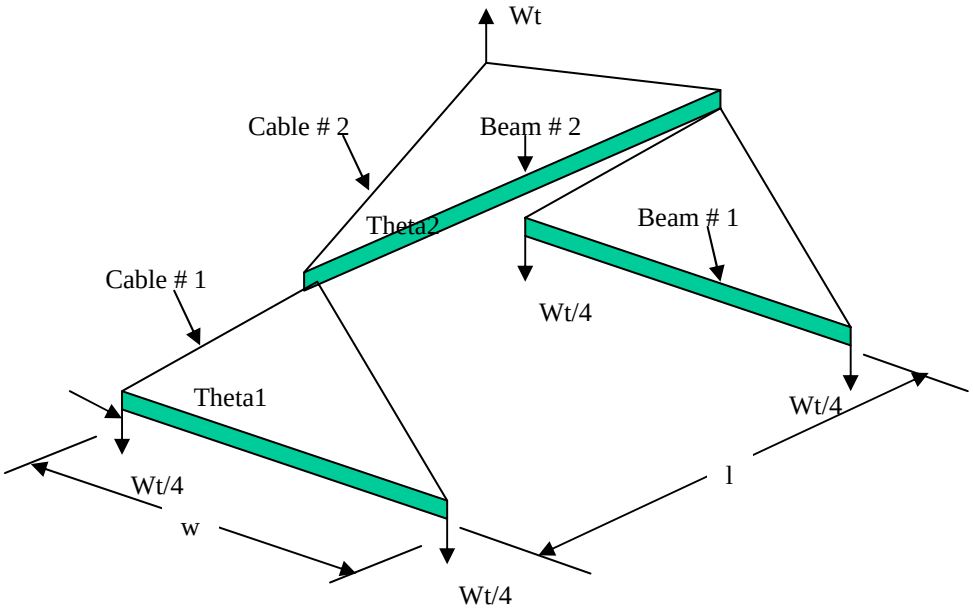
Three (3) Bar Lifting System

Job #:	080064	Designed by:	CR
Desc:	Lifting System for Model 168-2Z	Date:	6/27/08

Wt	Total Lifting Weight (Not Including Impact Factor)	71,700	lbs
w	Length of Beam # 1	15.000	ft
l	Length of Beam # 2	24.333	ft



Cable # 1:

Dia1	Diameter of Cable (EXIWRC)	1.25	in
Len1	Length of Cable # 1	11.0000	ft
Theta1	Angle between Cable # 1 and Beam # 1	0.82	rad
		47.01	Deg
BrStr1	Breaking Strength for Cable	143,820	lbs
LinWt1	Linear Weight of Cable	2.89	lb/ft
Force1	Axial force in Cable	24,504	lbs
SF1	Safety Factor in Cable (Min. 5 Recommended)	5.87	

Cable # 2:

Dia2	Diameter of Cable (EXIWRC)			1.25	in
Len2	Length of Cable # 2			17.0000	ft
Theta2	Angle between Cable # 2 and Beam # 2			0.77	rad
				44.30	Deg
BrStr2	Breaking Strength for Cable			275,400	lbs
LinWt2	Linear Weight of Cable			5.67	lb/ft
Force2	Axial Force in Cable			51,330	lbs
SF2	Safety Factor in Cable (Min. 5 Recommended)			5.37	
Check1	Included angle between Cables <= 120 Deg	Angle =	91.4	TRUE	

Shackle # 1: (Below Beam # 1) {Minimum of 9.5 ton required to make Shackle-Shackle Connection}

Shackle # 1	Size of Shackle				9 1/2 Ton	
Cap	Capacity of Shackle				19,000	lbs
Width	Jaw Width of Shackle				1.81	in
Depth	Jaw Depth (from Top of Pin to Inside surface of Shackle)				4.25	in
PinDia	Diameter of Pin				1.25	in
Check1	Included angle between Cables <= 120 Deg		Angle =	0.0	TRUE	
Check2	Is Capacity of Shackle Adequate	19,000	>	17,925	TRUE	
Check3	Is Jaw Spacing Adequate	1.810	>	1.500	TRUE	
Check4	Depth of Shackle Adequate	4.25	>	3.38	TRUE	

Shackle # 2: (Above Beam # 1)

