Illinois Department of Transportation

Memorandum

To:	ALL BRIDGE DESIGNERS	15.3
From:	D. Carl Puzey	
Subject:	Superstructure Concrete Compressive Strength; Live Load Distribution and Overhang Limits	
Date:	April 29, 2015	

Superstructure Concrete Compressive Strength

The concrete compressive strength used for the design of Bridge Superstructure and Bridge Approach Slab (Class BS Concrete) shall be increased from 3,500 psi to 4,000 psi. This design policy revision takes full advantage of the material properties specified in Section 1020 of the Standard Specifications for Road and Bridge Construction. This change was identified as necessary to achieve longer span lengths for the new PPC IL-Beams as noted in ALL BRIDGE DESIGNERS (ABD) memorandum 15.2 and will be beneficial to all bridge superstructure types. An updated deck design chart may be found in ABD 15.2. An example of the contract plan presentation of concrete design strengths for a typical project shall be as follows:

DESIGN STRESSES
Field Units
f'c = 3,500 psi
f'c = 4,000 psi (superstructure concrete)

Live Load Distribution Policy for Typical Bridges

IDOT policy is intended to have interior beams govern the design and rating of a bridge. As such, IDOT follows the live load distribution equations for moment in interior beams specified in AASHTO LRFD Table 4.6.2.2.2b-1. These equations may be simplified for steel beams with the "C" factor, as specified in Section 3.3.1 of the Bridge Manual; however, the simplified "C" factor for precast prestressed concrete beams shall no longer be used. Variable strand patterns and rebar are not considered in determining the beam section properties which eliminate the iterative process required to generate K_g and therefore a simplified equation offers no time savings. Also, the current "C" factors do not always give a conservative result for the new PPC IL-Beams.

In order to meet the interior beam policy intent, the following rules for the exterior beam live load distribution equations, specified in AASHTO Table 4.6.2.2.2d-1, shall be followed. The equation for two or more design lanes loaded suggests that if d_e is limited to 2'-1", the exterior beam will have less influence than the interior beam. Therefore, to help ensure the exterior beam does not govern, IDOT bridges shall be designed such that the exterior beam overhang is limited to the smaller of d_e plus the width of a continuous parapet or curb, or half the beam spacing. Illustrated examples of d_e and the exterior beam overhang for a typical Illinois parapet and railing are included. On structures with raised sidewalks the overhang shall be limited to half the beam spacing. The AASHTO Specifications

also suggest the lever rule for one design lane loaded; however, this yields very conservative results that are not consistent with the Department's experience and therefore should not be applied. Typical bridges satisfying these live load distribution and overhang requirements should satisfy IDOT's interior beam design and rating policy.

Contract plans for typical bridges shall contain an Interior Girder Moment Table and Reaction Table. The table has been revised to include the Live Load Distribution Factor (LLDF) for moment and shear, the obtuse correction factor (OCF) and the impact reaction as shown in the attached example. Similar Girder Moment and Reaction Table updates shall be made for the PPC I-Beam tables. The OCF shall be applied to non-continuous exterior beam ends and may be taken as defined in AASHTO Table 4.6.2.2.3c-1 or as simplified in Section 3.3.1 of the Bridge Manual. The largest reaction between the interior reaction and the exterior reaction corrected for the OCF shall be used to size all the bearings at a substructure support.

Finally, note the standard IDOT diaphragms and cross frames are not considered sufficiently rigid to allow a typical beam slab cross section to rotate and deflect as a rigid cross section and therefore the pile analogy provisions discussed in AASHTO Article 4.6.2.2.2d are not applicable.

Live Load Distribution Policy for Atypical Bridges

On rare occasions, as approved by the Bureau of Bridges and Structures, it may be necessary to have an overhang that exceeds half the beam spacing or a d_e that exceeds 2'-1". In these cases, the LLDF for moment in exterior beams from AASHTO Table 4.6.2.2.2d-1 shall be investigated utilizing the correction factor "e" for two or more design lanes and utilizing the lever rule with a multiple presence factor of 1.0 for one design lane loaded. The governing LLDF shall be used to design all the beams. The interior and exterior beam at a given cross section should ideally be the same size. The effective flange width for the exterior beam shall be taken as no greater than the effective flange width for the interior beam for design calculations. The additional dead load from the wider exterior overhang shall be applied only to the exterior girder as additional DC1.

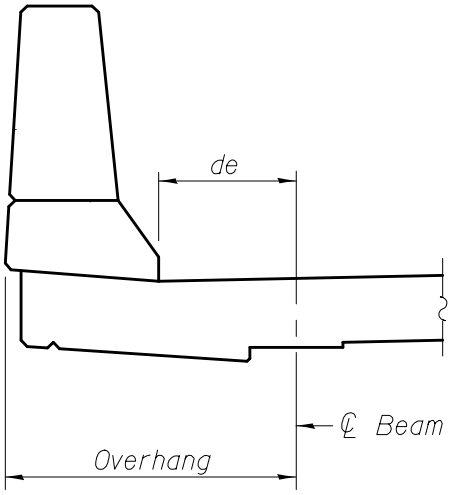
Contract plans for atypical bridges shall contain a Girder Moment Table and Reaction Table which combines the interior and exterior beam data as illustrated on the attached example. Similar Girder Moment and Reaction Table updates shall be made for the PPC I-Beam tables. The exterior girder data provides the information that controlled the beam design and generated the rating of the structure. The interior girder data values may be used for evaluation of future ratings and permit loads.

