COLUMN-CAPACITY

Member Ref:23Frame:MomentFloor:FirstMember:ColumnRef. 2:1-M

ASSUMPTIONS:

No transverse loads are applied to the member (Per section 7)

1. MATERIAL PROPERTIES:

Modulus of Elasticity: E = 29000 ksi G = 11200 ksi Yield Strength: $F_{y=}$ 50 ksi

2. MEMBER GEOMETRIC INFORMATION:

Beam Length L = 15 ft 15 Project Information

Column Slenderness Parameters:

Unbraced Length, x: 15 ft Global or Local System? L_{bx} = Unbraced Length, y: L_{by =} 15 ft Unbraced Length, z: 15 ft $L_{bz} =$ Eff. Length Factor, x: K_x = 1 Eff. Length Factor, y: $K_{y} =$ 1 Eff. Length Factor, z: 1 $K_{z} =$

Reference: Excel

3. SECTION PROPERTIES				Section Information		Eq/Fig/Ta	ble/Notes
3. SECTION I NOT ENTIES				mormation			
Section:	W	W8X40					
Member is in:		Compression					
Moment of Inertia, x:	I _{xw} =	146	in ⁴	Depth:	d =	8.25	in
Moment of Inertia, y	I _{yw} =	49.1	in ⁴	Width:	b _{f=}	8.07	in
Polar Moment of Inertia:	J _{w=}	1.12	in ⁴	Flange Thickness:	t _{f=}	0.56	in
Radius of Gyration, x:	r _{xw =}	3.53	in	Web Thickness:	t _{w =}	0.36	in
Radius of Gyration, y	ryw =	2.04	in	Area:	A =	11.7	in ²
Section Modulus:	S _{x =}	35.5	in ³	r _{ts}	r _{ts =}	2.81	in
Plastic Section Modulus, x:	Z =	39.8	in ³	Distance flange/centro	h _{0 =}	11.60	in
Т	T =	0	in	Warping Constant	C _{w =}	726	in
3. PRELIMINARY ANALYSIS				Eq. E 6-2a/b			
				_			
Slenderness Ratios:	$(KL/r)_{x=}$	51.0					
	$(KL/r)_{y=}$	88.2		AISC	T	Table	3-2
	$(KL)_{z} =$	180.0		AISC	T	Table	3-2
Largest Possible Ratio:		88.2					
Compressive Control:		113.43		Е			
Critical Stress, Fcr equation:		USE E3-2					

4. LOCAL SLENDERNESS CHECK:

Table B4.1a

	Web	Flange
Member	h/tw	bf/2t
	17.6	7.21
Critical	$\lambda_{\rm r}$	λ_{r}
Case	[case 5]	[case 1]
	35.9	35.9
Check	Nonslender	Nonslender

				Reference: Section	AISC 14th Eq/Fig/Table/Notes
5. BUCKLING ANALYSIS:				E	
Euler Buckling Stress:	F _{e3 =}	36.8	ksi		Eq. E3-4
Torsional Buckling Stress:	F _{e4 =}	97.2	ksi		Eq. E4-4
Controling Euler Stress:	Fe3 =	36.8	ksi		
Critical Buckling Stress:	F _{cr =}	28.3	ksi		Eq. E3-2
6. COLUMN CAPACITY:				Eq. E3-1	

14.551 Advanced Steel Design Homework 5

Problem # 5.1 Member-Capacity and Beam-Column Analysis

Ana Gouveia 12/8/2014

Compressive Strength: P_{n=} 331.1 ksi *Eq. E3-1*

Factor: $\Phi_{=} \qquad 0.9$ Column Capacity: $\Phi.P_{n=} \qquad 298.0 \qquad ksi$

BEAM-COLUMN ANALYSIS

1. MATERIAL PROPERTIES:

Modulus of Elasticity: E = 29000 ksi G = 11200 ksi

Yield Strength: $F_{y=}$ 50 ksi

2. MEMBER GEOMETRIC INFORMATION:

Beam Length L = 15 ft Project Information

Column Slenderness Parameters:

Unbraced Length, x: $L_{bx} = 15$ ft Global or Local System?