Shackle # 1	Size of Shackle				13 1/2 Ton	
Cap	Capacity of Shackle				27,000	lbs
Width	Jaw Width of Shackle				2.25	in
Depth	Jaw Depth (from Top of Pin to Inside surface of Shackle)				5.25	in
PinDia	Diameter of Pin				1.50	in
Check1	Included angle between Cables <= 120 Deg		Angle =	0.0	TRUE	
Check2	Is Capacity of Shackle Adequate	27,000	>	24,504	TRUE	
Check3	Is Jaw Spacing Adequate	2.250	>	2.000	TRUE	
Check4	Depth of Shackle Adequate	5.25	>	3.25	TRUE	

Shackle # 3: (Below Beam # 2)

Shackle # 3	Size of Shackle				25 Ton	
Cap	Capacity of Shackle				50,000	lbs
Width	Jaw Width of Shackle				2.88	in
Depth	Jaw Depth (from Top of Pin to Inside surface of Shackle)				7.00	in
PinDia	Diameter of Pin				2.00	in
Check1	Included angle between Cables <= 120 Deg		Angle =	86.0	TRUE	
Check2	Is Capacity of Shackle Adequate	50,000	>	35,850	TRUE	
Check3	Is Jaw Spacing Adequate	2.880	>	2.500	TRUE	
Check4	Depth of Shackle Adequate	7.00	>	3.00	TRUE	

Shackle # 4: (Above Beam # 2)

Shackle # 4	Size of Shackle				35 Ton	
Cap	Capacity of Shackle				70,000	lbs
Width	Jaw Width of Shackle				3.25	in
Depth	Jaw Depth (from Top of Pin to Inside surface of Shackle)				7.75	in
PinDia	Diameter of Pin				2.25	in
Check1	Included angle between Cables <= 120 Deg		Angle =	0.0	TRUE	
Check2	Is Capacity of Shackle Adequate	70,000	>	51,330	TRUE	
Check3	Is Jaw Spacing Adequate	3.250	>	3.000	TRUE	
Check4	Depth of Shackle Adequate	7.75	>	2.88	TRUE	

Shackle # 5: (At Crane Hook)

Shackle # 5	Size of Shackle				55 Ton	
Cap	Capacity of Shackle				110,000	lbs
Width	Jaw Width of Shackle				4.13	in
Depth	Jaw Depth (from Top of Pin to Inside surface of Shackle)				10.50	in
PinDia	Diameter of Pin				2.75	in
Check1	Included angle between Cables <= 120 Deg		Angle =	91.4	TRUE	
Check2	Is Capacity of Shackle Adequate	110,000	>	71,700	TRUE	
Check4	Depth of Shackle Adequate	10.50	>	2.63	TRUE	

Beam # 1:

OD1	Outer Diameter of Pipe	8.625	in
Thk1	Thickness of Pipe	0.322	in
Offset1	Dist from OD of pipe to Lug Hole	3	in
A	Area of Pipe	8.40	in^2
I	Moment of Inertia of Pipe	72.49	in^4
r	Radius of Gyration	2.94	in
Slend	Slenderness Ratio	61.27	
Pa	Axial force in Beam (Including 1.5 Impact Factor)	25,061	lbs
fa	Axial Stress in Beam	2,984	psi
Fa	Allowable Axial Stress in Beam	17,337	psi
Fb	Bending Moment on Beam	122,171	lb-in
fb	Bending Stress on Beam	7,268	psi
Fb	Allowable Bending Stress in Beam	21,600	
SR	Stress Ratio (> 1 is failure)	0.48	

Beam # 2:

OD2	Outer Diameter of Pipe	10.75	in
Thk2	Thickness of Pipe	0.365	in
Offset2	Dist from OD of pipe to Lug Hole	3	in
A	Area of Pipe	11.91	in^2
I	Moment of Inertia of Pipe	160.73	in^4
r	Radius of Gyration	3.67	in
Slend	Slenderness Ratio	79.48	
Pa	Axial force in Beam	55,104	lbs
fa	Axial Stress in Beam	4,627	psi
Fa	Allowable Axial Stress in Beam	15,458	psi
Fb	Bending Moment on Beam	307,666	lb-in
fb	Bending Stress on Beam	10,288	psi
Fb	Allowable Bending Stress in Beam	21,600	
SR	Stress Ratio (> 1 is failure)	0.80	

Lug # 1:

LugT1	Thickness of Lug				1	in
LugR1	Radius of Lug				4.000	in
LugPD1	Lug Re-Pad Diameter				6.000	in

