Dynamic and Analysis of A Geo-Polymer Concrete Structure

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Abstract: The standard portland cement (OPC) was traditionally used as the binding agent in concrete. However it is also important to find alternative emissions-free concrete binding agents to reduce environmental damage caused by cement manufacturing. Geopolymers, also known as inorganic polymers, use byproducts like fly ash rather than cement. Recent studies have shown that geopolymer concrete based on fly ash has enough properties for use. As the geopolymer strength mechanism is different from the OPC binder, an appropriate constituent model for geopolymer concrete must be obtained in order to predict the load-deflection behavior and strength of geopolymer concrete structural components. A number of problems faced with today's cement industry are addressed by geopolymer binders. These binders have similar or better engineering qualities in comparison with cement and can use many types of waste materials.

This project describes the seismic analysis of buildings with high-rise structures, the model of residential G+10 buildings with traditional concrete and geopolymer concrete properties is modelled and analysis is carried out using the response spectra method considering the position of the building in zone III, this analysis would generate the effect of higher vibration modes and real force distribution in elastic range. Test results include maximum story shifts, maximum story drifts, story shears and story stiffness, and an efficient lateral load resistance system, helping to establish whether geo-polymer concrete can be used in high-rise building construction as dynamic loads are included in the high-rise structures

***Keywords*: Geo-Polymer Concrete, ETABS 2016 software, Response Spectra**

1. Introduction

1.1 Introduction:-

Earthquakes are very popular these days in nature for many reasons. Instead, we don't discuss why the earthquake is but how to cope with the burden of the earthquake in structures or buildings. This is the most important criteria for us because the earthquakes become very frequent to us, particularly in the case of high-rises buildings it is impossible to design a safer building or analyze the buildings in general regular form using static loads such as live loads, dead loads etc, The dynamic analysis and modeling the necessary structure using ETABS software is not sufficient and therefore the structure in the ETABS is analyzed with the response spectra process.

1.2 Geo- Polymer Concrete:-

Geopolymer concrete is an advanced and environmentally friendly construction material and an alternative to cement concrete in Portland. The utilization of geopolymers has lowered demand for Portland cement with heavy emissions of CO2. Geopolymer has been named after materials found by Daidovits in 1978 via chains or networks or inorganic molecules. Geopolymer cement concrete consists of waste material, fly ash and granular soil furnace slag (GGBS). The waste product generated by the thermal power plant is Fly Ash. Fly Ash is a stainless steel waste material. Both fly ash and GGBS are treated with sufficient technologies and used in concrete construction as geopolymer concrete. Through using this concrete the inventories of waste are reduced, and by decreasing Portland cement demand, carbon emissions are reduced. The key component of silicone and aluminum source geopolymers supplied by thermal-activated natural materials (for example kaolinite) or industrial byproducts (for example, fly ash, or plates) and an alkaline activation solution that polymerizes these materials into molecular chains and networks for the production of hardened binders. Often called inorganic cement or cement with alkaline activation.

1.3 Response Spectra:-

The plot is calculated by a series of oscillators of different natural frequencies, causing them to travel through the same base vibration, i.e. the move, velocity and acceleration (OR) It represents the continuum of maximal response during an idealized one-degree system with different natural cycles and given damping during a given earthquake ground motion.This is the most useful term in earthquake engineering and in applying seismological principles to the design of the structure by the powerful earthquake. In the case of the response continuum, the time differences in the response range are not taken into account, but the extreme value transmits the critical details relating to maximum powers, maximum displacement and maximum deformation, which must be capable of sustaining.

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2. Methodology

All the designs are designed to show both the vertical and lateral strength and rigidity needed for the structural efficiency and the acceptability deformity defined by the governing code of building for the seismic and seismic loads combined effects. Due to its safety factor, most structures appear to be adequately shielded from vertical shaking, in particular because of the design specification. In structures with wide spans, where stability for the design or the overall stability analysis for structures, vertical acceleration should be considered too.

