CE 414
Prestressed Concrete (PC)

Materials
Used in Prestressed Concrete

By
Md. Abu Hasan

Lecturer
Department of Civil Engineering
Daffodil International University

PRESTRESSING STEEL

- The development of prestressed concrete was influenced by the invention of high strength steel.
- It is an alloy of iron, carbon, manganese and optional materials.
- In addition to prestressing steel, conventional non-prestressed reinforcement is used for flexural capacity (optional), shear capacity, temperature and shrinkage requirements.

Types of Prestressing Steel

- Weir
- Strand
- Tendon
- Cable

WIRE

The different types of wires are as follows.

1) Plain wire: No indentations on the surface.

2) Indented wire: There are circular or elliptical indentations on the surface.

STRANDS

A strand or cable is made of a bundle of wires spun together. The overall diameter of a cable or stand is from 7 to 17mm. They are used for post-tensioning systems.

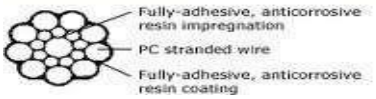
1)Two-wire strand:

2)Three-wire strand:

3)Seven-wire strand: In this type of strand, six wires are spun around a central wire. The central wire is larger than the other wires.

Tendons

A group of strands or wires are placed together to form a prestressing tendon. The tendons are used in post-tensioned members.



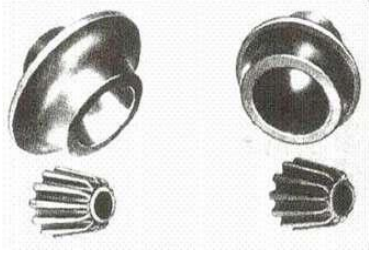
Cables

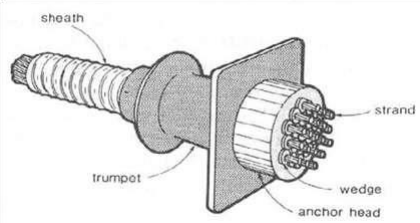
A group of tendons form a prestressing cable. The cables are used in bridges

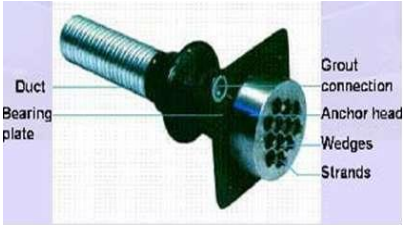
Bars

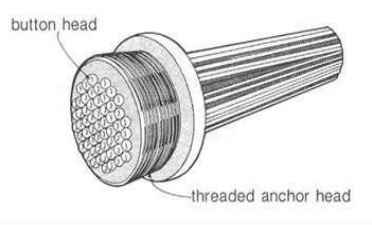
The diameter of a bar is much larger than that of a wire. Bars are available in the following sizes: 10, 12, 16, 20, 22, 25, 28 and 32 mm.

Anchorage



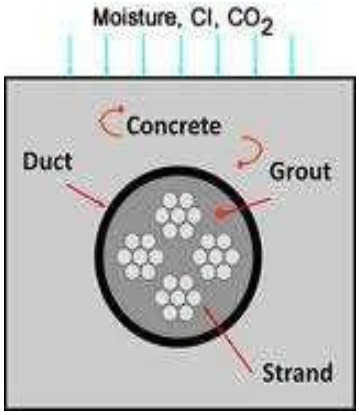






GROUT

Grout is a mixture of water, cement and optional materials like sand, water-reducing admixtures, expansion agent and pozzolans. The water-to- cement ratio is around 0.5. Fine sand is used to avoid segregation.



GROUT

The desirable properties of grout are as follows.

1) Fluidity
2) Minimum bleeding and segregation
3) Low shrinkage
4) Adequate strength after hardening
5) No detrimental compounds
6) Durable.

AGGREGATE

The nominal maximum coarse aggregate size is limited by the lowest of the following quantities.

1) 1/4 times the minimum thickness of the member
2) Spacing between the tendons/strands minus 5 mm
3) 40 mm.

ADMIXTURES

The admixtures can be broadly divided into two types: chemical admixtures and mineral admixtures.

The common chemical admixtures are as follows.

1) Air-entraining admixtures
2) Water reducing admixtures
3) Set retarding admixtures
4) Set accelerating admixtures
5) Water reducing and set retarding admixtures
6) Water reducing and set accelerating admixtures.

ADMIXTURES

The common mineral admixtures are as follows.

1) Fly ash
2) Ground granulated blast-furnace slag
3) Silica fumes
4) Rice husk ash
5) Metakoline

PROPERTIES OF HARDENED CONCRETE

1) High strength
2) Durability
3) Stiffness
4) Minimum shrinkage and creep

High Strength

The maximum grade of concrete is 60 MPa.

The minimum grades of concrete for prestressed applications are as follows.

1)30 MPa for post-tensioned members

2)40 MPa for pre-tensioned members.

Stiffness Of Concrete

The stiffness of concrete is required to estimate the deflection of members. The stiffness is given by the modulus of elasticity.

Durability Of Concrete

The durability of concrete is of vital importance regarding the life cycle cost of a structure. The life cycle cost includes not only the initial cost of the materials and labour, but also the cost of maintenance and repair.

Creep Of Concrete

Creep of concrete is defined as the increase in deformation with time under constant load. Due to the creep of concrete, the prestress in the tendon is reduced with time. Hence, the study of creep is important in prestressed concrete to calculate the loss in prestress.

The creep occurs due to two causes.

Shrinkage Of Concrete

Shrinkage of concrete is defined as the contraction due to loss of moisture. The study of shrinkage is also important in prestressed concrete to calculate the loss in prestress.

The shrinkage occurs due to two causes.

1. Loss of water from voids
2. Reduction of volume during carbonation