Lug # 1 Above Beam # 1:

LugD1	Hole Diameter				1.625	in
LugPT1a	Lug Re-Pad Thickness (Above Beam # 2)	Min =		0.38	0.500	in
Force1a	Load on Lug with 1.5 impact factor				36,756	lbs
EdgeR	Req'd Minimum Edge Distance (per J3-6): 2*V/(Fu*tg)				1.225	in
EdgeA	Actual Edge Distance				3.1875	in
fv	Shear: (Force1) / (LugR-LugD/2)*LugT1+(LugPD-LugD/2)*2*LugPT				3,419	psi
Fv	Allowable Shear				14,400	psi
fbr	Bearing: (Force1)/(PinD*(LugT1+2*LugPT))				12,252	
Fbr	Allowable Bearing				32,400	psi
fb	Bending: Force1*Cos(Theta1)*Offset1/(LugT1*(2*LugR)^2)/6				7,048	psi
Fb	Allowable Bending				21,600	
Check1a	*Shear Stress (Above Beam)*	3,419	<=	14,400	TRUE	
Check2a	Bearing Stress (Above Beam)	12,252	<=	32,400	TRUE	
Check3a	Bending Stress (Above Beam)	7,048	<=	21,600	TRUE	
Check4a	Jaw Spacing OK (Above Beam)	2.25	>	2.000	TRUE	
Check5a	Edge Distance (Above Beam)	1.225	<=	3.1875	TRUE	

Lug # 1 Below Beam # 1

LugD1	Minimum Hole Diameter				1.375	in
LugPT1b	Lug Re-Pad Thickness (Below Beam # 2)	Min =		0.16	0.250	in
Force1b	Load on Lug with 1.5 impact factor				26,888	lbs
EdgeR	Req'd Minimum Edge Distance (per J3-6): 2*V/(Fu*tg)				1.225	in
EdgeA	Actual Edge Distance				3.1875	in
fv	Shear: (Force1b) / (LugR-LugD/2)*LugT1+(LugPD-LugD/2)*2*LugPT				3,008	psi
Fv	Allowable Shear				14,400	psi
fbr	Bearing: (Force1)/(PinD*(LugT1+2*LugPT))				14,340	
Fbr	Allowable Bearing				32,400	psi
Check1b	*Shear Stress (Below Beam)*	3,008	<=	14,400	TRUE	
Check2b	Bearing Stress (Below Beam)	14,340	<=	32,400	TRUE	
Check4b	Jaw Spacing OK (Below Beam)	1.81	>	1.500	TRUE	
Check5b	Edge Distance (Below Beam)	1.225	<=	3.1875	TRUE	

Lug # 2:

LugT2	Thickness of Lug				1	in
LugR2	Radius of Lug				4.000	in
LugPD2	Lug Re-Pad Diameter				6.000	in

Lug # 2 Above Beam # 2

LugD2	Minimum Hole Diameter				2.375	in
LugPT2a	Lug Re-Pad Thickness	Min =		0.69	1.000	in
Force2a	Load on Lug with 1.5 impact factor				76,995	lbs
EdgeR	Req'd Minimum Edge Distance (per J3-6): 2*V/(Fu*tg)				2.567	in
EdgeA	Actual Edge Distance				2.8125	in
fv	Shear: (Force2) / (LugR-LugD/2)*LugT+(LugPD-LugD/2)*2*LugPT				5,980	psi
Fv	Allowable Shear				14,400	psi
fbr	Bearing: (Force2)/(PinD*(LugT+2*LugPT))				11,407	
Fbr	Allowable Bearing				32,400	psi
fb	Bending: Force2*Cos(Theta)*Offset/(LugT*(2*LugR)^2)/6				15,498	psi
Fb	Allowable Bending				21,600	
Check1	*Shear Stress*	5,980	<=	14,400	TRUE	
Check2	Bearing Stress	11,407	<=	32,400	TRUE	
Check3	Bending Stress	15,498	<=	21,600	TRUE	
Check4	Jaw Width OK	3.250	>	3.000	TRUE	
Check5	Edge Distance	2.567	<=	2.8125	TRUE	

