AN OVERVIEW OF PRESTRESSED CONCRETE

Er. Monu kumar[1], Er. Jitendra chaudhary[2]

[1]Assistant Professor, Civil engineering, Roorkee College Of Engineering, U.K., India

[2]Assistant Professor, Civil engineering, Roorkee College Of Engineering, U.K., India

Abstract: Nowadays prestressed concrete are a widely adopted solution for buildings and bridges, because of their economic and functional advantage. in addition they simplify and speed up site operations, allow easy and flexural partition of space and reduce the overall height of buildings and bridges.strenght of concrete in tension is very low and hence we ignore it in R.C.C.Thus R.C.C. design is developed assuming that concrete can resist only compressive force .so steel is provided to take entire tensile force. The principal of prestressed concrete is to introduce calculated compressive stress in the zone wherever tensile stresses are expected when the concrete element is put to use.

INTRODUCTION

In case of big concrete construction projects like bridges steel reinforcement bars is alone bond be sufficient to provide the necessary tensile strength. In this case prestressed concrete is being used, in prestressing the rods or tendons are stretched along the axis and cement is poured later win the tendon are released the compression is generated at the bottom which try to count the balance the compression due to loading at the top part of the beam.

The main function of the prestressed concrete is that compressive stressed introduced by the high strength steel tendons in a concrete member before loads are applied. This will balanced the stresses imposed in the member during the service.

Prestressed concrete can be used for the construction of roofs, floors, walls, and bridges with longer unsupported spans.

Keywords: Pressed concrete introduction, prestressed concrete materials, types of prestressed concrete, tensioning devices, scope of prestressed concrete, and methods of prestressing.

Prestressed concrete materials-

In the prestressed concrete high strength concrete and high strength steel will be used to increase the crack control and load bearing capacity.

1. In high strength concrete elastic strain, shrinkage and plastic flow are much small. These qualities lower, the loss of prestress considerably.
2. There is concentration of stresses under the end of anchorage of prestressing wires. To gain the strength, high quality concrete is required, which can bear these heavy stresses.
3. In order to receive full benefits of high strength concrete and high tensile steel is necessary.
4. The ratio of cost to strength reduces with increase in the grade of concrete. So it is economical to use high strength concrete.To the high strength for the prestressed concrete steel used of whose characteristic strength 1400N/mm2.after is tensioning the anchoring prestressing wires, there will loss of prestresssed due to shrinkage, creep and elastic strain in concrete. Mild steel has yield stress of 230n/mm^2 and yield strain 0.12%.due to shrinkage and creep of concrete and creep of steel the loss of prestress is estimated to be of the order of 175n/mm^2 to 250n/mm^2.hence hardly any prestress is finally left. If we are using steel which is having strength of 1400n/mm^2 and strain 0.3-0.6%, it can provide considerable amount of effective prestressing force even after loss.

prestressed concrete strands

china prestressing materials

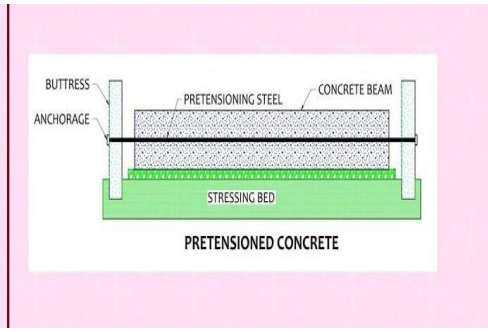
Types of prestressed concrete-

According to the construction method, there are two kind of prestressed concrete.

1. Pre-tensioned concrete.
2. Post-tensioned concrete(bonded and unbounded)

Pre-tensioned concrete-

In the pre-tensioning concrete method, wires are tensioned first and concrete is poured later. It creates a good bond between tendons and concrete. Tendons are protected from the corrosion and tensions are transferred directly. The tendons comprising individual strands are stretched with constant eccentricity as shown in fig.



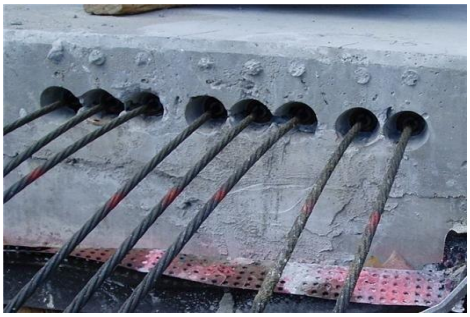
pre-tensioned concrete

Post-tensioned concrete-

Post-tensioned concrete is a technique for reinforcing the concrete by which steel is stressed before the concrete has to support the service loads. Most precast, prestressed concrete is actually pre-tensioned the steel is pulled before the concrete is poured.

Most commonly patented prestressing systems are based on the foll. Principles of anchoring the tendons.