Unbraced Length, y: $L_{by} = 15$ ft Unbraced Length, z: $L_{bz} = 15$ ft

Eff. Length Factor Check: K>1 Check for values below

Eff. Length Factor, x: $K_{x=}$ 1.88 Eff. Length Factor, y: $K_{y=}$ 1.88 Eff. Length Factor, z: $K_{z=}$ 1

Plastic Zones Lengths and Info:

Full plastic yield Length: $L_{p=}$ 7.2 ft

LTB Length: $L_r = 29.9$ ft $h_r BF = 2.46$ kins

 $\phi_b BF =$ 2.46 kips $\phi_b M_{px} =$ 149 kip.ft

Reference: Excel

Section *Eq/Fig/Table/Notes*

3. SECTION PROPERTIES Information

Section:	W	W8X40					
Member is in:		Compression					
Moment of Inertia, x:	I _{xw =}	146	in ⁴	Depth:	d =	8.25	in
Moment of Inertia, y	I _{yw =}	49.1	in ⁴	Width:	b _{f=}	8.07	in
Polar Moment of Inertia:	J _{w=}	1.12	in ⁴	Flange Thickness:	t _{f=}	0.56	in
Radius of Gyration, x:	r _{xw =}	3.53	in	Web Thickness:	t _{w =}	0.36	in
Radius of Gyration, y	ryw =	2.04	in	Area:	A =	11.7	in ²
Section Modulus:	S _{x =}	35.5	in ³	\mathbf{r}_{ts}	r _{ts =}	2.81	in
Plastic Section Modulus, x:	Z =	39.8	in ³	Distance flange/centro	h _{0 =}	11.60	in
Plastic Section Modulus, y:	$Z_{y} =$	18.5	in	Warping Constant	C _{w =}	726	in
Т	T =	0	in	Section Modulus:	S _{y =}	12.2	in ³

3. SLENDERNESS CHARACTERISTICS:

Table B4.1a

	Web	Flange				
Flexure	Compact	Compact				
Compression	Mntx =	26				
4. CONSIDERATION OF IMP	ERFECTIONS -	NOTIONAL L	OADS:	C2.2(b)		
Notional Load:	Z _{i =}	0.428	kip		Eq.	C2-1
Second/First order drift rati		2	in		-1	
Is it applied at all levels in al	I combinations	55	YES	Ref. to C.2.3(3)		
				Reference:	GTS	
				Section		Table/Not
5. FIRST ORDER ANALYSIS F	ORCES:			GTS		
			_			
Ultimate Axial Load, NT	P _{nt} =	30	kips			
Ultimate Moment, NT, x	$M_{ntx} =$	26	kip.ft			
Ultimate Moment, NT, y	$M_{nty} =$	0	kip.ft			
Ultimate Axial Load, LT	P _{It =}	26	kips			
Ultimate Moment, LT, y	MI _{tx} =	88	kip.ft			
Ultimate Moment, LT, y	MI _{tx =}	0	kip.ft			
Total V. load in story	P _{story} =	3643.2	kip			
Total V. load III Story	P _{mf} =	607.6	kip			
Story Shear in Direction of	' mt = H =	31	kip			
otory offeat in Direction of	α =	1	νih	LRFD		
Lateral Deflection	ΔH =	0.215	in			
Fact. Story Drift Limit	ΔH/L =	0.0012				

Axial Capacity	φ.P _{n =}	298.0
Flexure Capacity		
Along axis x:	Zone =	2
	Cb =	1.34

