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DESIGN OF DOUBLE BASEMENT SHOPPING COMPLEX USING POST TENSIONED SLAB

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Abstract:
Nowadays, design of modern an architectural building structure requires the use of slender and free from numerous supports slabs. The most suitable solution for above requirements is the post-tensioned slabs with unbounded tendons. Slabs prestressed by unbounded tendons are successfully used worldwide for several decades. During that time many recommendations dealing with the forming of geometry and prestressing, dimensioning and erection technology were issued. During the recent years prestressed slabs characterized by span and slenderness substantially exceeding recommended limitations were designed and erected with success in Poland. During the slabs erection and in two years of their using, the deflection of three oversized slabs was monitoring. In spite of designed the slabs significantly larger and slenderer than the recommended maximum value of span and span to depth ratio, the deflection of the slabs is definitely far from the limit value. The paper shows the design of the structure and detailing of the PT slab. The slab length is 17.5 m.

Key Word: Analysis of column, beam in STAAD PRO, Design of Foundation, Design of Slab, Detailing of PT Slab, Concrete Mix Design

1. INTRODUCTION

A double basement mutistoried shopping complex is planned and designed. The building length is 126' and width is 80'. Firstly the building was designed with two intermediate columns along the span. But to minimize the cost, for proper utilisation of the area and to do the central AC in the shopping complex the building is redesigned with no intermediate columns along the span. As the span length is increased upto 50' the beam depth is increased above 1 m. So the clear floor height is reduced. To minimize the depth of the beam it is planned to do the post tensioned slab in stead of normal slab. Firstly the building was designed in M20 grade of concrete and Fe 500D grade of steel. But after redesign of the building the grade of concrete is taken for column M40, slab and foundation is designed in grade of concrete is M30. The grade of steel is taken Fe500D. So the foundation size, column size is increased. Combined footing and raft foundation is designed in the building. In the PT slab post tensioned Tendons are used to reduced the depth of the beam.

2. LITERATURE OF REVIEW

Subhakankhi Choudhiry (2011): Carried study on analysis and design of a multi-storied residential building of S+G+4 by using most economical column method. The height of the building was 70 ft.The building was constructed in Patia Square, Bhubaneswar,Odisha.The wide of the building was 40'. The building was designed on most economically. The building was designed as per the NBC. The economizing was done by means of column orientation in longer span in longer direction as it will reduce the amount of bending and the area of steel was also reduced .

Ar.S.S. Roy (2013): Had presented study of single basement staff residence of four story residential building having three meters height for each storey. The whole building design had carried out according to IS code for seismic resistant design and the building had considered fixed at base. Structural element for design had assumed as square or rectangular in section. The building was designed of width 50ft with one intermediate column. The column size was of rectangular shape. Most of the foundations was designed in isolated footing type.

Er.Subhasis Bose (2013) : had designed a building of 12 storied of width 24' using pot tensioned slab. He used STAAD PRO soft ware to design the footing and column. The building was designed for a market complex. Pile foundations were designed for this building. This building was constructed in Rourkela, Odisha. Light weight bricks were used in the building to reduce the dead load of the building. To reduce the floor load epoxy paints are used instead of fixing of tiles. The height of the building was 168'. Ground floor of the building was used for parking space.

Er.L.N.Barik (2009): Had designed a 4 stories parking space for a shopping complex in Kolkata,WB. Glass was used in the parking area for the elevation purpose. Two numbers of lifts were used in the building to take the four wheelers up

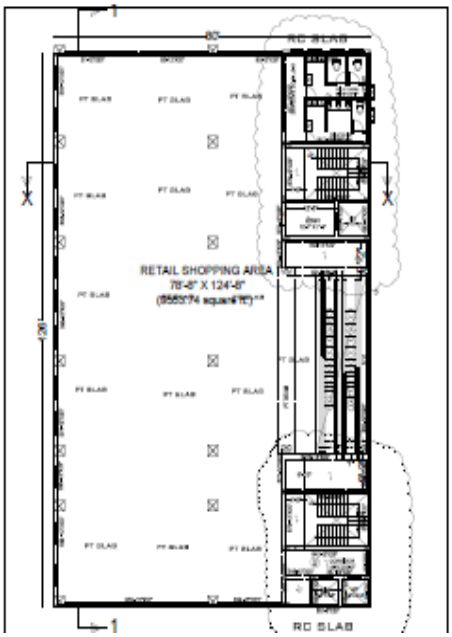
and down . The building were designed in a less space and park large numbers of vehicles. The terrace was designed using polycarbonate sheet and MS structures.

