Comparative Analysis of Hexagrid Structure With Conventional Structure by using STAAD Pro.

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Abstract- *Multi storey or skyscrapers buildings are very mundane these days because of the efficiency use of location is justified. The study is about honeycombed system which also known as the hexagrid structural system used in tall structure construction. This paper deals with the technique and its effect on the normal conventional type structure. The response , mode shapes and forces of the building with the earthquake and lateral forces is studied. The comparative analysis is done by using software based results. All over the world new innovations are been done by researchers so as to minimize the structural and environmental damage to the society. This technique used in this paper is one of such newly evolved technique by using which a software based experiment is carried out to check the effect various seismic parameters are considered.*

Keywords- Hexagrid Structure, wind analysis , conventional structure

I. INTRODUCTION

High rise building structure construction have grown in large number recently. Due to less availability of area and plots . Multi storey building are more effective utilise the space rather than small height building. As the height of building increases, it exposes to various forces which are dominant in lateral. Such forces are wind and seismic which tremendously effect the life of the building. Thus the high rise building are to be improved for such parameters and hence hexagrid structure is introduced.

Honeycomb structure is a type of structure which achieves both the goals and also by increasing the strength increases the aesthetic appearance of the structure found to be environment friendly.

In hexagrid structural system axial stress of the members resists gravity and lateral loads. The members show no bending and they simply act in tension or compression which reduces the need of steel. This topology of the hexagrid system is vital design variable since the degree of an angle between diagonal member consisting of hexagrid explore the various stress distribution which resisting the internal forces in structure . Therefore the effects of diagonal angles in the honeycomb structure should be considered in order to obtain an optimal grid with the highest stiffness in design phases.

As the height increases, the wind forces begin to dominate. Therefore, structural framework for high rise buildings is developed around concepts associated with seismic and wind forces subjected to it at top level.

The structures which are inspired by nature are known as biomimetic structures. The hexagrid structure is also mimicry of beehives. The main advantage of bee hive structure is that it has a uniform distribution of load. The implementation of honeycomb structure can save material up to 12%. The structure is thus light weight. And thus the earthquake forces by virtue of its weight are considerably reduced with a larger difference.

The different way of the bee hive is that it has number of windows without obstructing the stiffness of the building the bee hive hexgrid is a surface skin given to a bare structure which takes axial forces on seismic loadings. All the lateral forces are greatly reduced by using this type of structural construction. The masonry construction is totally removed from the outer side the wall is now replaced by the hexagrid.

Figure 1. Beehive Tower, London

II. OBJECTIVE

The objective of the project is to check the wind analysis & earthquake analysis of hexagrid structure with respect to the conventional type structure. The various forces and factors such as axial force, bending moment , shear force and lateral and base shear forces are to be studied. . And the results are to be compared with respect to the efficiency of each type of structure.

III. LITERATURE REVIEW

[1] Kai Hu et al 2007

In this paper multi-storey building with no perpendicular or parallel column is been used in design software." The main aim of this paper was to evaluate dynamic aspects such as Time history analysis , Response spectrum, and merged with experience knowledge in project, by using the design software such as SAP 2000, which were also compared with the results.

[2] By Payman Nejad et al 2011

The paper shows the details about the concept of hexagrid system. The building has no outer column and the material has saved up to 16% to 13% roughly. The structure which is mentioned in the paper is the honeycombed structure tower in London. The structural analysis is done in ETABS. The tall towers are more prone to natural disasters. So as a need of more safe structures these types of developing concepts are found more efficient to implement and are with having the entire structural environment.

[3] Zhou Fang 2012

Free form structures have important aspect to study. The best method to construct free form structures is by constructing space frame that usually consist unit in triangle form. Besides, hexagrid structure is also used in construction in reality. In this paper, the author will analysed the structural behaviour of them and the things and parameter that affect their properties.

[4] By Prof. Sarita Singla et al. 2012.

In this paper a 35 multistory building for different shape and size such as hexagonal , square etc. was used to design and analysis for lateral and seismic forces. The building drift was found to be reduced for hexagrid and octagrid building compared to other building.

[5] A.E Hasaballa et al. 2013

In high rise building ,earthquake analysis was done for moderate earthquake force the frames were analysed by response spectrum method and the storey displacement and stresses were found out.