Flexure Capacity, x M_{cx} = 149.0 kip.ft

Along axis y: Fy.Zy = 925 Eq. F6-1

1.6Fy.Sy = 976 Eq. F6-1

Flexure Capacity, y $M_{cy} = 832.5$ kip.ft Reference: AISC 14th

7. APPROXIMATE SECOND ORDER ANALYSIS: Section Eq/Fig/Table/Notes

Along axis x: DAM: Use reduced stiffness per C2.3

14.551 Advanced Steel Design Homework 5	N	/lember-Cap	Problem # 5.: acity and Beam-	1 Column Analysis		Ana Gouveia 12/8/2014
	τ_{b} =	1.00		Apply to all	С	2.3(2)
Type of Curvature:		Single				
Smaller 1st-O End Mom:	$M_1 =$	-1				
Larger 1st-O End Mom:	$M_2 =$	1				
Modif. Coefficient, x:	$C_{mx} =$	1		App. 8	Eq.	A-8-4
Elastic Buckling Strength, x	$P_{ex} =$	1612	kip	App. 8	Eq.	A-8-5
Amplification Factor	$B_{1x} =$	1.0		App. 8	Eq.	A-8-3
Factor Check:		ОК		Check		
Along axis y:						
	τ_b =	1		Apply to all	С	2.3(2)
Type of Curvature:		Single				
Smaller 1st-O End Mom:	M _{1 =}	-1				
Larger 1st-O End Mom:	$M_2 =$	1				
Modif. Coefficient, y	$C_{my} =$	1		App. 8	Eq.	A-8-4
Elastic Buckling Strength	$P_{ey} =$	542	kip	App. 8	Eq.	A-8-5
Amplification Factor	$B_{1y} =$	1.0		App. 8	Eq.	A-8-3
Factor Check:		OK		Check		
Calculate P-∆ Amplification Fa	actor:					
Along axis x:						
	$R_{m} =$	0.97				A-8-8
	$P_{e-story} =$	25304.2	kip			A-8-7
	$B_{2x} =$	1.17				A-8-6
2nd-Order Axial Strength	$P_{r} =$	60.4	kip			A-8-2
2nd-Order Mom. Strength	$M_{rx} =$	0.0	kip.ft			A-8-1
Along axis y:						
	$R_{my} =$	0.97				A-8-8
	$P_{e-storyY} =$	25304.2	kip			A-8-7
	$B_{2y} =$	1.00				A-8-6
2nd-Order Axial Strength	$P_{ry} =$	56.0	kip			A-8-2
2nd-Order Mom. Strength	M_{ry} =	-26.0	kip.ft			A-8-1
8. COMBINED FORCES INTERA	ACTION EQUA	ATION:		GTS		
Check Pr/Pc	$P_r/P_{c} =$	0.203				
Pr/Pc ≥ 0,2	-	1.294	OK		Eq.	H.1-1a
Pr/Pc < 0,2		0.000	ОК		Eq.	H.1-1b

ОК

Eq.

H.1-1a

Design Check

COLUMN-CAPACITY

Member Ref:26Frame:MomentFloor:RoofMember:Interior BeamRef. 2:2-M

ASSUMPTIONS:

No transverse loads are applied to the member (Per section 7)

1. MATERIAL PROPERTIES:

Modulus of Elasticity: $E = 29000 \hspace{0.2in} ksi$ $G = 11200 \hspace{0.2in} ksi$

Yield Strength: $F_{y=}$ 50 ksi

2. MEMBER GEOMETRIC INFORMATION:

Beam Length L = 24 ft 24 Project Information

Column Slenderness Parameters:

Unbraced Length, x: $L_{bx} = 24$ ft Global or Local System?

Unbraced Length, y: $L_{by} = 24$ ft Unbraced Length, z: $L_{bz} = 24$ ft Eff. Length Factor, x: $K_{x} = 1$

Eff. Length Factor, x: $K_{x=}$ 1 Eff. Length Factor, y: $K_{y=}$ 1

Eff. Length Factor, z: $K_{z=}$ 1

Reference: Excel

3. SECTION PROPERTIES				Section Information		Eq/Fig/Ta	ble/Notes
3. SECTION PROPERTIES				illiorillation			
Section:	W	W18X35					
Member is in:		Compression					
Moment of Inertia, x:	I _{xw =}	510	in ⁴	Depth:	d =	17.7	in
Moment of Inertia, y	I _{yw} =	15.3	in ⁴	Width:	b _{f=}	6	in
Polar Moment of Inertia:	J _{w=}	0.506	in ⁴	Flange Thickness:	t _{f=}	0.425	in
Radius of Gyration, x:	r _{xw =}	7.04	in	Web Thickness:	t _{w =}	0.3	in
Radius of Gyration, y	ryw =	1.22	in	Area:	A =	10.3	in ²
Section Modulus:	S _{x =}	57.6	in ³	r_{ts}	r _{ts =}	2.81	in
Plastic Section Modulus, x:	Z =	66.5	in ³	Distance flange/centro	h _{0 =}	11.60	in
Т	T =	0	in	Warping Constant	C _{w =}	1140	in
3. PRELIMINARY ANALYSIS				Eq. E 6-2a/b			
Slenderness Ratios:	$(KL/r)_{x=}$	40.9					
	$(KL/r)_{y=}$	236.1		AISC	Т	able	3-2
	$(KL)_{z} =$	288.0		AISC	Т	able	3-2
Largest Possible Ratio:		236.1					
Compressive Control:		113.43		E			
Critical Stress, Fcr equation:		USE E3-3					

