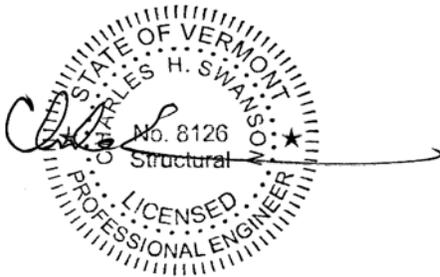


VTRANS

VT100A REPLACEMENT OF BRIDGE OVER PINNEY HOLLOW BROOK PLYMOUTH, VT

BRIDGE NO. 47
PROJECT ER BRS 0149(5)

PRECAST NEXT BEAM ELONGATION CALCULATIONS June 28, 2013



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Project Description:	PLYMOUTH - VT		
Task:	ELONGATION OF BEAMS		
Calc By:	LKW	Date:	6/28/2013
Check By:	CHS	Date:	6/28/2013

BEAM ELONGATION

REF. AASHTO BRIDGE MANUAL 2012
 PCI JOURNAL FALL 2012 - ARTICLE FOR "AASHTO LRFD BRIDGE DESIGN SPECIFICAITONS
 PROVISION FOR LOSS OF PRESTRESS"

ELASTIC SHORTENING:

$$(L-L') = PL/(AnEc) \qquad \Delta L = PL/(AnEc)$$

- L = LENGTH OF CONCRETE MEMBER BEFORE TRANSFER
- L' = LENGTH OF CONCRETE MEMBER AFTER TRANSFER, CONSIDER ELASTIC SHORTENING DUE TO PRESTRESS
- P = EFFECTIVE TENSILE STRESS IN PRESTRESSING STRAND BEFORE TRANSFER
- *NOTE: VALUE OF P BEOFRE LOSSES IS USED HERE, WHICH IS CONSERVATIVE. THE ACTUAL VALUE OF P WOULD BE AFTER LOSSES DUE TO ELASTIC SHORTENING.
- N = NUMBER OF PRESTRESSING STRANDS
- An = NET AREA OF CONCRETE MEMBER
- Ec = MODULUS OF ELASTICITY CONCRETE MEMBER
- fci' = STRENGTH OF CONCRETE AT RELEASE
- fc' = FINAL STRENGTH OF CONCRETE
- fpu = ULTIMATE STRENGTH OF PRESTRESSING TENDON

L (FT) =	61.17	N =	38
An (in2) =	1580	As (in2) =	0.217
fc' (ksi) =	8	fpu (ksi) =	270
fci' (ksi) =	6	wc (k/ft^3) =	0.15
fsi (kip) = 0.75*fpu =			202.5 ksi
Pi (kip) = N*As*fsi =			1669.815 kip
Ec (ksi) = 33,000 (wc)^1.5 (fci')^0.5 =			4695.982 ksi
$\Delta L = PL/(AnEc) =$			0.013769 ft
			0.165227 in



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TIME DEPENDENT SHRINKAGE

SHRINKAGE OF CONCRETE IS A DECREASE IN VOLUME PRIMARILY DUE TO LOSS OF EXCESSIVE WATER OVER TIME.

$$\epsilon_{sn} = K_f * K_{hs} * K_{td} * K_s * 0.48 \times 10^{-3}$$

ϵ_{sn} = CONCRETE SHRINKAGE STRAIN AT GIVEN TIME

K_f = FACTOR FOR THE EFFECT OF CONCRETE STRENGTH

K_{hs} = HUMIDITY FACTOR FOR SHRINKAGE

K_{td} = TIME DEPENDENT FACTOR

K_s = FACTOR FOR THE EFFECT OF VOLUME TO SURFACE RATIO

H = HUMIDITY

t = NUMBER OF DAYS TO CONSIDER FOR SHRINKAGE TIME EFFECT

V/S = VOLUME TO SURFACE AREA RATIO IN INCHES ALONG THE BEAM

H = 70

t = 30

V = An * 12" = 18955 in³/in

S = (111.5" * 2 + 8" * 2 + 24" * 2) * 12 = 3444 in/in

V/S = 5.503913645

$K_f = 5 / (1 + f_{ci}') = 0.714285714$

$K_{hs} = (2.00 - 0.014 * H) = 1.02$

$K_{td} = t / (61 - 4f_{ci}' + t) = 0.508474576$

$K_s = \{t / [26 * \exp(0.36 * V/S) + t] / [t / (45 + t)]\} * \{[1064 - 94 * (V/S)] / 923\} = 0.203213 \quad K_s \geq 1.0$

therefore $K_s = 1.00$

$\epsilon_{sn} = 0.0001778$

$\Delta L(30) = \epsilon_{sn} * L * 12 = 0.131 \text{ in}$

TOTAL CHANGE:

$\Delta L = \Delta L + \Delta L(30) = 0.296 \text{ in} \quad \text{SHORTENING}$