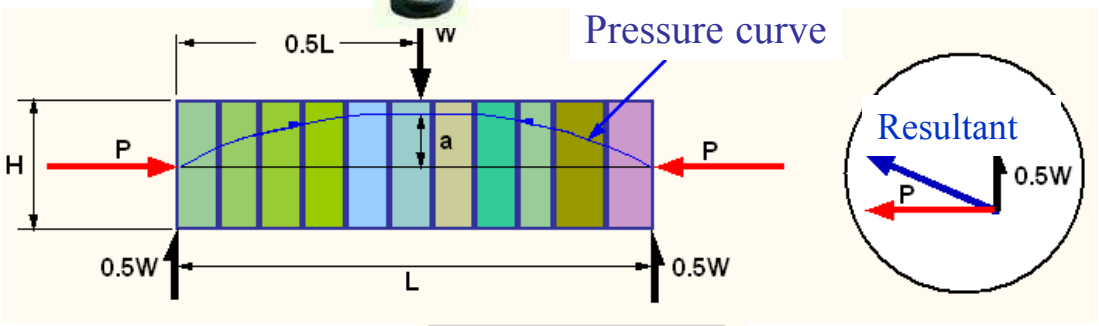
Prestressed concrete

Purpose of prestressing



$0.5W \times 0.5L = P\,a$

$W = \frac{4\,P\,a}{L}$

$P = \frac{W\,l}{4\,a}$

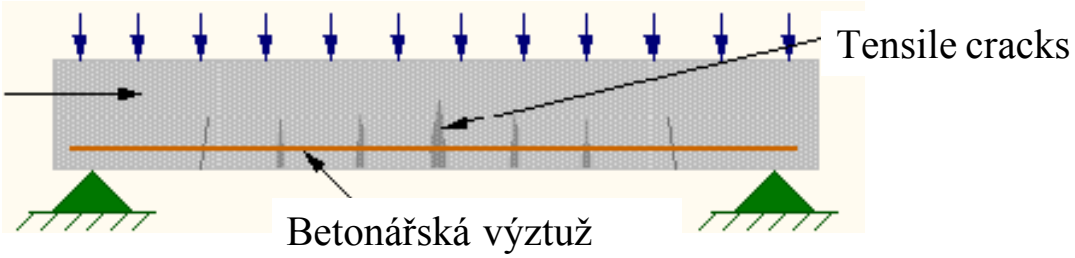
What force is needed to curry a bottle?

Example: W=10 N (a bottle), L=1m, a=0,1m→P=10×1/(4×0,1=25 N

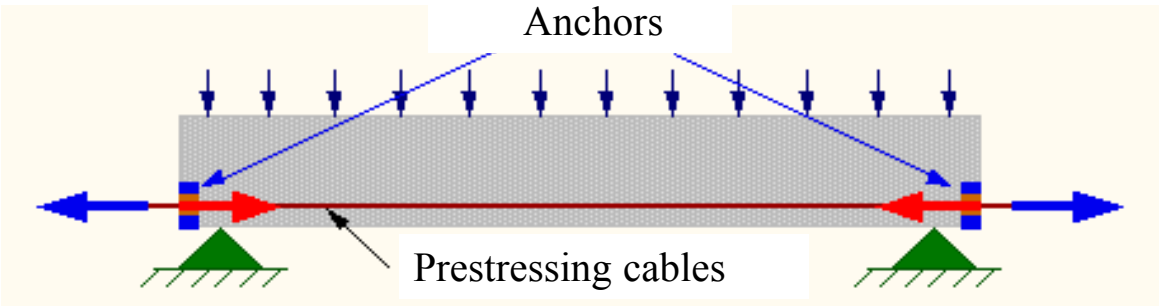
Why prestressing?