In general, the majority of provisions on earthquake codes suggested that the structures would resist:-

• Minor damage-free earthquake.

• Mild earthquakes and certain non-structural accidents with minimal structural damage.

• Majors earthquake and non-structural disruption without collapse.

• It is expectable, in certain structural members, that the structure can undergo a reasonably highdeformation.

The seismic codes apply to a specific country or region. The core code that provides for the measurement of seismic design forces in India is IS 1893:2002 (part 1.). This force is conditioned by a seismic coefficient, and the structural mass of the structure, and then by characteristics such as the seismic field, structural importance, rigidity, soil and ductiles. In IS 1893:2002 the calculation of seismic stresses for various structures and buildings is addressed (part 1).

The estimation of the base shear and the distribution of its height. The study may be carried out by external intervention, structural or structural material behavior and the chosen structural mode form. In all these instances, the system is discreet and the mass is contained in floors, which comprise the top and bottom of half of the column and walls. Furthermore, it also lumps in live loads on this floor.

Seismic analysis of the structure is important to determine seismic responses. Depending on the type of external action and the behavior of the structure, this review can further be defined as:

• Linear Static Evaluation
• Equivalent static analysis
• Linear Functional Analysis
• Answer to spectrum
• Linear History Review
• Non-linear static analyzing
• Drive over research
• Dynamics non-linear analysis.
• Nonlinear time history review
• Linear static analysis or static equivalent approach can be used for regular limited-height structures.

Dynamic linear analyzes can be conducted with a spectrum response approach. Intensity degree and its distribution in the structural height is the major difference between linear static and linear dynamic studies. The inelastic comportement of the system over linear, static or dynamic analyses is enhanced by nonlinear static analysis. A nonlinear dynamic analysis is the only way of understanding the real actions of an organization during an earthquake. In the direct numerical integration of differential motion equations the method is based on the elasto-plastic distortion of the structural component.

3. Modelling

Analysis data:-

1	**Details of the building**	
i)	Structure	OMRF
ii)	Number of stories	G+10
iii)	Type of building	Regular and Symmetrical in plan
iv)	Plan area	10.5 m x 14.5 m
v)	Height of the building	33 m
vi)	Support	Fixed
vii)	Seismic zones	III
2	**Material properties**	
i)	Grade of concrete	M30
ii)	Grade of steel	Fe415
iii)	Density of reinforced concrete	25 kN/m3
iv)	Young's modulus of M30 concrete, Ec	27386.13 KN/m2
v)	Young's modulus steel, EG	247800 KN/m2
vi)	Poissions ration$_2\mu_c$	0.2
vii)	Poissions ration$_2$ μ_G	0.15
viii)	Young's modulus steel, Es	2 x 108kN/m2

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3	**Type of Loads & their intensities**			
i)	Floor finish			1.5 kN/m2
ii)	Live load on floors			2 kN/m2
iii)	External wall load on beams			11.5 kN/m2
iv)	Internal wall load on beams			5.27kN/ m2
4	**Seismic Properties**			
i)	Zones	III		0.16
ii)	Importance factor (I)			1
iii)	Response reduction factor (R)			5%
iv)	Soil type			II
v)	Damping ratio			0.05
vi)	Wind Speed – Zone III			39 m/sec
vii)	Wind coefficients Terrain category Risk coefficient Topography			 2 1 1
5	**Member Properties**	**No. of stories**	**Grade**	**Section sizes (mm)**
i)	Column	All	M30	450 x 450
ii)	Beam	All	M30	500 x 230
iii)	Slab	All	M30	175

Structural models from ETABS: (Plan and 3D view of flat slab structures):

