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Analysis of a Tall Structure Considering Precast Hollow Flat and Pretensioning Slab Considering Lateral Load using ETABS

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ABSTRACT

As the number of residential, commercial, and institutional buildings increases, a substantial portion of the national capital and construction budget is allocated to the construction of concrete building structures. Precast Hollow Core Slabs (HCS) have, however, proven to be more desirable than RCC slabs in recent years due to the demand for affordable and speedy construction, and they have been suggested as a feasible substitute for RCC slabs. This study presents a comparative examination of a G+9 story structure employing three different slab types: post tensioned slab, precast hollow slab, and flat slab. All case studies are modeled and analyzed using the analytical program ETABS, and the outcomes are compared with respect to the parameters of storey displacement, storey shear, and base shear, and base

Keywords : Precast Hollow Core Slab, Storey Drift , Story Shear, Lateral Displacement

I. INTRODUCTION

It is the underlying architect's liability to ensure that the fabricated climate can areas of strength for endure occasions like breeze, seismic tremors and traffic. All Manufacturers need to know how their assembled climate responds to these unique activities. An immediate aftereffect of tremors is that many individuals pass on from the breakdown of designs and rubble, and over the long haul, a large number of individuals lose their homes because of the breakdown of structures and the vulnerability and reproduction process and the designing division plan the immediate result of these program by better the seismic reaction of building designs and working ceaselessly to work on the seismic plan.

A construction moves horizontally and in an upward direction during a tremor because of surface ground movement driven on by seismic waves. In most cases, the ground is moving faster (ag) and has a significantly greater lateral motion than vertical motion. This horizontal movement makes the structure experience inertial powers, which are determined as the amount of the construction's mass (m) and speed increase (a). As indicated by Newton's Subsequent Regulation (Power = Mass x Accleartion). The fundamental factors that determine a structure's response to an earthquake are its mass, size, and configuration.

Flat Slab

Drop panels are square slabs that have a one- or two-sided support system and are referred to as "flat slabs." The slab's sheer force is concentrated on the supporting columns. Drop boards are vital in this present circumstance since they increment the general strength and limit of the ground surface framework underneath the upward loads while likewise working on the development's expense adequacy. Commonly, the level of drop boards is twofold that of the section.

For most of development projects as well as lopsided segment plans like bended or sloped floors, level pieces are viewed as reasonable. Applying level pieces has different advantages, remembering adaptability for plan course of action, level soffit, and profundity arrangements. Even though it can be expensive to build flat slabs, it gives architects and engineers a lot of freedom with their designs. The utilization of level pieces enjoys various benefits, not just regarding future plan and design viability yet in addition for the whole development process, especially for smoothing out establishment cycles and eliminating development time. Make the most of the thickness of flat slabs rather than drop panels by avoiding their use as much as possible. To keep up with the benefits of level soffits for the floor surface and to ensure that drop boards are given a role as a component of the section, this is important.

Fig 1 Flat Slab

II. LITERATURE REVIEW

Vanteddu Satwika and Mohit Jaiswal (2022) In the examination report, a level chunk was fortified utilizing the post tensioning methodology. Contrasting RCC level pieces with post-tensioned fat sections with different ligament profiles, both scattered and joined ligaments were utilized. The boundaries were assessed: thickness, supporting responses, punching shear, and diversion when contrasted with ordinary level chunks. The models were built as per ACI 318-14, and these piece models were created utilizing ETABS programming.

The outcomes demonstrate that post-tensioned level chunks have better punching shear limits even at more profound profundities, prompting segments that are all the more financially sound. Lower redirection is one more advantage of the consideration of ligaments.

Distributed tendons are more successful at reaching shallower depths than banded tendons. The post-tensioned flat slab required fewer construction materials because there was less dead weight and fewer support responses. Subsequently, development costs are lower. Because of the lower support reaction for PT pieces, less segments and less support are expected for the parts that bear load from the chunks, for example, sections and establishments, which brings down the expense of development generally. A flat slab's punching shear strength can be increased even at shallower depths by employing the post-tensioning method. This resolves one of the primary issues with the flat slab design. By including post-tensioning ligaments, descending diversions can be altogether diminished, bringing about great functionality. The most proficient strategy, while considering the whole adequacy of the level piece, is the arrangement of scattered ligaments along with drop.

Dheekshith K and Prasad Naik (2021) research paper looked at the reaction of RCC section building and empty center piece under the seismic burden conditions for a G+9 story structure demonstrated utilizing insightful application ETABS considering shear walls on the sides. As empty center sections can't be straightforwardly demonstrated by ETABS, Optional Pillars were taken on with similar aspects as Empty Center Chunks. The empty center piece were displayed utilizing ANSYS(Investigation of Frameworks programming). Three models were assessed for each RCC working in Zones 3, 4, and 5 and for every normal roof structure.

Results expressed that story uprooting expanded for empty center chunk contrasted with RCC structure. Storey's hollow core slab building acceleration is lower in the X direction than that of the RCC building, but it is higher in the Y direction. When contrasted with RCC building, empty center section development takes less time and has less story float. Because the building is lighter, hollow core slab construction has a lower base shear than RCC construction.

Omar Ahmad (2021) In an exploration work, an expense examination of post-tensioned and built up substantial level sections was introduced. As per the article, less concrete is required for post-pressure sections than for level chunks in light of the fact that the post-strain pieces are more slender and there are less segments given. A hydraulic jack extends the special steel tendons that were used in post-tensioned slabs after the concrete is cast, eliminating the need for reinforcement steel bars. Albeit just post-pressure chunks use ligaments, there is less steel utilized in post-strain sections than in level pieces. The expense of the worker for hire's work shifts relying upon whether a level section or a post-tensioned chunk is being constructed. The study compared the costs of concrete, steel, and contractor work.

The results of the comparison study between flat slabs made of reinforced concrete and post-tension slabs indicate that post-tension slabs are less expensive.

OBJECTIVES:

- To justify the utilization of hollow slab
- Modelling and analysis of structure using etabs
- To evaluate the performance of RCC and hollow core slabs adapt to seismic load conditions. To calculate the seismic zone IV responses of RCC slab frame buildings and hollow core slab buildings.

III. METHODOLOGY

Step 1: The research papers were reviewed which used different slab systems for structural stability.
Step 2: Defining the grid system as per ETABS in x and y direction and preparing the plan of the structure for the structure storey data as G+9 storey structure is considered with typical storey height and bottom storey height is 3m.

