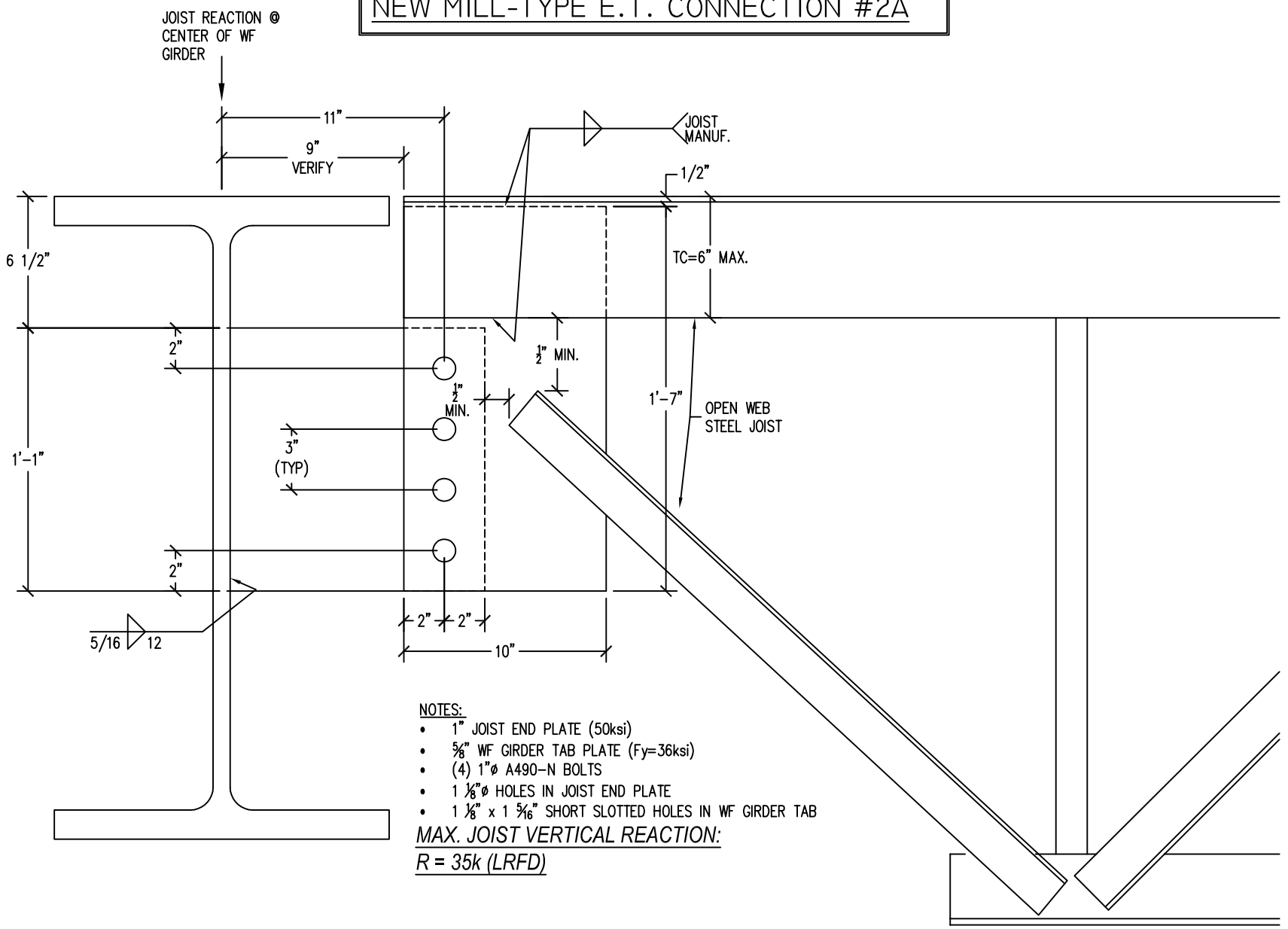
EXTENDED-TAB (ET) CONNECTION

NEW MILL-TYPE E.T. CONNECTION #2A



NOTES:

- 1" JOIST END PLATE (50ksi)
- 5/8" WF GIRDER TAB PLATE (Fy=36ksi)
- (4) 1"ø A490-N BOLTS
- 1 1/8"ø HOLES IN JOIST END PLATE
- 1 1/8" x 1 5/16" SHORT SLOTTED HOLES IN WF GIRDER TAB

MAX. JOIST VERTICAL REACTION:

R = 35k (LRFD)