A small strength of concrete in tension is compensated

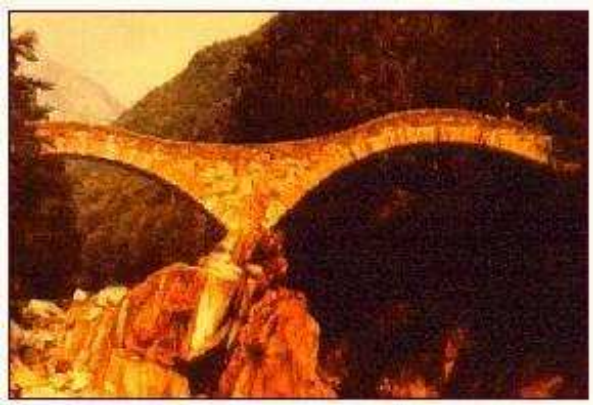
- in reinforced concrete by stell bars

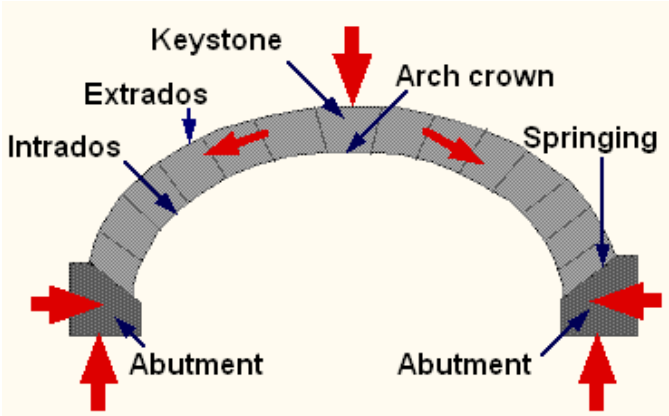


- In prestressed concrete by removing tension
  - by arch effect - arches
  - by prestressing – prestressed concrete