Er.N.K.Parida(2017) : Had designed a building of G+4 multistorey type shopping complex in CRP Square,Bhubaneswar. The building was designed as per the IS codal provision taking the fire and life safety in account. The slab was of PT slab. The building was designed taking wind and seismic load as per the IS codes. Most of the footings are of combined footings. Walls are constructed in hollows bricks to reduce the dead load of the building.

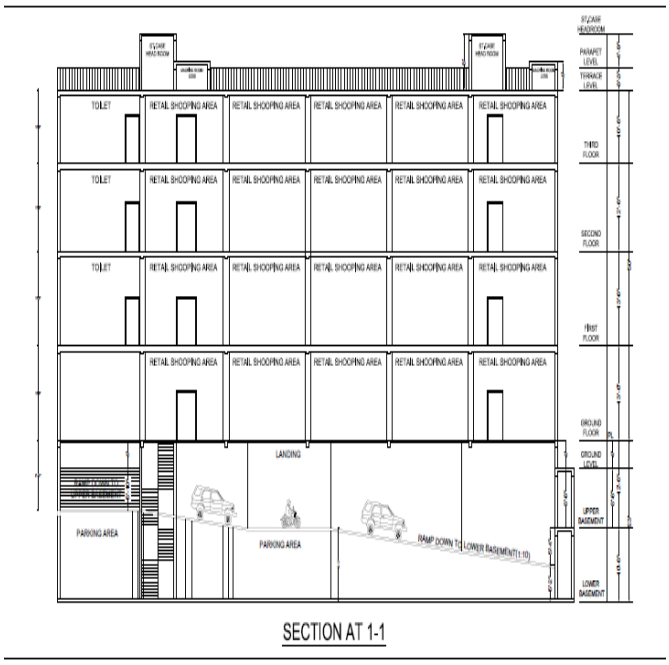
Er.Debraj Behera (2017) : Had planned and designed a double basement residential building in of 14 storied building. The height of the building was 145'. The building is designed as per the IS code provisions. Win load and Seismic loads are applied in the building while it was designed. Retaining walls were designed in the basement part. Inside partition walls were 6" instead of 10" to reduce the dead load of the building. Pile foundations were designed for this building. The building was designed in economically. The plinth area of the building was 15000 Sqft.

3. BUILDING DETAILS

The length of the building 126' and wide is 80'. The plinth area of the building is 1008 Sqft. The height of the building from ground level is 56'. The building is of double basement + 4. The two basements are planned for parking for two wheelers and four wheelers. The upper four floors are planned for shopping are. One lift and one escalator are used in the building. Two numbers of stairs cases are used in the building. The building is planned as per the life and fire safety precautions. There is no intermediate column in between the shopping area of a width 50'. The slab of the building is designed using PT slab to reduce the depth of the beam. So the clear height of one floor is increased. High tensile tendons are used in the PT slab. So the quantity of reinforcement and concrete is reduced. M40 grade of concrete is used in columns and M30 grade of concrete is used in foundation and slab. Fe500D grade of steel is used in the building design. Isolated footing, combined footing and raft foundation are designed in the building. The building is designed using STAAD PRO.