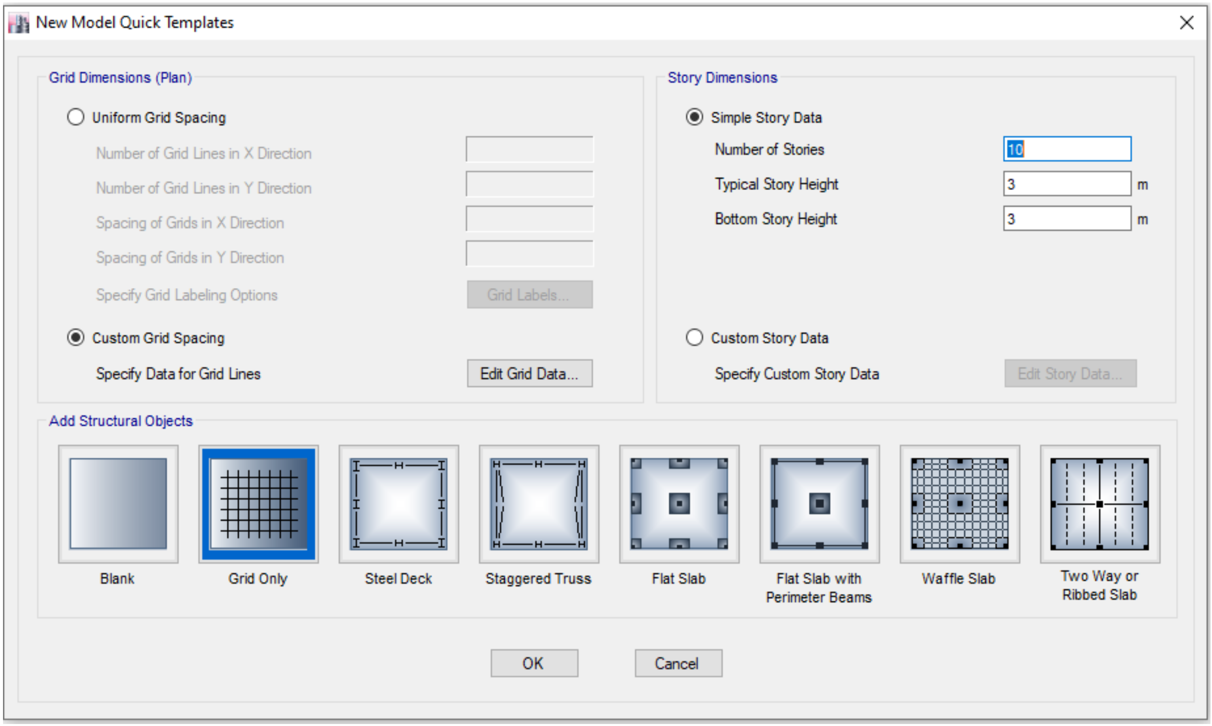


Fig 2 Model Template

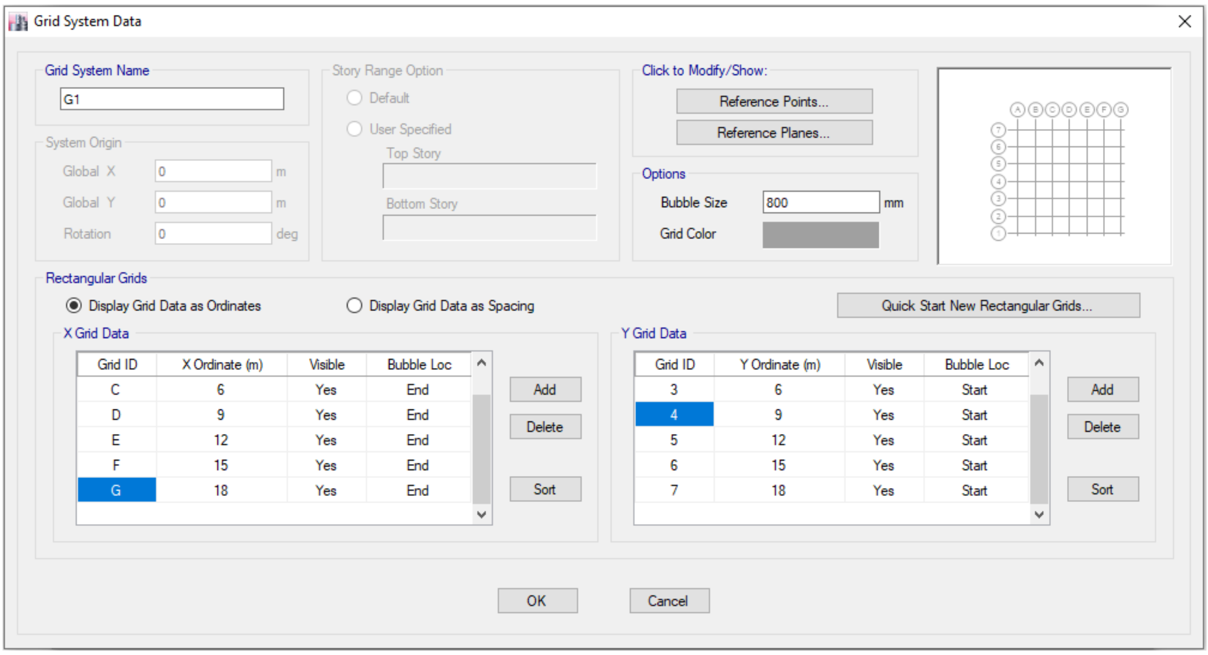


Fig 3 Grid System Data

Step 3: Defining material properties of column, beam and slabs.

