Prestressed concrete

Purpose of prestressing

Example: $W=10 \text{ N (a bottle)}, \ L=1\text{m}, \ a=0.1\text{m} \rightarrow P=10 \times \frac{1}{4 \times 0.1}=25 \text{ N}$

What force is needed to curry a bottle?

Why prestressing?

A small strength of concrete in tension is compensated
- in reinforced concrete by stell bars
- In prestressed concrete by removing tension
  - by arch effect - arches
  - by prestressing – prestressed concrete
Arches - vaults

Prestressed concrete
History of prestressing

Pre-tensioning prestressed concrete

fixed anchorage

tendon
Pre-tensioning

Cross-sections of prestressed beams
Post-tensioning

Anchorage

Multi-strand anchorage

Hand held jack
Anchorage - section

Types of tendons

Bending moments caused by prestressing has opposite sign then the moments due to load

a) Curved tendons
b) Combination of straight and curved tendons
c) Combination of straight tendons at both surfaces and curved tendons at supports.
Position of prestressing tendons

Stresse in reinforced and prestressed beams

Reinforced concrete  Prestressed concrete
Shear in prestressed beams

Shear cracks prestressed beams develop at smaller angle than in reinforced beams. Cracks in prestressed beams open at greater loading than in reinforced beams.

Deflection

Deflections of prestressed beams are significantly smaller than that of reinforced concrete beams.

\[ w_s = (0.6 - 0.7) w_u \]
Losses of prestress

Short time losses:
- elastic deformation
- friction
- slip in anchor

Long time losses:
- relaxation of steel
- creep of concrete
- shrinkage of concrete

Bridge structures

The Eshly Bridge over the Marne, France 1950
Continuous beam

Small prefabricated elements

ties
floors elements
lintels
beams
Recent applications

La Grande Arche in Paris Paříži používá 4 post tensioned beams of 70 m span at top three floors.

Main topics

Why prestressed concrete
Pre - and post prestressing
Stress due to prestressing and loading
Shear in prestressed concrete
Deflection of prestressed beams
Losses of prestressing
Examples of prestressed structures