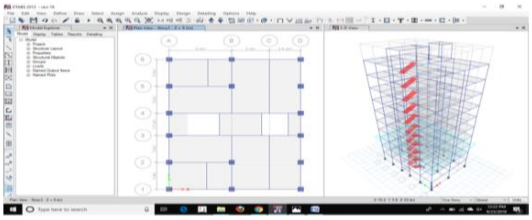

Figure 3.1 Plan and 3D view of the Structure

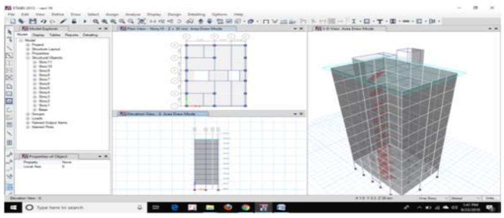

Figure 3.2 Plan, Elevation and 3D View of the structure

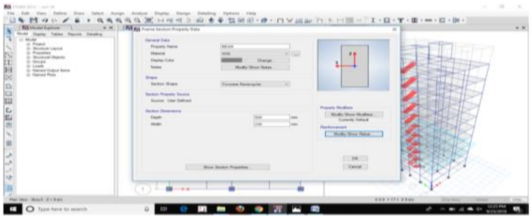

Figure 3.3 Defining of Beam

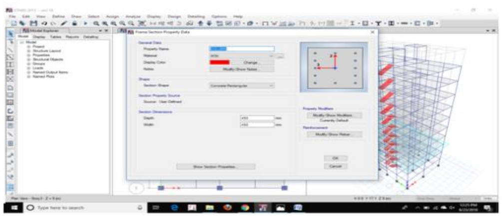

Figure 3.4 Defining of Column

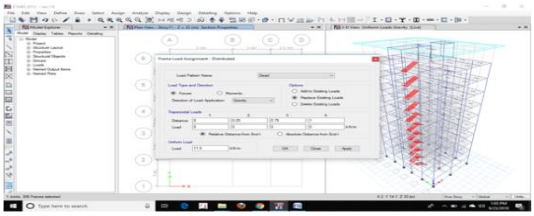

Figure 3.5 Defining Outer Wall Load

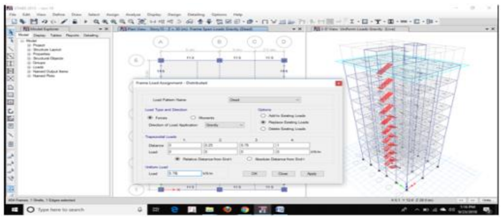

Figure 3.6 Defining Inner Wall Load

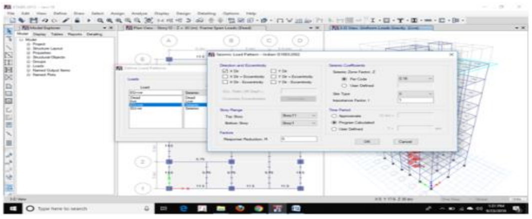

Figure 3.7 Defining the Earth Quake Load

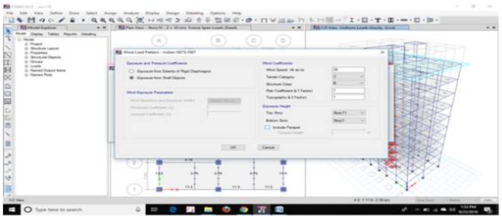

Figure 3.8Defining the Wind Load

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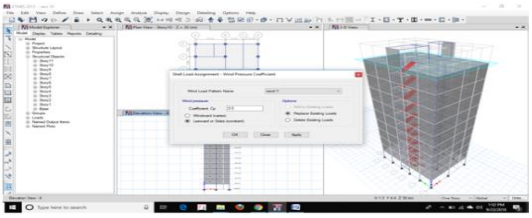