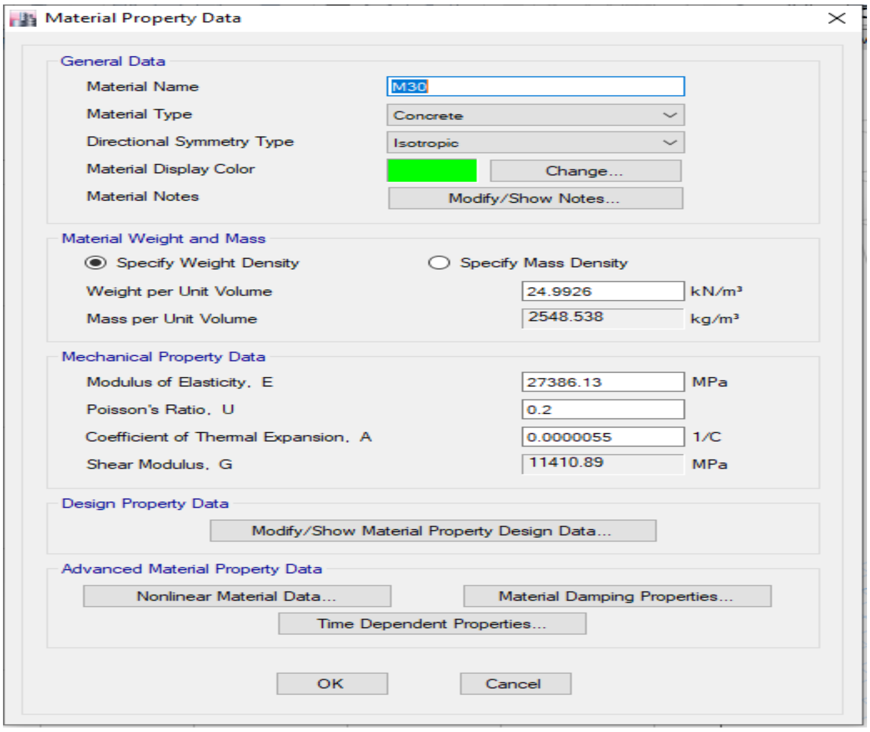


Fig 4 Material Properties for Concrete

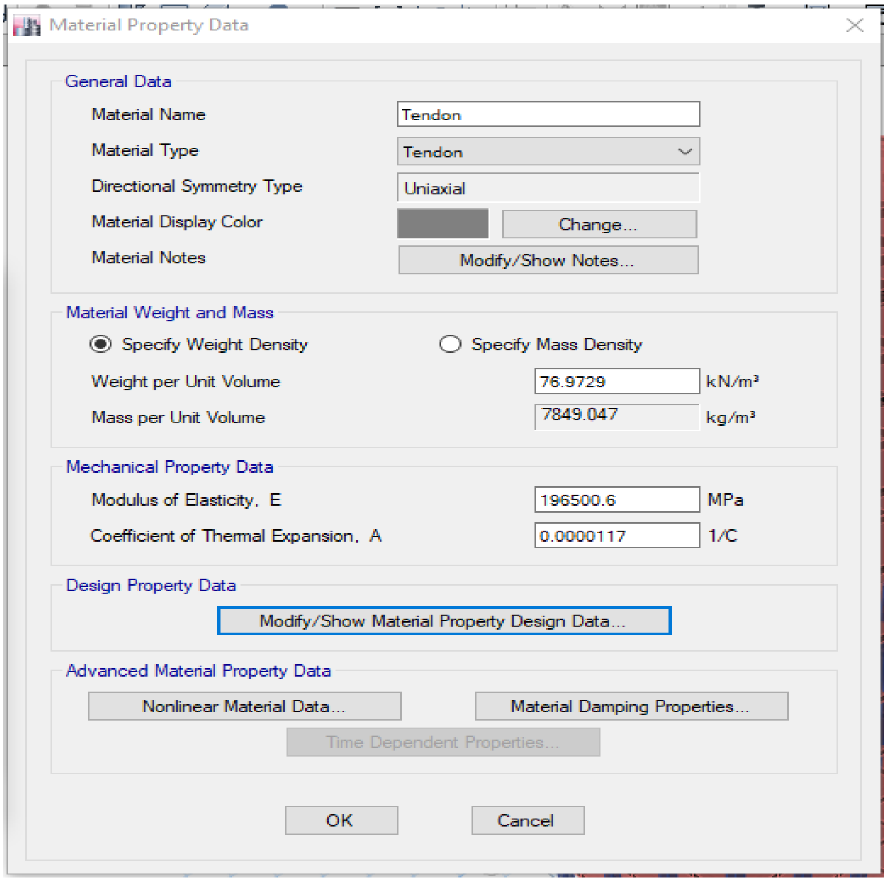


Fig 5 Material Properties for Tendons

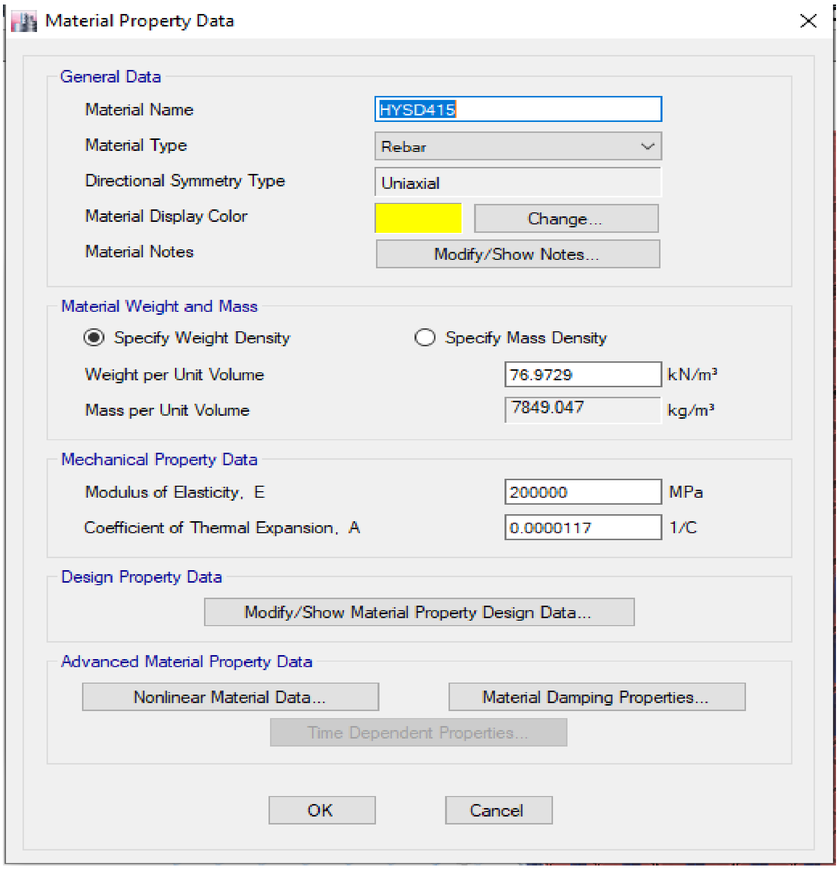


Fig 6 Material Property Data for Rebar

Step 4 Defining sections properties for the size of column, beams and slab.

