Advanced concreting methods

- pre-stressed concrete.

pre-stressed concrete is the one in which there have been introduced internal stresses of such magnitude and distribution that the stresses resulting from the external loading are counter balanced to a desired degree.

- prestressed concrete got developed along with reinforced concrete.
- Basically, in pre-stressed concrete, internal stresses are developed in a pre-determined manner such that the stresses induced due to external loading gets nullified with these internal stresses of concrete.
- concrete is strong in compression and weak in tension. Reinforcement provided in concrete helps the concrete to withstand a little tension. Components of prestressed concrete is same as that of ordinary concrete,
  - concrete
  - Reinforcement
- In prestressed concrete high strength concrete and high tensile steel wires are used.
- A prestressed concrete member is a usual concrete member but tendons are provided to supply the necessary pre-stressing force.

- **Grade of concrete**

High grade concrete is used in prestressed concrete Beause,—

① With the use of high strength concrete shrinkage cracks are low.

② High strength concrete will have high modulus of elasticity of concrete ($5000\sqrt{f_{ck}}$) and hence elastic and crack strains are very low resulting in smaller loss of prestressing force.

③ Use of high strength concrete reduces the size of concrete members thereby resulting in reduction of self weight of the member.

④ Stress transfer from tendons to concrete take place due to bond between concrete and steel. High bond strength can be achieved by the use of high strength concrete.

⑤ Bursting stresses at the ends cannot be effectively resisted by low strength concrete.

⑥ Due to large prestressing force to be applied by tendons, large bearing stresses gets developed in concrete at the ends by anchoring devices

⑦ High bending stresses are provided only due to high strength concrete.

⑧ Because of high strength concrete, cross sectional area required for member are be reduced & reduce dead loads.

- The prestressed work shall be in grades as per table below —

Grade	Characteristic Strength at 28days (N/mm^2)
M_{30}	30
M_{35}	35
M_{40}	40
M_{45}	45
M_{50}	50
M_{55}	55
M_{60}	60

- <u>prestressing Steel</u>

High tensile steel wires (cable) used in prestressed concrete are called as tendons.

↳ Steel used for prestressing the concrete should have on the following properties —

① Hard drawn, high tensile steel wires of diameter 1.5mm to 8mm and having tensile properties. These wires may be used as single wire or in form of cable.

② High tensile alloy steel bars of 9.5mm to 32mm diameter having a tensile strength as per :-