Figure 3.9 Assigning the Wind Load

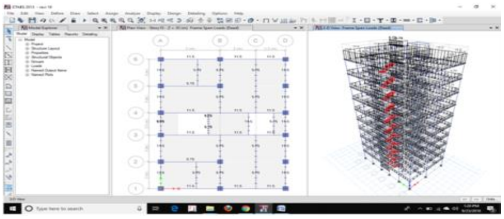

Figure 3.10 Assigning of Loads

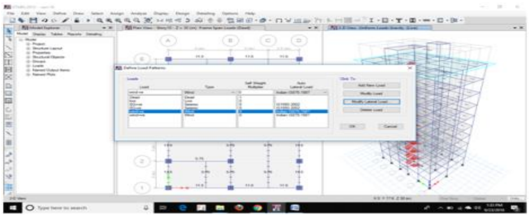

Figure 3.11 Loading Patterns

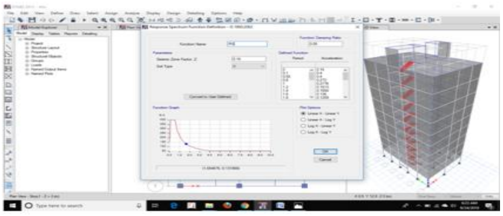

Figure 3.12 Defining Response Spectrum Data

4. Results And Discussions

1. Story displacement:-

It's the full relocation of the story from the field. The story displacement of modular structures in zone III using the X-direction response spectrum process.

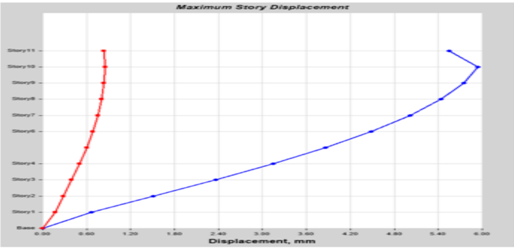

Fig 4.1 Story Displacement of conventional Concrete in zone III in X- Direction Using Response Spectrum Method

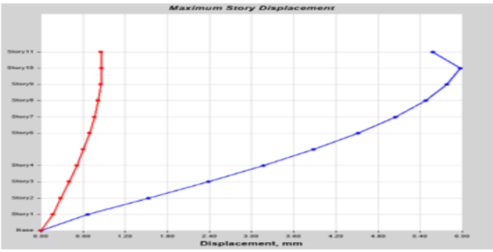

Fig 4.2 Story Displacement of Geo-Polymer Concrete in Zone III in X- Direction Using Response Spectrum Method

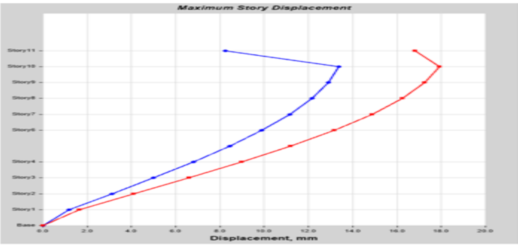

Fig 4.3 Story Displacement of conventional Concrete in zone III in Y- Direction Using Response Spectrum Method

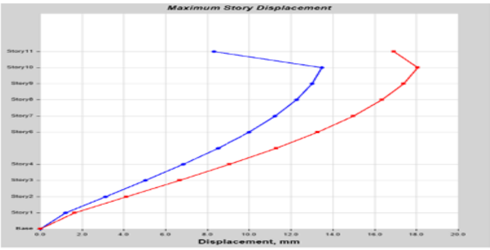

Fig 4.4 Story Displacement of Geo-Polymer Concrete in Zone III in Y- Direction Using Response Spectrum Method

2. **Story drifts:-**

Story Drift is characterized as the two consecutive floors displacement ratio to the height of that building. Frame structure shortcomings are due to the contributions in flexure and shear mode. Higher axial forces and deformations in columns and their effects build-up over higher structures render bending part displacement dominant.