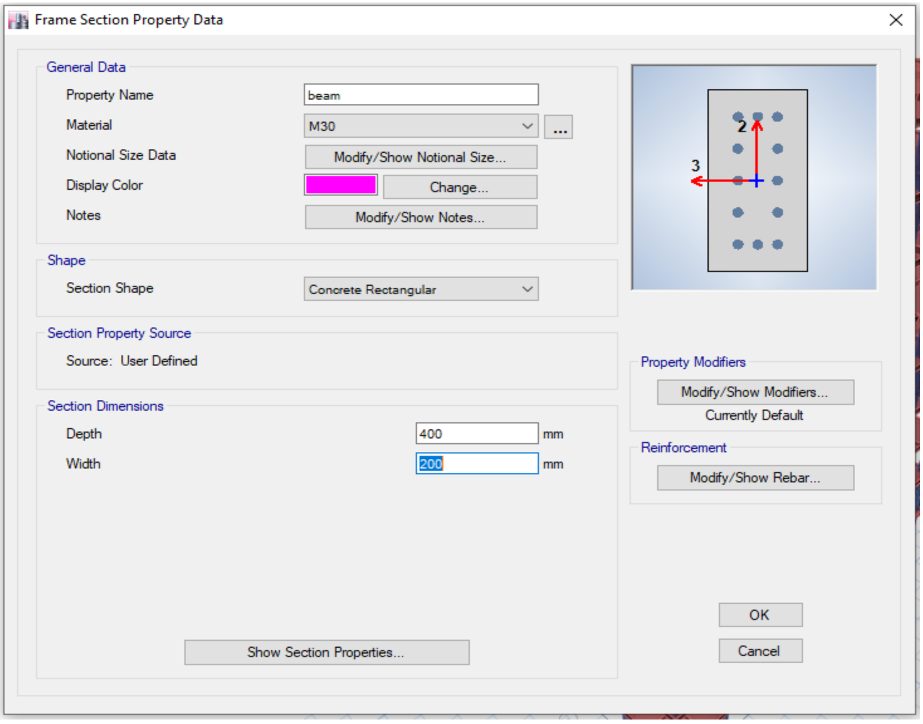


Fig 7 Section Properties for Beam

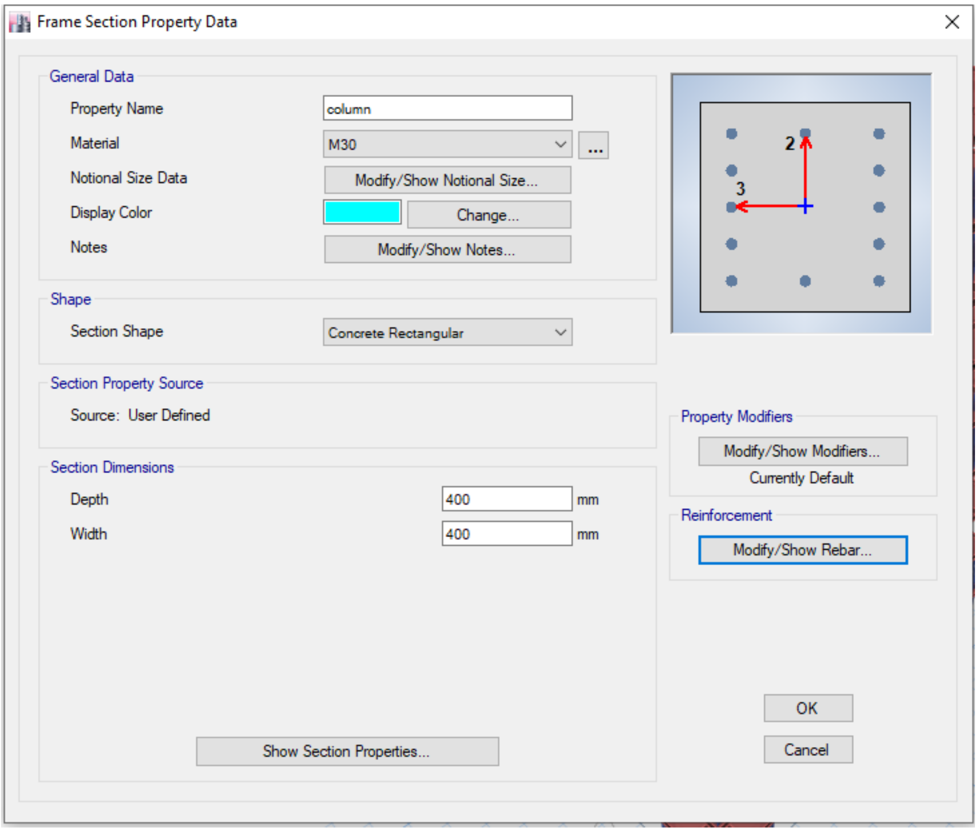


Fig 8 Defining section properties of beam and column.