Date: 3/18/2025

NEW MILLENNIUM
A Steel Dynamics Company

JOB NAME:	JOB #:		
LOCATION:	NMBS E.T. #2A Joist End Plate	DATE:	3/18/2025

AISC 16TH - p. 10-49 (Extended Configuration)

Holes must satisfy AISC J3.3

Horizontal Axial forces (seismic or wind) if present, to be transferred from beam to joist via tie plate

Joist Plate, Fu =	65	ksi	TC Hold Back Distance (H) =	9	in	Joist Plate w =	10 in
Joist Tab Plate, Fy =	50	ksi	TC Angle Size =	3.5	in	Joist Plate d =	19 in
Joist Plate, d or w=	10	in	Joist Plate Hold-Down from TC =	0.5	in		
Joist Plate Thickness, t=	1	in					
Joist Plate Edge Distances, de=	2	in					
e =	11	in				L_{i1} =	4.5
Vertical Shear , Vu=	35	k (LRFD)				L_{i2} =	1.5
Vertical Ecc. Moment , Mu=	385	k*in (LRFD)				L_{i3} =	0
Bolt Diameter, Db =	1	in				L_{i4} =	0
Bolt Shear Capacity ϕRn =	40	k (A490-N)				L_{i5} =	0
# of Bolts, Nb=	4	(Spreadsheet design limitation, max. 10 bolts)					
Spacing of Bolt Group, S=	3	in					
Vert. C.G. of Bolt Group =	4.5	in					
Fnv/0.9 =	75.56	ksi (Table J3.2, A490-N Bolts)					
Short Slotted Hole, Lh =	1.31	in (conservative design, allows for slotted holes in joist plate)					
Joist Top Chord Axial Force, V_{TC}=	52.5	k (LRFD)...**Assumes 1.5:1 End Web Slope**					

Gross Plate Area, Ag =	10	in^2
Effective Plate Area, Ae =	8.88	in^2
Z =	25	in^3 (1/4t*w^2)
S =	16.6667	in^3 (1/6t*w^2)

Bolt Shear - Elastic Vector Method: (AISC p. 7-7, 7-8)

Bolt Group I_p =	45.00	in4/in2
r_{py} =	8.75	k (Vu/# Bolts)
r_{mx} =	38.50	k ($Mu*L_{i1}/I_p$)
Hm =	38.50	k (rmx *Nc) Nc = 1 column of bolts
Ru =	39.48	k $(r_{py}^2+r_{mx}^2)^{1/2}$
Ru / ϕRn =	**0.99**	**< 1.0 OK**

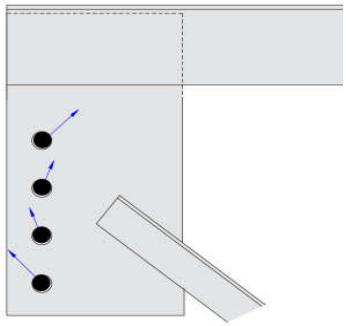
Bolt Bearing & Tearout: (AISC J3.11)

Bearing Rnb =	156.00	k/bolt (2.4*Db*t*Fu) AISC J3-6a
L_{ch} =	1.34	in (d_e - Lh/2)
Horizontal Tearout Rnt =	104.81	k/bolt (1.2*L_{ch}*t*Fu) AISC J3-6c
Ru =	39.48	k (worst case bolt shear)
r_{mx} =	38.50	k (worst case horiz. bolt shear)
ϕ =	0.75	(AISC J3.11)
Bearing Ru / ϕRnb =	**0.34**	**< 1.0 OK**
Tearout r_{mx} / ϕRnt =	**0.49**	**< 1.0 OK**

Stress Ratio Results:	
Bolt Shear (V&M):	**0.99**
Bolt Bearing & Tearout:	**0.49**
Shear Plate Rupture:	**0.18**
Shear Plate Block Shear:	**0.21**
Shear Plate Flexural Rupture:	**0.34**
Shear Plate Yielding & Flexural:	**0.13**

Min. Joist TC to Plate Weld:

2 /16th x 9.5 " Fillet Weld



NOTE: FOR VISUAL FORCE SCHEMATIC ONLY

NEW MILLENNIUM
A Steel Dynamics Company

JOB NAME:	JOB #:		
LOCATION:	NMBS E.T. #2A Joist End Plate	DATE:	3/18/2025

Shear Plate Rupture: (AISC J4.2)

Crushed Hole Width, W' = 1.1875 in (plate hole + 1/16" Crushed width)