Plan



Section

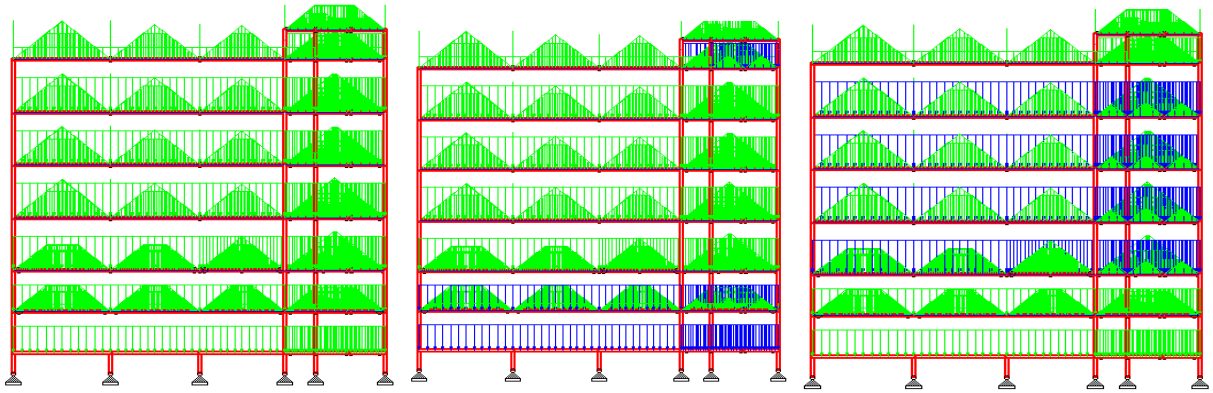
4.LOADS

Loads applied on the structure:

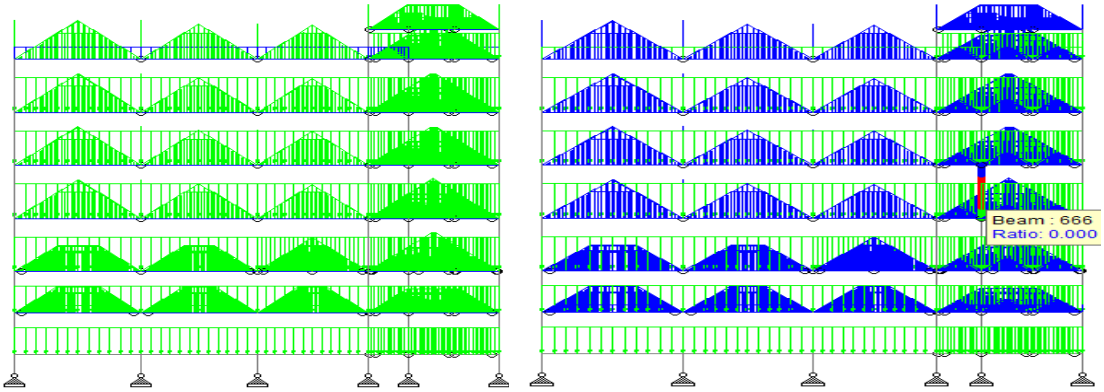
- Dead Load
- Live load
- Wind load
- Seismic Load

Dead Load :

Self Weight taken= 6.25 KN/m2
Brick load = 14 KN/mm2
Brick load = 10.8 KN/m2
Parapet brick load = 5 KN/m2
Floor Load =0.5 KN/m2



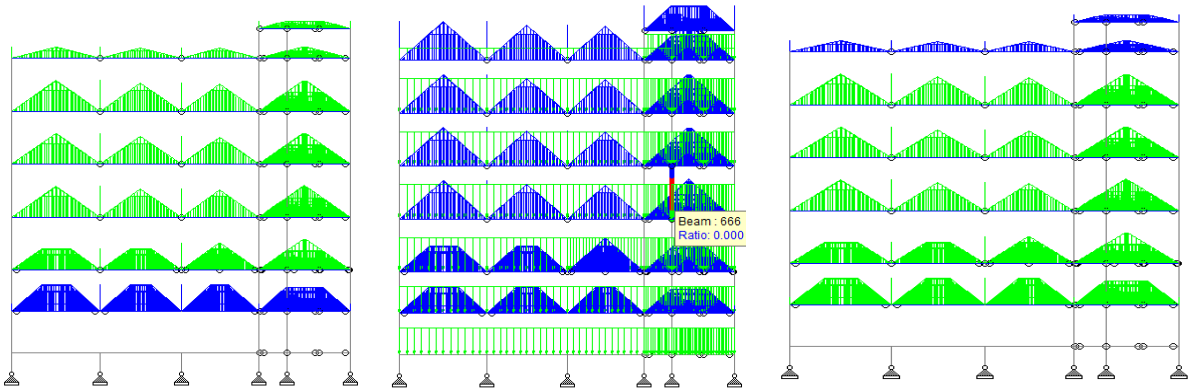
Self Weight taken= 6.25 KN/m2 Brick load = 14 KN/mm2 Brick load = 10.8 KN/m2