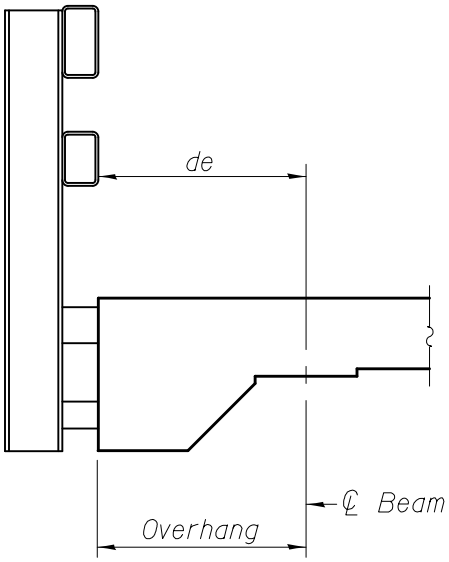
Implementation

These revisions shall be effective with TS&L's approved after May 1, 2015. Please direct questions to Gary Kowalski of the Policies, Standards and Specifications Unit at (217) 785-2914.

Attachments

KLR/kktABD15.3-20150430


de
℄ Beam
Overhang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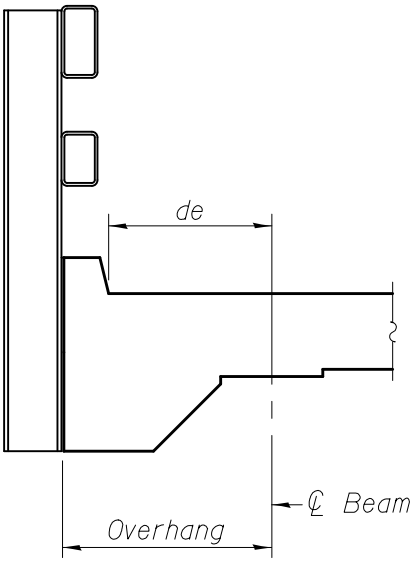
Overhang


de
℄ Beam
Overhang

Moment table - Symmetrical composite 2 span
(Composite in positive and negative moment areas)

INTERIOR GIRDER MOMENT TABLE			
		0.4 Sp. 1 or 0.6 Sp. 2	Pier
I_s	(in^4)		
$I_c(n)$	(in^4)		
$I_c(3n)$	(in^4)		
$I_c(cr)$	(in^4)		
S_s	(in^3)		
$S_c(n)$	(in^3)		
$S_c(3n)$	(in^3)		
$S_c(cr)$	(in^3)		
DC1	(k/')		
M_{DC1}	('k)		
DC2	(k/')		
M_{DC2}	('k)		
DW	(k/')		
M_{DW}	('k)		
LLDF			
M_{LL+IM}	('k)		
M_u (Strength I)	('k)		
$\phi_f M_n$	('k)		
f_s DC1	(ksi)		
f_s DC2	(ksi)		
f_s DW	(ksi)		
f_s (LL+IM)	(ksi)		
f_s (Service II)	(ksi)		
$0.95R_hF_{yf}$	(ksi)		
f_s (Total)(Strength I)	(ksi)		
$\phi_f F_n$	(ksi)		
V_f	(k)		

GIRDER REACTION TABLE					
		Abut.		Pier	
		Interior	Exterior	Interior	Exterior
LLDF					
OCF		———		———	
R_{DC1}	(k)				
R_{DC2}	(k)				
R_{DW}	(k)				
R_{LL}	(k)				
R_{Im}	(k)				
R_{Total}	(k)				

LRFD DESIGN DATA TABLES
FOR TYPICAL BRIDGES

Moment table - Symmetrical composite 2 span
(Composite in positive and negative moment areas)

GIRDER MOMENT TABLE					
		0.4 Span 1 or 0.6 Span 2		Pier	
		Interior	Exterior	Interior	Exterior
I_s	(in^4)				
$I_c(n)$	(in^4)				
$I_c(3n)$	(in^4)				
$I_c(cr)$	(in^4)				
S_s	(in^3)				
$S_c(n)$	(in^3)				
$S_c(3n)$	(in^3)				
$S_c(cr)$	(in^3)				
DC1	(k/')				
M_{DC1}	('k)				
DC2	(k/')				
M_{DC2}	('k)				
DW	(k/')				
M_{DW}	('k)				
LLDF					
M_{LL+IM}	('k)				
M_u (Strength I)	('k)				
$\phi_f M_n$	('k)				
f_s DC1	(ksi)				
f_s DC2	(ksi)				
f_s DW	(ksi)				
f_s (LL+IM)	(ksi)				
f_s (Service II)	(ksi)				
$0.95R_hF_{yf}$	(ksi)				
f_s (Total)(Strength I)	(ksi)				
$\phi_f F_n$	(ksi)				
V_f	(k)				

GIRDER REACTION TABLE					
		Abut.		Pier	
		Interior	Exterior	Interior	Exterior
LLDF					
OCF		———		———	
R_{DC1}	(k)				
R_{DC2}	(k)				
R_{DW}	(k)				
R_{LL}	(k)				
R_{Im}	(k)				
R_{Total}	(k)				

LRFD DESIGN DATA TABLES
FOR ATYPICAL BRIDGES