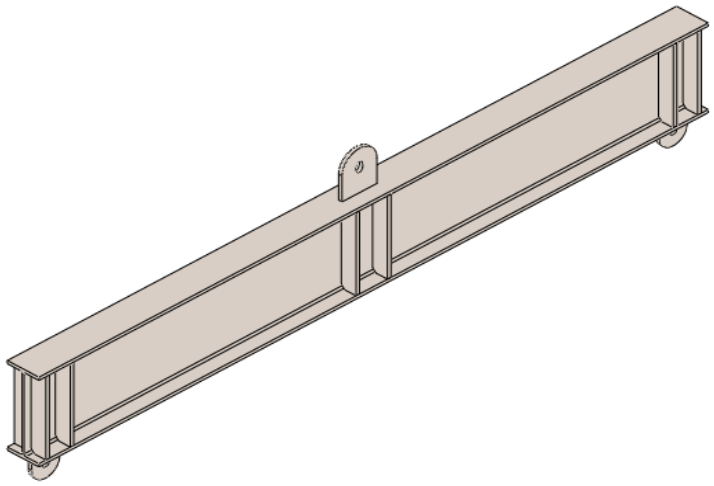
Design Conditions

Code:	**ASME BTH-1**
Year:	**2005**
Addenda:	**-**
Rated Load:	**65,000** lb
Design Factor:	**3**
Category:	**B**
Fatigue Design Basis:	**No**
Maximum Cycles:	**<20,000**
Service Class:	**0**

ASME BTH-1 Calculations

Cust: **Pressure Vessel Engineering**
File: **PVEclc-3857-1.0**
Desc: **Spreader Beam**
Dwg: **PVEdwg-3857-1.0**
Date: **January 31, 2013**



Author: Cameron Moore
Reviewer: Laurence Brundrett, P. Eng.

Conclusion: The Spreader Beam has been designed to ASME BTH-1 and has a maximum lifting capacity of 65,000 lb.

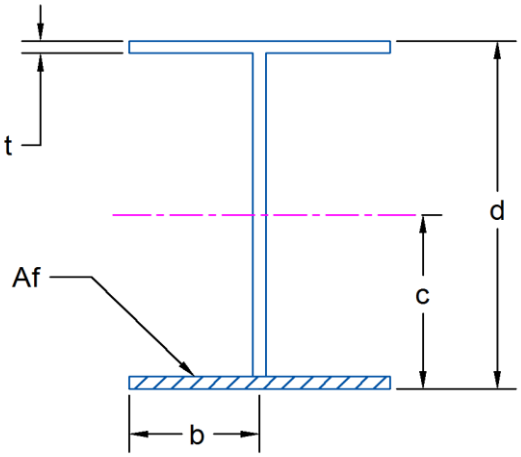
Table of Contents

	Author	Reviewer
Drawing:	CBM	LB
Calculation Method:	CBM	LB
Calculation Results:	CBM	LB

Revision(s)			
Rev	Description	Date	By
0	Release	31-Jan-13	CBM

Spreader Beam: ASME BTH-1

	W24x94	**Description**
65,000	**W** [lb]	- Weight of the load
3	**Nd**	- Design factor
Material:		
SA-36	**Material**	
36,000	**Fy** [psi]	- Yield strength
29,000,000	**E** [psi]	- Modulus of elasticity
Dimensions:		
180	**L** [in]	- Length of beam
2,700	**I** [in^4]	- Moment of inertia
12.155	**c** [in]	- Distance to neutral axis
24.31	**d** [in]	- Depth of section
4.533	**b** [in]	- width of compression flange
0.875	**t** [in]	-Thickness of compression flange
7.9319	**Af** [in^2]	- Area of compression flange
1.98	**ry** [in]	- Minor axis radius of gyration



Compact Section: Check that this is a compact section per Table 3-1. Must be a compact section to use this sheet

check b/t =	b/t < 0.38*sqrt(E/Fy)		4.533/0.875 < 0.38*SQRT(29000000/36000) =	**Acceptable**