Net Plastic Modulus, Z_{net} = 19.77 in^3 (Z - W'*t*d_{hole}) d_{hole} = 4.40625

ϕVn = 259.59 k (ϕ = 0.75, ϕ*.60*Fu*Ae) AISC J4-4

ϕMn = 963.67 k*in (ϕ = 0.75, ϕ*Fu*Z)

Ru / ϕRn = **0.18** **< 1.0 OK** $(Vu/\phi Vn)^2+(Mu/\phi Mn)^2$

Shear Plate Block Shear: (AISC J4.3)

Vertical Direction

Gross Area in Shear, Agv= 11.00 in^2 (t*(d_e+(Nb-1)*S)

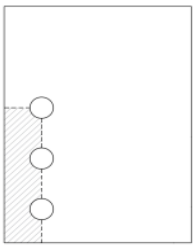
Net Area in Shear, Anv= 6.25 in^2 Agv-(Nb*W')*t

Net Area in Tension, Ant= 1.34 in^2 (t*(d_e-Lh/2)

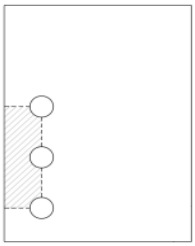
Note: Use of Lh for determination of Net Plate Area, allows for the slots to be in either the joist end plate or the beam tab.

Gross Area, ϕRn = 313.01 k (0.75*(0.6*Fy*Agv+Ubs*Fu*Ant)) Ubs = 1.0 for single bolt line

Net Area, ϕRn = 248.32 k (0.75*(0.6*Fu*Anv+Ubs*Fu*Ant)) AISC J4-5



NOTE: SCHEMATIC ONLY, HOLES OR PLATE MAY VARY



Horizontal Direction

Gross Area in Shear, Agv= 4.00 in^2 (2*t*d_e)

Net Area in Shear, Anv= 2.69 in^2 (2*t*(d_e-Lh/2)

Note: Use of Lh for determination of Net Plate Area, allows for the slots to be in either the joist end plate or the beam tab.

Net Area in Tension, Ant= 5.44 in^2 (t*((Nb-1)*S-(Nb-1)*W)

Gross Area, ϕRn = 355.08 k (0.75*(0.6*Fy*Agv+Ubs*Fu*Ant)) Ubs = 1.0 for single bolt line

Net Area, ϕRn = 343.69 k (0.75*(0.6*Fu*Anv+Ubs*Fu*Ant)) AISC J4-5

ϕRn = **248.32 k** **Controls**

Ru / ϕRn = 0.21 < 1.0 OK $(Vu^2+Hm^2)^{1/2}/\phi Rn$

Shear Plate Flexural Rupture: (AISC F11)

Yielding Mc = 1125.0 k*in (ϕ = 0.9, ϕ*(Fy*Z<1.5Fy*S)) AISC F11-1

Lateral-Torsional Buckling Check: 110.0 Lb*d/t^2, Lb = e Check for Lateral Torsional Buckling per AISC F11-3

Lateral-Torsional Buckling, Mc = 1125 k*in AISC F11-3

Ru / ϕRn = **0.34** **< 1.0 OK** (Mu/Mc)

Shear Plate Yielding & Flexural Strength: (AISC 10-8)

Vc = 300 k (ϕ = 1.0, ϕ*0.6*Fy*Ag) AISC J4-3

Yielding Mc = 1125 k*in (ϕ = 0.9, ϕ*(Fy*Z<1.5Fy*S)) AISC F11-1

Lateral-Torsional Buckling Check: 110.0 Lb*d/t^2, Lb = e Check for Lateral Torsional Buckling per AISC F11-3

Lateral-Torsional Buckling, Mc = 1125 k*in AISC F11-3

Ru / ϕRn = **0.13** **< 1.0 OK** $(Vu/Vc)^2+(Mu/Mc)^2$ AISC 10-8

Joist Plate Weld (Angle = 0 deg. & C_1 = 1.00 E70 Electrode):

Length of Plate Weld L_w = 9.5 in (w-0.5")

a_y = 0.2 AISC Table 8-4 a_y = (Weld Centroid - TC Centroid) / L_w

k_y = 0.4 AISC Table 8-4 k_y = Weld Spacing / L_w

Cy = 3.47 (y-axis weld eccentricity, AISC Table 8-4)

D_{min} = **2** /16ths of an inch Fillet Weld Size (min)

NEW MILLENNIUM
A Steel Dynamics Company

JOB NAME:		JOB #:	
LOCATION:	NMBS Beam Tab E.T. #2A	DATE:	3/18/2025

AISC 16TH - p. 10-49 (Extended Configuration)

