

## KDOT LRFD Prestressed Beam Design Guidelines Summary

### Section Properties

- For Strength Limit States use *Article 5.7.2*
- For Fatigue and Services Limit States, use gross un-cracked and un-transformed sections without reductions for reinforcement per *Article 5.7.1*
- Composite sections use the effective flange = tributary slab width, *Article 4.6.2.6*

### Concrete Stresses

#### LRFD Design Stress Limit, (ksi) at Service Limit States

Stage	Stresses, (ksi)	Article (s)
Initial Compression	$0.60 f'_{ci}$	5.9.4.1.1
* Initial Tension	$0.24 \sqrt{f'_c}$	5.9.4.1.2
Final Compression	$0.60 f'_c$	5.9.4.2.1
Final Tension	$0.0948 \sqrt{f'_c}$	5.9.4.2.2
Final Allowable Compression with $LL+1/2(P_{eff}+DL)$	$0.40 f'_c$	5.9.4.2.1
Final DL Compression	$0.45 f'_c$	5.9.4.2.1
Shipping & Handling Compression	$0.60 f'_c$	5.9.4.2.1
* Shipping & Handling Tension	$0.24 \sqrt{f'_c}$	5.9.4.1.2

\* Where  $A_s$  is proportioned as stated in *Article C.5.9.4.1.2*

### Concrete Strength and Strand Usage

- Use 0.5 in. 270 ksi strands for K2 and K3 with  $f'_{ci} = 4$  ksi and  $f'_c = 5$  ksi
- Use 0.5 or 0.6 in. 270 ksi strands for K4 with up to  $f'_{ci} = 5$  ksi and  $f'_c = 6$  ksi
- Use 0.6 in. 270 ksi strand for K6 with  $f'_{ci} = 5$  ksi and  $f'_c = 6$  ksi

Note: Adjust  $f'_{ci}$  in 0.10 ksi increments as needed

### Calculation of Losses

- Include elastic shortening per *Article 5.9.5.2.3*
- Use the “Approximate Method” for time dependant losses, *Article 5.9.5.3*; this calculated value can be used as a lump sum for software which does not have the “Approximate Method” available.

**Diaphragms**

- Use temporary intermediate diaphragms for the following conditions
  - Up to 40 ft. spans: none are required
  - 40-80 ft. spans: use at first and third quarter points
  - 80 -120 ft. spans: use at first three quarter points
  - Greater than 120 ft. spans: use a special design
- Temporary diaphragms are property of the contractor, to be removed from site
- Use CIP diaphragms at all supports (detail per Bridge Design Manual)
- Use CIP intermediate diaphragms when the structure is heavily skewed or splayed

**Time to Continuity** (*Article 5.14.1.4.4*)

- KDOT assumes continuity is made at approximately 50 days; use this to calculate camber  
The minimum beam age will be 28 days at the time of continuity
- Restraint moments are not used in determining beam design moments
- The CIP continuity diaphragm is considered partially effective per *Article 5.14.1.4.5*
- Full continuity is assumed at interior supports for determining the required slab reinforcement at the Strength Limit State

**Analysis (+M) regions**

- Beam self weight will be resisted by considering simply supported member conditions for Service and Strength Combinations
- Non-Composite DL will be resisted by considering simply supported member conditions for Service and Strength Combinations
- Composite DL will be resisted by considering simply supported member conditions for Service and Strength Combinations
- Live Load and Dynamic Load will be resisted by considering simply supported member conditions for Service and Strength Limits States.

**Analysis (-M) regions**

- Composite DL will be resisted by considering the members as continuous
- Live Load and Dynamic Load (LL/IM) will be resisted by considering the members as continuous
- As a minimum, reinforce the slab per *Article(s) 5.7.3.2, 5.7.3.3 and 5.7.3.4*
- As a minimum, develop the slab reinforcing steel past the quarter point of the longest span, in-lieu of *Article 5.14.1.4.8*, and then begin to stagger the bars to be cut-off

**Strand Extension** (*Article 5.14.1.4.9a*)

- Provide positive restraint moment capacity at piers and abutments by extending strands a minimum of 36 in. to resist  $0.6 * M_{cr}$
- As a minimum extend six strands; four on the bottom and two on the top

**Confinement /Splitting** (*Article 5.10.10*)

- Do not exceed 3 in. spacing within the splitting zone defined as a region  $h/4$  from the beam end
- Do not exceed 6 in. spacing within the distance of  $1.5d$  for the confinement reinforcing steel

**Shear** (*Article 5.8.3*)

- Do not exceed 18 in. spacing, or exceed 6 in. change in spacing, or reduce the shear capacity by more the 50% at a section along the member