Comparative Study of Flat Slabs and PT Slabs

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Abstract

A building which is proposed to construct using PT slabs is more efficient and provides the advantage of longer span with durability,reduced cracks and deflection when compared to flat slabs.The primary objective of this comparative study of flat slab and PT slab is to prove that PT slabs are better in technical,economical and utility aspect when compared to flat slabs. The flat slabs are vulnerable to punching shear at the intersection point of slab and column which is one of the major failure in flat slabs whereas in the case of PT slabs drop caps are provided to prevent the punching shear failure.The flat slabs are provided with reinforcement and the tendons are provided in PT slabs.The another objective of this study is to gain sufficient knowledge about PT slabs and to prove that PT slabs are cost efficient , time saving and the quantity of materials used in construction can be reduced.Since,flat slabs are time consuming , material consuming and uneconomical.

Keywords - *PT slabs , Flat slabs , tendons , punching shear , flexural failure , deflection , drop caps.*

I. INTRODUCTION

Post tensioned slabs are widely used in many countries than conventional flat slabs.The floor system plays a vital role in overall cost of the structure,hence PT slabs provides quality of the construction at affordable cost and time saving.PT slabs are seismic resistant,so it is widely used in earthquake prone regions to withstand seismic forces.The post-stressing methodologies has been practiced from olden days.The examples are shrink fitting of metal tyres on wooden wheels in temple cars.Nowadays,multi-storeyed building are constructed with the help of PT slabs namely bridge decks, girders etc.

A. Flat slab

The Flat slab is a two-way reinforced concrete slab that usually does not have beams and girders, and the loads are transferred directly to the supporting concrete columns.

FIG 1.1 Flat Slab

II. BENEFITS OF FLAT SLABS

- Flat slabs are resistant to fire.
- Flat slabs are well known for its robustness.
- Flat slabs provide thermal mass to the building.
- Flat slabs exhibit better sound control.

III. MAJOR PROBLEMS IN FLAT SLAB

- Slab column connection does not have the rigidity of the beam column joint
- The possibility of the column punching through the slab is because of the shear concentration around the column
- Deflections are large because of lesser depth of slab.

IV. TECHNICAL FAILURE MODES OF FLAT SLABS

A. Punching Shear Failure

- The most common failure mode of flat slab is punching shear failure.Punching shear is a brittle failure mode in flat slabs.punching shear failure is witnessed at the intersection points of slab and column in a structure.this point is more vulnerable to punching shear.
- When the total shear exceeds the shear resistance of the slab,the slab will be pushed down around the column or the column is being punched through the slab.
- Some examples are occurrence of concentrated loads on a slab or a column

particularly on pad foundation and wheel loads.

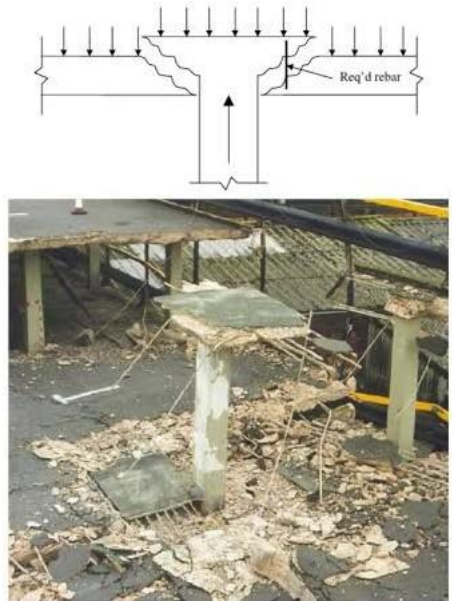

Fig1.2 Punching shear failure

B. Reasons For Punching Shear Failure

- No proper means of providing optimum thickness for slabs is a major cause
- No proper calculation of punching shear strength in a structure
- Since there is a direct connection between slabs and columns and the beams are not provided,so the load is transferred directly from slab to beam.It is also a major cause.

- No proper designing of drop panels and column heads leads to punching shear failure.

C. Preventive measures

There are many ways to overcome punching shear in a structure.They are

- Increasing the thickness of the slab in a structure, whereas increasing the column thickness which affects the aesthetic appearance.

Provide slab with shear reinforcement.Providing shear reinforcement makes the slab both structurally and economically efficient.

Providing drop caps to the column resists the punching shear,because the drop cap acts as beam and avoid the load directly acting upon the column,which prevents the punching shear failure.

D. Flexural failure

This occurs before the punching shear failure in slabs due to relatively low flexural reinforcement ratio.

1.2 PT SLABS

Post-tensioned slabs are typically flat slabs, band beams and slabs or ribbed slabs. PT slabs offer the thinnest slab type, as concrete is worked to its strengths, mostly being kept in compression.

Fig 1.3 Pt Slab

PT slab is more preferable because of its utility ,technical and economic benefits.

E. Technical aspect

- Thickness of the slab can be reduced
- Beams can be avoided.
- Optimum time required for the completion of the project.
- Odd beams and columns can be connected easily. So connectivity is efficient.
- Future extension of the beam and column is possible.

F. Economical Aspect

Concrete can be reduced by 25% when compared to conventional concrete.
The rebar can be reduced by 65% when compared to conventional bar.

G. Utility Aspect

- It reduces or eliminates shrinkage cracking-therefore no joints, or fewer joints, are needed.

- It allows slabs and other structural members to be thinner.

H. Issues in pt slabs

- Bursting of tendons at the time of stressing due to formation of honey-combs.
- Defects of core-cutting in PT Slab.
- Over 33m span should prefer double end stressing.

I. Solution

- To overcome the bursting of tendons there should not be any honey-combs near casting.
- Vibrators should be done properly.
- To overcome the defects of core cutting before laying should check any cut-out is coming or not.
- In case, after laying the future expansion is necessary means should prefer the Diamond-cutting.

- At the time of double end stressing if wedges are not locked properly the tendons may remove to overcome this the tendons have to fixed correctly.

V. MAJOR PROBLEM IN PT SLABS

A. Corrosion

Early available unbounded post-tensioning systems were susceptible to corrosion including paper wrapped,plastic push-through and heat sealed sheathing systems due to their susceptibility to the ingress of water.

Fig 1.4 Corrosion failure

Corrosion was induced by adding additional chlorides in the grout mix or by performing wet-dry cycling of Nacl solution.

The corrosion can be monitored with the help of acoustic emission sensors.

It was observed that cracking of the ducts due to fault in the construction practices or slipping of the ducts at deviator blocks or anchorages in the Mid Bay Bridge.

Fig1.5 Cracked duct showing severely corroded strand.

Fig 1.6 Slipping of duct at deviator block

B. Solution

- Inhibitors should not have any negative effects on concreteproperties.It is preferred to resist corrosion.
- There are four major commercially available corrosion inhibitors namely
  - DCI- Darex corrosion inhibitor
  - Rheocrete
  - Armatec , Ferrograd
  - Catexol

VI. CONCLUSION

- As we compare the PT slab and Flat slab the PT slab is preferable because it control the Long term deflection ,cost and time.
- It control the crack of slab and beams.
- PT slab are durable and provide better serviceability.
- PT slab are safe from punching shear failure since drop caps are provided at slab-column joints.
- PT slabs are seismic resistant,so it is preferred in earthquake prone regions.
- Available in longer spans.

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