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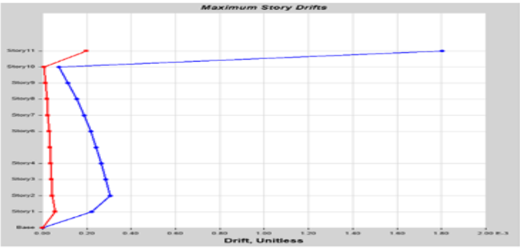

Figure 4.5 Story Drift of conventional Concrete in zone III in X- Direction Using Response Spectrum Method

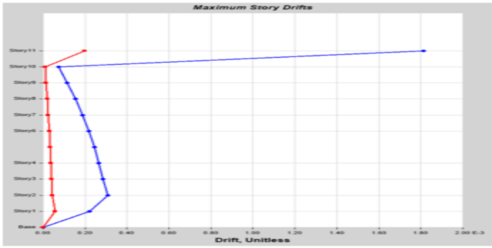

Figure 4.6 Story Drift of Geo-Polymer Concrete in Zone III in X- Direction Using Response Spectrum Method

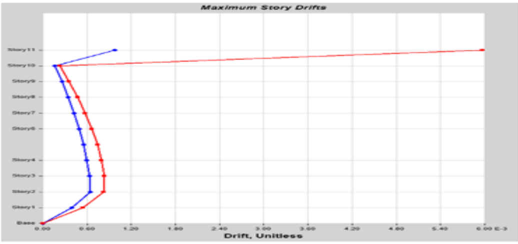

Figure 4.7 Story Drift of Modular Structures in Zone III using the Y-Direction using Response Spectrum method

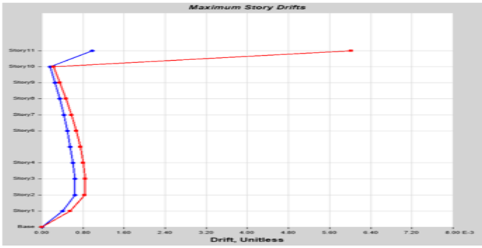

Figure 4.8 Story Drift of Geo-Polymer Concrete in Zone III using the Y-Direction using Response Spectrum Method

3. **Story shear:-**

Base shear is an approximation of the high lateral force predicted to occur at the base of a structure due to seismic soil motions. The shaving factor is the shear strength ratio of the story when a story collapse takes place with the shear strength of the story when the complete collapse is present.

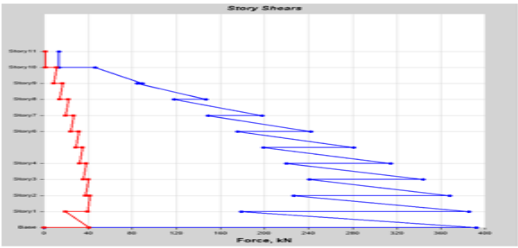

Figure 4.9 Story Shear of Conventional Concrete in zone III in X-Direction Using Response Spectrum Method

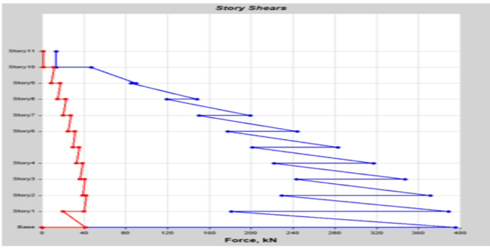

Figure 4.10 Story Shear of Geo-Polymer Concrete in zone III in X-Direction Using Response Spectrum Method

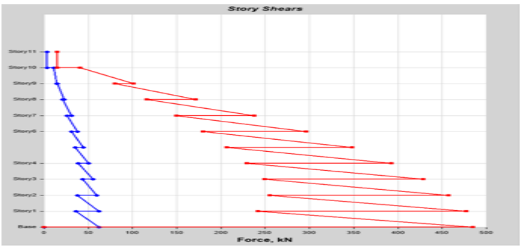

Figure 4.11 Story Shear of Conventional Concrete in zone III in Y-Direction Using Response Spectrum Method

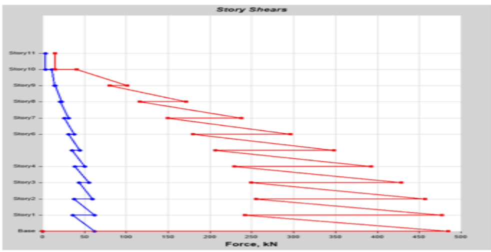

Figure 4.12 Story Shear of Geo-Polymer Concrete in zone III in Y-Direction Using Response Spectrum Method

4.**Story Stiffness:-**

In the lateral rigidity of a story Ks the proportion of story shear to story drift is generally established. When frames are laterally normal, the load distributions are small enough to ignore the differences in the side rigidity of a given story in many load cells.