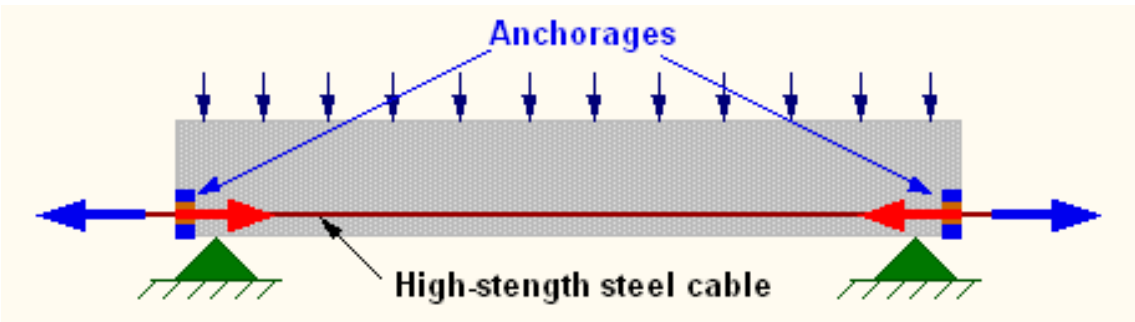


Arches - vaults





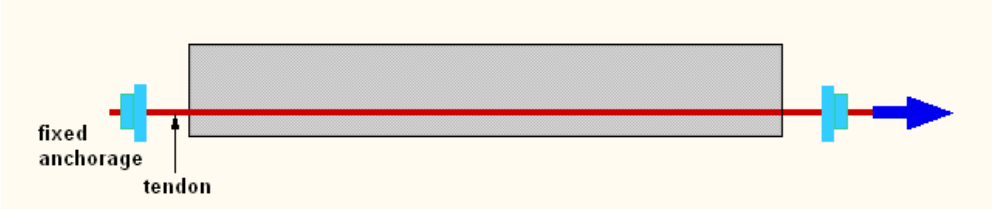
Prestressed concrete

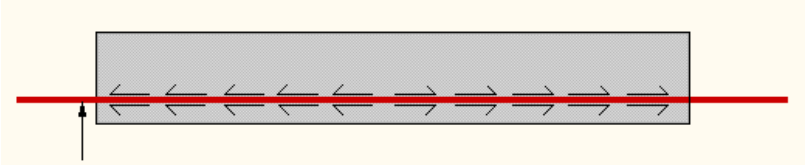


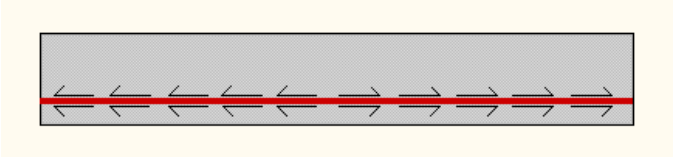
History of prestressing

Eugene Freyssinet (1879-1962)

