CODE

21.2.3 For sections in pretensioned flexural members where all strands are not fully developed, ϕ for moment shall be calculated in accordance with Table 21.2.3, where ℓ_{tr} is calculated using Eq. (21.2.3), ϕ_p is the value of ϕ determined in accordance with Table 21.2.2 at the cross section closest to the end of member where all strands are developed, and ℓ_d is given in 25.4.8.1.

$$\ell_{tr} = \left(\frac{f_{se}}{21}\right) d_b \qquad (21.2.3)$$

Table 21.2.3—Strength reduction factor ϕ for sections near the end of pretensioned members

Condition near end of member	Stress in concrete under service load[1]	Distance from end of member to section under consideration	ϕ	
All strands bonded	Not applicable	$\le \ell_{tr}$	0.75	(a)
		ℓ_{tr} to ℓ_d	Linear interpolation from 0.75 to ϕ_p[2]	(b)
One or more strands debonded	No tension calculated	$\le (\ell_{db} + \ell_{tr})$	0.75	(c)
		$(\ell_{db} + \ell_{tr})$ to $(\ell_{db} + \ell_d)$	Linear interpolation from 0.75 to ϕ_p[2]	(d)
	Tension calculated	$\le (\ell_{db} + \ell_{tr})$	0.75	(e)
		$(\ell_{db} + \ell_{tr})$ to $(\ell_{db} + 2\ell_d)$	Linear interpolation from 0.75 to ϕ_p[2]	(f)

[1]Stress calculated using gross cross-sectional properties in extreme concrete fiber of precompressed tension zone under service loads after allowance for all prestress losses at section under consideration.

[2]It shall be permitted to use a strength reduction factor of 0.75.

COMMENTARY

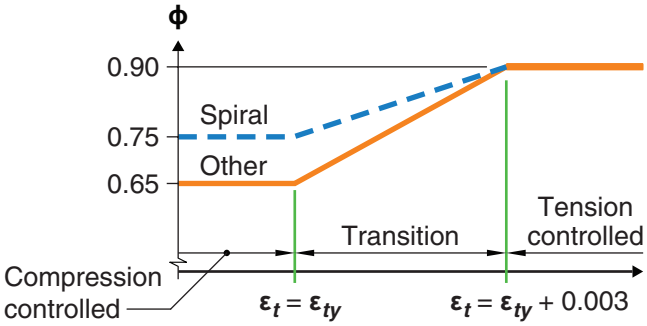

Fig. R21.2.2b—Variation of ϕ with net tensile strain in extreme tension reinforcement, ε_t.

R21.2.3 If a critical section along a pretensioned member occurs in a region where not all the strands are fully developed, bond slip failure may occur. This mode of failure resembles a brittle shear failure; hence, ϕ values for flexure are reduced relative to the value of ϕ at the cross section where all strands are fully developed. For sections between the end of the transfer length and the end of the development length, the value of ϕ may be determined by linear interpolation, as shown in Fig. R21.2.3a, where ϕ_p corresponds to the value of ϕ at the cross section closest to the end of the member where all strands are fully developed.

Where bonding of one or more strands does not extend to the end of the member, instead of more rigorous analysis, ϕ should be taken as 0.75 from the end of the member to the end of the transfer length of the strand with the longest debonded length. Beyond this point, ϕ may be varied linearly to ϕ_p at the cross section where all strands are developed, as shown in Fig. R21.2.3b. Alternatively, the value of ϕ may be taken as 0.75 until all strands are fully developed. Embedment of debonded strand is considered to begin at the termination of the debonding sleeves. Beyond this point, the provisions of 25.4.8.1 are used to determine whether the strands develop over a length of ℓ_d or $2\ell_d$, depending on the calculated stress in the precompressed tension zone under service loads (Fig. R21.2.3b).