- Wedge action producing a frictional gap on the wires.
- Direct bearing from rivet formed at the end of the wires.
- Looping the wires around the concrete.



post-tensioned concrete

Tensioning devices-

Various types of devices used for tensioning steel are grouped 4 principal categories, namely.

1. **Mechanical devices**-generally used weights with or without lever transmission, geared transmission in conjunction with pulley blocks, screw jacks with or without gear drives and wire winding machines.
2. **Hydraulic devices**-hydraulic devices are simplest devices producing large prestressing forces, are extensively used as tensioning devices.
3. **Thermal (electrical) devices**-Thermal or electrical devices are used in erstwhile USSR for tensioning of steel wires.
4. **Chemical devices**-in this method expending cements are used and degree of expansion is controlled by varying the curing.

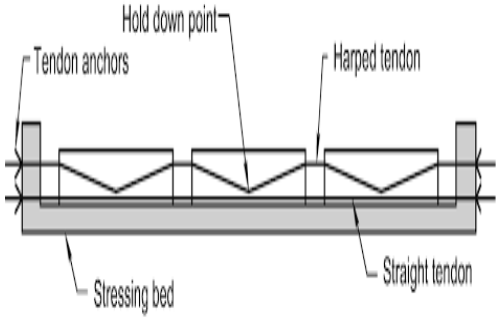
Scope of the prestressed concrete

Prestressed concrete are playing a big role in the construction of bridges and high rise building day to day.prestressed concrete bridges can also be precast in the factory and then moved to the construction sites. In the last few years precast concrete segmental bridge has been widely used in all over the world. Construction method will reduce the cost of construction and also will reduce the traffic density. This also offers the additional structural benefits of durability.prestressed concrete mostly use in the

construction of the bridges components and high rise building components.

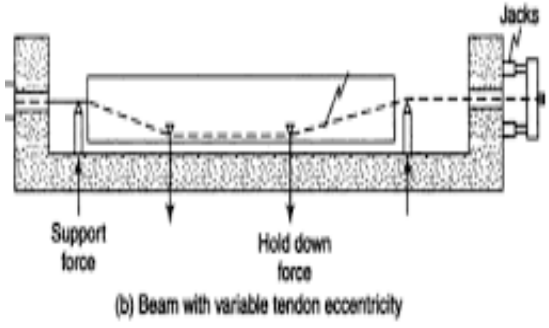
Methods of prestressing-

Methods of pre-tensioning-Railway sleepers, electric poles and beams are usually manufactured in factories by pre-tensioning method. Bulk heads are provided at desired distances. This distance may be 100m-200m also. One end of pre-tensioning wire is anchored to a bulk head. Another end passes through a bulk head and anchored to a moveable head, which is moved by hydraulic jacks.



pre-tensioning method with straight wires

Then a form is provided around wires and high strength concrete is paired. After concrete gains desired strength, jacks are released and wires are cut at the end of members. Due to bend wires are held in stretched position by concrete which results into desired compressive stress in concrete. Diameters of wire vary from 2-7mm.

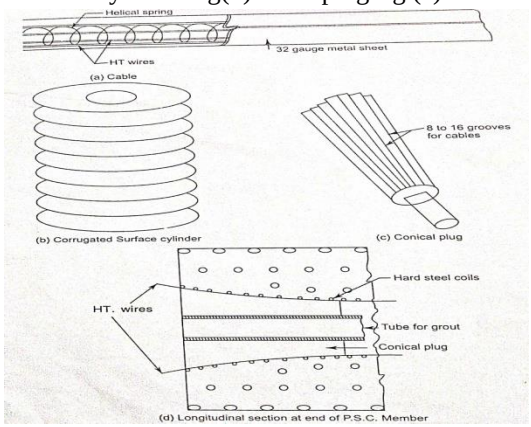


Methods of post-tensioning-mechanical post-tensioning using jacks and anchorising devices is more reliable technique and is commonly used in prestressing system. Rubber core or thin metallic cores are provided in the required profile inside formwork.prestressing wires are taken through cores and are projected beyond required length.

The following are some of the patented methods of post-tensioning which differ one from the other in the methods of anchoring.

1. Freyssinet system.
2. Magnel balton system.
3. Gifford Udall systems and
4. Lee-McCall system.

Freyssinet system: this is one of the commonly used post-tensioned methods. steel wires 5mm or 7mm in diameters and 8,10,12,14,16 or 18 in member are grouped into cable with helical spring inside a flexible sheathing as shown in fig.(a).the anchorage used at each end consist of two parts- a precast concrete cylinder fig(b) and a plug fig.(c).