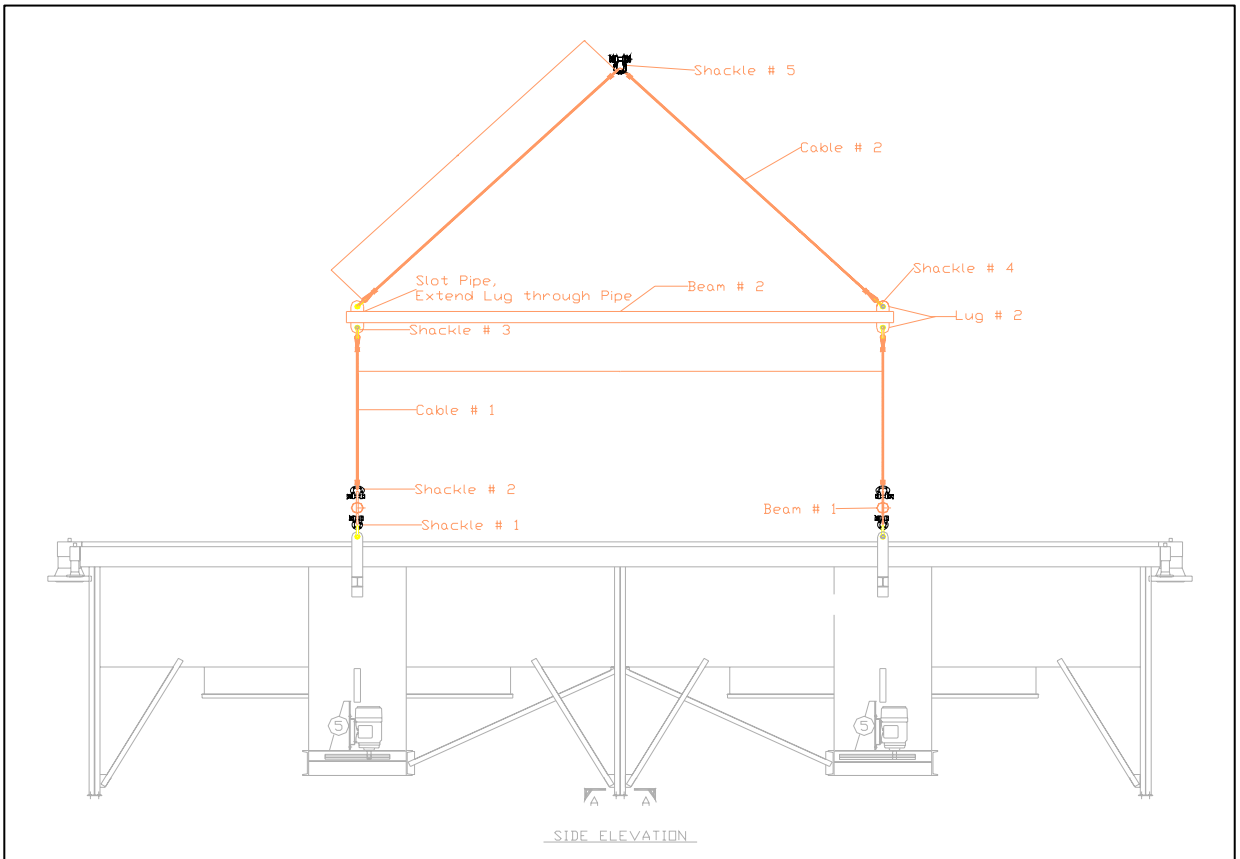
Lug # 2 Below Beam # 2

LugD2	Minimum Hole Diameter				2.125	in
LugPT2b	Lug Re-Pad Thickness	Min =		1.00	0.750	in
Force2b	Load on Lug with 1.5 impact factor				53,775	lbs
EdgeR	Req'd Minimum Edge Distance (per J3-6): 2*V/(Fu*tg)				1.793	in
EdgeA	Actual Edge Distance				2.8125	in
fv	Shear: (Force2) / (LugR-LugD/2)*LugT+(LugPD-LugD/2)*2*LugPT				4,601	psi
Fv	Allowable Shear				14,400	psi
fbr	Bearing: (Force2)/(PinD*(LugT+2*LugPT))				10,755	
Fbr	Allowable Bearing				32,400	psi
Check1	*Shear Stress*	4,601	<=	14,400	TRUE	
Check2	Bearing Stress	10,755	<=	32,400	TRUE	
Check4	Jaw Width of Shackle	2.880	>	2.500	TRUE	
Check5	Edge Distance	1.793	<=	2.8125	TRUE	