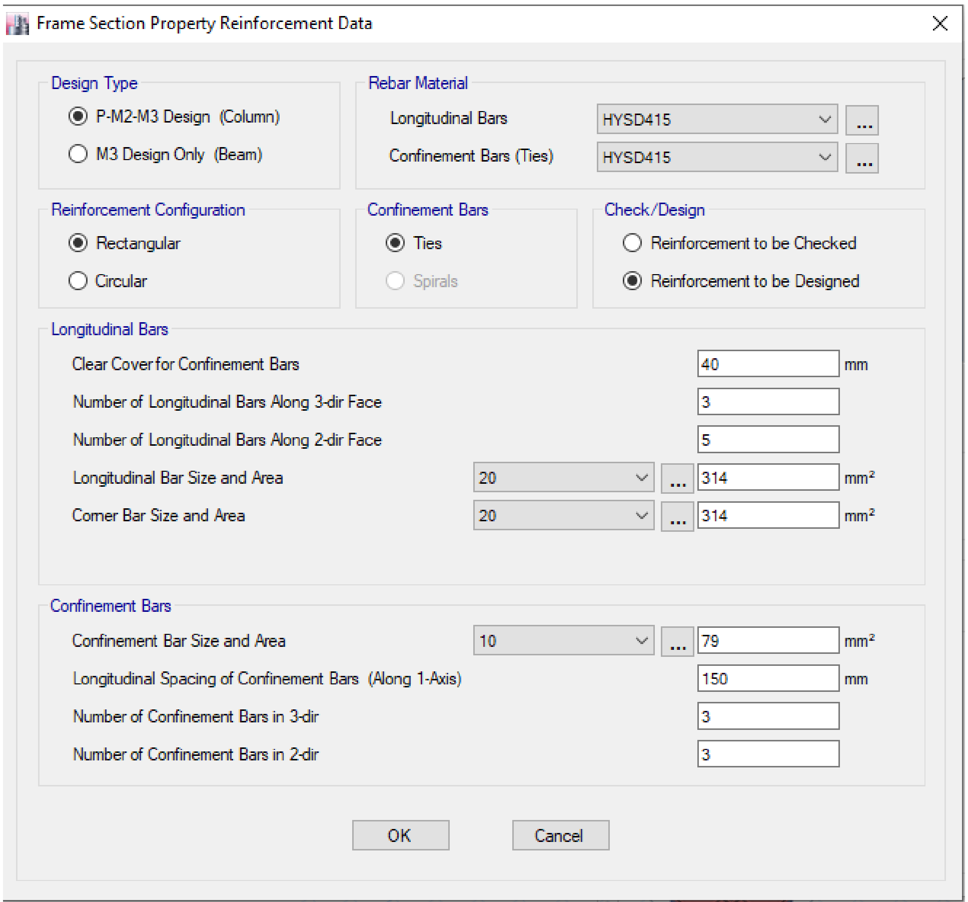


Fig 9 Frame Section Property Reinforcement Data

Step 5 Defining Properties of Slab Data

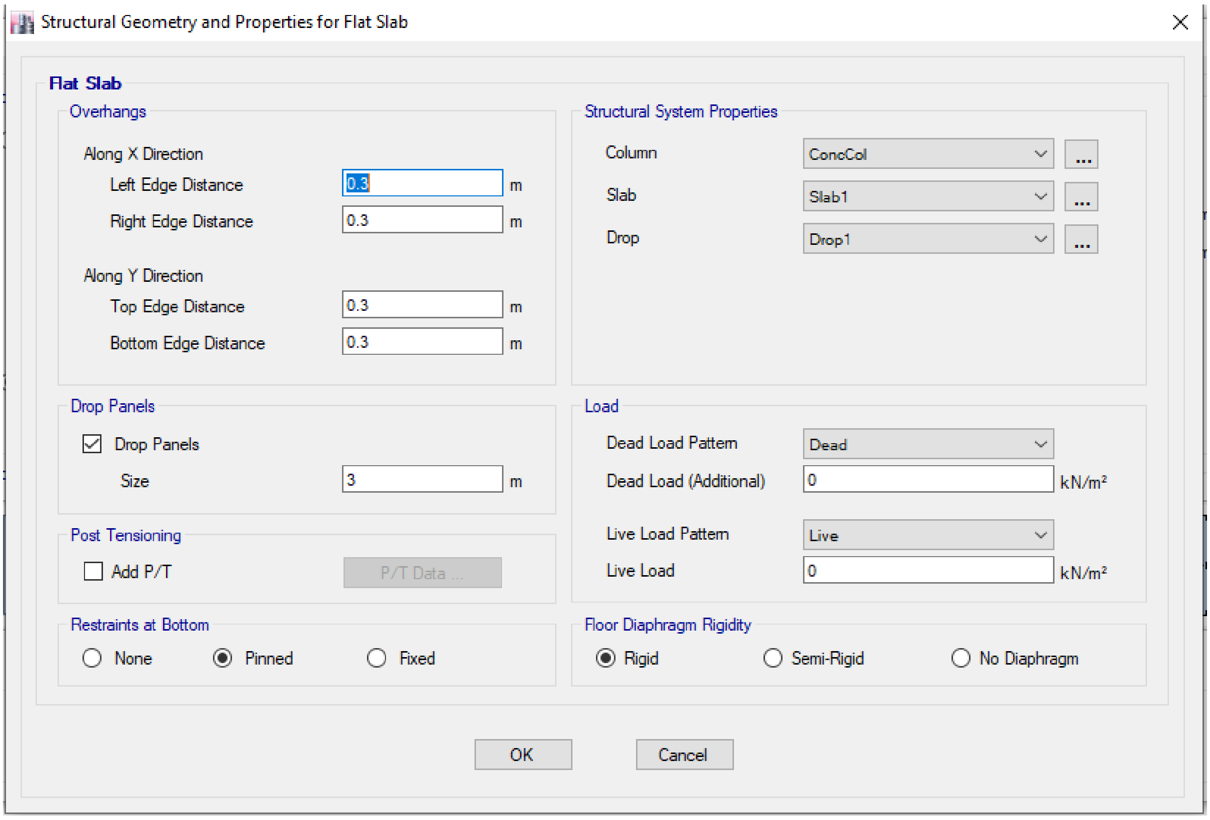


Fig 10 Structural Geoemtry and Properties for Flat Slab

Step 6: Defining Loading pattern for dead load, live load and earthquake load.

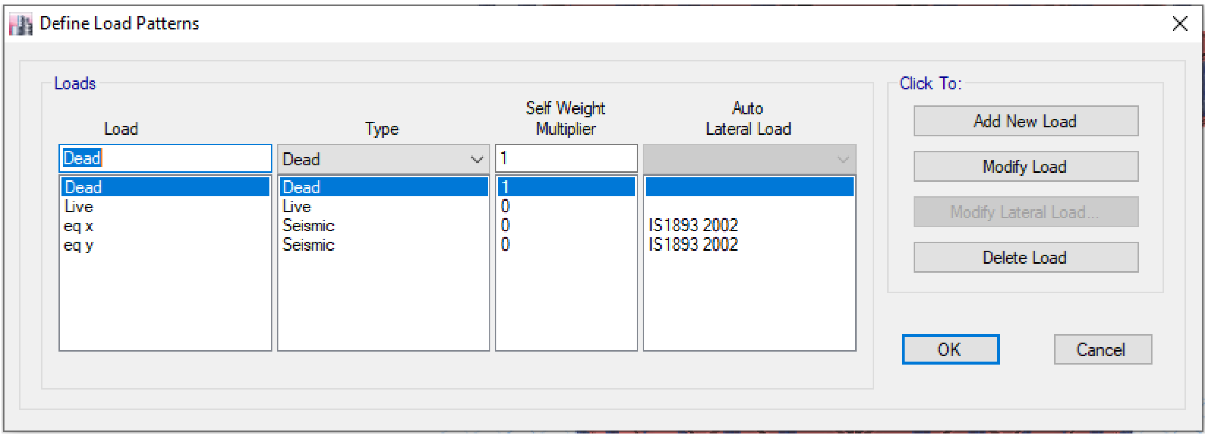


Fig 11 Load Pattern

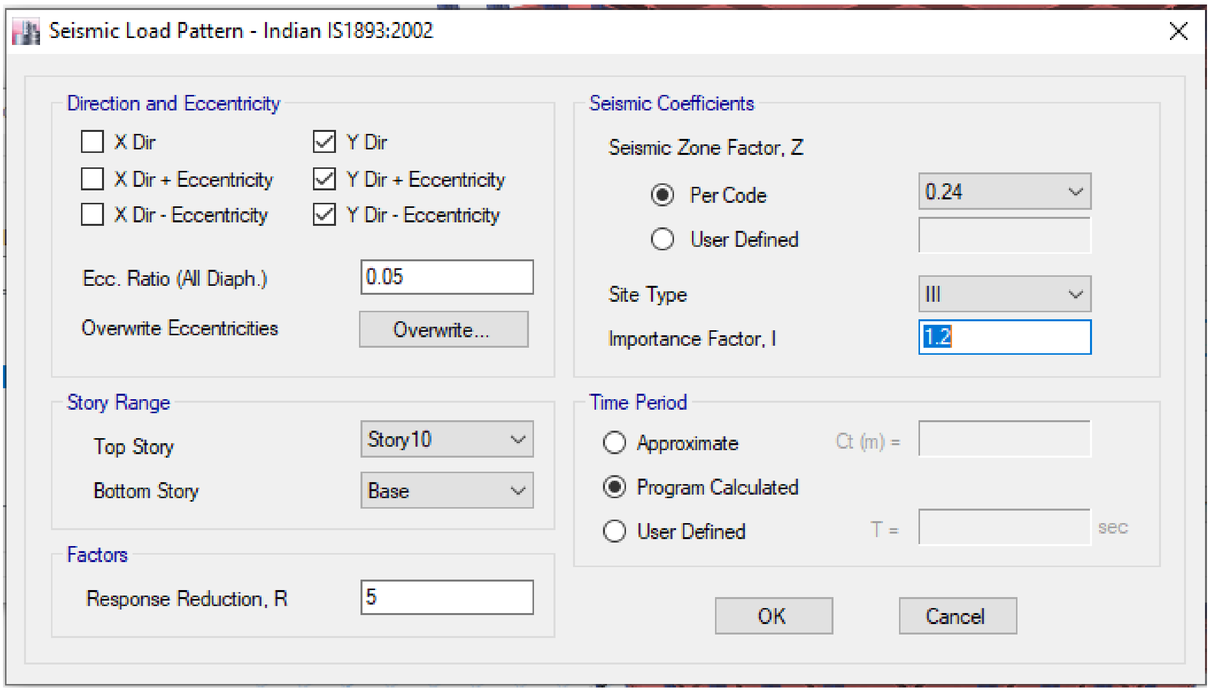


Fig 12 Defining Seismic Load Pattern as per IS 1893:2002.