4. LOCAL SLENDERNESS CHECK:

Table B4.1a

	Web	Flange
Member	h/tw	bf/2t
	53.5	7.06
Critical	$\lambda_{\rm r}$	$\lambda_{\rm r}$
Case	[case 5]	[case 1]
	35.9	35.9
Check	N.G	Nonslender

				Reference: Section	AISC 14th Eq/Fig/Table/Notes
5. BUCKLING ANALYSIS:				E	<u> </u>
Euler Buckling Stress:	F _{e3 =}	5.1	ksi		Eq. E3-4
Torsional Buckling Stress:	F _{e4 =}	18.3	ksi		Eq. E4-4
Controling Euler Stress:	Fe3 =	5.1	ksi		
Critical Buckling Stress:	F _{cr =}	0.8	ksi		Eq. E3-2
6. COLUMN CAPACITY:				Eq. E3-1	

14.551 Advanced Steel Design Homework 5

Problem # 5.1 Member-Capacity and Beam-Column Analysis

Ana Gouveia 12/8/2014

Compressive Strength: $P_{n=}$ 8.8 ksi Eq. E3-1

Factor: $\Phi_{=} \qquad 0.9$ Column Capacity: $\Phi.P_{n=} \qquad 7.9 \qquad \text{ksi}$

BEAM-COLUMN ANALYSIS

1. MATERIAL PROPERTIES:

Modulus of Elasticity: E = 29000 ksi G = 11200 ksi

Yield Strength: $F_{y=}$ 50 ksi

2. MEMBER GEOMETRIC INFORMATION:

Beam Length L = 24 ft Project Information

Column Slenderness Parameters:

Unbraced Length, x: $L_{bx} = 24$ ft Global or Local System?

Unbraced Length, y: $L_{by} = 24$ ft Unbraced Length, z: $L_{bz} = 24$ ft

Eff. Length Factor Check: K>1 Check for values below

Eff. Length Factor, x: $K_{x} = 1.25$ Eff. Length Factor, y: $K_{y} = 1.25$ Eff. Length Factor, z: $K_{z} = 1$

Plastic Zones Lengths and Info:

Full plastic yield Length: $L_{p} = 4.31$ ft

LTB Length: $\begin{array}{ccc} L_{r\,=} & 12.3 & \text{ft} \\ & & \\ \varphi_b BF = & 12.3 & \text{kips} \\ & & \\ \varphi_b M_{px\,=} & 249 & \text{kip.ft} \end{array}$

Reference: Excel

Section Eq/Fig/Table/Notes

3. SECTION PROPERTIES Information

Section:	W	W18X35				
Member is in:		Compression				
			4			
Moment of Inertia, x:	I _{xw =}	510	in ⁴	Depth:	d =	17.7
Moment of Inertia, y	I _{yw =}	15.3	in ⁴	Width:	b _{f=}	6
Polar Moment of Inertia:	$J_{w} =$	0.506	in ⁴	Flange Thickness:	t _{f=}	0.425
Radius of Gyration, x:	$r_{xw} =$	7.04	in	Web Thickness:	t _{w =}	0.3
Radius of Gyration, y	ryw =	1.22	in	Area:	A =	10.3
Section Modulus:	S _{x =}	57.6	in ³	r_{ts}	r _{ts =}	2.81
Plastic Section Modulus, x:	Z =	66.5	in ³	Distance flange/centro	h _{0 =}	11.60
Plastic Section Modulus, y:	$Z_{y} =$	8.06	in	Warping Constant	C _{w =}	1140
Т	T =	0	in	Section Modulus:	S _{y=}	5.12