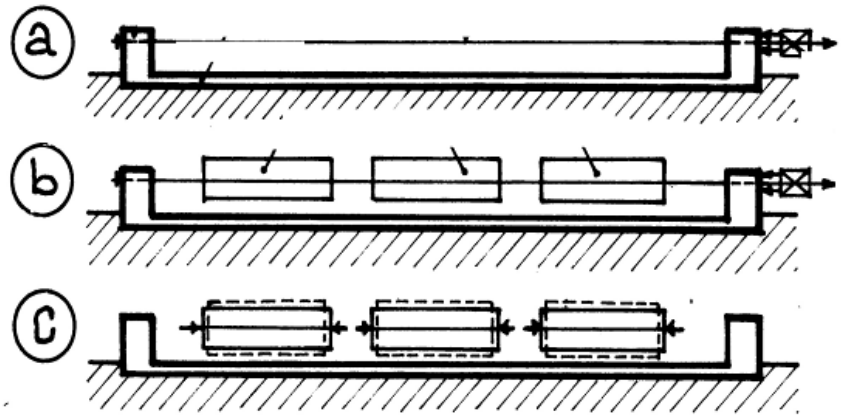
Pre tensioning prestressed concrete

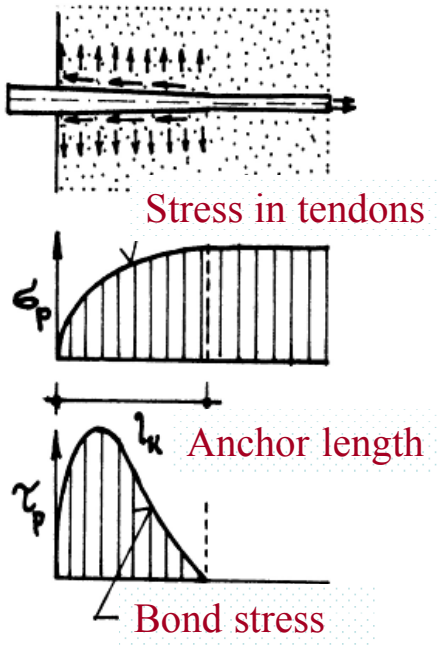




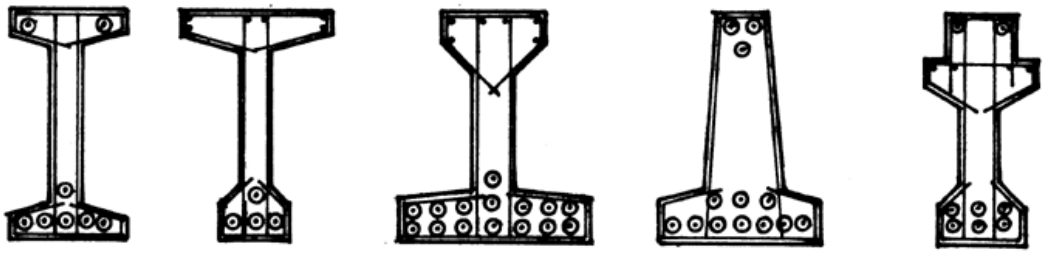


Pre-tensioning

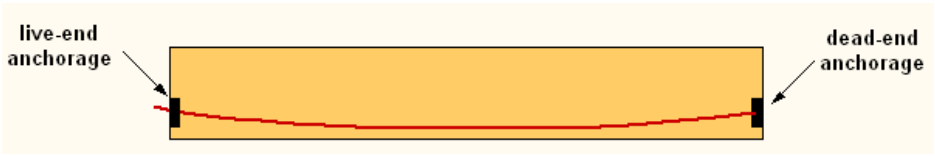


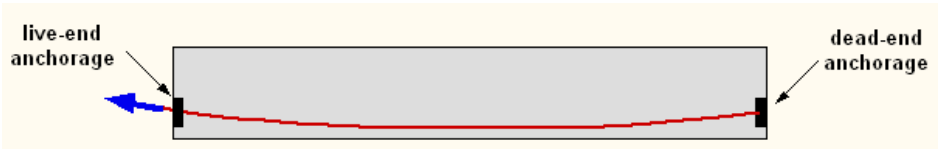


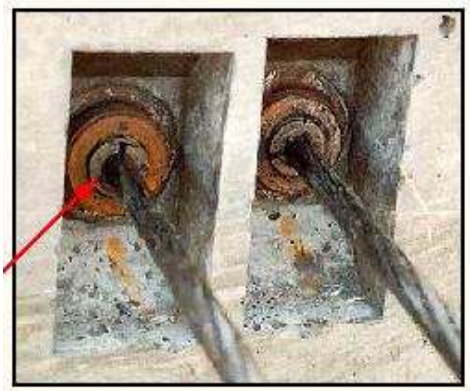
