Index 20005 Prestressed I-Beam Temporary Bracing (Rev. 07/14)

Design Criteria

AASHTO LRFD Bridge Design Specifications, 6th Edition; ***Structures Detailing Manual (SDM)***; ***Structures Design Guidelines (SDG)***

Design Assumptions and Limitations

Index 20005 provides useful bracing design information to assist the contractor, who is solely responsible for ensuring stability of beams and girders during all handling, storage, shipping and erection (See FDOT ***Specifications*** 5-1.4.5). Use this standard for all superstructures having simply supported Florida-I and non-FDOT standard pretensioned concrete I-Beams. Use this standard with Indexes 20010, 20036, 20045, 20063, 20072, 20078, 20084, 20096, 20199, 20510, 20511 and 20512.

This Index is generally not applicable in its entirety to segmented beams that are erected utilizing temporary shoring and then spliced together using post-tensioning

Companion MicroStation CADD cell 20005 includes the "TABLE OF TEMPORARY BRACING VARIABLES", the "TABLE OF WIND LOAD VARIABLES", the "TABLE OF ASSUMED CONSTRUCTION LOADS (UNFACTORED)", and the "BEAM TEMPORARY BRACING NOTES". These tables are to be completed and included in the plans along with the provided "BEAM TEMPORARY BRACING NOTES". The FDOT Beam Stability MathCAD program may be used to determine the variables to be input into these tables. See ***SDG*** Chapters 2 and 4 for more information and requirements.

The assumed weight for the finishing machine is left to the discretion of the designer, but suggested total weights for the finishing machine areas follows:

Bridge Width (feet)	26 - 32	32 - 44	44 - 56	56 - 68	68 - 80	80 - 120
Finishing Machine Weight (Kips)	6.4	10	11	12	13	16

These weights are based on specifications of the Terex Bid-Well Roller Paver, models 2450 and 4800.

Plan Content Requirements

In the Structures Plans:

Complete the following "TABLE OF WIND LOAD VARIABLES", “TABLE OF ASSUMED CONSTRUCTION LOADS (UNFACTORED)” and “TABLE OF TEMPORARY BRACING VARIABLES” and include them in the plans for all bridges with prestressed concrete I-beam superstructures. Use additional sheets when the actual number of spans exceeds the capacity of a single plan sheet using the standard tables. Supplemental details and modifications are permitted if special conditions require dimensions, details or notes. However, the tables themselves should not be modified. See Introduction I.3 for more information regarding use of Data Tables.

The forces that are entered into the columns for beam end and intermediate horizontal bracing forces in the 'TABLE OF TEMPORARY BRACING VARIABLES' shall be the horizontal reaction forces at each brace point. Forces should not be resolved into a diagonal component, regardless of any inclination of the actual bracing. These forces are to be used by the Contractor to design bracing members and connections.

If intermediate span braces are not required, enter "N/A" in the "Horizontal Force At Each Intermediate Span Brace" and "Overturning Moment At Each Intermediate Span Brace" columns for each span in which intermediate span braces are not required.

PRESTRESSED BEAM TEMPORARY BRACING DATA TABLES

TABLE OF WIND LOAD VARIABLES	Table Date 1-01-11
WIND SPEED, BASIC (MPH)	
WIND SPEED, CONSTRUCTION INACTIVE (MPH)	
WIND SPEED, CONSTRUCTION ACTIVE (MPH)	
VELOCITY PRESSURE EXPOSURE COEFFICIENT	
GUST EFFECT FACTOR	

TABLE OF ASSUMED CONSTRUCTION LOADS (UNFACTORED)	Table Date 1-01-11
BUILD-UP (PLF)	
FORM WEIGHT (PSF)	
FINISHING MACHINE TOTAL WEIGHT (KIP)	
FINISHING MACHINE WHEEL LOCATION BEYOND EDGE OF DECK OVERHANG (IN.)	
DECK WEIGHT (PSF)	
LIVE LOAD (PSF)	
LIVE LOAD AT EXTREME DECK EDGE (PLF)	