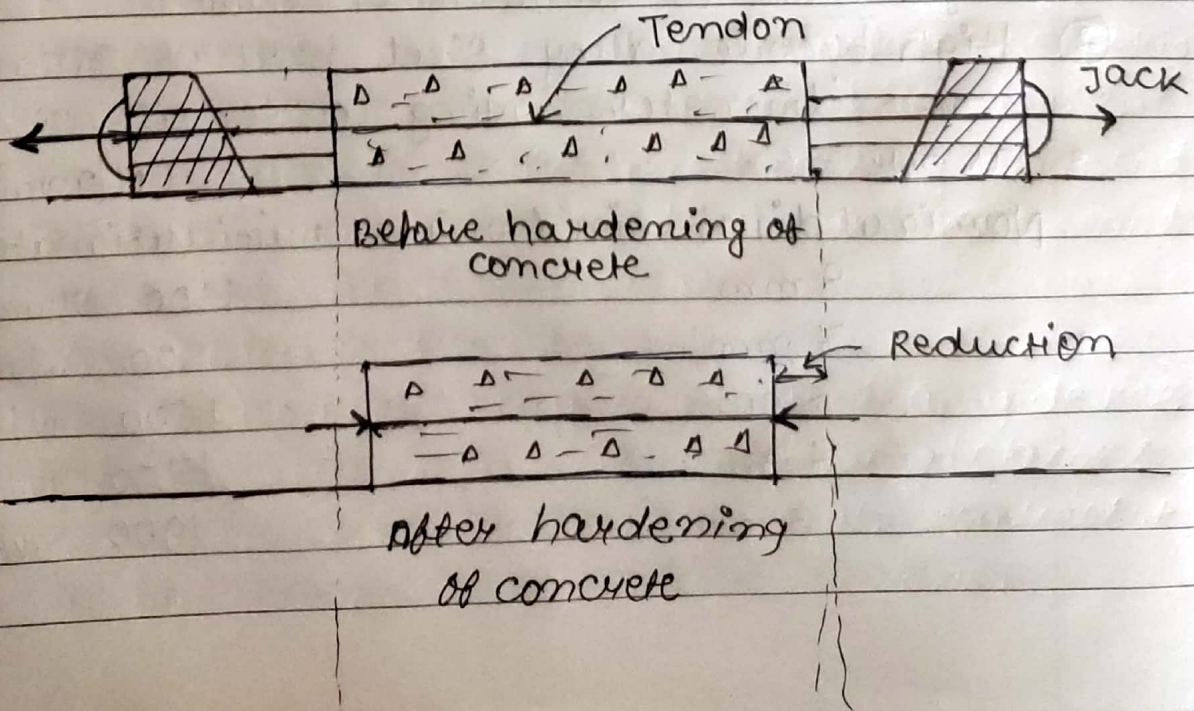
Nominal dia of wire (mm)	mini. ultimate strength (N/mm^2)
8mm	1400 N/mm^2
7mm	1500 N/mm^2
5mm	1600 N/mm^2
4mm	1750 N/mm^2
3mm	1900 N/mm^2

- High tensile alloy steel bars have minimum ultimate tensile strength of 950 N/mm^2.

- Methods of pre-tensioning and post tensioning

① pre-tensioning

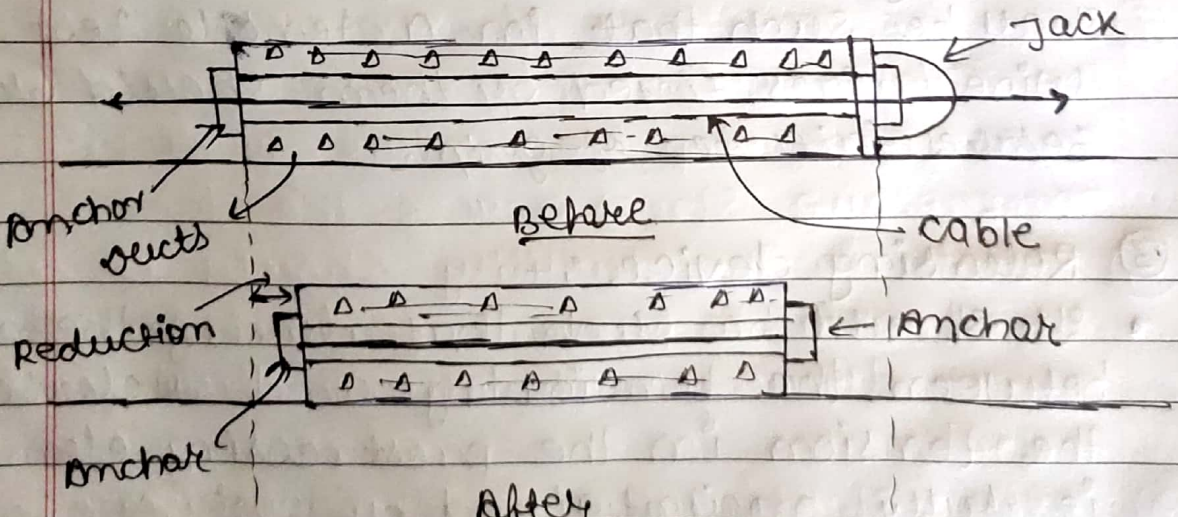
In this system, wires | cables are tensioned ~~before~~ before casting of the concrete. one end of reinforcement is secured to an abutment while the other end of reinforcement is pulled by using a jack and this end is then fixed to another abutment. The concrete is then poured. After the curing and hardening the ends of reinforcement are released from the abutments. The reinforcement which tends to resume its original length will compress the concrete surrounding it by bend action. Thus prestress is transmitted to concrete.