Cross-sections of prestressed beams

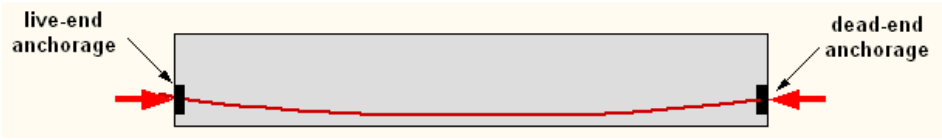


Post- tensioning



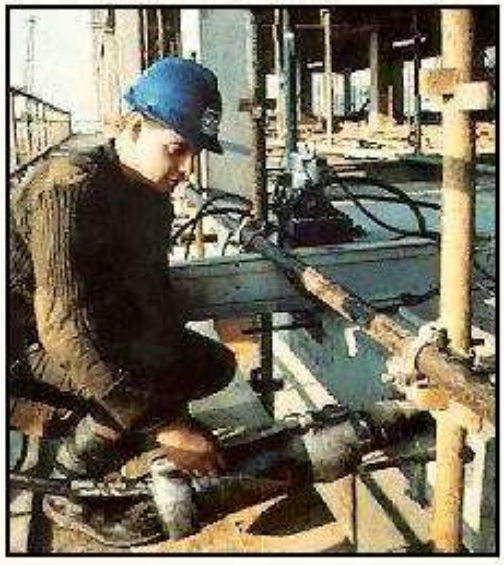






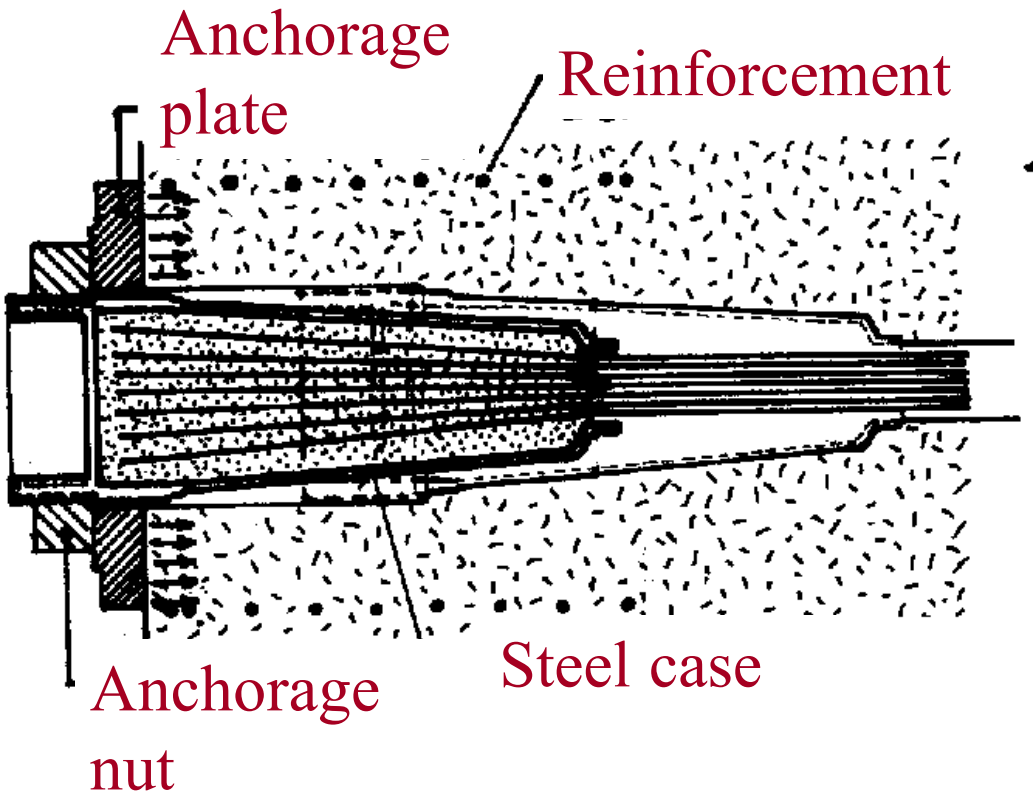
Anchorage

Multi-strand anchorage



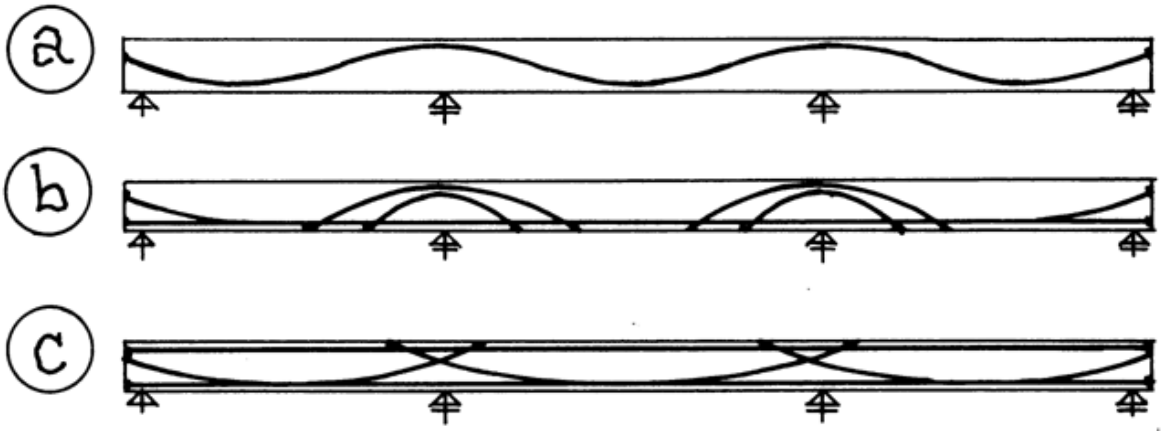
Hand held jack

Anchorage - section