3. SLENDERNESS CHARACTERISTICS:

Web

Flange

Table B4.1a

	WCD	riunge				
Flexure	Compact	Compact]			
Compression	Mntx =	11				
4. CONSIDERATION OF IMP	ERFECTIONS -	NOTIONAL LO	DADS:	C2.2(b)		
National Load.	7	0.04	Lite		Γ~	62.4
Notional Load:	Z _{i =}	0.94	kip		Eq.	C2-1
Second/First order drift ratio	0:	2	in			
Is it applied at all levels in al	l combinations	5?	YES	Ref. to C.2.3(3)		
				Reference:	GTS	
				Section	Eq/Fig/	Table/Notes
5. FIRST ORDER ANALYSIS F	ORCES:			GTS		
Ultimate Axial Load, NT	P _{nt =}	2	kips			
Ultimate Moment, NT, x	M _{ntx} =	11	kip.ft			
Ultimate Moment, NT, y	M _{nty} =	0	kip.ft			
Ultimate Axial Load, LT	P _{lt =}	1.35	kips			
Ultimate Moment, LT, y	MI _{tx} =	32.7	kip.ft			
Ultimate Moment, LT, y	MI _{tx =}	0	kip.ft			
Total V. load in story	P _{story} =	622.1	kip			
	P _{mf} =	607.6	kip			
Story Shear in Direction of	H =	31	kip			
	α =	1		LRFD		
Lateral Deflection	ΔH =	0.215	in			
Fact. Story Drift Limit	$\Delta H/L =$	0.0007				

6. MEMBER CAPACITY:	Eq. E3-1
---------------------	----------

Axial Capacity	φ.P _{n =}	7.9	ksi
Flexure Capacity			
Along axis x:	Zone =	3	
	Cb =	1.34	
Flexure Capacity, x	$M_{cx} =$	249.0	kip.ft
Along axis y:	Fy.Zy =	925	
	1.6Fy.Sy =	976	
Flexure Capacity, y	M _{cv} =	832.5	kip.ft

Reference: AISC 14th
Section Eq/Fig/Table/Notes

F6-1 F6-1

7. APPROXIMATE SECOND ORDER ANALYSIS:

Along axis x: DAM: Use reduced stiffness per C2.3

14.551 Advanced Steel Design Homework 5		Member-Cap	Problem # 5. acity and Beam	1 -Column Analysis		Ana Gouveia 12/8/2014
	τ_b =	1.00		Apply to all	С	2.3(2)
Type of Curvature:		Single				
Smaller 1st-O End Mom:	$M_1 =$	-1				
Larger 1st-O End Mom:	$M_2 =$	1				
Modif. Coefficient, x:	$C_{mx} =$	1		App. 8	Eq.	A-8-4
Elastic Buckling Strength, x	$P_{ex} =$	1612	kip	App. 8	Eq.	A-8-5
Amplification Factor	$B_{1x} =$	1.0		App. 8	Eq.	A-8-3
Factor Check:		OK		Check		
Along axis y:						
	τ_b =	1		Apply to all	С	2.3(2)
Type of Curvature:		Single				
Smaller 1st-O End Mom:	M _{1 =}	-1				
Larger 1st-O End Mom:	M ₂ =	1				
Modif. Coefficient, y	$C_{my} =$	1		App. 8	Eq.	A-8-4
Elastic Buckling Strength	$P_{ey} =$	542	kip	App. 8	Eq.	A-8-5
Amplification Factor	$B_{1y} =$	1.0		App. 8	Eq.	A-8-3
Factor Check:		OK		Check		
Calculate P-∆ Amplification Fa	actor:					
Along axis x:						
	$R_{m} =$	0.85				A-8-8
	$P_{e-story} =$	35441.9	kip			A-8-7
	$B_{2x} =$	1.02				A-8-6
2nd-Order Axial Strength	$P_{r} =$	3.4	kip			A-8-2
2nd-Order Mom. Strength	$M_{rx} =$	0.0	kip.ft			A-8-1
Along axis y:						
	$R_{my} =$	0.85				A-8-8
	$P_{e-storyY} =$	35441.9	kip			A-8-7
	$B_{2y} =$	1.00				A-8-6
2nd-Order Axial Strength	$P_{ry} =$	3.4	kip			A-8-2
2nd-Order Mom. Strength	M_{ry} =	-11.0	kip.ft			A-8-1
8. COMBINED FORCES INTERA	ACTION EQU	IATION:		GTS		
Check Pr/Pc	$P_r/P_{c} =$	0.428				
Pr/Pc ≥ 0,2		1.294	OK		Eq.	H.1-1a
Pr/Pc < 0,2		0.000	OK		Eq.	H.1-1b
Design Check			OK		Eq.	H.1-1a