Parapet brick load = 5 KN/m2 Floor Load =0.5 KN/m2

Live Load :

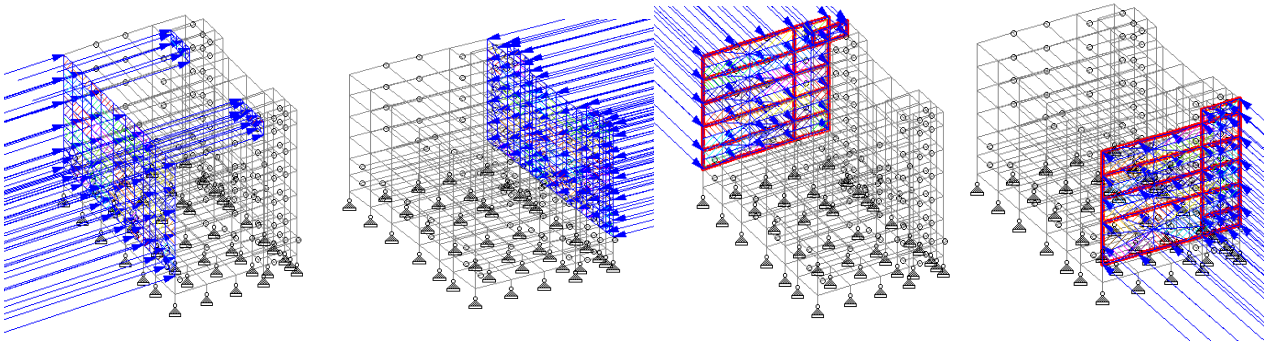
Basement 1 parking load = 5 KN/m2
Intermediate floor load = 4 KN/m2
Terrace load= 1.5 KN/m2



Basement 1 parking load = 5 KN/m2 Intermediate floor load = 4 KN/m2 Terrace load= 1.5 KN/m2

Wind Load

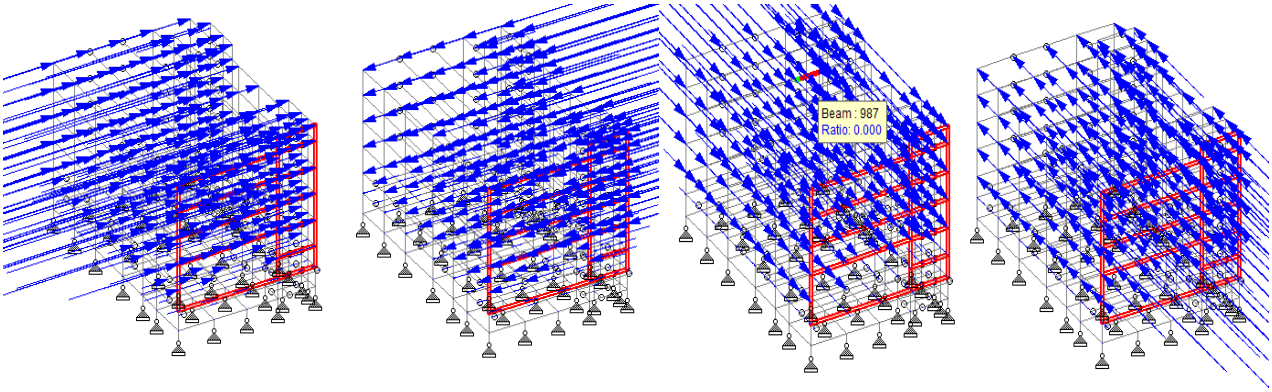
Buildings are subject to horizontal loads due to wind pressure acting on the buildings. Wind load is calculated as per IS 875(Part III)-1987. The horizontal wind pressures act on vertical external walls and exposed area of the buildings. Some of the pressure acting on exposed surfaces of structural walls and columns is directly resisted by bending of these members. The infill walls act as vertical plate supported at top and bottom by floor beams, thus transferring the loads at slab level. The parapet wall is at terrace transfers the wind loads to the surface slab by cantilever action. For simplicity, the wind loads acting on exposed surfaces of a given storey are idealized to be supported by upper and lower floors. The height of the building is = 22.03. The wind pressure is depends upon the height of the building.