Types of tendons

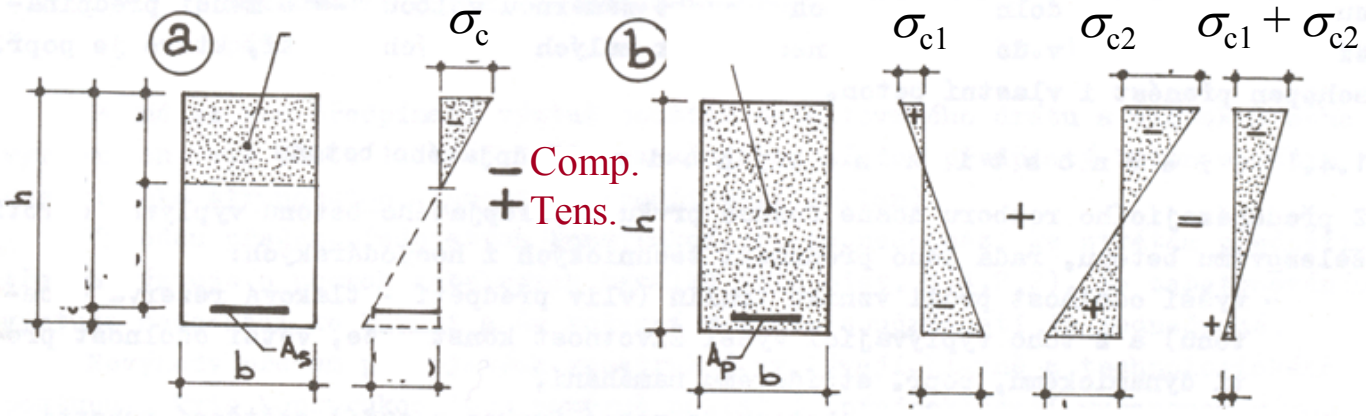
Bending moments caused by prestressing has opposite sign then the moments due to load



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

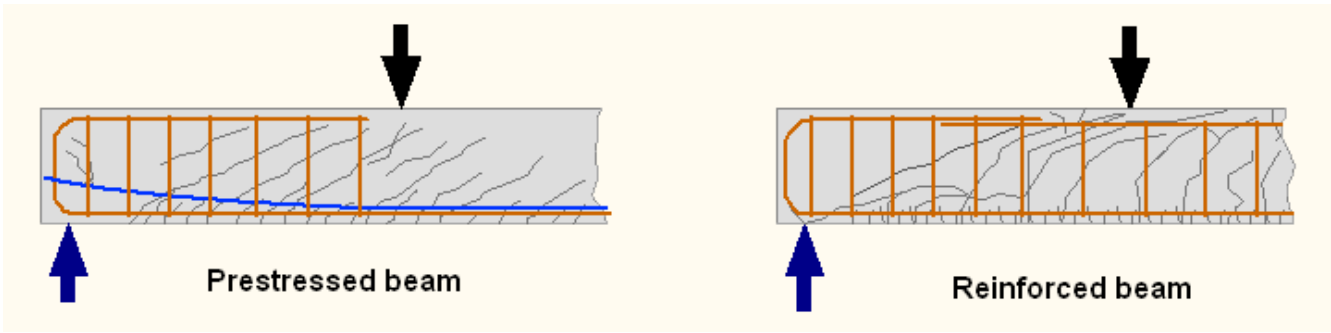
Stresse in reinforced and prestressed beams



