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## Steel Code Check

Design code: ANSI/AISC 360-05 ASD

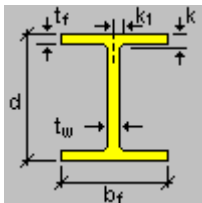
Note.- Only currently selected steel members are printed. AISI elements are not printed

Report: Comprehensive AISC

Member : 7 (Mill 1&2 Beams)  
Design status : N.G.

### PROPERTIES

Section : W 16X40



Width (bf)	7.00	[in]
Depth (d)	16.00	[in]
Distance k (k)	0.91	[in]
Distance k1 (k1)	0.81	[in]
Flange thickness (tf)	0.51	[in]
Web thickness (tw)	0.31	[in]

#### Section properties

	Unit	Major axis	Minor axis
Full unreduced cross-sectional area (A)	[in <sup>2</sup> ]	11.80	
Moment of Inertia (local axes) (I)	[in <sup>4</sup> ]	518.00	28.90
Moment of Inertia (principal axes) (I')	[in <sup>4</sup> ]	518.00	28.90
Bending constant for moments (principal axis) (J')	[in]	0.00	0.00
Radius of gyration (local axes) (r)	[in]	6.63	1.56
Radius of gyration (principal axes) (r')	[in]	6.63	1.56
Saint-Venant torsion constant (J)	[in <sup>4</sup> ]	0.79	
Warping constant of the cross-section (Cw)	[in <sup>6</sup> ]	1730.00	
Distance from centroid to shear center (principal axis) (xo, yo)	[in]	0.00	0.00
Top elastic section modulus of the section (local axis) (S top)	[in <sup>3</sup> ]	64.70	8.25
Bottom elastic section modulus of the section (local axis) (S bot)	[in <sup>3</sup> ]	64.70	8.25
Top elastic section modulus of the section (principal axis) (S' top)	[in <sup>3</sup> ]	64.70	8.25
Bottom elastic section modulus of the section (principal axis) (S' bot)	[in <sup>3</sup> ]	64.70	8.25
Plastic section modulus (local axis) (Z)	[in <sup>3</sup> ]	73.00	12.70
Plastic section modulus (principal axis) (Z')	[in <sup>3</sup> ]	73.00	12.70
Polar radius of gyration (ro)	[in]	6.81	
Area for shear (Aw)	[in <sup>2</sup> ]	7.07	4.88
Torsional modulus (1/C)	--	0.68	

Material : A36

Properties	Unit	Value
Yield stress (Fy):	[Kip/in2]	36.00
Tensile strength (Fu):	[Kip/in2]	58.00
Elasticity Modulus (E):	[Kip/in2]	29000.00
Shear modulus for steel (G):	[Kip/in2]	11507.94

## DESIGN CRITERIA

Description	Unit	Major axis	Minor axis
Top unbraced length between lateral supports (LbTop)	[ft]	21.33	
Bottom unbraced length between lateral supports (LbBop)	[ft]	21.33	
Effective length factor (K)	--	1.00	1.00
Effective length factor for torsion	--	1.00	
Length for axial tension (L)	[ft]	21.33	
Unbraced compression length (Lx, Ly)	[ft]	21.33	21.33
Length for torsion and lateral-torsional buckling	[ft]	21.33	
<b>Additional hypotheses</b>			
Continuous lateral torsional restraint		No	
Tension field action		No	

## SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
<b>Tension</b>				
Maximum geometric slenderness (L/r)	--	163.58		(Sec. D1)
<b>Compression</b>				
Geometric critical slenderness (KL/r)	--	163.58		(Sec. E2)

## DESIGN CHECKS

### DESIGN FOR FLEXURE $\Omega = 1.67$



#### Bending about major axis, M33

Ratio	:	1.54		
Capacity	:	83.49 [Kip*ft]	Ctrl Eq.	: D2 at 54.17%
Demand	:	-128.46 [Kip*ft]	Reference	: (Sec. F)

Intermediate results	Unit	Value	Reference
<u>Yielding (Mp)</u>	[Kip*ft]	219.00	(Sec. F)
<u>Lateral-torsional buckling (LTB Mn)</u>	[Kip*ft]	139.42	(Sec. F)
Limiting unbraced length for yielding (Lp)	[ft]	6.51	(Sec. F)
Limiting unbraced length for inelastic LTB (Lr)	[ft]	19.62	(Sec. F)
Modification factor for lateral-torsional buckling (Cb)	--	1.16	(Sec. F1)
Lateral-torsional factor (c)	--	1.00	(Sec. F2.2)
Calculated stress for nominal flexural strength (FL)	[Kip/in2]	25.20	(Sec. F4.2)
Radius of gyration of the flange (rt)	[in]	1.89	(Sec. F4.2)
Effective radius of gyration (rts)	[in]	1.86	(Sec. F2.2)
Web area ratio (aw)	--	1.29	(Sec. F4.2)
Web plastification factor (Rpc)	--	1.13	(Sec. F4.1)
Critical stress (Fcr)	[Kip/in2]	25.86	(Sec. F)
Slenderness parameter for web ( $\lambda$ )	--	46.51	(Sec. B4)
Limiting slenderness parameter for compact ( $\lambda_p$ )	--	106.72	(Sec. B4)

