Calculation Of Elongation

The stressing records are part of the structural design and serve as a basis for the stressing operation. Besides the prestressing data, they contain sequence of stressing and directions for procedures directly connected with stressing operation, such as lowering of the formwork and releasing of bearings.

calculation of strand tendon elongation at stressing

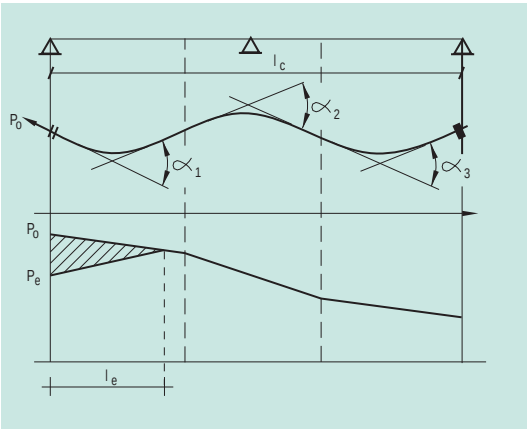
The total elongation Δl_{tot} which the tendon has to achieve during stressing should be calculated as:

$$\Delta l_{tot} = \Delta l_p + \Delta l_c + \Delta l_{sl} + \Delta l_e$$

Δl_p = elongation of the strand tendon [mm]

$$\Delta l_p = \frac{1}{A_p \cdot E_p} \cdot \int_0^{l_p} P_{x,0} \cdot dx$$

l_p = length of tendon [m]



$P_{x,0}$ = prestressing force of the tendon at any point distance x [kN]

$P_{x,0} = P_0 \cdot e^{-\mu \cdot \hat{\gamma} x}$

P_0 = prestressing force at the stressing end [kN]

γ_x = Σ angle of deflection between the stressing end and at any point distance x [rad]

$\hat{\gamma} = \frac{\pi}{180}\left[\sqrt{a_H^2 + a_V^2} + ß \cdot |\right]$

$\hat{\mu}$ = coefficient of friction (see p.5)

ß = wobble angle (see p.5)

P_e = prestressing force at the stressing end after unintentional slip of elongation [kN]

Δl_c = elastic deformation of the concrete (shortening must be treated as a positive value) [mm]

$$\Delta l_c = \frac{\sigma_{cm}}{E_c} \cdot l_c$$

σ_{cm} = average stress in the concrete cross section at the centre of gravity of all tendons due to prestressing force [MN/m²]

l_c = length of the concrete member [m]

Δl_{sl} = sum of anchor plates impressions and dead end wedge slip according anchorage type applied [mm]

Δl_{sl} [mm]

	life end anchorage	dead end anchorage	Bond Head anchorage	Coupler R	Coupler D	Coupler M
accessible	1	4	-	-	-	3
inaccessible	-	3	*)	3	6	-

*) see german approval

Δl_e = elongation of the prestressing steel in the jack and seating device (if applicable) [mm]

Calculation of life end prestressing force P_e [kN] and influence length l_e [m]

due to life end wedge slip Δl_n [mm] at release of stressing jack

$$l_e = \sqrt{\frac{\Delta l_n \cdot E_p \cdot A_p}{P_0 \cdot \mu \cdot \hat{\gamma}_1}}$$

$\hat{\gamma}_1$ = average angle of deflection along the influence length l_e of tendon behind the life end [rad/m]

$$P_e = P_0 \cdot (1 - 2 \cdot l_e \cdot \mu \cdot \hat{\gamma}_1)$$

unintentional slip Δl_n [mm]

tendon type	jack type	
	standard case	special case
6801 - 6807	4**	2**
6809 - 6827	2*	4
6802 - 6812	8	-

at the life end anchorage

at the coupler M

*) with wedge seating **) without wedge seating

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modulus of elasticity [N/mm²]

concrete class	B 25	B 35	B 45	B 55
E_c	30,000	34,000	37,000	39,000

strand E_p = 195,000 [N/mm²]

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required cube strength of the concrete at stressing acc. DIN 4227, part 1

partical prestressing	12	16	20	24
full prestressing	24	32	40	48