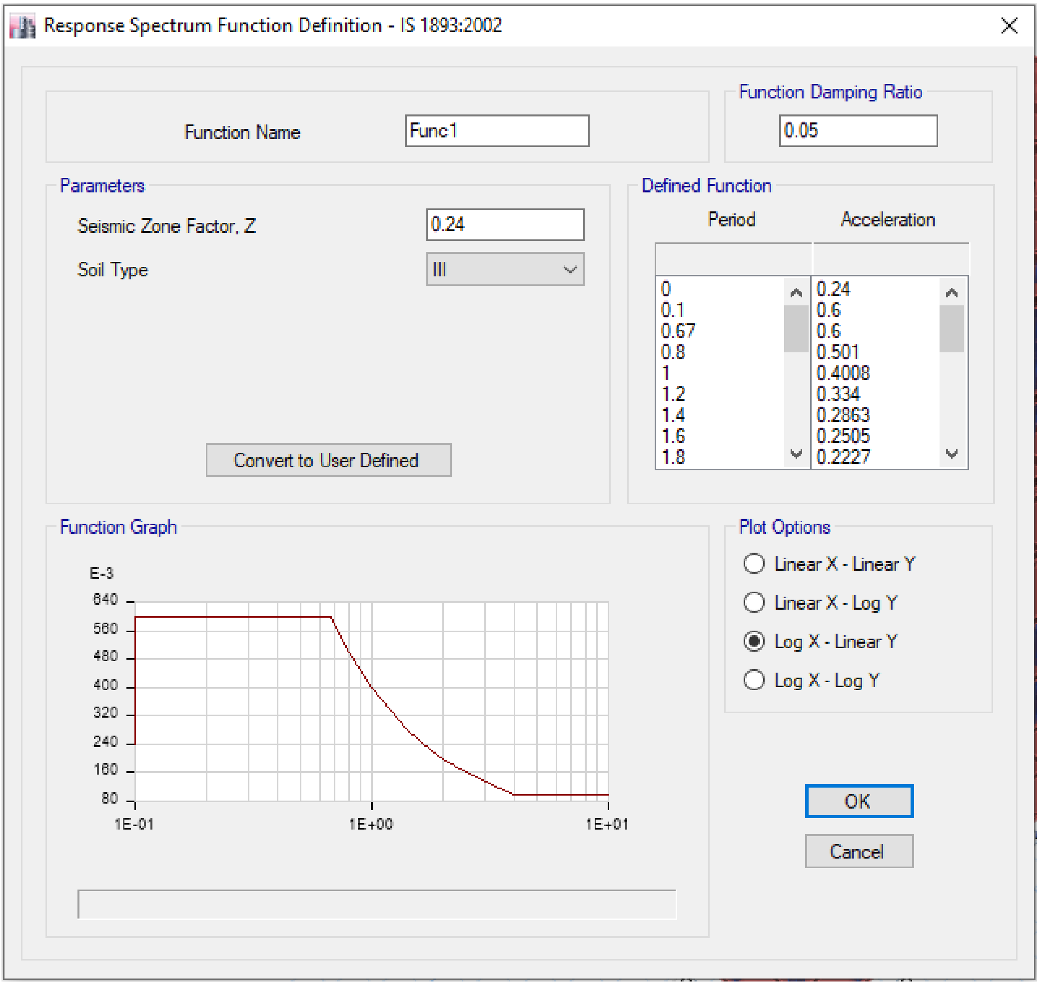


Fig 13 Response Spectrum Function as per IS 1893:2002.

Step 7 Analysing the structure on the parameters of displacement, drift and stiffness.