TABLE OF TEMPORARY BRACING VARIABLES						Table Date 7-01-14	
SPAN NO.	L_B, MAXIMUM UNBRACED LENGTH (FT)	HORIZONTAL FORCE AT EACH BEAM END AND ANCHOR BRACE (KIP)	HORIZONTAL FORCE AT EACH INTERMEDIATE SPAN BRACE (KIP)	OVERTURNING MOMENT AT EACH BEAM END AND ANCHOR BRACE (KIPxFT)	OVERTURNING MOMENT AT EACH INTERMEDIATE SPAN BRACE (KIPxFT)	BRACE ENDS PRIOR TO CRANE RELEASE?	TOTAL LINES OF BRACING
						YES/NO	
						YES/NO	
						YES/NO	
						YES/NO	

BEAM TEMPORARY BRACING NOTES [Notes Date 7-01-14]:

In accordance with Specification 5-1.4.5, temporary bracing as shown in the 'TABLE OF TEMPORARY BRACING VARIABLES' and Design Standard Index No. 20005 is required. The Table and following information is provided to aid the Contractor in design of beam temporary bracing:

1. *Design the bracing members and connections to transfer both compressive and tensile forces equal to the horizontal forces given in the 'TABLE OF TEMPORARY BRACING VARIABLES'. Also design bracing members and connections to be capable of resisting the overturning moments given in the Table, non-simultaneously with horizontal forces. Assume that horizontal bracing forces are applied perpendicular to the beam web at mid-height of the beam, and assume that overturning bracing moments are applied at the centerline of the beam at the top of the top flange. Apply the loads to one bay of bracing. Assume a 2D model with pinned boundary conditions.*
2. *The horizontal brace forces have been determined by application of the Construction Inactive Wind Load as listed in the 'TABLE OF WIND LOAD VARIABLES'. The overturning brace forces have been determined by application of the Construction Active Wind Load as listed in the 'TABLE OF WIND LOAD VARIABLES' plus the assumed construction loads shown in the 'TABLE OF ASSUMED CONSTRUCTION LOADS'. It is the Contractor's responsibility to re-calculate the bracing requirements if the actual construction loads exceed the assumed loads shown, or if the finishing machine wheel location from the edge of the deck overhang exceeds the value listed.*
3. *The temporary bracing at the ends of the beams shall be installed prior to crane release if indicated in the 'TABLE OF TEMPORARY BRACING VARIABLES'. At a minimum, provide temporary bracing at each end of each beam during non-work hours. Bracing shall remain in place until bridge deck concrete reaches 2500 psi.*
4. *The exposure period (defined as the time period for which temporary load cases of the superstructure exist) is assumed to be less than one year. Horizontal bracing forces, as specified in the 'TABLE OF TEMPORARY BRACING VARIABLES', are not valid if the exposure period is more than one year; for this case the Contractor shall re-calculate bracing requirements.*
5. *Horizontal and overturning forces are factored per the Strength III limit state for construction.*
6. *Use the same bracing in all bays. Intermediate and end span bracing may be different.*

Payment

The cost of temporary bracing is incidental to the cost of the prestressed beams it is used with. No separate payment is made.

Example Problem

The following example shows the data required for completion of the Data Table for the Prestressed Beam Temporary Bracing Index No. 20005. This case shows a Florida-I 78 Beam (Index No. 20078). The example assumes a three equal span bridge designed for the following conditions:

Girder Span: 182'-0"

Girder Spacing: 6'-0"

Number of Girder Lines: 7

Deck Thickness: 8½"

Deck Overhang: 3'-0"

Skew Angle: 0°

Bridge Height: 60'-0"

Construction Inactive Wind Load: 150 mph reduced by 0.6 to 90 mph

Construction Active Wind Load: 20 MPH (girder only)

Based on beam stability calculations, (1) intermediate brace point would be sufficient, but the bracing force would be very large. Therefore, the bracing requirements will be calculated based on (2) intermediate brace points.