Holes must satisfy AISC J3.3

Horizontal Axial forces (seismic or wind) if present, to be transferred from beam to joist via tie plate

Beam Tab Plate, Fu =	58	ksi		
Beam Tab Plate, Fy =	36	ksi		
Beam Tab Plate Depth, d=	13	in		
Beam Tab Thickness, t=	0.625	in		
Beam Tab Edge Distances, d_e=	2	in	L_{i1} =	4.5
e =	11	in	L_{i2} =	1.5
Vertical Shear , Vu=	35	k (LRFD)	L_{i3} =	0
Vertical Ecc. Moment , Mu=	385	k*in (LRFD)	L_{i4} =	0
Bolt Diameter, Db =	1	in	L_{i5} =	0
Bolt Shear Capacity ϕRn =	40	k		
# of Bolts, Nb=	4	(Spreadsheet design limitation, max. 10 bolts)		
Spacing of Bolt Group, S=	3	in		
C.G. of Bolt Group =	4.5	in		
Fnv/0.9 =	75.56	ksi (Table J3.2, A490-N Bolts)		
Short Slotted Hole, Lh =	1.31	in		

Ab=	0.79	in^2 (Bolt Area)
C'=	11.26	AISC Eq. 7-17
Mmax =	667.96	k*in (Fnv/0.9*Ab*C', Eq. 10-7)
Max. Beam Tab Thickness, tmax =	**0.66**	**in** (6*Mmax)/(Fy*d^2) **AISC Eq. 10-6**

Gross Plate Area, Ag =	8.125	in^2
Effective Plate Area, Ae =	5.31	in^2
Z =	26.4063	in^3 (1/4t*d^2)
S_{net} =	17.60	in^3 (1/6t*d^2)

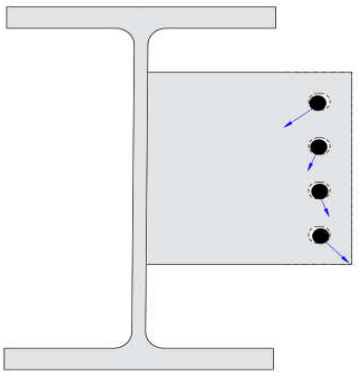
Stress Ratio Results:	
Bolt Shear (V&M):	**0.99**
Bolt Bearing & Tearout:	**0.88**
Shear Tab Rupture:	**0.32**
Shear Tab Block Shear:	**0.38**
Shear Tab Flexural Rupture:	**0.45**
Shear Tab Yielding & Flexural:	**0.24**
5 /16" Tab Weld:	**0.19**
Plate Stability Acceptable	

Bolt Shear - Elastic Vector Method: (AISC p. 7-7, 7-8)

Bolt Group I_p =	45.00	in4/in2
r_{py} =	8.75	k (Vu/# Bolts)
r_{mx} =	38.50	k (Mu*L_{i1}/I_p)
Hm =	38.50	k (rmx *Nc) Nc = 1 column of bolts
Ru =	39.48	k (r_{py}^2+r_{mx}^2)$^{1/2}$
Ru / ϕRn =	**0.99**	**< 1.0 OK**

Bolt Bearing & Tearout: (AISC J3.11)

Bearing Rnb =	87.00	k/bolt (2.4*Db*t*Fu) AISC J3-6a
L_{ch} =	1.34	in (d_e - Lh/2)
Horizontal Tearout Rnt =	58.45	k/bolt (1.2*L_{ch}*t*Fu) AISC J3-6c
Ru =	39.48	k (worst case bolt shear)
r_{mx} =	38.50	k (worst case horiz. bolt shear)
ϕ =	0.75	(AISC J3.11)
Bearing Ru / ϕRnb =	**0.61**	**< 1.0 OK**
Tearout r_{mx} / ϕRnt =	**0.88**	**< 1.0 OK**



NOTE: FOR VISUAL FORCE SCHEMATIC ONLY

NEW MILLENNIUM
A Steel Dynamics Company

JOB NAME:		JOB #:		
LOCATION:	NMBS Beam Tab E.T. #2A		DATE:	3/18/2025

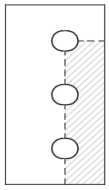
Shear Tab Rupture: (AISC J4.2)