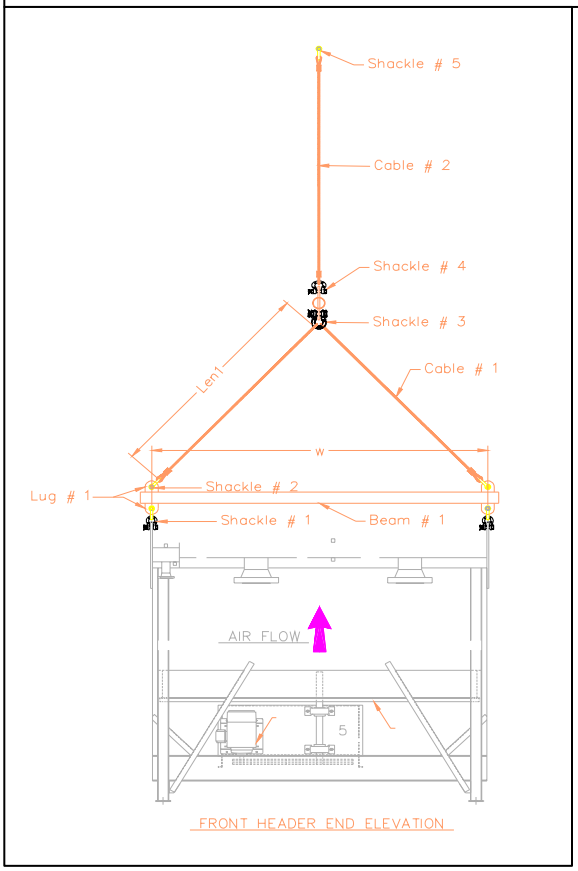
Summary

Shackle # 1	Crosby G-2130 Shackle	9 1/2 Ton
Shackle # 2	Crosby G-2130 Shackle	13 1/2 Ton
Shackle # 3	Crosby G-2130 Shackle	25 Ton
Shackle # 4	Crosby G-2130 Shackle	35 Ton
Shackle # 5	Crosby G-2130 Shackle	55 Ton

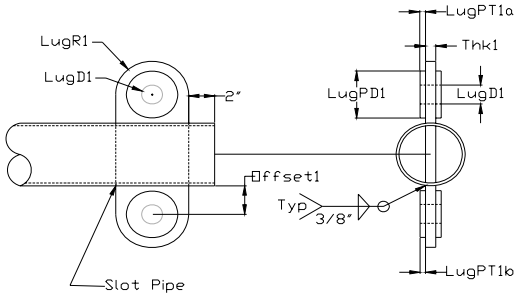
Lug # 1 Thickness	1	in
Lug # 1 Upper Repad Thickness	0.5	in
Lug # 1 Lower Repad Thickness	0.25	in
Lug # 1 Lower Minimum Hole Diameter	1.375	in
Lug # 1 Upper Minimum Hole Diameter	1.625	in
Lug # 2 Thickness	1	in
Lug # 2 Upper Repad Thickness	1	in
Lug # 2 Lower Repad Thickness	0.75	in
Lug # 2 Lower Minimum Hole Diameter	2.125	in
Lug # 2 Upper Minimum Hole Diameter	2.375	in
Beam # 1 Pipe Outer Diameter	8.625	in
Beam # 1 Pipe Thickness	0.322	in
Beam # 2 Pipe Outer Diameter	10.75	in
Beam # 2 Pipe Thickness	0.365	in
Cable # 1 Diameter (W6x19 EX IWRC)	1.25	in
Cable # 1 Length	11	ft
Cable # 2 Diameter (W6x19 EX IWRC)	1.75	in
Cable # 2 Length	17	ft



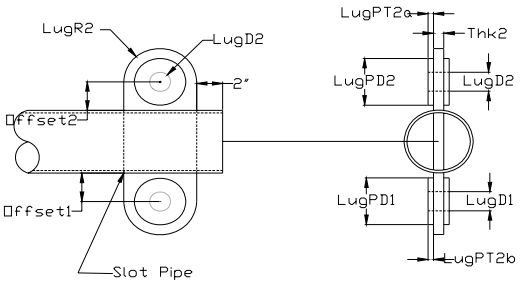
SIDE ELEVATION



FRONT HEADER END ELEVATION



Lug # 1



Lug # 2