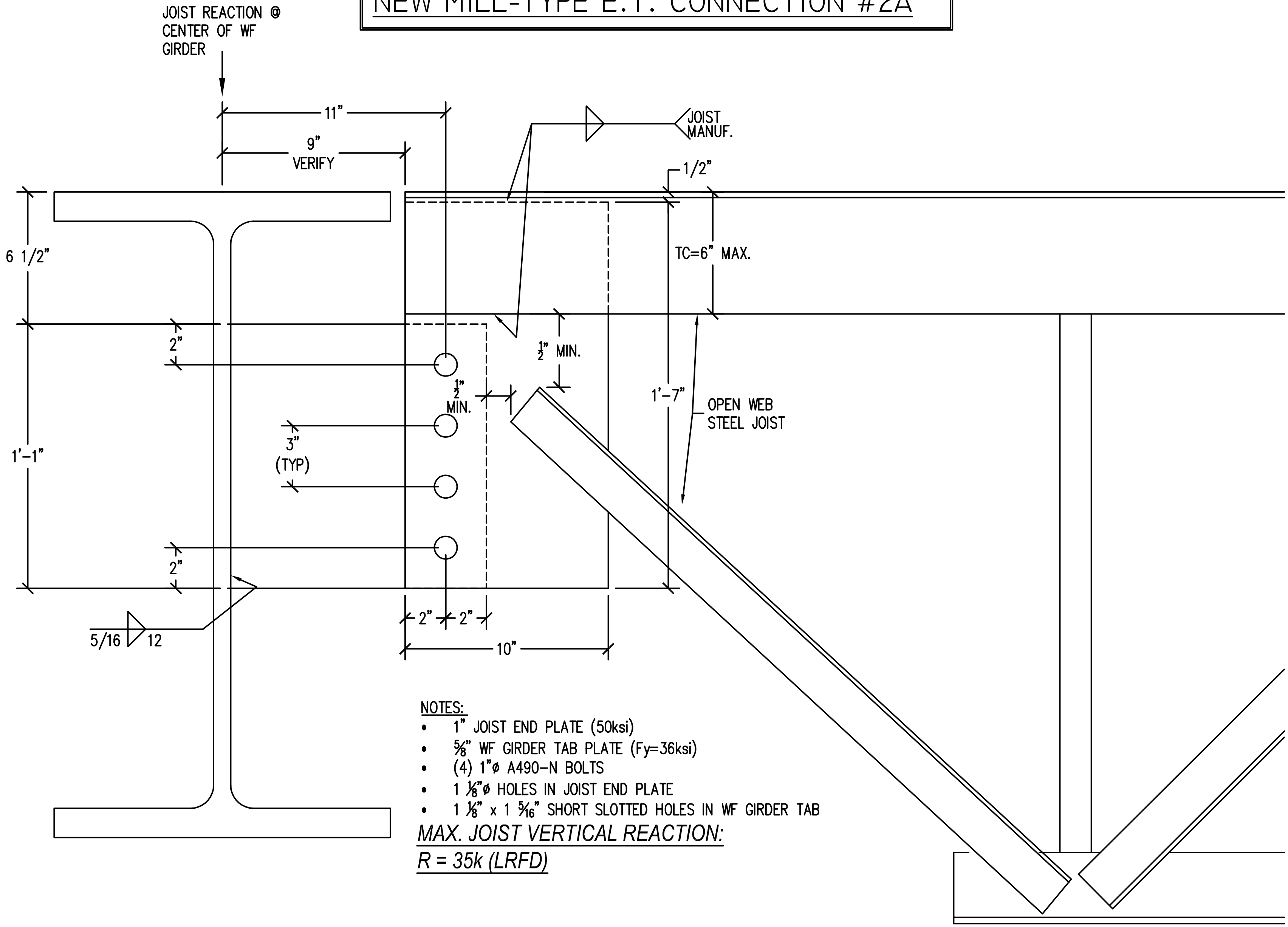
EXTENDED-TAB (ET) CONNECTION

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



NOTES:

- 1" JOIST END PLATE (50ksi)
- 5/8" WF GIRDER TAB PLATE (Fy=36ksi)
- (4) 1"ϕ A490-N BOLTS
- 1 1/8"ϕ 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
Joist Tab Plate, Fy =	50	ksi
Joist Plate, d or w=	10	in
Joist Plate Thickness, t=	1	in
Joist Plate Edge Distances, de=	2	in
e =	11	in
Vertical Shear , Vu=	35	k (LRFD)
Vertical Ecc. Moment , Mu=	385	k*in (LRFD)
Bolt Diameter, Db =	1	in
Bolt Shear Capacity ϕRn =	40	k (A490-N)
# 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**

TC Hold Back Distance (H) =	9	in
TC Angle Size =	3.5	in
Joist Plate Hold-Down from TC =	0.5	in

L_{i1} =	4.5
L_{i2} =	1.5
L_{i3} =	0
L_{i4} =	0
L_{i5} =	0

Joist Plate w =	10	in
Joist Plate d =	19	in

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)

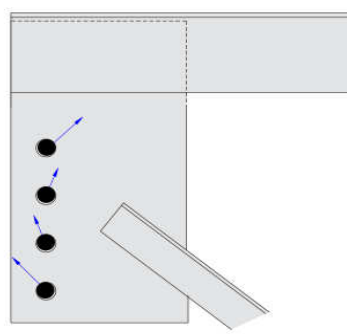
Bolt Group I_p =	45.00	in4/in2
r_{py} =	8.75	k (Vu/# Bolts)
r_{mx} =	38.50	k ($Mu*L_{i1}/I_p$)
Hm =	38.50	k (rmx *Nc) Nc = 1 column of bolts
Ru =	39.48	k $(r_{py}^2+r_{mx}^2)^{1/2}$
Ru / ϕRn =	**0.99**	**< 1.0 OK**

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

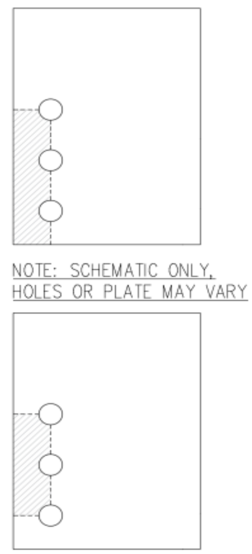
Shear Plate Rupture: (AISC J4.2)

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)
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: 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.



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)
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

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.

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
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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
e =	11	in
Vertical Shear , Vu=	35	k (LRFD)
Vertical Ecc. Moment , Mu=	385	k*in (LRFD)
Bolt Diameter, Db =	1	in
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

L_{i1} =	4.5
L_{i2} =	1.5
L_{i3} =	0
L_{i4} =	0
L_{i5} =	0

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)

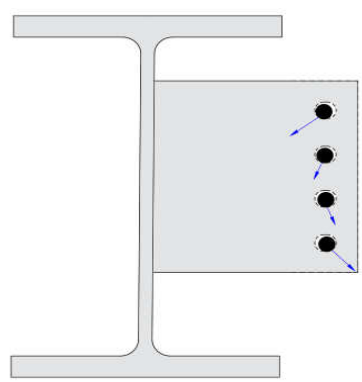
Stress Ratio Results:	
Bolt Shear (V&M):	**0.99**
Bolt Bearing & Tearout:	**0.88**
Shear Tab Rupture:	**0.32**
Shear Tab Block Shear:	**0.38**
Shear Tab Flexural Rupture:	**0.45**
Shear Tab Yielding & Flexural:	**0.24**
5 /16" Tab Weld:	**0.19**
Plate Stability Acceptable	

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

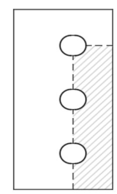
Shear Tab Rupture: (AISC J4.2)

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** $(Vu/\phi Vn)^2+(Mu/\phi Mn)^2$

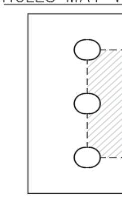
Shear Tab Block Shear: (AISC J4.3)

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



NOTE: SCHEMATIC ONLY, HOLES MAY VARY



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 $(\phi*0.6*F_{EXX}*0.707*t_w*d*2)$

Ru / ϕRn = **0.19 < 1.0 OK**

Shear Tab Stability: (Thorton and Fortney, 2011)

Lateral 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 $(R*(t_p+t_j)/2$

$$M_{t,u} \le \left[\phi_v\left(0.6F_{yp}\right) - \frac{R_u}{lt_p}\right]\frac{lt_p^2}{2} \quad \text{(LRFD)} \qquad \phi_v = 1.0$$

Acceptable