② post tensioning

In this system, reinforcement is tensioned after the concrete has hardened. The beam is first cast leaving ducts for placing cables. The ducts are made in a number of ways by leaving corrugated steel tubes in the concrete by providing steel spirals.

When concrete is hardened and developed its strength, cable is passed through ducts, one end is fixed to anchor, which is on one end of member. Then other end of cable is pulled by jack. The jack pulls the cable and at the same time compresses the concrete.



- Equipments used in prestressing ⇒

① Tensioning apparatus
② Temporary gripping device
③ Releasing device
④ Anchorage

① Tensioning apparatus :-

- pre-stressing steel may be tensioned by means of levers, screw jacks, hydraulic jacks or similar mechanical apparatus. The type of tensioning apparatus shall be such that a controlled force can be applied. A device should be attached to
- this apparatus for measuring applied force. This measuring device should not have more than 5%.

② Temporary gripping devices :-

- wedges, yokes, double cones are the gripping devices.
- The prestressing wires & may be gripped signally or in group. Gripping device shall be such that in a tensile test, the wire / wires fixed by them should break before failure of grip.

③ Releasing device :-

- It should be such that during the period between the tensioning and release, the tension in the prestressing elements is fully maintained by positive means, as external anchorage.

④ Anchorage :-

- The anchorage may consist of any device which will provides following clauses.

① It should be strong enough to resist a breaking strength of tendons.

(2) Holding capacity should be more.
(3) It should be safe against dynamic, static and impact loads.

- Equipments and accessories for prestressing
↳ main equipments for pre-stressing of pre-tensioning work are hydraulic jack, two steel beam section act as abutment on either side of casting work of pre-stressing and steel channel bearer.
↳ various accessories require for prestressing work are as follows -

(1) Steel tendons
(2) Anchar
(3) Steel Anchar plate
(4) Support piers
(5) Dividing plates or spacers
(6) Nut Bolts
(7) Helical reinforcement
(8) Bearing plate
(9)

- precautions during pre-stressing of members
↳ following are the important precautions to be taken carefully during prestressing of members.

(1) It is well inspected that whether the beam mould on either side is properly fixed to steel beam section or steel joist which used as abutment.
(2) check whether steel anchar plate and abutment with nut and washer is properly fixed.

③ Check whether anchor is secured or not before stressing commences.

④ In case of pre-tensioning, the wires are cut or released and bond between the stressed wire.

⑤ post tensioning is the method usually employed where stressing is to be carried out on site in which curved tendons are required. so as to overcome the -ve bending moments at the fixed ends and for continuous span.

⑥ Shearing reinforcement in the form of stirrups should be introduced along short transfer length of tendon. Hence, check whether the shearing rein-forcement are introduced or not.

⑦ At the positions of zero bending moment the prestressing force can be arranged so as to develop the uniformly distributed compressive stress across the face.

⑧ Joints in the ductility should be well taped so as to prevent penetration of the grout during subsequent filling of the void.

⑨ Before starting tensioning by hydraulic jack the end plate washers and anchors nuts must be positioned.

⑩ On completion the prestressing, the jack is removed and the duct grouted as a precaution against of the tendon.

- **Under water concreting**

↳ Sometimes, some structeures which are in water, they needs special type of concreting method. in such situations, concrete needs to be placed under water.

↳ In these situations, bottom dump buckets or tremie pipers are used.

In bottom dump buckets, concrete is taken through buckets to desired position and then buckets are opened mechanically, But this method will not give satisfactory results as the washing away of cement from concrete takes place.

↳ Tremie method is a good method of under water concreting which gives satisfactory ~~results~~ results.

- **Tremie method**