COLUMN-CAPACITY

Member Ref:29Frame:MomentFloor:FirstMember:Interior BeamRef. 2:1-M

ASSUMPTIONS:

No transverse loads are applied to the member (Per section 7)

1. MATERIAL PROPERTIES:

Modulus of Elasticity: E = 29000 ksi G = 11200 ksi

Yield Strength: $F_{y=}$ 50 ksi

2. MEMBER GEOMETRIC INFORMATION:

Beam Length L = 24 ft 24 Project Information

Column Slenderness Parameters:

Unbraced Length, x: 24 ft Global or Local System? Unbraced Length, y: L_{by =} 24 ft Unbraced Length, z: $L_{bz} =$ 24 ft Eff. Length Factor, x: 1 K_x = Eff. Length Factor, y: $K_{y} =$ 1 Eff. Length Factor, z: 1 $K_{z} =$

Reference: Excel

2 CECTION PROPERTIES				Section		Eq/Fig/Tak	ole/Notes
3. SECTION PROPERTIES				Information			
Section:	w	W21X44					
Member is in:		Compression					
			in ⁴	5			
Moment of Inertia, x:	I _{xw} =	843		Depth:	d =	20.7	in
Moment of Inertia, y	I _{yw} =	20.7	in ⁴	Width:	b _{f =}	6.5	in
Polar Moment of Inertia:	J _{w=}	0.77	in ⁴	Flange Thickness:	t _{f=}	0.45	in
Radius of Gyration, x:	r _{xw =}	8.06	in	Web Thickness:	t _{w =}	0.35	in
Radius of Gyration, y	ryw =	1.26	in	Area:	A =	13	in ²
Section Modulus:	S _{x =}	81.6	in ³	r _{ts}	r _{ts =}	2.81	in
Plastic Section Modulus, x:	Z =	95.4	in ³	Distance flange/centro	h _{0 =}	11.60	in
Т	T =	0	in	Warping Constant	C _{w =}	2110	in
2. DDELINAINIA DV ANIAL VOIC				Fa. F.C 2a/b			
3. PRELIMINARY ANALYSIS				Eq. E 6-2a/b			
Slenderness Ratios:	(KL/r) _{x =}	35.7					
	$(KL/r)_{y=}$	228.6		AISC	٦	Гable	3-2
	(KL) _{z =}	288.0		AISC	٦	Гable	3-2
Largest Possible Ratio:		228.6					
Compressive Control:		113.43		E			
Critical Stress, Fcr equation:		USE E3-3					

4. LOCAL SLENDERNESS CHECK:

Table B4.1a

	Web	Flange
Member	h/tw	bf/2t
	53.6	7.22
Critical	λ_{r}	λ_{r}
Case	[case 5]	[case 1]
	35.9	35.9
Check	N.G	Nonslender

				Reference: Section	AISC 14th <i>Eq/Fig/Table/Notes</i>
5. BUCKLING ANALYSIS:				E	
Euler Buckling Stress:	F _{e3 =}	5.5	ksi		Eq. E3-4
Torsional Buckling Stress:	F _{e4 =}	18.4	ksi		Eq. E4-4
Controling Euler Stress:	Fe3 =	5.5	ksi		
Critical Buckling Stress:	F _{cr =}	1.1	ksi		Eq. E3-2
6. COLUMN CAPACITY:				Eq. E3-1	

14.551 Advanced Steel Design Homework 5

Problem # 5.1 Member-Capacity and Beam-Column Analysis

Ana Gouveia 12/8/2014

Compressive Strength: $P_{n=}$ 14.3 ksi Eq. E3-1

Factor: $\Phi_{=} \qquad 0.9$ Column Capacity: $\Phi.P_{n=} \qquad 12.8 \qquad ksi$

BEAM-COLUMN ANALYSIS

1. MATERIAL PROPERTIES:

Modulus of Elasticity: E = 29000 ksi

G = 11200 ksi

Yield Strength: $F_{y=}$ 50 ksi

2. MEMBER GEOMETRIC INFORMATION:

Beam Length L = 24 ft Project Information

Column Slenderness Parameters:

Unbraced Length, x: $L_{bx} = 24$ ft Global or Local System?

