Prestressed Concrete Beam: Stresses at Transfer and Service

Top and bottom fibre stresses of a prestressed concrete beam at transfer and in service from prestress, eccentricity, losses and the applied moments.

Method: Elastic fibre stresses of prestressed members

Input parameters

Unit system: SI

Parameter	Value	Unit
Initial prestress force (at transfer)	1,200.0	kN
Long-term losses	18.000	%
Tendon eccentricity below the centroid	250.00	mm
Section area	0.18000	m²
Section modulus, top fibre	28,000	cm³
Section modulus, bottom fibre	24,000	cm³
Moment at transfer (self-weight)	150.00	kN·m
Total service moment	520.00	kN·m

Calculated results

Parameter	Value	Unit
Top fibre at transfer (compression positive)	1.3095	MPa
Bottom fibre at transfer	12.917	MPa
Top fibre in service	15.252	MPa
Bottom fibre in service	-5.9500	MPa
Effective prestress after losses	984.00	kN

Notes for this case

• With compression positive, a prestress P at eccentricity e below the centroid gives P/A ∓ Pe/Z at the top and bottom fibres, and a sagging moment M adds ±M/Z. At transfer the full initial force acts with only the self-weight moment, so the top fibre risks tension and the bottom fibre high compression; in service the force has fallen by the losses and the full moment acts, so the bottom fibre risks tension. Compare the four stresses with the permissible limits of the design code for each stage.

Formula and method

$$f = \frac{P}{A} \mp \frac{Pe}{Z_t} \pm \frac{M}{Z_t}\ \text{(top)}, \quad f = \frac{P}{A} \pm \frac{Pe}{Z_b} \mp \frac{M}{Z_b}\ \text{(bottom)}$$

Variables

P_i	Initial prestress force (at transfer)	N
η_L	Long-term losses	-
e	Tendon eccentricity below the centroid	m
A	Section area	m²
Z_t	Section modulus, top fibre	m³
Z_b	Section modulus, bottom fibre	m³
M_g	Moment at transfer (self-weight)	N·m
M_s	Total service moment	N·m
$f_{t,i}$	Top fibre at transfer (compression positive)	Pa

$f_{b,i}$	Bottom fibre at transfer	Pa
$f_{t,s}$	Top fibre in service	Pa
$f_{b,s}$	Bottom fibre in service	Pa
P_e	Effective prestress after losses	N

Method and standards

Prestress stresses.

Assumptions and limits

- Uncracked elastic section; gross section properties; straight tendon at the section.

References

Elastic fibre stresses of prestressed members

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

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Reopens the calculator with the inputs of this report.