[6] T. Mahdia et al 2013

The aim of this paper was to calculate the nonlinear seismic behaviour of intermediate moment-resisting reinforced concrete structure (RC) space frames with irregular & unsymmetrical plan in three, four and five storeys buildings. Analysis of the unsymmetrical buildings was made with and without considering the masonry infill (MI).

[7] B K Raghu Prasad, et al. 2014

In case of low rise buildings the effect of loading is different than in case of high rise building. The effect of lateral loads become vital in case of high rise building and so are considered as the major forces that act on the structure the effect of wind force and seismic is more and so the intensity of these forces with increased in the height is more. The effect of bracing systems with octagrid and hexagrids are studied on 30,40 and 50 storied buildings.

[8] By Arvind Reddy et al 2015

The building which are irregular in shape are damaged tremendously when subjected to seismic and wind force . The paper shows results of different structure which regular and irregular in shape. The results obtained from analysis showed that the values of displacement are less in static than the response spectrum analysis. A very little difference was found out in storey drift by both methods. And finally the base shear force was less for building less in height compared to other structure

[9] Taranath S. D, et al 2015

The paper has shown the comparative study of newly developed structural systems for structures. The comparative study of honeycomb and pentagrid system with normal flab slab and structure with shear wall is done in this paper.

[10] Dr.K.Muthumani 2016

This paper is mainly focus on wind induced pressures which would be cause due to wind intensity and how lateral forces varies according to various size & shapes of buildings structure. The wind intensity of a wind load depends on how quickly it changes and also on the response of

structure with change in wind. Ansys Fluent has been used for CFD analyses to study the wind induced response.

III. METHODOLOGY

Methodology of this project consists of the converting a conventional type structure into a biometric hexagrid structure by using the software STAAD pro.

Creating model of below mentioned architectural drawing in STAAD pro V8i.

- Providing property of the members.
- Applying loads on member according to IS 875:1987
- Details of parameters for wind analysis.
- Analysis of structure using STAAD pro V8i.
- Obtaining results and comparing the results with manual calculations.

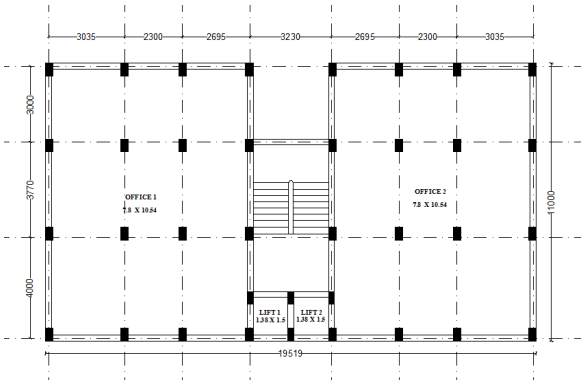

Figure 2.

LOADING.

I. Live load (Imposed load)

As per IS 875:1987 Part. Imposed floor load on any residential building is given as. Live load on all the floors of commercial building - 3 KN/m2.Live load on roof with access provided - 1.5 KN/m2.

II. Dead load

Weight of slab, beams and columns
Brickwork in structure
Floor Finish of 1kN/m2

III. Seismic load

EQ in X direction
EQ in Z direction.

IV. Wind load

According to IS 875:1987 PART 3
Applying wind in X & Z direction.

V. Load Combination

According to seismic load combination according to IS 1893:2002 part 1 .Applying wind combination according to IS456:2000.

V. CONCLUSION

Following points were observed after literature review with their resp. numbers are such as :

- In paper [1] it has been studied that the response spectrum analysis done in different software has same result except in ETABS, because it didn't consider oblique columns. Slabs should be considered during complex structure, as it resist the lateral forces.
- In paper[2] it was observed that hexagrid structure are independent , which are great in moment transfer and has less effect due to wind forces.
- In paper[4] it was found that using hexagrid structure has reduced storey drift with 18-20% than conventional structure. Thus it concluded that shape of building play vital role in resisting the forces.
- In paper[5] if PEB section are used in the building then the minimum consumption of steel is around 19.22 kg/m3. The steel consumption also varies depending upon soil condition, earthquake zone etc.
- From paper[6] it can be concluded that , the building with irregular stiffness will not change in storey drift and diaphragm. But when the height increases there is huge changes.