Unbraced Length, y: $L_{by} = 24$ ft Unbraced Length, z: $L_{bz} = 24$ ft

Eff. Length Factor Check: K>1 Check for values below

Eff. Length Factor, x: $K_{x=}$ 1.28 Eff. Length Factor, y: $K_{y=}$ 1.28 Eff. Length Factor, z: $K_{z=}$ 1

Plastic Zones Lengths and Info:

Full plastic yield Length: $L_{p} = 4.45$ ft

 $\phi_b M_{px} = 16.8$ kips $\phi_b M_{px} = 358$ kip.ft

Reference: Excel

Section *Eq/Fig/Table/Notes*

3. SECTION PROPERTIES Information

Section:	W	W21X44					
Member is in:		Compression					
Moment of Inertia, x:	I _{xw =}	843	in ⁴	Depth:	d =	20.7	in
Moment of Inertia, y	I _{yw =}	20.7	in⁴	Width:	$b_{f} =$	6.5	in
Polar Moment of Inertia:	J _{w=}	0.77	in⁴	Flange Thickness:	$t_{f=}$	0.45	in
Radius of Gyration, x:	r _{xw =}	8.06	in	Web Thickness:	t _{w =}	0.35	in
Radius of Gyration, y	ryw =	1.26	in	Area:	A =	13	in ²
Section Modulus:	S _{x =}	81.6	in ³	r_ts	$r_{ts} =$	2.81	in
Plastic Section Modulus, x:	Z =	95.4	in ³	Distance flange/centro	h _{0 =}	11.60	in
Plastic Section Modulus, y:	$Z_{y} =$	10.2	in	Warping Constant	C _{w =}	2110	in
Т	T =	0	in	Section Modulus:	$S_{y=}$	6.37	in ³

3. SLENDERNESS CHARACTERISTICS:

Ta	h	le	R4	. 1	2

	Web	Flange
Flexure	Compact	Compact
Compression	Mntx =	54.3

4. CONSIDERATION OF IMPERFECTIONS - NOTIONAL LO			OADS:	C2.2(b)		
Notional Load:	Z _{i =}	0.428	kip		Eq.	C2-1
Second/First order drift rati	o:	2	in			
Is it applied at all levels in al	I combinations	?	YES	Ref. to C.2.3(3)		
				(-)		
				Reference:	GTS	
E FIRST ORDER ANALYSIS F	ODCEC.			Section	Eq/Fig/	Table/Notes
5. FIRST ORDER ANALYSIS F	ORCES:			GTS		
Ultimate Axial Load, NT	P _{nt} =	5	kips			
Ultimate Moment, NT, x	M _{ntx} =	54.3	kip.ft			
Ultimate Moment, NT, y	M _{nty} =	0	kip.ft			
Ultimate Axial Load, LT	P _{lt} =	4	kips			
Ultimate Moment, LT, y	MI _{tx} =	98	kip.ft			
Ultimate Moment, LT, y	MI _{tx} =	0	kip.ft			
Total V. load in story	P _{story} =	3643.2	kip			
	P _{mf} =	607.6	kip			
Story Shear in Direction of	H =	31	kip			
	α =	1		LRFD		
Lateral Deflection	ΔH =	0.215	in			
Fact. Story Drift Limit	ΔH/L =	0.0007				
6. MEMBER CAPACITY:				Eq. E3-1		
Axial Capacity	φ.P _{n =}	12.8	ksi			
- ·						
Flexure Capacity	Zone =	2				
Along axis x:	2011e = Cb =	3 1.34				
Flexure Capacity, x	M _{cx} =	358.0	kip.ft			
Along axis y:	Fy.Zy =	925	·		Eq.	F6-1
	1.6Fy.Sy =	976			Eq.	F6-1
Flexure Capacity, y	M_{cy} =	832.5	kip.ft			
				Reference:	AISC 14t	
				Section	Eq/Fig/	Table/Notes
7. APPROXIMATE SECOND	ORDER ANALYS	SIS:		С		

Along axis x:

DAM:

Use reduced stiffness per C2.3

$\tau_{b} = 1.00 \qquad Apply to all \qquad C \qquad 2.3(2)$ Type of Curvature: Single Smaller 1st-O End Mom: $M_1 = -1$ Larger 1st-O End Mom: $M_2 = 1$ App. 8 Eq. A-8-4 Elastic Buckling Strength, $x \qquad P_{ex} = 1612 \qquad kip \qquad App. 8 \qquad Eq. \qquad A-8-5 \qquad Amplification Factor B_{1x} = 1.0 \qquad App. 8 \qquad Eq. \qquad A-8-3 \qquad Factor Check: OK \qquad Check Along axis y: \tau_{b} = 1 \qquad Apply to all \qquad C \qquad 2.3(2) Type of Curvature: Single$	ıveia 2014
Smaller 1st-O End Mom: $M_1 = -1$ Larger 1st-O End Mom: $M_2 = 1$ Modif. Coefficient, x: $C_{mx} = 1$ Elastic Buckling Strength, x $P_{ex} = 1612$ kip App. 8 Eq. A-8-4 Elastic Buckling Strength, x $P_{ex} = 1612$ kip App. 8 Eq. A-8-5 Amplification Factor $B_{1x} = 1.0$ App. 8 Eq. A-8-3 Factor Check: OK Check Along axis y: $T_{b} = 1$ Apply to all C 2.3(2) Type of Curvature:	
Larger 1st-O End Mom: $M_2 = 1$	
Modif. Coefficient, x: $C_{mx} = 1$ App. 8 Eq. A-8-4 Elastic Buckling Strength, x $P_{ex} = 1612$ kip App. 8 Eq. A-8-5 Amplification Factor $B_{1x} = 1.0$ App. 8 Eq. A-8-3 Factor Check: OK Check Along axis y: $\tau_{b} = 1$ Apply to all C 2.3(2) Type of Curvature: Single	
Elastic Buckling Strength, x $P_{ex} = 1612$ kip App. 8 Eq. A-8-5 Amplification Factor $B_{1x} = 1.0$ App. 8 Eq. A-8-3 Factor Check: OK Check Along axis y: $\tau_{b} = 1$ Apply to all C 2.3(2) Type of Curvature: Single	
Amplification Factor $B_{1x} = 1.0$ App. 8 Eq. A-8-3 Factor Check: OK Check Along axis y: $\tau_{b} = 1 \qquad \qquad Apply \ to \ all \qquad C \qquad 2.3(2)$ Type of Curvature: Single	
Factor Check: OK Check	
Along axis y: $\tau_{b} = 1 \qquad \qquad \textit{Apply to all} \qquad C \qquad 2.3(2)$ Type of Curvature: $Single$	
$\tau_{b} = 1 \hspace{1cm} \textit{Apply to all} \hspace{1cm} C \hspace{1cm} 2.3(2)$ Type of Curvature: Single	
Type of Curvature: Single	
Smaller 1st-O End Mom: $M_{1=}$ -1	
Larger 1st-O End Mom: $M_2 = 1$	
Modif. Coefficient, y $C_{my} = 1$ App. 8 Eq. A-8-4	
Elastic Buckling Strength P _{ey =} 542 kip App. 8 Eq. A-8-5	
Amplification Factor $B_{1y} = 1.0$ App. 8 Eq. A-8-3	
Factor Check: OK Check	
Calculate P-∆ Amplification Factor:	
Along axis x:	
$R_{m} = 0.97$ A-8-8	
$P_{e-story} = 40486.8$ kip A-8-7	
$B_{2x} = 1.10$ A-8-6	
2nd-Order Axial Strength $P_r = 9.4$ kip A-8-2	
2nd-Order Mom. Strength $M_{rx} = 0.0$ kip.ft A-8-1	
Along axis y:	
$R_{my} = 0.97$ A-8-8	
$P_{e-storyY} = 40486.8 kip$ A-8-7	
$B_{2y} = 1.00$ A-8-6	
2nd-Order Axial Strength $P_{ry} = 9.0$ kip A-8-2	
2nd-Order Mom. Strength $M_{ry} = -54.3$ kip.ft A-8-1	
8. COMBINED FORCES INTERACTION EQUATION: GTS	
Check Pr/Pc $P_r/P_{c} = 0.732$	
Pr/Pc ≥ 0,2 1.294 OK Eq. H.1-1a	
Pr/Pc < 0,2 0.000 OK Eq. H.1-1b	

ОК

Eq.

H.1-1a

Design Check