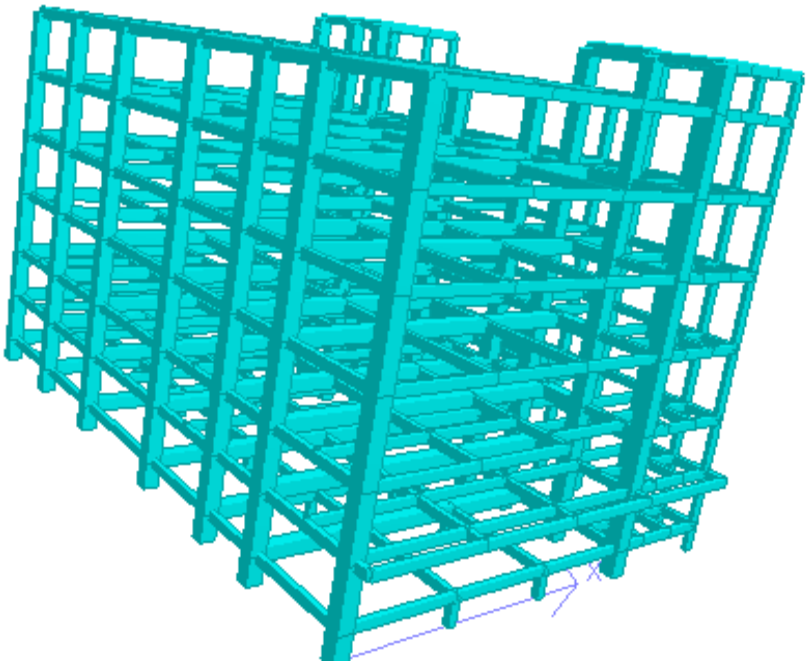
Wind load at X direction | Wind load at -X direction | Wind load at Z direction | Wind load at -Z direction

Seismic Load:

Significant horizontal loads can be imposed on a structure during an earthquake. Buildings in areas of seismic activity need to be carefully analyzed and designed to ensure they do not fail if an earthquake should occurs India has divided in to four zones as i.e. zone II, zone III, zone IV,zone V This building is constructed At- Saheed Nagar,Bhubaneswar,Odisha,India Bhubaneswar comes under the zone III. Its zone factor is 0.10**.**