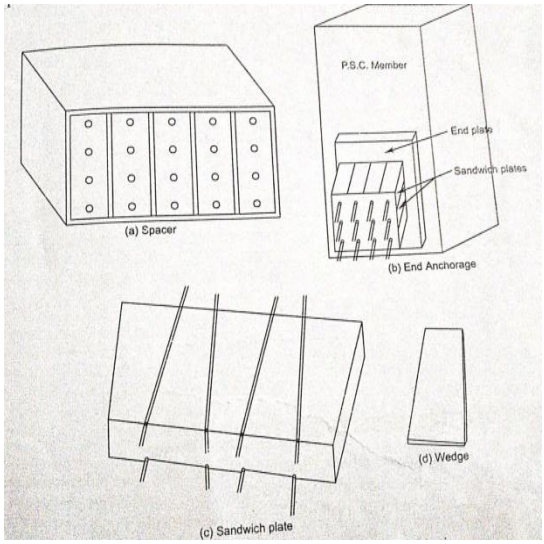
Freyssinet system of post-tensioning

The precast concrete cylinder is having corrugated on the outside, conical hole in the centre and a hoop reinforcement inside. The cylinders are placed in position before concreting and are embedded as part of prestressed concrete element.

Magnel blaton system: in this system concrete members are cast with rectangular ducts at suitable places, which are achieved by using rubber cores with steel tubes. After concrete hardens rubber care along with steel tubes in it are withdrawn. This saves cost of sheathing which is Fressienet system is embedded.

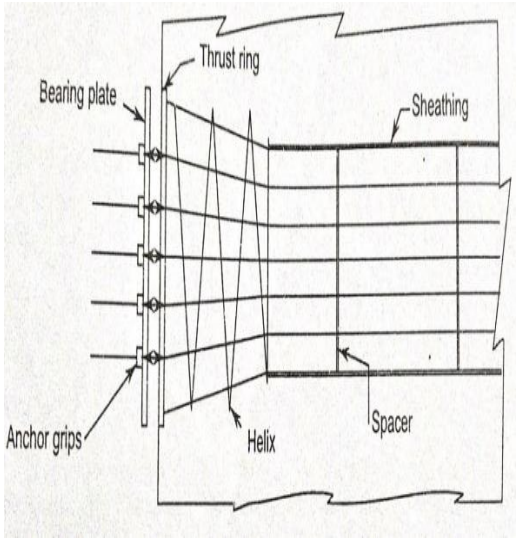
In the duct prestressing wires of 5mm or 7mm are introduced. Their number in each duct may vary from 2-64.usually they are prefabricated in multiples of 8 wires and provided with spacers fig.(a).the end of anchoring systems consists of a number of sandwich plates resting against end plates fig.(b).each sandwich

plates holds 8 wires .after pulling the wire with jacks wedge plates are one driven in position to anchor them.



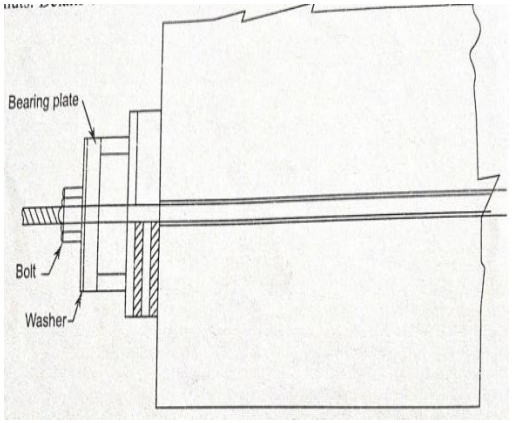
Magnel Blaton system of post-tensioning

Gifford-Udall systems: in this system a cable similar to the Fressient cable is used. At its cable passes through a steel end plate, termed as thrust ring which is perforated with one hole for each wire. Near thrust ring, helix reinforcement or a tube unit with helix ring is provided fig.



Gifford Udall system

Lee McCall system: using rubber core, holes are made in the concrete member. In this holes high tensile bars are inserted .this diameter of such bars may vary from 12-28mm.details of such anchorage is shown in fig



Lee McCall system

CONCLUSION

- Degradation of prestressed concrete an important factor is that prestressed steel is unable to withstand the combined effects of variable quality of construction and corrosion within the construction itself.
- P.S.C. is more durable since there are no tensile cranks hence there is greater benefits' in structure of P.S.C.
- The material cost in the prestressed concrete is lesser as compare to reinforce concrete members.
- The fatigue strength of P.S.C. is very good.

Losses of prestressing-Initially applied prestressing force get reduced due to various reasons. This reduction of prestressing force is termed as loss of prestress.The various reasons for which losses of prestress takes place are listed in table.

S.No.	Types	In pre-tensioning	In post-tensioning
1.	Due to creep of concrete	Takes place	Takes place
2.	Due to shrinkage of concrete	Takes place	Takes place
3.	Due to relaxation of steel	Takes place	Takes place
4.	Due to shorting of member	Takes place	If all wires are stressed simultaneous no such loss .if wires are stressed successively, there will be loss of prestress.
5.	Due to slip in anchorage		Takes place
6.	Due to friction		Takes place

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