 35 storeys. Five structural configurations were used: moment resisting frames (MRFs), chevron braced frames (CBFs), V-braced frames (VBFs), X-braced frames (XBFs) and zipper braced frames (ZBFs). The effects of some parameters influencing the seismic performance, including type of the bracing system, the height of the building and lateral load patterns, were investigated. The results show that the different braced frames performed well in terms of storey displacement, inter-storey drift ratio, base shear and performance point when compared with themoment resisting frame in high rise steel buildings.

Xi Chen & Hongxing Yang (2017): This article proposes a two-stage design optimization approach which is applied to a prototype passively designed high-rise residential building under different ventilation modes and thermal load requirements. The lighting, cooling and heating demands of the generic building model are determined by the hybrid ventilation and light diming control strategies in compliance with local green building assessment criteria in Hong Kong. The multiple linear regression (MLR), multivariate adaptive regression splines (MARS), and support vector machines (SVM) are examined by the statistical modelling. SVM is capable of fitting a surrogate model with the best prediction performance based on the coefficient of determination and root mean square error. In addition, both single-sided ventilation and cross-ventilation models under varied thermal load requirements are investigated to compare the preferable design solutions for each scenario

Yun-tian Wu et al (2016): This paper studies the seismic behaviour of steel and concrete composite shear walls with embedded steel truss, a crucial structural element for use in high-rise buildings. Three one-fourth scaled composite wall specimens with an aspect ratio of 1.0 were tested until to failure under reversed cyclic lateral load and constant axial load. The test parameters were the amounts of embedded truss chord and web brace. The behavior of the test specimens, including the damage formation, failure mode, hysteretic curve, stiffness and strength degradation, energy dissipation and ductility, were examined. Test results indicated that the embedded truss web braces affect significantly the hysteretic behavior of the composite walls in terms of lateral load capacity, energy dissipation and ductility, while the embedded truss chords can enhance the lateral load capacity.

Juan Li et al (2013) This paper summarizes and prospects the current situation of energy-saving design in china's high-rise building, energy-saving potential in high-rise building ontology technology, high-rise building materials products and high-rise building equipment for thermal environment. Therefore, under the premise of guaranteeing its use features, construction quality and indoor environment, the energy-saving design in high-rise buildings should take effective and advanced energy-saving technologies and management measures. thermal insulation design methods are reducing the glass area, using sun-shield glass (such as: Low-E glass, Heat-reflective

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glass, Solar control glass) and using shading devices. In cold areas, double-skin curtain wall is a new type of curtain wall. It makes the building envelope has a buffer layer, and thus a lot of negative factors which are large temperature change, solar radiation, excessive humidity and noise have been eased.

Table.1 Load index contrast of positive laying method

XPS thickness [mm]	heating load(kWh/m2)	cooling load(kWh/m2)	total load (kWh/m2)
60	54.46	68.89	123.35
70	53.23	68.78	122.01
80	52.36	67.89	120.25
90	51.22	67.1	118.32
100	50.03	66.45	116.48

Heikkila, et al: In this paper the utilisation of building information models (BIM) and construction automation on building sites is discussed. A lot of research has been carried out to develop new applications for using BIM to assist construction site planning, different operations and logistics. The methods of production control and management on site utilize BIM together with machine control and navigation systems. In Finland machine control systems and the automation of construction equipment is widely used in infrastructure construction. Recently similar methods have been introduced also in building construction. This paper describes some latest Finnish examples where BIM-software is used for the planning, execution and control of building construction operations. University of Oulu has studied methods and technologies to capitalize BIM-models. The research has been mainly in infrastructure construction but the activities have recently been extended to building construction. In this paper a BIM-based tower crane operation and control system is discussed as a case study. The aim of this study was to highlight the potential areas where automation can increase the crane productivity and improve site operations and logistics.

Mahjoub Elnimeiri et al. Discussing sustainable structures in tall buildings, the concept presented in the recent Energy efficient building design is becoming increasingly important, as we think more about the environment and energy conservation. In this review The Chicago Spire, a 150 story tower designed by architect Santiago Calatrava, has an unusual building facade formed by its pointed floor plan which is twisted 360 degrees around its axis towards the top. In this tower, the exterior skin doesn't express the structural system of the building. It was difficult to integrate an exterior structural system with the twisted building facade because structures tend to lose their stiffness and bearing capacity when excessively twisted. Therefore a conventional internal core structure was designed. It suggests some building concepts to enhance architectural and structural form design development with regards to energy efficiency strategies. A successful sustainable structure can only be achieved by collaboration between the architect and structural engineer during the design.

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Table.2 comparison table for software based papers

Sr.No	Paper /author's name	SOFTWARE	Analysis/Description	Feature 1	F-2
1	Integration of BIM and Automation in high rise building	simulation tool of Tekla Structures	Earth work and site excavation for building.	3-D control model	BIM-based tower crane operation and control system was used
2	BIM extension for the sustainability appraisal of conceptual steel design/ Akponanabofa Henry Oti et al	Autodesk revit	AEC SOFTWARE comparision with RSA SOFTWARE	Simulation with different building arrangements	check different structural scenarios & cases
3	Implementation of BIM in Small Home-Building.Businesses /Angelo-Joseph Garcia et al	ArchiCAD		Parametric modeling	Multi-disciplinary collaboration
4	Application of BIM in Structural Engineering /Bhusar Arpit et al	ETABS, SAP2000	interlinking of BIM with structural analysis softwares like ETABS, SAP2000 and Robot Structural Analysis is evaluated	Designed in Robot Structural Analysis software.	
5	Brunesi E. et all.(2016)	Analysis were performed using finite element software ETABS 15.2.2	Dynamic finite element analyses with high-rise mega-frame prototypes with outriggers	Thirty- and sixty-storey planar frames	Outriggers bracing is used
6	Research on High-rise Buildings Energy Efficiency Design in Advanced Structure/ Juan Li et al	Ontology tecnology	Energy-saving on Exterior Wall Thermal Insulation	Themal insulation by polystyrene board /glass wool ,rock wool	Roof insulation by extruded polystyrene (XPS)

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IV. CONCLUSION

Integrating BIM functions with sustainable design of high rise structure will give most feasible in terms of energy and economical aspects. At the different location of building with different geographical condition will easily estimate its operation requirement with this technique .

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