Bending Stress:

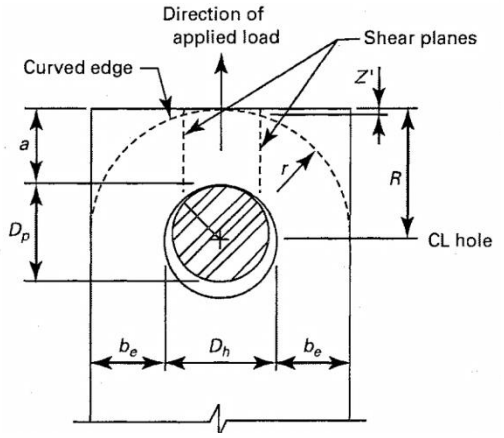
Fb [psi] =	1.1*Fy/Nd	Allowable bending stress (eq 3-6)	1.1*36000/3 =	**13,200**
M [lb-in] =	W*L/4	Bending moment	65000*180/4 =	**2,925,000**
S [psi] =	M*c/I	Actual bending stress	2925000*12.155/2700 =	**13,168**
checkS =	S < Fb		13168 < 13200 =	**Acceptable**
Wmax [lb] =	4*Fb*I/(c*L)		4*13200*2700/(12.155*180) =	**65,158**

Gusset Spacing: eq 3-7

Lp1 [in] =	0.67*E/(Fy*d/Af)		0.67*29000000/(36000*24/8) =	**176**
Lp2 [in] =	1.76*ry*sqrt(E/Fy)		1.76*2*SQRT(29000000/36000) =	**99**
Lp [in] =	Min(Lp1, Lp2)	Maximum spacing between gussets	MIN(176, 99) =	**99**

Lug with Pinned Connection: ASME BTH-1

Top Lug	Description
65,000	**W** [lb] - Weight of the load
3	**Nd** - Design factor



Material:

SA-36	**Material**
36,000	**Fy** [psi] - Yield strength
58,000	**Fu** [psi] - Tensile strength
29,000,000	**E** [psi] - Modulus of elasticity

Dimensions:

3.000	**Dh** [in] - Hole diameter
10.000	**w** [in] - Width of lug
1.000	**t** [in] - Thickness of lug
5.000	**R** [in] - Outer radius
0.625	**Leg** [in] - Weld leg height

Tensile Stress:

Ft [psi] =	Fy/Nd	Allowable tensile stress (eq 3-1)	36000/3 =	**12,000**
A [in^2] =	t*(w-Dh)	Area in tension	1*(10-3) =	**7.000**
St [psi] =	W/A	Tensile stress	65000/7 =	**9,286**
CheckSt =	St < Ft		9286 < 12000 =	**Acceptable**

Shear Strength Through Pinhole:

Av [in^2] =	2*(R-(Dh/2)*cos(radians(45)))*t	Total area of two shear planes (eq 3-50)		
			2*(5-(3/2)*COS(RADIANS(45)))*1 =	**7.879**
Pv [lb] =	0.7*Fu/(1.2*Nd)*Av	Double plane shear strength (eq 3-49)		
			*0.7*58000/(1.2*3)*7.879* =	**88,854**
CheckPv =	W < Pv		65000 < 88854 =	**Acceptable**

Shear Stress in Weld:

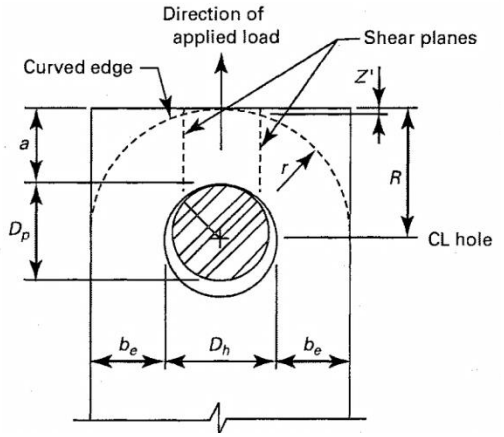
Exx [psi] =	Fu	Tensile strength of weld filler metal	58000 =	**58,000**
Fv [psi] =	0.6*Exx/(1.2*Nd)	Allowable weld shear stress (eq 3-53)	0.6*58000/(1.2*3) =	**9,667**
Aw [in^2] =	(2*w+2*t) * (0.707*Leg)	Area of the weld	(2*10+2*1) * (0.707*0.625) =	**9.721**
Fw [lb] =	Fv*Aw	Allowable weld load	9667*9.721 =	**93,972**
CheckFw =	W < Fw		65000 < 93972 =	**Acceptable**

Minimum Weld Throat: 3-3.4.3

throat_3-3 [in] =	IF(K14<=0.25,0.125,IF(K14<0.5,0.188,(IF(K14<0.75,0.25,0.313))))	
	IF(K14<=0.25,0.125,IF(K14<0.5,0.188,(IF(K14<0.75,0.25,0.313)))) =	**0.313**
check_throat =	Leg*0.707 >=throat_3-3	0.625*0.707 >=0 = **Acceptable**

Lug with Pinned Connection: ASME BTH-1

Bottom Lug	Description
65,000	**W** [lb] - Weight of the load
3	**Nd** - Design factor



Material:

SA-36	**Material**
36,000	**Fy** [psi] - Yield strength
58,000	**Fu** [psi] - Tensile strength
29,000,000	**E** [psi] - Modulus of elasticity

Dimensions:

2.000	**Dh** [in] - Hole diameter
8.000	**w** [in] - Width of lug
1.000	**t** [in] - Thickness of lug
4.000	**R** [in] - Outer radius
0.625	**Leg** [in] - Weld leg height

Tensile Stress:

Ft [psi] =	Fy/Nd	Allowable tensile stress (eq 3-1)	36000/3 = **12,000**
A [in^2] =	t*(w-Dh)	Area in tension	1*(8-2) = **6.000**
St [psi] =	W/A	Tensile stress	65000/6 = **10,833**
CheckSt =	St < Ft		10833 < 12000 = **Acceptable**

Shear Strength Through Pinhole:

Av [in^2] =	2*(R-(Dh/2)*cos(radians(45)))*t	Total area of two shear planes (eq 3-50)	
			2*(4-(2/2)*COS(RADIANS(45)))*1 = **6.586**
Pv [lb] =	0.7*Fu/(1.2*Nd)*Av	Double plane shear strength (eq 3-49)	
			*0.7*58000/(1.2*3)*6.586* = **74,273**
CheckPv =	W < Pv		65000 < 74273 = **Acceptable**

Shear Stress in Weld:

Exx [psi] =	Fu	Tensile strength of weld filler metal	58000 = **58,000**
Fv [psi] =	0.6*Exx/(1.2*Nd)	Allowable weld shear stress (eq 3-53)	0.6*58000/(1.2*3) = **9,667**
Aw [in^2] =	(2*w+2*t) * (0.707*Leg)	Area of the weld	(2*8+2*1) * (0.707*0.625) = **7.954**
Fw [lb] =	Fv*Aw	Allowable weld load	9667*7.954 = **76,886**
CheckFw =	W < Fw		65000 < 76886 = **Acceptable**

Minimum Weld Throat: 3-3.4.3

throat_3-3 [in] = IF(K14<=0.25,0.125,IF(K14<0.5,0.188,(IF(K14<0.75,0.25,0.313))))

IF(K14<=0.25,0.125,IF(K14<0.5,0.188,(IF(K14<0.75,0.25,0.313)))) = **0.313**

check_throat = Leg*0.707 >=throat_3-3 0.625*0.707 >=0 = **Acceptable**