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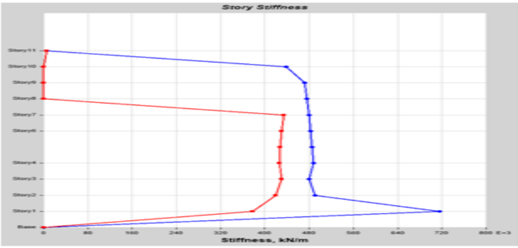

Figure 4.13 Story stiffness of Conventional Concrete in Zone III in X-Direction Using Response Spectrum Method

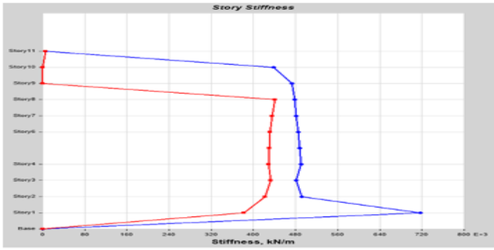

Figure 4.14 Story Stiffness of Geo-Polymer Concrete in Zone III in X-Direction Using Response Spectrum Method

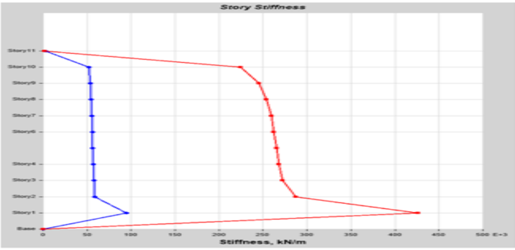

Figure 4.15 Story Stiffness of Conventional Concrete in Zone III in Y-Direction Using Response Spectrum Method

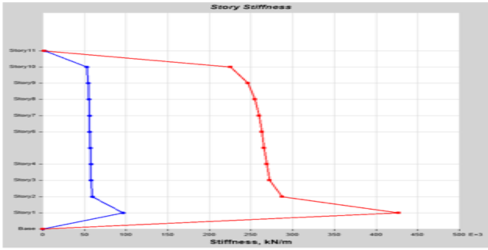

Figure 4.16 Story Stiffness of Geo-Polymer Concrete in Zone III in Y-Direction Using Response Spectrum Method

5. CONCLUSION

The seismic pattern behavior in seismic zone III is discussed, and seismic comportements are contrasted between a structure with traditional concrete and geopolymer concrete structure with a response continuum process i.e. displacement of the storyteller, history drifts, historical shear and history stiffness. The results of the results obtained are discussed in depth in this chapter.

The maximum change between conventional concrete and geopolymer concrete is 3.22 percent, but even when compared with conventional concrete, it can be seen that the displacement is higher at the coded limits.

READ. The overall drift in the story between traditional concrete and the geopolymer concrete is 2.7%.

The maximum shear story between a traditional concrete framework and a geopolymer concrete structure, as opposed to conventional concrete, raises the shear story, which resists seismic loads as compared to conventional concrete, but we can see that we are still able to use the geopolymer structure, which is more than 2.2 percent.

The maximum stiffness of the tale between the traditional framework of concrete and the geopolymer structure is 1.64 percent.

We concluded that the structure of the tension and of traditional concrete and the spatial structure, with its built structure, could be used even though the seismic charge and the wind charge plays a large part for this in its architecture. But by using the structure of the geo-polymer concrete, it can be inexpensive, but the environmental construction can only be promoted, at that time.

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