The maximum unbraced length is: 182'-0" / 3 = 60'-8"

PRESTRESSED BEAM TEMPORARY BRACING DATA TABLES

TABLE OF WIND LOAD VARIABLES	Table Date 1-01-11
WIND SPEED, BASIC (MPH)	150
WIND SPEED, CONSTRUCTION INACTIVE (MPH)	90
WIND SPEED, CONSTRUCTION ACTIVE (MPH)	20
VELOCITY PRESSURE EXPOSURE COEFFICIENT	1.137
GUST EFFECT FACTOR	0.85

TABLE OF ASSUMED CONSTRUCTION LOADS (UNFACTORED)	Table Date 1-01-11
BUILD-UP (PLF)	50
FORM WEIGHT (PSF)	20
FINISHING MACHINE TOTAL WEIGHT (KIP)	10
FINISHING MACHINE WHEEL LOCATION BEYOND EDGE OF DECK OVERHANG (IN.)	$2\frac{1}{2}$
DECK WEIGHT (PSF)	106.3
LIVE LOAD (PSF)	20
LIVE LOAD AT EXTREME DECK EDGE (PLF)	75

TABLE OF TEMPORARY BRACING VARIABLES							Table Date 7-01-14
SPAN NO.	L_B, MAXIMUM UNBRACED LENGTH (FT)	HORIZONTAL FORCE AT EACH BEAM END AND ANCHOR BRACE (KIP)	HORIZONTAL FORCE AT EACH INTERMEDIATE SPAN BRACE (KIP)	OVERTURNING MOMENT AT EACH BEAM END AND ANCHOR BRACE (KIPxFT)	OVERTURNING MOMENT AT EACH INTERMEDIATE SPAN BRACE (KIPxFT)	BRACE ENDS PRIOR TO CRANE RELEASE?	TOTAL LINES OF BRACING
1	60.67	2.47	24.2	36.5	66.6	NO	4
2	60.67	2.47	24.2	36.5	66.6	NO	4
3	60.67	2.47	24.2	36.5	66.6	NO	4

BEAM TEMPORARY BRACING NOTES [Notes Date 7-01-14]:

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1. Design the bracing members and connections to transfer both compressive and tensile forces equal to the horizontal forces given in the 'TABLE OF TEMPORARY BRACING VARIABLES'. Also design bracing members and connections to be capable of resisting the overturning moments given in the Table, non-simultaneously with horizontal forces. Assume that horizontal bracing forces are applied perpendicular to the beam web at mid-height of the beam, and assume that overturning bracing moments are applied at the centerline of the beam at the top of the top flange. Apply the loads to one bay of bracing. Assume a 2D model with pinned boundary conditions.
2. The horizontal brace forces have been determined by application of the Construction Inactive Wind Load as listed in the 'TABLE OF WIND LOAD VARIABLES'. The overturning brace forces have been determined by application of the Construction Active Wind Load as listed in the 'TABLE OF WIND LOAD VARIABLES' plus the assumed construction loads shown in the 'TABLE OF ASSUMED CONSTRUCTION LOADS'. It is the Contractor's responsibility to re-calculate the bracing requirements if the actual construction loads exceed the assumed loads shown, or if the finishing machine wheel location from the edge of the deck overhang exceeds the value listed.
3. The temporary bracing at the ends of the beams shall be installed prior to crane release if indicated in the 'TABLE OF TEMPORARY BRACING VARIABLES'. At a minimum, provide temporary bracing at each end of each beam during non-work hours. Bracing shall remain in place until bridge deck concrete reaches 2500 psi.
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5. Horizontal and overturning forces are factored per the Strength III limit state for construction.
6. Use the same bracing in all bays. Intermediate and end span bracing may be different.