Reinforced concrete

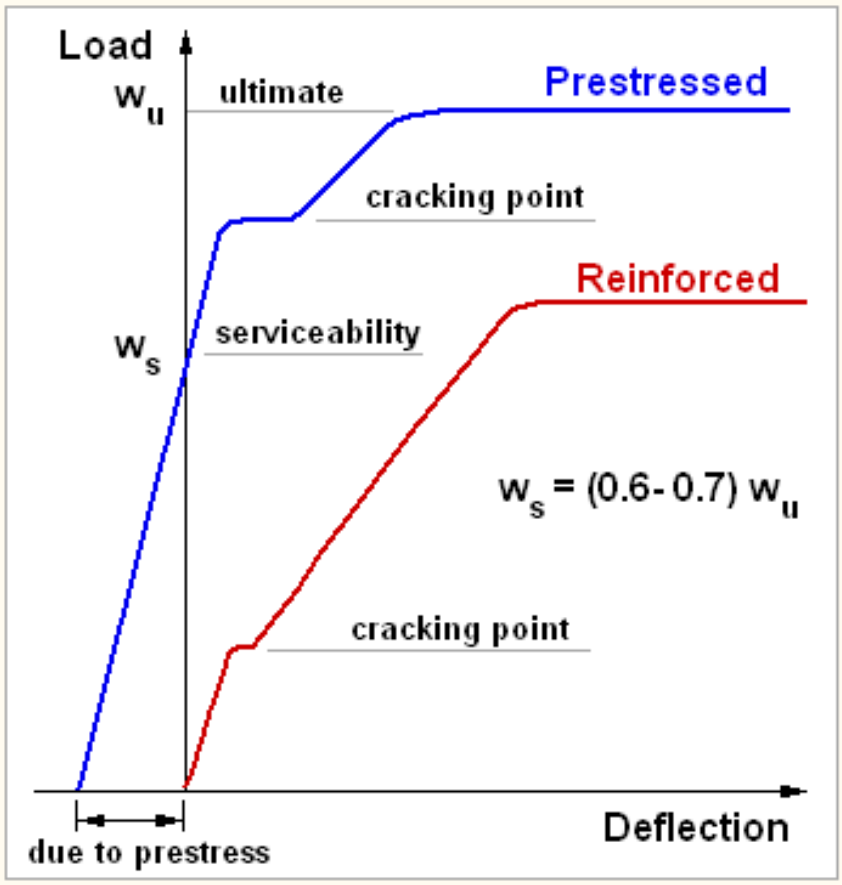
Prestressed concrete

Shear in prestressed beams

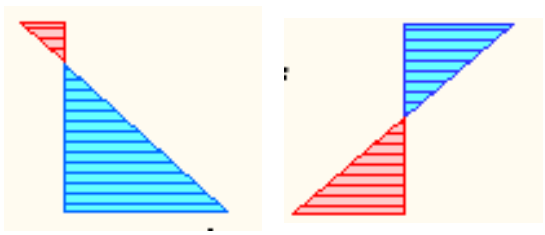


Shear cracks prestressed beams develop at smaller angel than in reinforced beams.
Cracks in prestressed beams open at greater loading then in reinforced beams.

Deflection



Deflections of prestressed beams are significantly smaller then that of reinforced concrete beams



prestress - load

Losses of prestress

P_j	Prestressing force
P_o	Force after
P_e	Effective forse
$P_j - P_o$	Short time looses
$P_o - P_e$	Log time looses

Short time losses:	elastic deformation
	friction
	slip in anchor
Long time losses:	relaxation of steel
	creep of concrete
	shrinkage of concrete

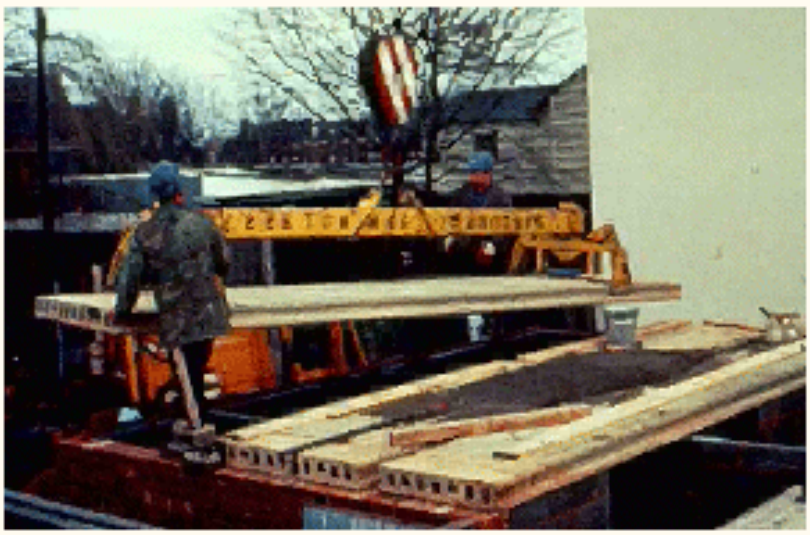
Bridge structures

The Esbly 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 structurtes