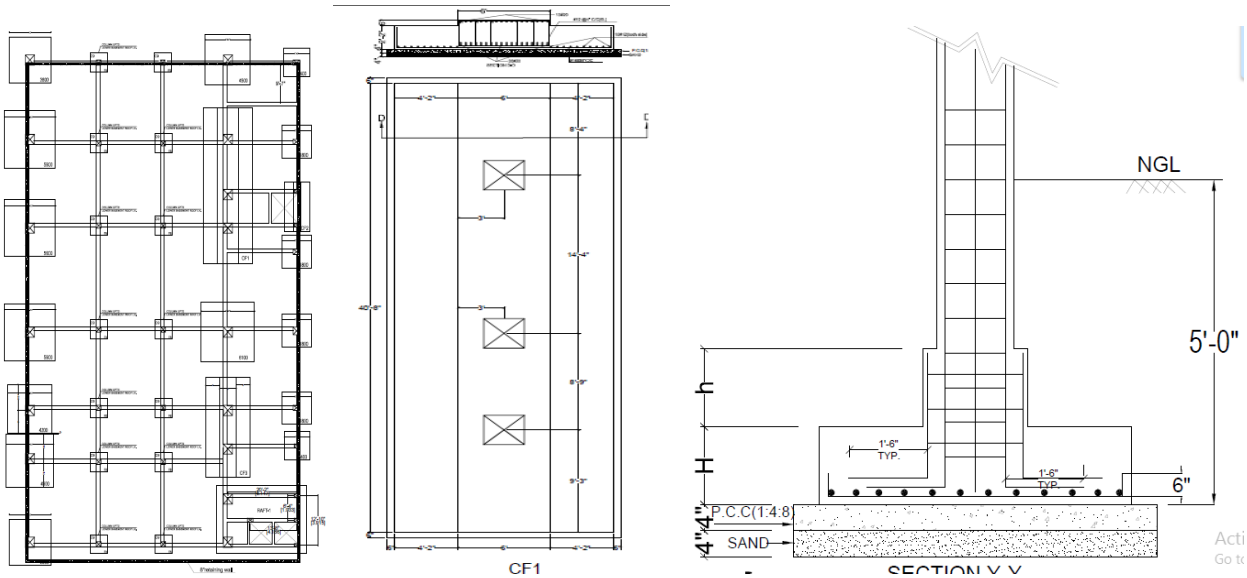


Seismic load at X direction | Seismic load at -X direction | Seismic load at Z direction | Seismic load at –Z direction