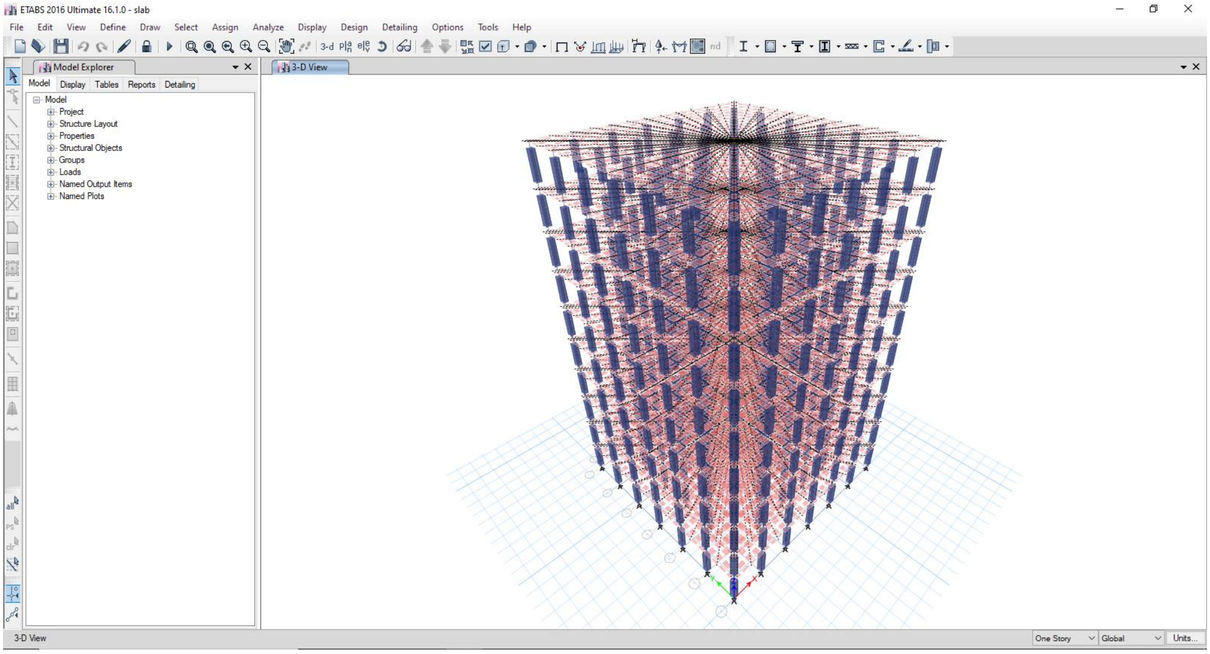


Fig 14 Stress Analsyis

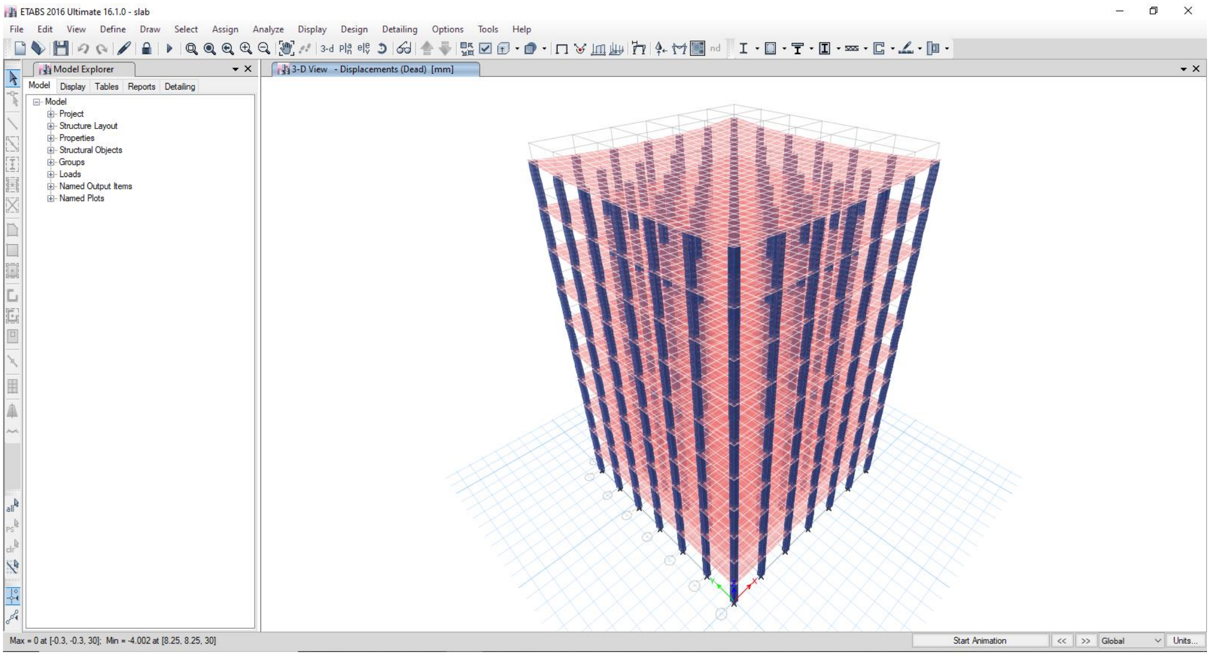


Fig 15 Dead Load

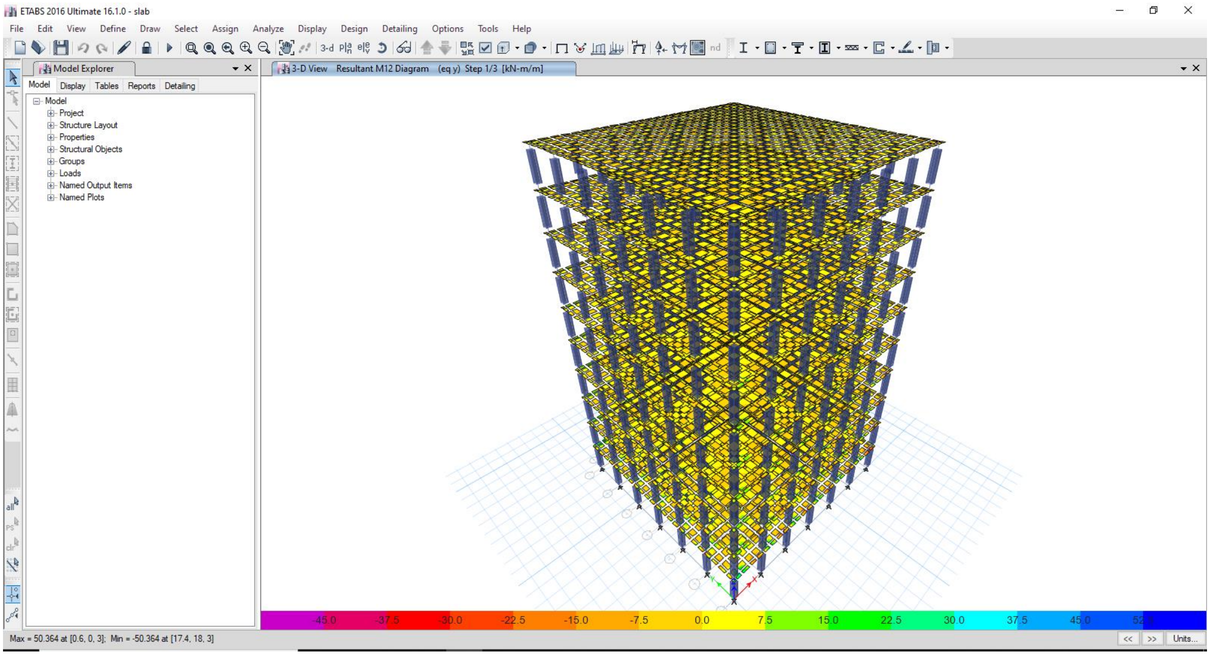


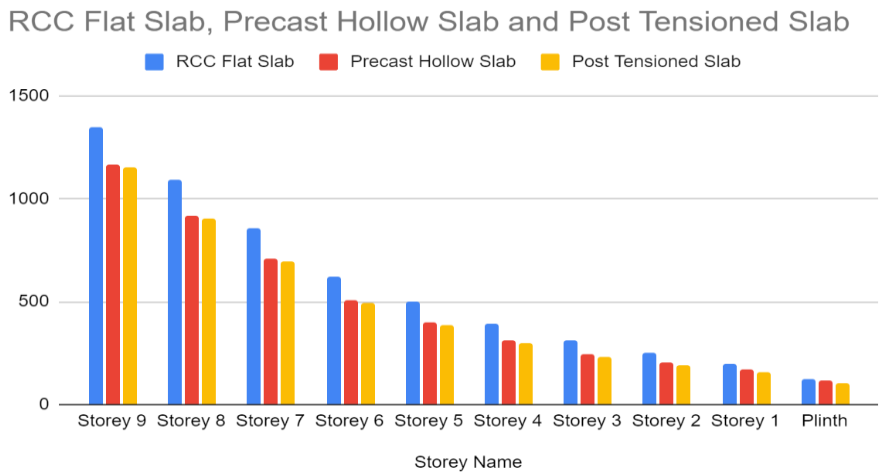
Fig 16 Concrete Slab Stress

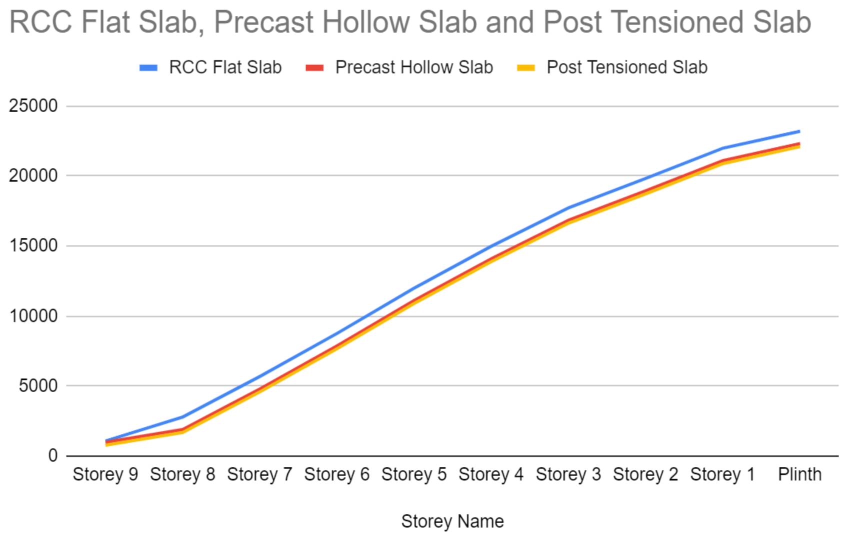
Step 8 Sumamrizing the results generated from ETABS for all the three cases and presenting the graphical representation as per the tabulated data.

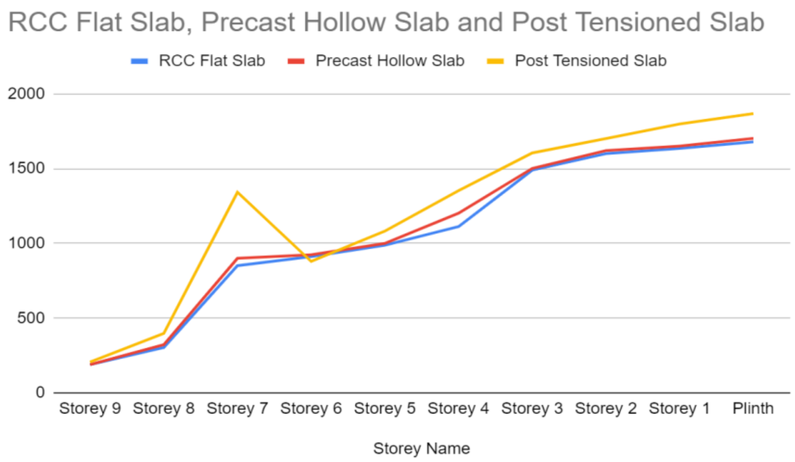
Table 1 Building Configuration

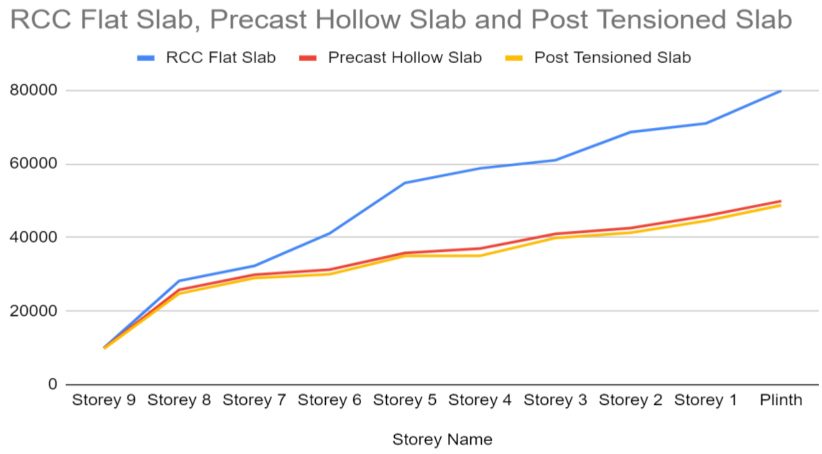
Building Description	
Description	Values
Building size	18*15 m
Number of storeys	G+9
Height of Storeys	3m
Bottom Storey Height	3m
Beam	400*200mm
Column	400*400mm
Flat Slab	210mm
Post Tensioned Slab	200mm
Precast Hollow Slab	175mm

IV. ANALYSIS RESULT









V. CONCLUSIONS

It was analyzed that PT piece firmness is a lot of productive in contrast with Level chunk outline framework and Precast Empty Section outline in decreasing second, story removal, displacement

Displacement:
The lateral force-resisting system can control the building's excessive lateral movement. The satisfactory sidelong removal limit on account of a breeze load is H/500 (yet certain individuals might utilize H/400). Story removal was found most extreme at the popular narrative story in structure with Level section 1349.921 mm when contrasted with structure with precast empty piece 1167.116 mm and 1154.216 mm which expresses that story uprooting was story relocation was 8% more when contrasted with Case II and 9% more when contrasted with case III. As far as dislodging it very well may be reasoned that PT piece structure is relatively more steady 25% less relocation when contrasted with RCC Level section structure.

Axial Force:
The power working on a design in its hub bearing is known as a hub strain force. The body will extend straightly in the vertical course because of the pulling force, changing its aspect. Most extreme pressure was apparent at the lower part of the design with 23200.987 KN Level chunk. The design with post tensioned chunk was viewed as especially stable when contrasted with structure with precast empty piece and construction with Level Section. One might say that upward dispersion is by and large same in both the cases. Variety of 8% is seen in PT piece as it is really opposing and circulating.

Shear force: similar to the tension of wind stream over a plane wing, is a power that demonstrations toward a path that is lined up with (over) a surface or cross segment of a body. "Shear" in the term alludes to the capacity of such a power to slice through the surface or item that is being extended. Shear force was greatest at base in structure with Post tensioned piece which diminished continuously at the popular narrative. Shear force was tracked down least in the design with level piece. As far as unbalance compels it was seen that unbalance powers are straight in every one of the three cases, and values on PT section case is on the better quality with rough variety of 5%.

Bending Moment:
When an outside power or second is applied to a primary component, making it twist, the component answers by encountering a bowing

second. The bar is the underlying part that is twisted the most often or basically. Twisting second was most extreme in structure with Level section though bowing second was tracked down stable in structure with Precast Empty piece and design with Post Tensioned chunk. As far as bowing second it is seen that Pt section structure is relatively more prudent and stable design since finishing second noticed is less by 15%.

Future Scope

- The building can be compared to post-tensioned slab construction techniques.
- the behaviour of structures in various seismic zones and the behaviour of buildings with flat slabs and drops.

The effect of the shear wall on the structure can be examined.

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