Crushed Hole Width, W' = 1.1875 in (plate hole + 1/16" Crushed width)
Net Plastic Modulus, Z_{net} = 17.50 in^3 (Summation of A*d of net plate section)
ϕVn = 138.66 k (ϕ = 0.75, ϕ*.60*Fu*Ae) AISC J4-4
ϕMn = 761.25 k*in (ϕ = 0.75, ϕ*Fu*Z)
Ru / ϕRn = **0.32** **< 1.0 OK** $(Vu/\phi Vn)^2+(Mu/\phi Mn)^2$

Shear Tab Block Shear: (AISC J4.3)

Vertical Direction

Gross Area in Shear, Agv= 6.88 in^2 (t*(d_e+(Nb-1)*S)
Net Area in Shear, Anv= 3.91 in^2 Agv-(Nb*W')*t
Net Area in Tension, Ant= 0.84 in^2 (t*(d_e-Lh/2)
Gross Area, ϕRn = 147.91 k (0.75*(0.6*Fy*Agv+Ubs*Fu*Ant)) Ubs = 1.0 for single bolt line
Net Area, ϕRn = 138.49 k (0.75*(0.6*Fu*Anv+Ubs*Fu*Ant)) AISC J4-5



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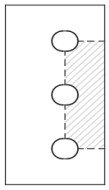

Horizontal Direction

Gross Area in Shear, Agv= 2.50 in^2 (2*t*d_e)
Net Area in Shear, Anv= 1.68 in^2 (2*t*(d_e-*Lh/2)
Net Area in Tension, Ant= 3.40 in^2 (t*((Nb-1)*S-(Nb-1)*W)
Gross Area, ϕRn = 188.33 k (0.75*(0.6*Fy*Agv+Ubs*Fu*Ant)) Ubs = 1.0 for single bolt line
Net Area, ϕRn = 191.67 k (0.75*(0.6*Fu*Anv+Ubs*Fu*Ant)) AISC J4-5

ϕRn = **138.49 k** **Controls**
Ru / ϕRn = 0.38 < 1.0 OK $(Vu^2+Hm^2)^{1/2}/\phi Rn$

Shear Tab Flexural Rupture: (AISC F11)

Yielding Mc = 855.6 k*in (ϕ = 0.9, ϕ*(Fy*Z<1.5Fy*S)) AISC F11-1
Lateral-Torsional Buckling Check: 366.1 Lb*d/t^2, Lb = e Check for Lateral Torsional Buckling per AISC F11-3
Lateral-Torsional Buckling, Mc = 855.6 k*in AISC F11-3
Ru / ϕRn = **0.45** **< 1.0 OK** (Mu/Mc)

Shear Tab Yielding & Flexural Strength: (AISC 10-8)

Vc = 175.5 k (ϕ = 1.0, ϕ*0.6*Fy*Ag) AISC J4-3
Yielding Mc = 855.6 k*in (ϕ = 0.9, ϕ*(Fy*Z<1.5Fy*S)) AISC F11-1
Lateral-Torsional Buckling Check: 366.1 Lb*d/t^2, Lb = e Check for Lateral Torsional Buckling per AISC F11-3
Lateral-Torsional Buckling, Mc = 855.6 k*in AISC F11-3
Ru / ϕRn = **0.24** **< 1.0 OK** $(Vu/Vc)^2+(Mu/Mc)^2$ AISC 10-8

Shear Tab Weld:

Min. Weld Thickness t_{wmin} = 0.28 in. $t_{wmin} = (t*Fy*3^{1/2})/(2*F_{EXX})$, F_{EXX} = 70ksi Electrode, AISC Engineering Journal, Vol. 46, 2009
Weld Provided t_w = 0.3125 in
Min. Plate Thickness = 0.53 in (AISC Eq. 9-7, 6.19*D/Fu) **GOOD**
ϕRw = 180.95 k (ϕ*0.6*F_{EXX}*0.707*t_w*d*2)

Ru / ϕRn = 0.19 < 1.0 OK

Shear Tab Stability: (Thorton and Fortney, 2011)

Laterial Torsional Buckling Check:

ϕRn = **111** k **Acceptable**

$$R_{req'd} \le \phi R_n \text{ (LRFD)}$$

$$R_n = 1500\pi\frac{lt^3}{a^2}$$

l = beam tab plate length (depth)
t = tp = beam tab plate thickness
a = Eccentricity 'e'

Lap Splice Eccentricity Check:

ϕMt,u = 43.9 k*in
Mt,u = 28.4 k*in (R*(t_p+t_j)/2

$$M_{t,u} \le \left[\phi_v\left(0.5F_w\right)\frac{R_u}{lt_p}\right]\frac{lt_p^2}{2} \quad \phi_v = 1.0$$

(LRFD)

Acceptable