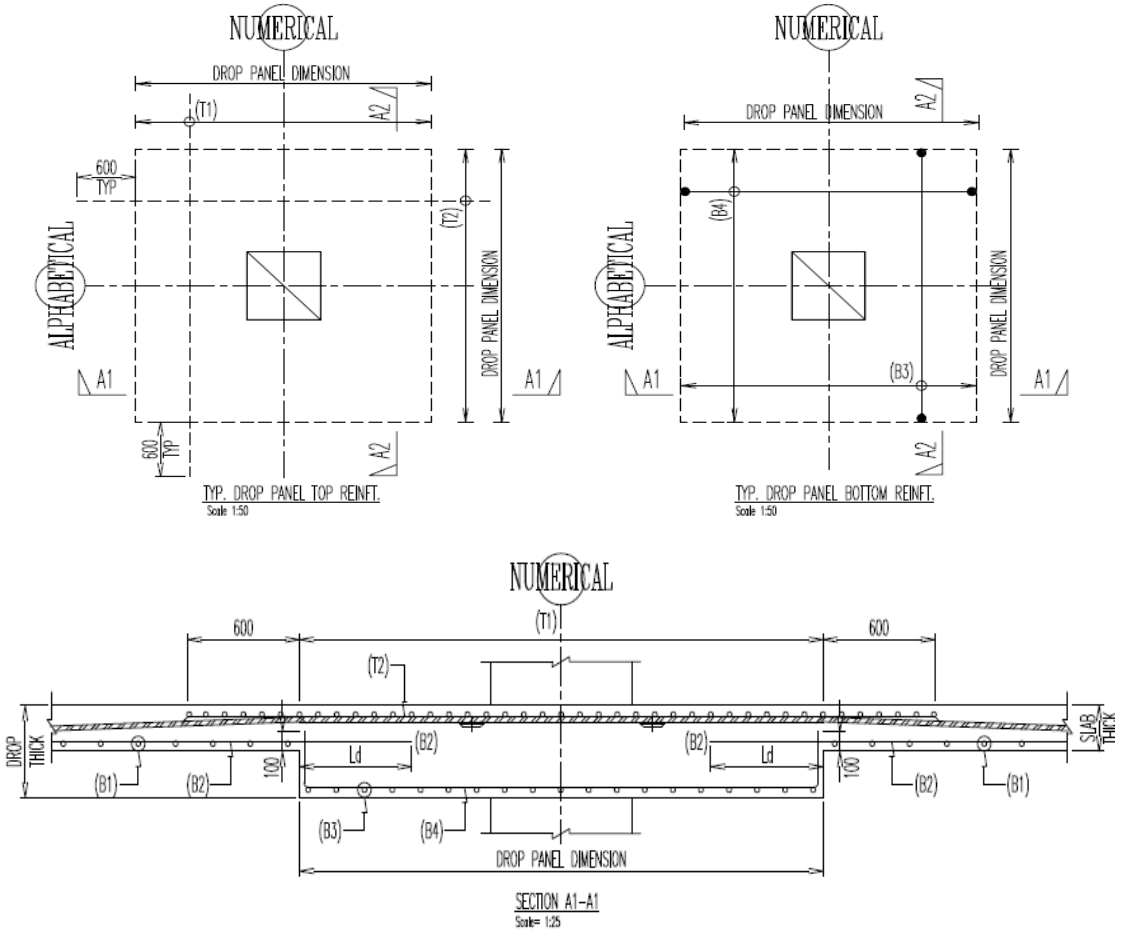
3D view of the stucture

5. FOUNDATION DETAILING

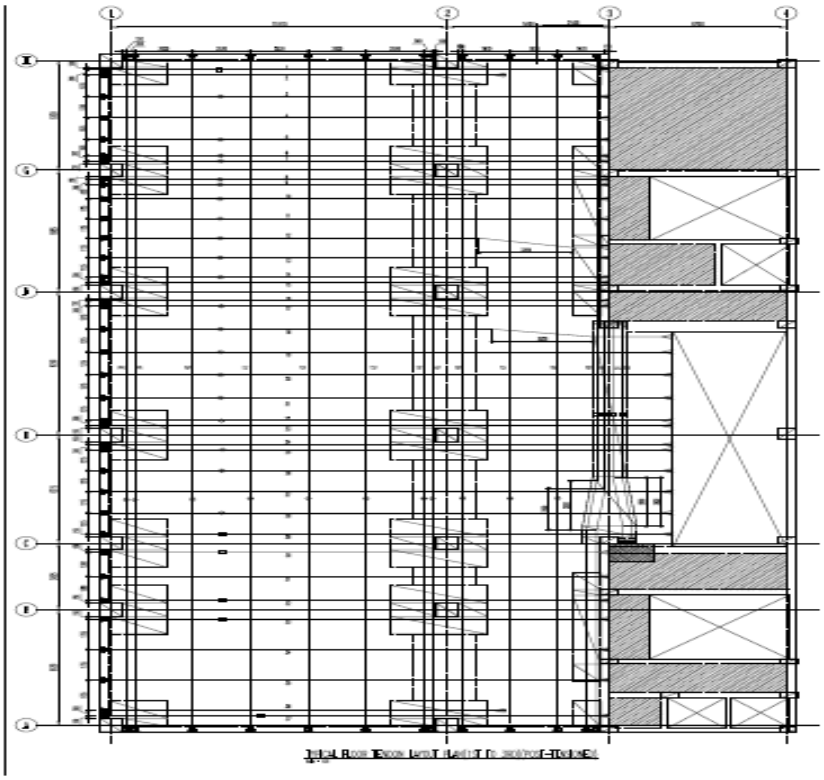


DETAILING OF SLAB

The thickness of the slab is taken 250mm as it has high live load and the span length is 18m. To reduce the depth of the beam PT slab is designed . High post tensioned tendons are used in both the direction.



Panel plan and section



Tendon profile layout on slab

6. CONCLUSION

- It is concluded that the slab can be design in 18m long span of a building structure using PT slab.
- Using PT slab the beam depth is reduced.
- The percentage of reinforcement is reduced in PT slab.
- The volume of concrete is reduced.

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