Limiting slenderness parameter for non-compact web ( $\lambda_r$ )	--	161.78	(Sec. B4)
Web local buckling (WLB Mn)	--	N/A	(Sec. F)
Local buckling (LB Mn)	--	N/A	(Sec. F)
Flange local buckling (FLB Mn)	--	N/A	(Sec. F)
Slenderness parameter for flange ( $\lambda$ )	--	6.93	(Sec. B4)
Limiting slenderness parameter for compact flange ( $\lambda_p$ )	--	10.79	(Sec. B4)
Limiting slenderness parameter for non-compact flange ( $\lambda_r$ )	--	28.38	(Sec. B4)
Tension flange yielding (TFY Mn)	--	N/A	(Sec. F)

#### **Bending about minor axis, M22**

Ratio	:	0.00		Ctrl Eq.	:	D2 at 0.00%
Capacity	:	22.81 [Kip*ft]		Reference	:	(Sec. F)
Demand	:	0.00 [Kip*ft]				

Intermediate results	Unit	Value	Reference
Yielding (Mp)	[Kip*ft]	38.10	(Sec. F)
Flange local buckling (FLB Mn)	--	N/A	(Sec. F)
Slenderness parameter for flange ( $\lambda$ )	--	6.93	(Sec. B4)
Limiting slenderness parameter for compact flange ( $\lambda_p$ )	--	10.79	(Sec. B4)
Limiting slenderness parameter for non-compact flange ( $\lambda_r$ )	--	28.38	(Sec. B4)

#### **DESIGN FOR SHEAR** ✓

##### **Shear parallel to major axis, V3 ( $\Omega = 1.67$ )**

Ratio	:	0.00		Ctrl Eq.	:	D2 at 0.00%
Capacity	:	91.44 [Kip]		Reference	:	(Sec. G)
Demand	:	0.00 [Kip]				

Intermediate results	Unit	Value	Reference
Web Shear coefficient (Cv)	--	1.00	
Web plate buckling coefficient (kv)	--	1.20	(Sec. G2)

##### **Shear parallel to minor axis, V2 ( $\Omega = 1.50$ )**

Ratio	:	0.34		Ctrl Eq.	:	D2 at 100.00%
Capacity	:	70.27 [Kip]		Reference	:	(Sec. G)
Demand	:	-23.95 [Kip]				

Intermediate results	Unit	Value	Reference
Web Shear coefficient (Cv)	--	1.00	
Web plate buckling coefficient (kv)	--	5.00	(Sec. G2)

#### **DESIGN FOR TENSION $\Omega = 1.67$** ✓

##### **Tension**

Ratio	:	0.00		Ctrl Eq.	:	D1 at 0.00%
Capacity	:	254.37 [Kip]		Reference	:	(Sec. D)
Demand	:	0.00 [Kip]				

#### **DESIGN FOR COMPRESSION $\Omega = 1.67$** ✓

## Compression

Ratio : 0.00  
Capacity : 66.28 [Kip]  
Demand : 0.00 [Kip]

Ctrl Eq. : D4 at 0.00%  
Reference : (Sec. E)

### Intermediate results

	Unit	Value	Reference
Slenderness parameter for web ( $\lambda_w$ )	--	46.51	(Sec. B4)
Limiting slenderness parameter for non-compact web ( $\lambda_{rw}$ )	--	42.29	(Sec. B4)
Slenderness parameter for flange ( $\lambda_f$ )	--	6.93	(Sec. B4)
Limiting slenderness parameter for non-compact flange ( $\lambda_{rf}$ )	--	15.89	(Sec. B4)
Elastic flexural stress (Fex)	[Kip/in <sup>2</sup> ]	191.73	(Eq. E4-9)
Elastic flexural stress (Fey)	[Kip/in <sup>2</sup> ]	10.70	(Ec. E4-10)
Elastic torsional buckling stress (Fez)	[Kip/in <sup>2</sup> ]	30.52	(Eq. E4-11)
Critical elastic flexural-torsional buckling stress (Fe)	[Kip/in <sup>2</sup> ]	30.52	(Sec.E4)
Critical flexural buckling stress (Fcr)	[Kip/in <sup>2</sup> ]	9.38	(Sec.E)
Critical flexural-torsional buckling stress (FcrTor)	[Kip/in <sup>2</sup> ]	21.97	(Sec.E4)
Stress reduction factor in unstiffened elements (Qs)	--	1.00	(Sec.E7)
Effective section reduction factor in stiffened elements (Qa)	--	1.00	(Sec.E7)
Effective area at a uniform stress (Aeff)	[in <sup>2</sup> ]	11.80	(Sec.E7)

## DESIGN FOR TORSION ( $\Omega = 1.67$ )



### Torsion

Ratio : 0.00  
Capacity : 1.60 [Kip\*ft]  
Demand : 0.00 [Kip\*ft]

Ctrl Eq. : D2 at 0.00%  
Reference : (Sec. H3)

### Intermediate results

	Unit	Value	Reference
Critical stress (Fcr)	[Kip/in <sup>2</sup> ]	21.60	(Sec. H)

## INTERACTION



### Combined axial and flexure interaction value

Ratio : 1.54  
Ctrl Eq. : D2 at 54.17%  
Reference : (H1-1b)

### Combined shear and torsion interaction value

Ratio : 0.34  
Ctrl Eq. : D2 at 100.00%  
Reference : (Ec. 4.9) DG 9

## CRITICAL STRENGTH RATIO



Ratio : 1.54  
Ctrl Eq. : D2 at 54.17%  
Reference : (H1-1b)